

**SPECIFICATIONS
FOR
PORTLAND STATE UNIVERSITY
CAMPUS WIDE LOOP – PHASE 1
STEAM & CHILLED WATER IMPROVEMENTS
Portland, OR**

**SEPTEMBER 2, 2008
Bid Package No. 2
ISSUED FOR CONSTRUCTION**



EXPIRES: 12/31/09

Prepared By:



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**FACILITIES AND PLANNING
INVITATION TO BID
Campus Wide Loop – Phase 1
Steam & Chilled Water Improvements – BP2
May 28, 2008**

Portland State University invites Contractors to participate in the bid process for the Campus Loop – Steam and Chilled Water Improvements –BP2.

All bidders must comply with requirements of the BOLI Prevailing Wage law, dated January 1, 2008, and any amendments thereof, and the provisions of ORS 279C.800 through ORS 279C.870, and any amendments. All bidders must be registered with the Construction Contractor's Board at the time of bid submission. No bid will be considered unless fully completed in the manner provided in the "Instructions to Bidders" upon the Bid Form provided and accompanied by Bid Security. No bid will be considered unless fully completed in the manner provided in the "Instructions to Bidders" upon the Bid Form provided and accompanied by Bid Security.

This project includes steam and chilled water extensions to ASRC Building, chilled water extension to Shattuck Hall, new chiller in Cramer East Chiller Plan, condenser cooling water injection well, boiler economizer for Boiler #5 in Cramer East Heating Plant, metering of steam boiler and chilled water.

For additional information contact fapcontracts@pdx.edu .

Sealed bids will be received by the Oregon State Board of Higher Education at PSU, Facilities and Planning Office, University Services Building, Room 202, 617 SW Montgomery St., until 3:00 p.m. Local time, June 26, 2008 for the Campus Wide Loop-Phase 1, Steam & Chilled Water Improvements – BP-2.

Bids will be opened and publicly read aloud on June 26, 2008 at 3:00 p.m., local time, at Facilities and Planning Office by the designated representative.

A mandatory pre-bid walk through will be conducted at 9:30 am on Thursday, June 5, 2008. Bidders shall meet with the Owner's Representative at Facilities and Planning, Conference Room for that purpose. Questions from applicants regarding this ITB must be received no later than 5:00 pm on June 16, 2008 and shall be directed to fapcontracts@pdx.edu, or delivered to University Services Building, Suite 202, and SW Montgomery Street, Portland, OR 97207. Questions received shall be answered via addendum. Applicants are encouraged to check on the status of such addenda prior to submission of their proposal.

The project schedule is identified below; if there are any changes to the dates, it shall be noted in a subsequent Addendum (all times PDT).

Invitation to Bid	May 28, 2008
Mandatory walk-through	June 5, 2008 @ 9:30 am
Applicant Questions Due	June 16, 2008 @ 5:00 pm
Bids Due	June 26, 2008 @ 3:00 pm
Bids Opened	June 27, 2008 @ 3:00 pm
Contract award	July 15, 2008
End of Protest Period	July 22, 2008,
Notice to proceed	July 23, 2008
Piping to Shattuck Hall	May 1, 2009
Substantial completion on all work	June 30, 2009
Final Completion	August 1, 2009

OREGON STATE BOARD OF HIGHER EDUCATION
By: Robyn K. Pierce
Director of Facilities and Planning

OREGON UNIVERSITY SYSTEM
GENERAL CONDITIONS
FOR PUBLIC IMPROVEMENT CONTRACTS

May 1, 2008 Edition

INSTRUCTIONS: The attached **Oregon University System General Conditions for Public Improvement Contracts ("OUS General Conditions")** apply to all designated public improvement contracts. Changes to the OUS General Conditions (including any additions, deletions or substitutions) should only be made by attaching Supplemental General Conditions. The text of these OUS General Conditions should not otherwise be altered. These OUS General Conditions have been reviewed as to form by the Oregon Department of Justice. The legal sufficiency and approval requirements of ORS 291.047 remain applicable to individual OUS procurements, unless an exemption has been granted pursuant to that statute and Department of Justice administrative rules at OAR Chapter 137, Division 45.

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**OREGON UNIVERSITY SYSTEM
GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACTS
("OUS General Conditions")**

**SECTION A
GENERAL PROVISIONS**

A.1 DEFINITION OF TERMS

In the Contract Documents the following terms shall be as defined below:

ARCHITECT/ENGINEER, means the Person appointed by the Owner to make drawings and specifications and, to provide contract administration of the Work contemplated by the Contract to the extent provided herein or by supplemental instruction of Owner (under which Owner may delegate responsibilities of the Owner's Authorized Representative to the Architect/Engineer), in accordance with ORS Chapter 671 (Architects) or ORS Chapter 672 (Engineers) and administrative rules adopted thereunder.

CHANGE ORDER, means a written order issued by the Owner's Authorized Representative to the Contractor requiring a change in the Work within the general scope of the Contract Documents, issued under the changes provisions of Section D.1 in administering the Contract, including Owner's written change directives as well as changes reflected in a writing executed by the parties to this Contract and, if applicable, establishing a Contract Price or Contract Time adjustment for the changed Work.

CLAIM, means a demand by Contractor pursuant to Section D.3 for review of the denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, submitted in accordance with the requirements and within the time limits established for review of Claims in these General Conditions.

CONTRACT, means the written agreement between the Owner and the Contractor comprised of the Contract Documents which describe the Work to be done and the obligations between the parties.

CONTRACT DOCUMENTS, means the Solicitation Document and addenda thereto, Instructions to Offerors, Supplemental Instructions to Offerors, the OUS Public Improvement Agreement Form, OUS General Conditions, Supplemental General Conditions, if any, the accepted Offer, Plans, Specifications, amendments and Change Orders.

CONTRACT PERIOD, as set forth in the Contract Documents, means the total period of time beginning with the issuance of the Notice to Proceed and concluding upon Final Completion.

CONTRACT PRICE, means the total of the awarded Offer amount, as increased or decreased by the price of approved alternates and Change Orders.

CONTRACT TIME, means any incremental period of time allowed under the Contract to complete any portion of the Work as reflected in the project schedule.

CONTRACTOR, means the Person awarded the Contract for the Work contemplated.

DAYS, are calendar days, including weekdays, weekends and holidays, unless otherwise specified.

DIRECT COSTS, means, unless otherwise provided in the Contract Documents, the cost of materials, including sales tax, cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom;

worker's compensation insurance; project specific insurance; bond premiums, rental cost of equipment, and machinery required for execution of the work; and the additional costs of field personnel directly attributable to the Work.

FINAL COMPLETION, means the final completion of all requirements under the Contract, including Contract Closeout as described in Section K but excluding Warranty Work as described in Section I.2, and the final payment and release of all retainage, if any, released.

FORCE MAJEURE, means an act, event or occurrence caused by fire, riot, war, acts of God, nature, sovereign, or public enemy, strikes, freight embargoes or any other act, event or occurrence that is beyond the control of the party to this Contract who is asserting Force Majeure.

NOTICE TO PROCEED, means the official written notice from the Owner stating that the Contractor is to proceed with the Work defined in the Contract Documents. Notwithstanding the Notice to Proceed, Contractor shall not be authorized to proceed with the Work until all initial Contract requirements, including the Contract, performance bond and payment bond, and certificates of insurance, have been fully executed and submitted to Owner in a suitable form.

OFFER, means a bid in connection with Instructions to Bidders and a proposal in connection with a Request for Proposals.

OFFEROR, means a bidder in connection with Instructions to Bidders and a proposer in connection with a Request for Proposals.

OVERHEAD, means those items which may be included in the Contractor's markup (general and administrative expense and profit) and that shall not be charged as Direct Cost of the Work, including without limitation such Overhead expenses as wages or salary of personnel above the level of foreman (i.e., superintendents and project managers), and expenses of Contractor's offices at the job site (e.g. job trailer) including expenses of personnel staffing the job site office.

OWNER, means the State of Oregon acting by and through the Oregon State Board of Higher Education, in its own right or on behalf of one of its institutions as identified in the Solicitation Document, also known as the Oregon University System (OUS).

OWNER'S AUTHORIZED REPRESENTATIVE, means those individuals identified in writing by the Owner to act on behalf of the Owner for this project. Owner may elect, by written notice to Contractor, to delegate certain duties of the Owner's Authorized Representative to more than one party, including without limitation, to an Architect/Engineer. However, nothing in these General Conditions is intended to abrogate the separate design professional responsibilities of Architects under ORS Chapter 671 or of Engineers under ORS Chapter 672.

PERSON, means an entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company or partnership, or any other entity possessing the legal capacity to contract.

PLANS, means the drawings which show the location, type, dimensions, and details of the Work to be done under the Contract.

PUNCHLIST, means the list of Work yet to be completed or deficiencies which need to be corrected in order to achieve Final Completion of the Contract.

RECORD DOCUMENT, means the as-built Plans, Specifications, testing and inspection records, product data, samples, manufacturer and distributor/supplier warranties evidencing transfer to Owner, operational and maintenance manuals, shop drawings, Change Orders, correspondence, certificate(s) of occupancy, and other documents listed in Subsection B.9.1 of these General Conditions, recording all Services performed.

SOLICITATION DOCUMENT, means Instructions to Bidders or Offerors or a Request for Proposal or a Request for Quotes.

SPECIFICATION, means any description of the physical or functional characteristics of the Work, or of the nature of a supply, service or construction item. Specifications may include a description of any requirement for inspecting, testing or preparing a supply, service or construction item for delivery and the quantities or qualities of materials to be furnished under the Contract. Specifications generally will state the results or products to be obtained and may, on occasion, describe the method and manner of doing the work to be performed. Specifications may be incorporated by reference and/or may be attached to the Contract.

SUBCONTRACTOR, means a Person having a direct contract with the Contractor, or another Subcontractor, to perform one or more items of the Work.

SUBSTANTIAL COMPLETION, means the date when the Owner accepts in writing the construction, alteration or repair of the improvement to real property or any designated portion thereof as having reached that state of completion when it may be used or occupied for its intended purpose. Substantial Completion of facilities with operating systems occurs only after thirty (30) continuous Days of successful, trouble-free operation of the operating systems as provided in Section K.4.2.

SUBSTITUTIONS, means items that in function, performance, reliability, quality, and general configuration are the same or better than the product(s) specified. Approval of any substitute item shall be solely determined by the Owner's Authorized Representative. The decision of the Owner's Authorized Representative is final.

SUPPLEMENTAL GENERAL CONDITIONS, means those conditions that remove from, add to, or modify these OUS General Conditions. Supplemental General Conditions may be included in the Solicitation Document or may be a separate attachment to the Contract.

WORK, means the furnishing of all materials, equipment, labor, transportation, services and incidentals necessary to successfully complete any individual item or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents.

A.2 SCOPE OF WORK

The Work contemplated under this Contract includes all labor, materials, transportation, equipment and services for, and incidental to, the completion of all construction work in connection with the project described in the Contract Documents. The Contractor shall perform all Work necessary so that the project can be legally occupied and fully used for the intended use as set forth in the Contract Documents.

A.3 INTERPRETATION OF CONTRACT DOCUMENTS

A.3.1 Unless otherwise specifically defined in the Contract Documents, words which have well-known technical meanings or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Contract Documents are intended to be complementary. Whatever is called for in one, is interpreted to be called for in all. However, in the event of conflicts or discrepancies among

the Contract Documents, interpretations will be based on the following descending order of precedence:

- (a) Contract amendments and Change Orders, with those of later date having precedence over those of an earlier date;
- (b) The Supplemental General Conditions;
- (c) The OUS Public Improvement Agreement Form;
- (d) The OUS General Conditions;
- (e) Division One (General Requirements) of the Specifications;
- (f) Detailed Schedules of finishes, equipment and other items included in the Specifications;
- (g) Plans and Specifications (other than Division One and the Detailed Schedules to the Specifications);
- (h) Large-scale drawings on Plans;
- (i) Small-scale drawings on Plans;
- (j) Dimension numbers written on Plans which shall prevail and take precedence over dimensions scaled from Plans;
- (k) The Solicitation Document, including Instructions to Offerors and Supplemental Instructions to Offerors, and any addenda thereto;
- (l) The accepted Offer.

A.3.2 In the case of an inconsistency between Plans and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Owner or Owner's Authorized Representative's interpretation in writing.

A.3.3 If the Contractor finds discrepancies in, or omissions from the Contract Documents, or if the Contractor is in doubt as to their meaning, the Contractor shall at once notify the Owner or Owner's Authorized Representative. Matters concerning and interpretation of requirements of, the Contract Documents will be decided by the Owner's Authorized Representative, who may delegate that duty in some instances to the Architect/Engineer. Responses to Contractor's requests for interpretation of Contract Documents will be made in writing by Owner's Authorized Representative (or the Architect/Engineer) within any time limits agreed upon or otherwise with reasonable promptness. Interpretations and decisions of the Owner's Authorized Representative (or Architect/Engineer) will be consistent with the intent of and reasonably inferable from the Contract Documents. Contractor shall not proceed without direction in writing from the Owner's Authorized Representative (or Architect/Engineer).

A.3.4 References to standard specifications, manuals, codes of any technical society, organization or association, to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws or regulations in effect in the jurisdiction where the project is occurring on the first published date of the Solicitation Document, except as may be otherwise specifically stated.

A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

A.4.1 It is understood that the Contractor, before submitting an Offer, has made a careful examination of the Contract Documents; has become fully informed as to the quality and quantity of materials and the character of the Work required; and has made a careful

examination of the location and conditions of the Work and the sources of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to acquire full information in advance in regard to all conditions pertaining to the Work. No oral agreement or conversation with any officer, agent, or personnel of the Owner, or with the Architect/Engineer either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

- A.4.2 Should the Plans or Specifications fail to particularly describe the materials, kind of goods, or details of construction of any aspect of the Work, Contractor shall have the duty to make inquiry of the Owner and Architect/Engineer as to what is required prior to performance of the Work. Absent Specifications to the contrary, the materials or processes that would normally be used to produce first quality finished Work shall be considered a part of the Contract requirements.
- A.4.3 Any design errors or omissions noted by the Contractor shall be reported promptly to the Owner's Authorized Representative, including without limitation, any nonconformity with applicable laws, statutes, ordinances, building codes, rules and regulations.
- A.4.4 If the Contractor believes that additional cost or Contract Time is involved because of clarifications or instructions issued by the Owner's Authorized Representative (or Architect/Engineer) in response to the Contractor's notices or requests for information, the Contractor must submit a written request to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt by Contractor of the clarifications or instructions issued. If the Owner's Authorized Representative denies Contractor's request for additional compensation, additional Contract Time, or other relief that Contractor believes results from the clarifications or instructions, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process. If the Contractor fails to perform the obligations of Sections A.4.1 to A.4.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

A.5 INDEPENDENT CONTRACTOR STATUS

The service or services to be performed under this Contract are those of an independent contractor as defined in ORS 670.600. Contractor represents and warrants that it is not an officer, employee or agent of the Owner as those terms are used in ORS 30.265.

A.6 RETIREMENT SYSTEM STATUS AND TAXES

Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment received under this Contract. Contractor will not be eligible for any benefits from these Contract payments of federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual. Unless the Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

A.7 GOVERNMENT EMPLOYMENT STATUS

- A.7.1 If this payment is to be charged against federal funds, Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor from holding another contract with the Federal Government.
- A.7.2 Contractor represents and warrants that Contractor is not an employee of the State of Oregon for purposes of performing Work under this Contract

SECTION B ADMINISTRATION OF THE CONTRACT

B.1 OWNER'S ADMINISTRATION OF THE CONTRACT

- B.1.1 The Owner's Authorized Representative will provide administration of the Contract as described in the Contract Documents (1) during construction (2) until final payment is due and (3) during the one-year period for correction of Work. The Owner's Authorized Representative will act on behalf of the Owner to the extent provided in the Contract Documents, unless modified in writing in accordance with other provisions of the Contract. In performing these tasks, the Owner's Authorized Representative may rely on the Architect/Engineer or other consultants to perform some or all of these tasks.
- B.1.2 The Owner's Authorized Representative will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. The Owner's Authorized Representative will not make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Owner's Authorized Representative will neither have control over or charge of, nor be responsible for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work.
- B.1.3 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, the Owner and Contractor shall endeavor to communicate with each other through the Owner's Authorized Representative or designee about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner's Authorized Representative.
- B.1.4 Based upon the Architect/Engineer's evaluations of the Contractor's Application for Payment, or unless otherwise stipulated by the Owner's Authorized Representative, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

B.2 CONTRACTOR'S MEANS AND METHODS; MITIGATION OF IMPACTS

- B.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures.
- B.2.2 The Contractor is responsible to protect and maintain the Work during the course of construction and to mitigate any adverse impacts to the project, including those caused by authorized changes, which may affect cost, schedule, or quality.

B.2.3 The Contractor is responsible for the actions of all its personnel, laborers, suppliers, and Subcontractors on the project. The Contractor shall enforce strict discipline and good order among Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of persons who are unfit or unskilled for the tasks assigned to them.

B.3 MATERIALS AND WORKMANSHIP

- B.3.1 The intent of the Contract Documents is to provide for the construction and completion in every detail of the Work described. All Work shall be performed in a professional manner and unless the means or methods of performing a task are specified elsewhere in the Contract Documents, Contractor shall employ methods that are generally accepted and used by the industry, in accordance with industry standards.
- B.3.2 The Contractor is responsible to perform the Work as required by the Contract Documents. Defective Work shall be corrected at the Contractor's expense.
- B.3.3 Work done and materials furnished shall be subject to inspection and/or observation and testing by the Owner's Authorized Representative to determine if they conform to the Contract Documents. Inspection of the Work by the Owner's Authorized Representative does not relieve the Contractor of responsibility for the Work in accordance with the Contract Documents.
- B.3.4 Contractor shall furnish adequate facilities, as required, for the Owner's Authorized Representative to have safe access to the Work including without limitation walkways, railings, ladders, tunnels, and platforms. Producers, suppliers, and fabricators shall also provide proper facilities and access to their facilities.
- B.3.5 The Contractor shall furnish Samples of materials for testing by the Owner's Authorized Representative and include the cost of the Samples in the Contract Price.

B.4 PERMITS

Contractor shall obtain and pay for all necessary permits and licenses, except for those specifically excluded in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project. Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities. The Contractor shall pay all royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent or other proprietary rights and save harmless and blameless from loss, on account thereof, the State of Oregon, and its departments, divisions, members and employees.

B.5 COMPLIANCE WITH GOVERNMENT REGULATIONS

- B.5.1 Contractor shall comply with all federal, state and local laws, codes, regulations and ordinances applicable to the Work and the Contract. Failure to comply with such requirements shall constitute a breach of Contract and shall be grounds for Contract termination. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following, as applicable:
- (i) Title VI and VII of Civil Rights Act of 1964, as amended; (ii) Section 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Health Insurance Portability and Accountability Act of 1996; (iv) the Americans with Disabilities Act of 1990, as amended; (v) ORS Chapter 659A; as amended; (vi) all regulations and administrative rules established pursuant to the foregoing laws; and (vii) all other applicable requirements

of federal and state civil rights and rehabilitation statutes, rules and regulations.

- B.5.2 Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations, and
- (a) Contractor shall not discriminate against Disadvantaged, Minority, Women or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, in the awarding of subcontracts.
 - (b) Contractor shall maintain, in current and valid form, all licenses and certificates required by law, regulation, or this Contract when performing the Work.
- B.5.3 Unless contrary to federal law, Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work as described in ORS 701.005 under this Contract unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time they submit their bids to the Contractor.
- B.5.4 Unless contrary to federal law, Contractor shall certify that each landscape contractor, as defined in ORS 671.520(2), performing Work under this Contract holds a valid landscape contractor's license issued pursuant to ORS 671.560.
- B.5.5 The following notice is applicable to Contractors who perform excavation Work. ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of the rules by calling the center at (503)232-1987.
- B.5.6 Failure to comply with any or all of the requirements of B.5.1 through B.5.5 shall be a breach of Contract and constitute grounds for Contract termination. Damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

B.6 SUPERINTENDENCE

Contractor shall keep on the site, during the progress of the Work, a competent superintendent and any necessary assistants who shall be satisfactory to the Owner and who shall represent the Contractor on the site. Directions given to the superintendent by the Owner's Authorized Representative shall be confirmed in writing to the Contractor.

B.7 INSPECTION

- B.7.1 Owner's Authorized Representative shall have access to the Work at all times.
- B.7.2 Inspection of the Work will be made by the Owner's Authorized Representative at its discretion. The Owner's Authorized Representative will have authority to reject Work that does not conform to the Contract Documents. Any Work found to be not in conformance with the Contract Documents, in the discretion of the Owner's Authorized Representative, shall be removed and replaced at the Contractor's expense.
- B.7.3 Contractor shall make or obtain at the appropriate time all tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. Tests or inspections conducted pursuant to the Contract Documents shall be made

promptly to avoid unreasonable delay in the Work. The Contractor shall give the Owner's Authorized Representative timely notice of when and where tests and inspections are to be made so that the Owner's Authorized Representative may be present for such procedures. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner's Authorized Representative.

- B.7.4 As required by the Contract Documents, Work done or material used without inspection or testing by the Owner's Authorized Representative may be ordered removed at the Contractor's expense.
- B.7.5 If directed to do so any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore such portions of Work to the standard required by the Contract. If the Work uncovered is unacceptable or was done without sufficient notice to the Owner's Authorized Representative, the uncovering and restoration shall be done at the Contractor's expense. If the Work uncovered is acceptable and was done with sufficient notice to the Owner's Authorized Representative, the uncovering and restoration will be paid for as a Change Order.
- B.7.6 If any testing or inspection reveals failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Owner's Authorized Representative's and Architect/Engineer's services and expenses, shall be at the Contractor's expense.
- B.7.7 When the United States government participates in the cost of the Work, or the Owner has an agreement with other public or private organizations, or if any portion of the Work is being performed for a third party or in close proximity to third party facilities, representatives of these organizations have the right to inspect the Work affecting their interests or property. Their right to inspect shall not make them a party to the Contract and shall not interfere with the rights of the parties of the Contract. Instructions or orders of such parties shall be transmitted to the Contractor, through the Owner's Authorized Representative.

B.8 SEVERABILITY

If any provision of this Contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

B.9 ACCESS TO RECORDS

- B.9.1 Contractor shall keep, at all times on the Work site, one record copy of the complete Contract Documents, including the Plans, Specifications, Change Orders and addenda, in good order and marked currently to record field changes and selections made during construction, and one record copy of Shop Drawings, Product Data, Samples and similar submittals, and shall at all times give the Owner's Authorized Representative access thereto.
- B.9.2 Contractor shall retain and the Owner and its duly authorized representatives shall have access, for a period not less than six (6) years, to all Record Documents, financial and accounting records, and other books, documents, papers and records of Contractor which are pertinent to the Contract, including records pertaining to Overhead and indirect costs, for the purpose of making audit, examination, excerpts and transcripts. If for any reason, any part of the Contract is involved in litigation, Contractor shall retain all such records until all litigation is resolved. The Owner and/or its agents shall continue to be provided full access to the records during litigation.

B.10 WAIVER

Failure of the Owner to enforce any provision of this Contract shall not constitute a waiver or relinquishment by the Owner of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

B.11 SUBCONTRACTS AND ASSIGNMENT

- B.11.1 Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound by the terms and conditions of these OUS General Conditions, and to assume toward the Contractor all of the obligations and responsibilities which the Contractor assumes toward the Owner thereunder, unless (1) the same are clearly inapplicable to the subcontract at issue because of legal requirements or industry practices, or (2) specific exceptions are requested by Contractor and approved in writing by Owner. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with sub-subcontractors at any level.
- B.11.2 At Owner's request, Contractor shall submit to Owner prior to their execution either Contractor's form of subcontract, or the subcontract to be executed with any particular Subcontractor. If Owner disapproves such form, Contractor shall not execute the form until the matters disapproved are resolved to Owner's satisfaction. Owner's review, comment upon or approval of any such form shall not relieve Contractor of its obligations under this Agreement or be deemed a waiver of such obligations of Contractor.
- B.11.3 Contractor shall not assign, sell, or transfer its rights, or delegate its responsibilities under this Contract, in whole or in part, without the prior written approval of the Owner. No such written approval shall relieve Contractor of any obligations of this Contract, and any transferee shall be considered the agent of the Contractor and bound to perform in accordance with the Contract Documents. Contractor shall remain liable as between the original parties to the Contract as if no assignment had occurred.

B.12 SUCCESSORS IN INTEREST

The provisions of this Contract shall be binding upon and shall accrue to the benefit of the parties to the Contract and their respective permitted successors and assigns.

B.13 OWNER'S RIGHT TO DO WORK

Owner reserves the right to perform other or additional work at or near the project site with other forces than those of the Contractor. If such work takes place within or next to the project site, Contractor will coordinate work with the other contractors or forces, cooperate with all other contractors or forces, carry out the Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being used so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable manner and perform it in proper sequence to that of the others. The Owner's Authorized Representative will resolve any disagreements that may arise between or among Contractor and the other contractors over the method or order of doing all work (including the Work). In case of unavoidable interference, the Owner's Authorized Representative will establish work priority (including the Work) which generally will be in the sequence that the contracts were awarded.

B.14 OTHER CONTRACTS

In all cases and at any time, the Owner has the right to execute other contracts related to or unrelated to the Work of this Contract. The Contractor of this Contract will fully cooperate with any and all other

contractors without additional cost to the Owner in the manner described in section B.13.

B.15 GOVERNING LAW

This Contract shall be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws.

B.16 LITIGATION

Any Claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review Process in Section D.3 shall be brought and conducted solely and exclusively within the Circuit Court of Marion County for the State of Oregon; provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by the State of Oregon on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR BY EXECUTION OF THIS CONTRACT HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION B.16.

B.17 ALLOWANCES

- B.17.1 The Contractor shall include in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.
- B.17.2 Unless otherwise provided in the Contract Documents:
- (a) when finally reconciled, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
 - (b) Contractor's costs for unloading and handling at the site, labor, installation costs, Overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Price but not in the allowances;
 - (c) whenever costs are more than or less than allowances, the Contract Price shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (i) the difference between actual costs and the allowances under Section B.17.2(a) and (2) changes in Contractor's costs under Section B.17.2(b).
 - (d) Unless Owner requests otherwise, Contractor shall provide to Owner a proposed fixed price for any allowance work prior to its performance.

B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- B.18.1 The Contractor shall prepare and keep current, for the Architect's/Engineer's approval (or for the approval of Owner's Authorized Representative if approval authority has not been delegated to the Architect/Engineer), a schedule and list of submittals which is coordinated with the Contractor's construction schedule and allows the Architect/Engineer reasonable time to review submittals. Owner reserves the right to finally approve the schedule and list of submittals. Submittals include, without limitation, Shop Drawings, Product Data, and Samples which are described below:
- (a) Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor (including any sub-

subcontractor), manufacturer, supplier or distributor to illustrate some portion of the Work.

- (b) Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

- (c) Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

B.18.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review of submittals by the Architect/Engineer is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, or for approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of its obligations under the Contract Documents. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

B.18.3 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect/Engineer without action.

B.18.4 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

B.18.5 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer.

B.18.6 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's review or approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and (i) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order has been executed by Owner authorizing the deviation. The

Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's review or approval thereof.

**SECTION C
WAGES AND LABOR**

B.18.7 In the event that Owner elects not to have the obligations and duties described under this Section B.18 performed by the Architect/Engineer, or in the event no Architect/Engineer is employed by Owner on the project, all obligations and duties assigned to the Architect/Engineer hereunder shall be performed by the Owner's Authorized Representative.

B.19 SUBSTITUTIONS

The Contractor may make Substitutions only with the consent of the Owner, after evaluation by the Owner's Authorized Representative and only in accordance with a Change Order. Substitutions shall be subject to the requirements of the bid documents. By making requests for Substitutions, the Contractor: represents that the Contractor has personally investigated the proposed substitute product; represents that the Contractor will provide the same warranty for the Substitution that the Contractor would for the product originally specified unless approved otherwise; certifies that the cost data presented is complete and includes all related costs under this Contract including redesign costs, and waives all claims for additional costs related to the Substitution which subsequently become apparent; and will coordinate the installation of the accepted Substitution, making such changes as may be required for the Work to be completed in all respects.

B.20 USE OF PLANS AND SPECIFICATIONS

Plans, Specifications and related Contract Documents furnished to Contractor by Owner or Owner's Architect/Engineer shall be used solely for the performance of the Work under this Contract. Contractor and its Subcontractors and suppliers are authorized to use and reproduce applicable portions of such documents appropriate to the execution of the Work, but shall not claim any ownership or other interest in them beyond the scope of this Contract, and no such interest shall attach. Unless otherwise indicated, all common law, statutory and other reserved rights, in addition to copyrights, are retained by Owner.

B.21 FUNDS AVAILABLE AND AUTHORIZED

Owner reasonably believes at the time of entering into this Contract that sufficient funds are available and authorized for expenditure to finance the cost of this Contract within the Owner's appropriation or limitation. Contractor understands and agrees that, to the extent that sufficient funds are not available and authorized for expenditure to finance the cost of this Contract, Owner's payment of amounts under this Contract attributable to Services performed after the last day of the current biennium is contingent on Owner receiving from the Oregon Legislative Assembly appropriations, limitations or other expenditure authority sufficient to allow Owner, in the exercise of its reasonable administrative discretion, to continue to make payments under this Contract.

B.22 NO THIRD PARTY BENEFICIARIES

Owner and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Contract.

C.1 MINIMUM WAGE RATES ON PUBLIC WORKS

Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Documents establishing those conditions, as determined by the Commissioner of the Bureau of Labor and Industries (BOLI), are included as attachments to or are incorporated by reference in the Contract Documents. Contractor shall pay workers at not less than the specified minimum hourly rate of wage, and shall include that requirement in all subcontracts.

C.2 PAYROLL CERTIFICATION AND FEE REQUIREMENTS

C.2.1 In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner's Authorized Representative, on the form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the project and further certifying that no worker employed on the project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract, which certificate and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor has read such statement and certificate and knows the contents thereof and that the same is true to the Contractor's or Subcontractor's best knowledge and belief. The certified statements shall set out accurately and completely the payroll records for the prior week including the name and address of each worker, the worker's correct classification, rate of pay, daily and weekly number of hours worked, deductions made and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a worker on the project shall be submitted once a month, by the fifth business day of the following month. The Contractor and Subcontractors shall preserve the certified statements for a period of six (6) years from the date of completion of the Contract.

C.2.2 Pursuant to ORS 279C.845(7), the Owner shall retain 25 percent of any amount earned by the Contractor on this public works project until the Contractor has filed the certified statements required by section C.2.1. The Owner shall pay to the Contractor the amount retained under this subsection within 14 days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

C.2.3 Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent of any amount earned by a first-tier Subcontractor on this public works project until the first-tier Subcontractor has filed with the Owner the certified statements required by C.2.1. Before paying any amount retained under this subsection, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement, Within 14 days after the first-tier Subcontractor files the required certified statement the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection.

C.2.4 In accordance with statutory requirements, and administrative rules promulgated by the Commissioner of the Bureau of Labor and Industries, the fee required by ORS 279C.825(1) will be paid by Owner to the Commissioner at the time Owner enters into the Contract.

C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS

C.3.1 As a condition to Owner's performance hereunder, the Contractor shall:

- C.3.1.1 Make payment promptly, as due, to all persons supplying to Contractor labor or materials for the prosecution of the Work provided for in this Contract.
- C.3.1.2 Pay all contributions or amounts due the State Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Contract.
- C.3.1.3 Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or material furnished. Contractor will not assign any claims that Contractor has against Owner, or assign any sums due by Owner, to Subcontractors, suppliers, or manufacturers, and will not make any agreement or act in any way to give Subcontractors a claim or standing to make a claim against the Owner.
- C.3.1.4 Pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.
- C.3.2 As a condition to Owner's performance hereunder, if Contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the Contractor of a Subcontractor by any person in connection with the project as such claim becomes due, the proper officer(s) representing the Owner may pay the claim and charge the amount of the payment against funds due or to become due Contractor under this Contract. Payment of claims in this manner shall not relieve the Contractor or the Contractor's surety from obligation with respect to any unpaid claims.
- C.3.3 Contractor shall include in each subcontract for property or services entered into by the Contractor and a first-tier subcontractor, including a material supplier, for the purpose of performing a construction contract, a payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within ten (10) Days out of such amounts as are paid to the Contractor by the public contracting agency under such contract.
- C.3.4 All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

C.4 PAYMENT FOR MEDICAL CARE

As a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of such Contractor, all sums of which the Contractor agrees to pay for such services and all moneys and sums which the Contractor has collected or deducted from the wages of personnel pursuant to any law, contract or agreement for the purpose of providing or paying for such services.

C.5 HOURS OF LABOR

As a condition to Owner's performance hereunder, no person shall be employed to perform Work under this Contract for more than ten (10) hours in any one day or forty (40) hours in any one week, except in cases of necessity, emergency or where public policy absolutely requires it. In such instances, Contractor shall pay the employee at least time and a half pay:

- (a) For all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work week is five consecutive Days, Monday through Friday; or

- (b) For all overtime in excess of ten (10) hours a day or forty (40) hours in any one week when the work week is four consecutive Days, Monday through Friday; and
- (c) For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

This section C.5 will not apply to Contractor's Work under this Contract if Contractor is currently a party to a collective bargaining agreement with any labor organization.

This Section C.5 shall not excuse Contractor from completion of the Work within the time required under this Contract.

**SECTION D
CHANGES IN THE WORK**

D.1 CHANGES IN WORK

D.1.1 The terms of this Contract shall not be waived, altered, modified, supplemented or amended in any manner whatsoever, without prior written approval of the Owner's Authorized Representative, and then only in a manner consistent with the Change Order provisions of this Section D.1 and after any necessary approvals required by public contracting laws have been obtained. Otherwise, a formal contract amendment is required, which shall not be effective until its execution by the parties to this Contract and all approvals required by public contracting laws have been obtained.

D.1.2 It is mutually agreed that changes in Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of construction. Within the general scope of this Contract, the Owner's Authorized Representative may at any time, without notice to the sureties and without impairing the Contract, require changes consistent with this Section D.1. All Change Order Work shall be executed under the conditions of the Contract Documents. Such changes may include, but are not limited to:

- (a) Modification of specifications and design.
- (b) Increases or decreases in quantities.
- (c) Increases or decreases to the amount of Work.
- (d) Addition or elimination of any Work item.
- (e) Change in the duration of the project.
- (f) Acceleration or delay in performance of Work.
- (g) Deductive changes.

Deductive changes are those that reduce the scope of the Work, and shall be made by mutual agreement whenever feasible. In cases of suspension or partial termination under Section J, Owner reserves the right to unilaterally impose a deductive change and to self perform such Work, for which the provisions of B.13 (Owner's Right to Do Work) shall then apply. Adjustments in compensation shall be made under the provisions of D.1.3, in which costs for deductive changes shall be based upon a Direct Costs adjustment together with the related percentage markup specified for profit, Overhead and other indirect costs, unless otherwise agreed to by Owner.

D.1.3 The Owner and Contractor agree that Change Order Work shall be administered and compensated according to the following:

- (a) Unit pricing may be utilized at the Owner's option when unit prices or solicitation alternates were provided that established the cost for additional Work, and a binding obligation exists under the Contract on the parties covering the terms and conditions of the additional Work.
- (b) If the Owner elects not to utilize unit pricing, or in the event that unit pricing is not available or appropriate, fixed pricing may be used for Change Order Work. In fixed pricing the basis of payments or total price shall be agreed

upon in writing between the parties to the Contract, and shall be established before the Work is done whenever feasible. The mark-ups set forth in D.1.3(c) shall be utilized by the parties as a guide in establishing fixed pricing, and will not be exceeded by Owner without adequate justification. Cost and price data relating to Change Orders shall be supplied by Contractor to Owner upon request, but Owner shall be under no obligation to make such requests.

- (c) In the event that unit pricing and fixed pricing are not utilized, then Change Order Work shall be performed on a cost reimbursement basis for Direct Costs. Such Work shall be compensated on the basis of the actual, reasonable and allowable cost of labor, equipment, and material furnished on the Work performed. In addition, the following markups shall be added to the Contractor's or Subcontractor's Direct Costs as full compensation for profit, Overhead and other indirect costs for Work directly performed with the Contractor's or Subcontractor's own forces:

On Labor.....	15%
On Equipment.....	10%
On Materials.....	10%

When Change Order Work under D.1.3(c) is invoiced by an authorized Subcontractor at any level, each ascending tier Subcontractor or Contractor will be allowed a supplemental mark-up on each piece of subcontract Work covered by such Change Order as follows:

\$0.00 - \$5,000.00	10%, and then
Over \$5,000.00	5%

Payments made to the Contractor shall be complete compensation for Overhead, profit, and all costs that were incurred by the Contractor or by other forces furnished by the Contractor, including Subcontractors, for Change Order Work. Owner may establish a maximum cost for Change Order Work under this Section D.1.3(c), which shall not be exceeded for reimbursement without additional written authorization from Owner. Contractor shall not be required to complete such Change Order Work without additional authorization.

- D.1.4 Any necessary adjustment of Contract Time that may be required as a result of a Change Order must be agreed upon by the parties before the start of the Change Order Work unless Owner's Authorized Representative authorizes Contractor to start the Work before agreement on Contract Time adjustment. Contractor shall submit any request for additional compensation (and additional Contract Time if Contractor was authorized to start Work before an adjustment of Contract Time was approved) as soon as possible but no later than thirty (30) Days after receipt of the Change Order. If Contractor's request for additional compensation or adjustment of Contract Time is not made within the thirty (30) Day time limit, Contractor's requests pertaining to that Change Order are barred. The thirty (30) Day time limit for making requests shall not be extended for any reason, including without limitation Contractor's claimed inability to determine the amount of additional compensation or adjustment of Contract Time, unless an extension is granted in writing by Owner. If the Owner's Authorized Representative denies Contractor's request for additional compensation or adjustment of Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process. No other reimbursement, compensation, or payment will be made, except as provided in Section D.1.5 for impact claims.
- D.1.5 If any Change Order Work under Section D.1.3 causes an increase or decrease in the Contractor's cost of, or the Contract Time required for the performance of any other part of the Work under this Contract, the Contractor must submit a written request

to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt of the Change Order by Contractor.

The thirty (30) Day time limit applies to claims of Subcontractors, suppliers, or manufacturers who may be affected by the Change Order and who request additional compensation or an extension of Contract Time to perform; Contractor has responsibility for contacting its Subcontractors, suppliers, or manufacturers within the thirty (30) Day time limit, and including their requests with Contractor's requests. If the request involves Work to be completed by Subcontractors, or materials to be furnished by suppliers or manufacturers, such requests shall be submitted to the Contractor in writing with full analysis and justification for the compensation and additional Contract Time requested. The Contractor will analyze and evaluate the merits of the requests submitted by Subcontractors, suppliers, and manufacturers to Contractor prior to including those requests and Contractor's analysis and evaluation of those requests with Contractor's requests for additional compensation or Contract Time that Contractor submits to the Owner's Authorized Representative. Failure of Subcontractors, suppliers, manufacturers or others to submit their requests to Contractor for inclusion with Contractor's requests submitted to Owner's Authorized Representative within the time period and by the means described in this section shall constitute a waiver of these Subcontractor claims. The Owner's Authorized Representative and the Owner will not consider direct requests or claims from Subcontractors, suppliers, manufacturers or others not a party to this Contract. The consideration of such requests and claims under this section does not give any person, not a party to the Contract the right to bring a claim against the State of Oregon, whether in this claims process, in litigation, or in any dispute resolution process.

If the Owner's Authorized Representative denies the Contractor's request for additional compensation or an extension of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

- D.1.6 No request or Claim by the Contractor for additional costs or an adjustment of Contract Time shall be allowed if made after receipt of final payment application under this Contract. Final payment application must be made by Contractor within the time required under Section E.6.4.
- D.1.7 It is understood that changes in the Work are inherent in construction of this type. The number of changes, the scope of those changes, and the effect they have on the progress of the original Work cannot be defined at this time. The Contractor is notified that numerous changes may be required and that there will be no compensation made to the Contractor directly related to the number of changes. Each change will be evaluated for extension of Contract Time and increase or decrease in compensation based on its own merit.

D.2 DELAYS

- D.2.1 Delays in construction include "Avoidable Delays", which are defined in Section D.2.1.1, and "Unavoidable Delays", which are defined in Section D.2.1.2. The effect of Avoidable Delays is described in Section D.2.2 and the effect of Unavoidable Delays is described in Section D.2.3.
 - D.2.1.1 Avoidable Delays include any delays other than Unavoidable Delays, and include delays that otherwise would be considered Unavoidable Delays but that:
 - (a) Could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

- (b) Affect only a portion of the Work and do not necessarily prevent or delay the prosecution of neither other parts of the Work nor the completion of the whole Work within the Contract Time.
- (c) Do not impact activities on the accepted critical path schedule.
- (d) Are associated with the reasonable interference of other contractors employed by the Owner that do not necessarily prevent the completion of the whole Work within the Contract Time.

D.2.1.2 Unavoidable Delays include delays other than Avoidable Delays that are:

- (a) Caused by any actions of the Owner, Owner's Authorized Representative, or any other employee or agent of the Owner, or by separate contractor employed by the Owner.
- (b) Caused by any site conditions which differ materially from what was represented in the Contract Documents or from conditions that would normally be expected to exist and be inherent to the construction activities defined in the Contract Documents. The Contractor shall notify the Owner's Authorized Representative immediately of differing site conditions before the area has been disturbed. The Owner's Authorized Representative will investigate the area and make a determination as to whether or not the conditions differ materially from either the conditions stated in the Contract Documents or those which could reasonably be expected in execution of this particular Contract. If Contractor and the Owner's Authorized Representative agree that a differing site condition exists, any additional compensation or additional Contract Time will be determined based on the process set forth in Section D.1.5 for Change Order Work. If the Owner's Authorized Representative disagrees that a differing site condition exists and denies Contractor's request for additional compensation or Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process.
- (c) Caused by Force Majeure acts, events or occurrences that could not have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.
- (d) Caused by adverse weather conditions. Any adverse weather conditions must be substantiated by documentary evidence that weather conditions were abnormal for the specific time period claimed, could not have been anticipated by the Contractor, and adversely impacted the project in a manner that could not be avoided by rescheduling the Work or by implementing measures to protect against the weather so that the Work could proceed. A rain, windstorm, high water, or other natural phenomenon for the specific locality of the Work, which might reasonably have been anticipated from the previous 10-year historical records of the general locality of the Work, shall not be construed as abnormal. The parties agree that rainfall greater than the following levels cannot be reasonably anticipated:
 - (i) Daily rainfall equal to, or greater than, 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by twenty-five percent (25 %) or more.
 - (ii) daily rainfall equal to, or greater than, 0.75 inch at any time.

The Office of the Environmental Data Service of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce nearest the project site shall be considered the official agency of record for weather information.

D.2.2 Contractor shall not be entitled to additional compensation or additional Contract Time for Avoidable Delays.

D.2.3 In the event of Unavoidable Delays, based on principles of equitable adjustment, Contractor may be entitled to the following:

- (a) Contractor may be entitled to additional compensation or additional Contract Time, or both, for Unavoidable Delays described in Section D.2.1.2 (a) and (b).
- (b) Contractor may be entitled to additional Contract Time for Unavoidable Delays described in Section D.2.1.2(c) and (d).

In the event of any requests for additional compensation or additional Contract Time, or both, as applicable, arising under this Section D.2.3 for Unavoidable Delays, other than requests for additional compensation or additional Contract Time for differing site conditions for which a review process is established under Section D.2.1.2 (b), Contractor shall submit a written notification of the delay to the Owner's Authorized Representative within two (2) Days of the occurrence of the cause of the delay. This written notification shall state the cause of the potential delay, the project components impacted by the delay, and the anticipated additional Contract Time extension or the additional compensation, or both, as applicable, resulting from the delay. Within seven (7) Days after the cause of the delay has been mitigated, or in no case more than thirty (30) Days after the initial written notification, the Contractor shall submit to the Owner's Authorized Representative, a complete and detailed request for additional compensation or additional Contract Time, or both, as applicable, resulting from the delay. If the Owner's Authorized Representative denies Contractor's request for additional compensation or adjustment of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

If Contractor does not timely submit the notices required under this Section D.2, then unless otherwise prohibited by law, Contractor's Claim shall be barred.

D.3 CLAIMS REVIEW PROCESS

D.3.1 All Contractor Claims shall be referred to the Owner's Authorized Representative for review. Contractor's Claims, including Claims for additional compensation or additional Contract Time, shall be submitted in writing by Contractor to the Owner's Authorized Representative within five (5) Days after a denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, provided that such initial request has been submitted in accordance with the requirements and within the time limits established in these General Conditions. Within thirty (30) Days after the initial Claim, Contractor shall submit to the Owner's Authorized Representative, a complete and detailed description of the Claim (the "Detailed Notice") that includes all information required by Section D.3.2. Unless the Claim is made in accordance with these time requirements, it shall be waived.

D.3.2 The Detailed Notice of the Claim shall be submitted in writing by Contractor and shall include a detailed, factual statement of the basis of the Claim, pertinent dates, Contract provisions which support or allow the Claim, reference to or copies of any documents which support the Claim, the dollar value of the Claim, and the Contract Time extension requested for the Claim. If the Claim involves Work to be completed by Subcontractors,

the Contractor will analyze and evaluate the merits of the Subcontractor claim prior to forwarding it and that analysis and evaluation to the Owner's Authorized Representative. The Owner's Authorized Representative and the Owner will not consider direct claims from Subcontractors, suppliers, manufacturers, or others not a party to this Contract. Contractor agrees that it will make no agreement, covenant, or assignment, nor will it commit any other act that will permit or assist any Subcontractor, supplier, manufacturer, or other to directly or indirectly make a claim against Owner.

D.3.3 The Owner's Authorized Representative will review all Claims and take one or more of the following preliminary actions within ten (10) Days of receipt of the Detailed Notice of a Claim: (1) request additional supporting information from the Contractor; (2) inform the Contractor and Owner in writing of the time required for adequate review and response; (3) reject the Claim in whole or in part and identify the reasons for rejection; (4) based on principles of equitable adjustment, recommend approval of all or part of the Claim; or (5) propose an alternate resolution.

D.3.4 The Owner's Authorized Representative's decision shall be final and binding on the Contractor unless appealed by written notice to the Owner within fifteen (15) Days of receipt of the decision. The Contractor must present written documentation supporting the Claim within fifteen (15) Days of the notice of appeal. After receiving the appeal documentation, the Owner shall review the materials and render a decision within thirty (30) Days after receiving the appeal documents.

D.3.5 The decision of the Owner shall be final and binding unless the Contractor delivers to the Owner its request for mediation, which shall be a non-binding process, within fifteen (15) Days of the date of the Owner's decision. The mediation process will be considered to have commenced as of the date the Contractor delivers the request. Both parties acknowledge and agree that participation in mediation is a prerequisite to commencement of litigation of any disputes relating to the Contract. Both parties further agree to exercise their best efforts in good faith to resolve all disputes within sixty (60) Days of the commencement of the mediation through the mediation process set forth herein.

In the event that a lawsuit must be filed within this sixty (60) Day period in order to preserve a cause of action, the parties agree that notwithstanding the filing, they shall proceed diligently with the mediation to its conclusion prior to actively prosecuting the lawsuit, and shall seek from the Court in which the lawsuit is pending such stays or extensions, including the filing of an answer, as may be necessary to facilitate the mediation process. Further, in the event settlements are reached on any issues through mediation, the parties agree to promptly submit the appropriate motions and orders documenting the settlement to the Court for its signature and filing.

D.3.6 Should the parties arrive at an impasse regarding any Claims or disputed Claims, it is agreed that the parties shall participate in mediation as specified in Section D.3.5. The mediation process will be considered to have been commenced as of the date one party delivers to the other its request in writing to mediate. The mediator shall be an individual mutually acceptable to both parties, but in the absence of agreement each party shall select a temporary mediator and the temporary mediators shall jointly select the permanent mediator. Each party shall pay its own costs for the time and effort involved in mediation. The cost of the mediator shall be split equally between the two parties. Both parties agree to exercise their best effort in good faith to resolve all disputes in mediation. Participation in mediation is a mandatory requirement of both the Owner and the Contractor. The schedule, time and place for mediation will be mutually acceptable, or, failing mutual agreement, shall be as established by the mediator. The parties agree to comply with Owner's

administrative rules governing the confidentiality of mediation, if any, and shall execute all necessary documents to give effect to such confidentiality rules. In any event, the parties shall not subpoena the mediator or otherwise require the mediator to produce records, notes or work product, or to testify in any future proceedings as to information disclosed or representations made in the course of mediation, except to the extent disclosure is required by law.

D.3.7 Unless otherwise directed by Owner's Authorized Representative, Contractor shall proceed with the Work while any Claim of Contractor is pending, including a Claim for additional compensation or additional Contract Time resulting from Change Order Work. Regardless of the review period or the final decision of the Owner's Authorized Representative, the Contractor shall continue to diligently pursue the Work as identified in the Contract Documents. In no case is the Contractor justified or allowed to cease Work without a written stop work order from the Owner or Owner's Authorized Representative.

SECTION E PAYMENTS

E.1 SCHEDULE OF VALUES

The Contractor shall submit, at least ten (10) Days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work. This schedule will provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown will demonstrate reasonable, identifiable, and measurable components of the Work. Unless objected to by the Owner's Authorized Representative, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner's Authorized Representative, Contractor shall revise the schedule of values and resubmit the same for approval of Owner's Authorized Representative.

E.2 APPLICATIONS FOR PAYMENT

E.2.1 Owner shall make progress payments on the Contract monthly as Work progresses. Payments shall be based upon estimates of Work completed and the Schedule of Values. All payments shall be approved by the Owner's Authorized Representative. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein. Owner shall pay to Contractor interest for over due claims at the rate of two-thirds of one percent per month on the progress payment, not including retainage, due the Contractor. Over due claims will be those that have not been paid within forty five (45) days from the latest of:

- (a) The date of the receipt of the accurate invoice;
- (b) The date of the initial billing statement if no invoice is received;
- (c) The date all goods have been received; or
- (d) The date the claim is made certain by agreement of the parties or by operation of law.

Notwithstanding the foregoing, in instances when an application for payment is filled out incorrectly, or when there is any defect or impropriety in any submitted application or when there is a good faith dispute, Owner shall so notify the Contractor within fifteen (15) Days stating the reason or reasons the application for payment is defective or improper or the reasons for the dispute. A defective or improper application for payment, if corrected by the Contractor within seven (7) Days of being notified by the Owner, shall not cause a payment to be made later than specified in this section unless interest is also paid. Payment of interest

will be postponed when payment on the principal is delayed because of disagreement between the Owner and the Contractor.

E.2.2 Contractor shall submit to the Owner's Authorized Representative, an application for each payment and, if required, receipts or other vouchers showing payments for materials and labor including payments to Subcontractors. Contractor shall include, in its application for payment, a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total, and shall include, on the face of each copy thereof, a certificate in substantially the following form:

"I, the undersigned, hereby certify that the above bill is true and correct, and the payment therefore, has not been received.

Signed: _____

E.2.3 Generally, applications for payment will be accepted only for materials that have been installed. Under special conditions, applications for payment for stored materials will be accepted at Owner's sole discretion. Such a payment, if made, will be subject to the following conditions:

(a) The request for stored material shall be submitted at least thirty (30) Days in advance of the application for payment on which it appears. Applications for payment shall be entertained for major equipment, components or expenditures only.

(b) The Contractor shall submit applications for payment showing the quantity and cost of the material stored.

(c) The material shall be stored in a bonded warehouse and Owner's Authorized Representative shall be granted the right to access the material for the purpose of removal or inspection at any time during the Contract Period.

(d) The Contractor shall name the Owner as co-insured on the insurance policy covering the full value of the property while in the care and custody of the Contractor until it is installed. A certificate noting this coverage shall be issued to the Owner.

(e) Payments shall be made for materials only. The submitted amount of the application for payment shall be reduced by the cost of transportation and for the cost of an inspector to check the delivery at out of town storage sites. The cost of said inspection shall be borne solely by the Contractor.

(f) Within sixty (60) Days of the application for payment, the Contractor shall submit evidence of payment covering the material stored.

(g) Payment for stored materials shall in no way indicate acceptance of the materials or waive any rights under this Contract for the rejection of the Work or materials not in conformance with the Contract Documents.

(h) All required documentation must be submitted with the respective application for payment.

E.2.4 The Owner reserves the right to withhold all or part of a payment, or may nullify in whole or part any payment previously made, to such extent as may be necessary in the Owner's opinion to protect the Owner from loss because of:

(a) Work that is defective and not remedied, or that has been demonstrated or identified as failing to conform with the Contract Documents,

(b) third party claims filed or evidence reasonably indicating that such claims will likely be filed unless security acceptable to the Owner is provided by the Contractor;

(c) failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment (in which case Owner may issue checks made payable jointly to Contractor and such unpaid persons under this provision, or directly to Subcontractors and suppliers at any level under Section C.3.2.1);

(d) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

(e) damage to the Owner or another contractor;

(f) reasonable evidence that the Work will not be completed within the Contract Time required by the Contract, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

(g) failure to carry out the Work in accordance with the Contract Documents; or

(h) assessment of liquidated damages, when withholding is made for offset purposes.

E.2.5 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

(a) Take that portion of the Contract Price properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Price allocated to that portion of the Work in the Schedule of Values, less retainage as provided in Section E.5. Pending final determination of cost to the Owner of changes in the Work, amounts not in the dispute may be included even though the Contract Price has not yet been adjusted by Change Order;

(b) Add that portion of the Contract Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner pursuant to Section E.2.3, suitably stored off the site at a location agreed upon in writing), less retainage as provided in Section E.5;

(c) Subtract the aggregate of previous payments made by the Owner; and

(d) Subtract any amounts for which the Owner's Authorized Representative has withheld or nullified payment as provided in the Contract Documents.

E.2.6 Contractor's applications for payment may not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

E.2.7 The Contractor warrants to Owner that title to all Work covered by an application for payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an application for payment all Work for which payments are received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

E.2.8 If Contractor disputes any determination by Owner's Authorized Representative with regard to any application for payment, Contractor nevertheless shall continue to prosecute expeditiously the Work. No payment made hereunder shall be or be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations hereunder.

E.3 PAYROLL CERTIFICATION REQUIREMENT

Payroll certification is required before payments are made on the Contract. Refer to Section C.2 for this information.

E.4 DUAL PAYMENT SOURCES

Contractor shall not be compensated for Work performed under this Contract from any state agency other than the agency that is a party to this Contract.

E.5 RETAINAGE

E.5.1 Retainage shall be withheld and released in accordance with OAR 580-063-0045.

E.5.1.1 Owner may reserve as retainage from any progress payment an amount not to exceed five percent of the payment. As Work progresses, Owner may reduce the amount of the retainage and may eliminate retainage on any remaining monthly Contract payments after 50 percent of the Work under the Contract is completed if, in the Owner's opinion, such Work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed only upon written application by the Contractor, which application shall include written approval of Contractor's surety; except that when the Work is 97-1/2 percent completed the Owner may, at its discretion and without application by the Contractor, reduce the retained amount to 100 percent of the value of the Work remaining to be done. Upon receipt of written application by the Contractor, Owner shall respond in writing within a reasonable time.

E.5.1.2 Contractor may request in writing:

- (a) to be paid amounts which would otherwise have been retained from progress payments where Contractor has deposited acceptable bonds and securities of equal value with Owner or in a custodial account or other mutually-agreed account satisfactory to Owner, with an approved bank or trust company to be held in lieu of the cash retainage for the benefit of Owner;
- (b) for construction projects over \$1,000,000, that retainage be deposited in an interest bearing account, established through the State Treasurer for state agencies, in a bank, savings bank, trust company or savings association for the benefit of Owner, with earnings from such account accruing to the Contractor; or
- (c) that the Owner allow Contractor to deposit a surety bond for the benefit of Owner, in a form acceptable to Owner, in lieu of all or a portion of funds retained, or to be retained. Such bond and any proceeds therefrom shall be made subject to all claims in the manner and priority as set forth for retainage.

When the Owner has accepted the Contractor's election of option (a) or (b), Owner may recover from Contractor any additional costs incurred through such election by reducing Contractor's final payment. Where the Owner has agreed to Contractor's request for option (c), Contractor shall accept like bonds from Subcontractors and suppliers on the project from which Contractor has required retainages.

E. 5.1.3 The retainage held by Owner shall be included in and paid to the Contractor as part of the final payment of the Contract Price. The Owner shall pay to Contractor interest at the rate of two-thirds of one percent per month on the final payment due Contractor, interest to commence forty five (45) Days after the Work under the Contract has been completed and accepted and to run until the date when final payment is tendered to

Contractor. The Contractor shall notify Owner in writing when the Contractor considers the Work complete and Owner shall, within fifteen (15) Days after receiving the written notice, either accept the Work or notify the Contractor of Work yet to be performed on the Contract. If Owner does not within the time allowed notify the Contractor of Work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run forty five (45) Days after the end of the 15-Day period.

E.5.1.4 Owner will reduce the amount of the retainage if the Contractor notifies the controller of the Owner that the Contractor has deposited in an escrow account with a bank or trust company, in a manner authorized by the Owner's Authorized Representative, bonds and securities of equal value of a kind approved by the Owner's Authorized Representative.

E.5.1.5 Contractor agrees that if Contractor elects to reserve a retainage from any progress payment due to any Subcontractor or supplier, such retainage shall not exceed five percent of the payment, and such retainage withheld from Subcontractors and suppliers shall be subject to the same terms and conditions stated in Subsection E.5 as apply to Owner's retainage from any progress payment due to Contractor.

E.5.2 As provided in subsections C.2.2 and C.2.3, additional retainage in the amount of 25% of amounts earned shall be withheld and released in accordance with ORS 279C.845(7) when the Contractor fails to file certified statements as required by section C.2.1.

E.6 FINAL PAYMENT

E.6.1 Upon completion of all the Work under this Contract, the Contractor shall notify the Owner's Authorized Representative, in writing, that Contractor has completed Contractor's part of the Contract and shall request final payment. Upon receipt of such notice the Owner's Authorized Representative will inspect the Work, and if acceptable, submit to the Owner a recommendation as to acceptance of the completed Work and as to the final estimate of the amount due the Contractor. If the Work is not acceptable, Owner will notify Contractor within fifteen (15) Days of Contractor's request for final payment. Upon approval of this final estimate by the Owner and compliance by the Contractor with provisions in Section K, AFFIDAVIT/RELEASE OF LIENS AND CLAIMS, and other provisions as may be applicable, the Owner shall pay to the Contractor all monies due under the provisions of these Contract Documents.

E.6.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Owner's Authorized Representative (1) a notarized affidavit/release of liens and claims in a form satisfactory to Owner that states that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner

against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

- E.6.3 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final application for payment.
- E.6.4 Contractor agrees to submit its final payment application within ninety (90) Days after Substantial Completion, unless written extension is granted by Owner. Contractor shall not delay final payment application for any reason, including without limitation nonpayment of Subcontractors, suppliers, manufacturers or others not a party to this Contract, or lack of resolution of a dispute with Owner or any other person of matters arising out of or relating to the Contract. If Contractor fails to submit its final payment application within ninety (90) Days after Substantial Completion, and Contractor has not obtained written extension by Owner, all requests or Claims for additional costs or an extension of Contract Time shall be waived.

SECTION F JOB SITE CONDITIONS

F.1 USE OF PREMISES

Contractor shall confine equipment, storage of materials and operation of Work to the limits indicated by Contract Documents, law, ordinances, permits or directions of the Owner's Authorized Representative. Contractor shall follow the Owner's Authorized Representative's instructions regarding use of premises, if any.

F.2 PROTECTION OF WORKERS, PROPERTY AND THE PUBLIC

- F.2.1 Contractor shall maintain continuous and adequate protection of all of the Work from damage, and shall protect the Owner's Authorized Representative, Owner's workers and property from injury or loss arising in connection with this Contract. Contractor shall remedy acceptably to the Owner, any damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by authorized representatives or personnel of the Owner. Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.
- F.2.2 Contractor shall take all necessary precautions for the safety of all personnel on the job site, and shall comply with the Contract Documents and all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the Work is being performed. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for protection of workers and the public against any hazards created by construction. Contractor shall designate a responsible employee or associate on the Work site, whose duty shall be the prevention of accidents. The name and position of the person designated shall be reported to the Owner's Authorized Representative. The Owner's Authorized Representative has no responsibility for Work site safety. Work site safety is the responsibility of the Contractor.
- F.2.3 Contractor shall not enter upon private property without first obtaining permission from the property owner or its duly authorized representative. Contractor shall be responsible for the preservation of all public and private property along and adjacent to the Work contemplated under the Contract and shall use every precaution necessary to prevent damage thereto. In the event the Contractor damages any property, the Contractor shall at once notify the property owner and make, or arrange to

make, full restitution. Contractor shall report, immediately in writing, to the Owner's Authorized Representative, all pertinent facts relating to such property damage and the ultimate disposition of the claim for damage.

- F.2.4 Contractor is responsible for protection of adjacent work areas including impacts brought about by activities, equipment, labor, utilities, and materials on the site.
- F.2.5 Contractor shall at all times direct its activities in such a manner as to minimize adverse effects on the environment. Handling of all materials will be conducted so no release will occur that may pollute or become hazardous.
- F.2.6 In an emergency affecting the safety of life or of the Work or of adjoining property, the Contractor, without special instruction or authorization from the Owner's Authorized Representative, shall act reasonably to prevent threatened loss or injury, and shall so act, without appeal, if instructed by the Owner's Authorized Representative. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with section D.

F.3 CUTTING AND PATCHING

- F.3.1 Contractor shall be responsible for coordinating all cutting, fitting, or patching of the Work to make its several parts come together properly and fit to receive or be received by work of other contractors or Subcontractors shown upon, or reasonably implied by, the Contract Documents.
- F.3.2 Contractor shall be responsible for restoring all cut, fitted, or patched surfaces to an original condition; provided, however, that if a different condition is specified in the Contract Documents, then Contractor shall be responsible for restoring such surfaces to the condition specified in the Contract Documents.

F.4 CLEANING UP

From time to time as may be ordered by the Owner and, in any event, immediately after completion of the Work, the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. If Contractor fails to do so within twenty-four hours after notification by the Owner the work may be done by others and the cost charged to the Contractor and deducted from payment due the Contractor.

F.5 ENVIRONMENTAL CONTAMINATION

- F.5.1. Contractor will be held responsible for and shall indemnify, defend (with counsel of Owner's choice), and hold harmless Owner from and against any costs, expenses, damages, claims, and causes of action, (including attorney fees), or any of them, resulting from all spills, releases, discharges, leaks and disposal of environmental pollution, including storage, transportation, and handling during the performance of the Contract which occur as a result of, or are contributed by, the negligence or actions of Contractor or its personnel, agents, or Subcontractors or any failure to perform in accordance with the Contract Documents (except to the extent otherwise void under ORS 30.140). Nothing in this section F.5.1 shall limit Contractor's responsibility for obtaining insurance coverages required under Section G.3 of this Contract, and Contractor shall take no action that would void or impair such coverages.
- F.5.1.1 Contractor agrees to promptly dispose of such spills, releases, discharge or leaks to the satisfaction of Owner and proper regulatory agencies in a manner that complies with applicable federal, state, and local laws and regulations. Cleanup shall be at no cost to the Owner and be performed by properly qualified personnel.

F.5.1.2 Contractor shall obtain the Owner's written consent prior to bringing onto the Work site any (i) environmental pollutants or (ii) hazardous substances or materials, as the same or reasonably similar terms are used in any applicable federal, state, or local statutes, rules or ordinances. Notwithstanding such written consent from the Owner, the Contractor, at all times, shall:

- (a) properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all applicable federal, state, or local statutes, rules, or ordinances;
- (b) be responsible for any and all spills, releases, discharges, or leaks of (or from) environmental pollutants or hazardous substances or materials which Contractor has brought onto the Work site; and
- (c) promptly clean up, without cost to the Owner, such spills, releases, discharges, or leaks to the Owner's satisfaction and in compliance with all applicable federal, state, or local statutes, rules or ordinances.

F.5.2 Contractor shall report all reportable quantity releases to applicable federal, state, and local regulatory and emergency response agencies. Reportable quantities are found in 40 CFR Part 302, Table 302.4 for hazardous substances and in OAR Chapter 340 Division 108 for all products addressed therein. Upon discovery, regardless of quantity, Contractor must telephonically report all releases to the Owner. A written follow-up report shall be submitted to Owner within 48 hours of the telephonic report. Such written report shall contain, as a minimum:

- (a) Description of items released (identity, quantity, manifest no., and all other documentation required by law.)
- (b) Whether amount of items released is EPA/DEQ reportable, and, if so, when it was reported.
- (c) Exact time and location of release, including a description of the area involved.
- (d) Containment procedures initiated.
- (e) Summary of communications about the release Contractor has had with members of the press or State officials other than Owner.
- (f) Description of cleanup procedures employed or to be employed at the site, including disposal location of spill residue.
- (g) Personnel injuries, if any, resulting from, or aggravated by, the release.

F.6 ENVIRONMENTAL CLEAN-UP

F.6.1 Unless disposition of environmental pollution is specifically a part of this Contract, or was caused by the Contractor (reference F.5 Environmental Contamination), Contractor shall immediately notify Owner of any hazardous substance(s) which Contractor discovers or encounters during performance of the Work required by this Contract. "Hazardous substance(s)" means any hazardous, toxic and radioactive materials and those substances defined as "hazardous substances," "hazardous materials," "hazardous wastes," "toxic substances," or other similar designations in any federal, state, or local law, regulation, or ordinance, including without limitation asbestos, polychlorinated biphenyl (PCB), or petroleum, and any substances, materials or wastes regulated in 40 CFR, Part 261 and defined as hazardous in 40 CFR S 261.3. In addition to notifying Owner of any hazardous substance(s) discovered or

encountered, Contractor shall immediately cease working in any particular area of the project where a hazardous substance(s) has been discovered or encountered if continued work in such area would present a risk or danger to the health or well being of Contractor's or any Subcontractor's work force.

F.6.2 Upon being notified by Contractor of the presence of hazardous substance(s) on the project site, Owner shall arrange for the proper disposition of such hazardous substance(s).

F.7 FORCE MAJEURE

A party to this Contract shall not be held responsible for delay or default due to Force Majeure acts, events or occurrences unless they could have been avoided by the exercise of reasonable care, prudence, foresight, and diligence by that party. The Owner may terminate this Contract upon written notice after determining that delay or default caused by Force Majeure acts, events or occurrences will reasonably prevent successful performance of the Contract.

SECTION G

INDEMNITY, BONDING, AND INSURANCE

G.1 RESPONSIBILITY FOR DAMAGES / INDEMNITY

G.1.1 Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay that may be caused by, or result from, the carrying out of the Work to be done under this Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, personnel, or agents.

G.1.2 To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel approved by Owner) and hold harmless the Owner, Owner's Authorized Representative, Architect/Engineer, Architect/Engineer's consultants, and their respective officers, directors, agents, employees, partners, members, stockholders and affiliated companies (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses (including reasonable attorney fees), demands and actions of any nature whatsoever which arise out of, result from or are related to, (a) any damage, injury, loss, expense, inconvenience or delay described in this Section G.1.2, (b) any accident or occurrence which happens or is alleged to have happened in or about the project site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects, (c) any failure of the Contractor to observe or perform any duty or obligation under the Contract Documents which is to be observed or performed by the Contractor, or any breach of any agreement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract, (d) the negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or any one of them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder (except to the extent otherwise void under ORS 30.140), and (e) any lien filed upon the project or bond claim in connection with the Work. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section G.1.2.

G.1.3 In claims against any person or entity indemnified under this Section G.1.2 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section G.1.2 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

G.2 PERFORMANCE AND PAYMENT SECURITY; PUBLIC WORKS BOND

- G.2.1 When the Contract Price is \$100,000 or more (or \$50,000 or more in the case of Contracts for highways, bridges and other transportation projects) the Contractor shall furnish and maintain in effect at all times during the Contract Period, a performance bond in a sum equal to the Contract Price, and a separate payment bond also in a sum equal to the Contract Price. The bonds may be required if the Contract Price is less than the above thresholds, if required by the Contract Documents.
- G.2.2 Bond forms furnished by the Owner and notarized by awarded Contractor's surety company authorized to do business in Oregon are the only acceptable forms of performance and payment security, unless otherwise specified in the Contract Documents.
- G.2.3 Before starting Work the Contractor shall file with the Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by Oregon Laws 2005, Chapter 360, and OAR 839-025-0015, unless otherwise exempt under those provisions. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work, unless otherwise exempt, and shall verify that the Subcontractor has filed a public works bond before permitting the Subcontractor to start Work.

G.3 INSURANCE

- G.3.1 Primary Coverage: Insurance carried by Contractor under this Contract shall be the primary coverage, and the Owner's insurance is excess and solely for damages or losses for which the Owner is responsible. The coverages indicated are minimums unless otherwise specified in the Contract Documents.
- G.3.2 Workers' Compensation: All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than \$100,000 for each accident. Contractors who perform the Work without the assistance or labor of any employee need not obtain such coverage if the Contractor certifies so in writing. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.
- G.3.3 Builder's Risk Insurance:
 - G.3.3.1 Builder's Risk: During the term of this Contract, for new construction the Contractor shall maintain in force, at its own expense, Builder's Risk insurance on an all risk form, including earthquake and flood, for an amount equal to the full amount of the Contract. Any deductible shall not exceed \$50,000 for each loss, except the earthquake and flood deductible shall not exceed 2 percent of each loss or \$50,000, whichever is more. The policy will include as loss payees the Owner, the Contractor and its Subcontractors as their interests may appear.
 - G.3.3.2 Builder's Risk Installation Floater: For other than new construction the Contractor shall obtain, at the Contractor's expense, and keep in effect during the term of this Contract, a Builder's Risk Installation Floater for coverage of the Contractor's labor, materials and equipment to be used for completion of the Work performed under this Contract. The minimum amount of coverage to be carried shall be equal to

the full amount of the Contract. This insurance shall include as loss payees the State of Oregon, the Owner, the Contractor and its Subcontractors as their interests may appear.

- G.3.3.3 Such insurance shall be maintained until Owner has occupied the facility.
- G.3.3.4 A loss insured under the Builder's Risk insurance shall be adjusted by the Owner and made payable to the Owner for the insureds, as their interests may appear. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner. The Owner shall have power to adjust and settle a loss with insurers.
- G.3.4 Liability Insurance:
 - G.3.4.1 Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Commercial General Liability Insurance covering bodily injury and property damage in a form and with coverages that are satisfactory to the State. This insurance shall include personal injury liability, products and completed operations, and contractual liability coverage for the indemnity provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace), and shall be issued on an occurrence basis. Combined single limit per occurrence shall not be less than \$1,000,000 for each job site or location. Each annual aggregate limit shall not be less than \$1,000,000.
 - G.3.4.2 Automobile Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, non-owned and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Combined single limit per occurrence shall not be less than \$1,000,000.00, or the equivalent.
 - G.3.4.3 "Tail" Coverage: If any of the required liability insurance is arranged on a "claims made" basis, "tail" coverage will be required at the completion of this Contract for a duration of 24 months or the maximum time period available in the marketplace if less than 24 months. Contractor will be responsible for furnishing certification of "tail" coverage as described or continuous "claims made" liability coverage for 24 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage, provided its retroactive date is on or before the effective date of this Contract. This will be a condition of the final acceptance of Work or services and related warranty (if any).
 - G.3.5 Additional Insured: The liability insurance coverage, except Professional Liability if included, required for performance of this Contract shall include the State of Oregon, its departments, divisions, officers, and employees, as Additional Insureds but only with respect to the Contractor's activities to be performed under this Contract.

If Contractor cannot obtain an insurer to name the State of Oregon, its departments, divisions, officers and employees as Additional Insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, naming the State of Oregon, its departments, divisions, officers and employees as Named Insureds with not less than a \$1,000,000.00 limit per occurrence. This policy must be kept in effect for 12 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to its issuance of a Notice to Proceed.

- G.3.6 Notice of Cancellation or Change: There shall be no cancellation, material change, potential exhaustion of aggregate limits or intent not to renew insurance coverages without thirty (30) Days' written notice from the Contractor or its insurer(s) to the Owner. Any failure to comply with the reporting provisions of this insurance, except for the potential exhaustion of aggregate limits, shall not affect the coverages provided to the State of Oregon, its Owner and their divisions, officers, and employees.
- G.3.7 Certificate(s) of Insurance: As evidence of the insurance coverage required by this Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to its issuance of a Notice to Proceed. The certificate(s) will specify all of the parties who are Additional Insureds or Loss Payees. Insurance coverage required under this Contract shall be obtained from insurance companies or entities acceptable to the Owner that are allowed to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to do an insurance business in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and are approved by the Owner. The certificates will also specify that there shall be no cancellation, material change, potential exhaustion of aggregate limits or intent not to renew insurance coverages without thirty (30) Days' written notice from the insurer(s) to the Owner. To the extent Certificates of Insurance contain words to the effect that Contractor shall "endeavor to send notice of cancellation" or similar language, Contractor shall require its insurer to send such notice by making sure that the words "endeavor to" or similar words are removed from the Certificate. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self-insurance included hereunder. Any deductible, self-insured retention and/or self-insurance in excess of \$50,000 shall be approved by the Owner in writing prior to issuance of a Notice to Proceed and is subject to Owner's approval.

**SECTION H
SCHEDULE OF WORK**

H.1 CONTRACT PERIOD

- H.1.1 Time is of the essence on this Contract. The Contractor shall at all times carry on the Work diligently, without delay and punctually fulfill all requirements herein. Contractor shall commence Work on the site within fifteen (15) Days of Notice to Proceed, unless directed otherwise.
- H.1.2 Unless specifically extended by Change Order, all Work shall be complete by the date contained in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, which may require the use of overtime. Such accelerated Work schedule shall be an acceleration in performance of Work under Section D.1.2 (f) and shall be subject to the Change Order process of Section D.1.
- H.1.3 The Owner shall not waive any rights under the Contract by permitting the Contractor to continue or complete the Work or any part of it after the date described in Section H.1.2 above.

H.2 SCHEDULE

- H.2.1 Contractor shall provide, by or before the pre-construction conference, a detailed schedule for review and acceptance by the Owner. The submitted schedule must illustrate Work by significant project components, significant labor trades, and long lead items broken down by building and/or floor where applicable. Each schedule item shall account for no greater than 5 % of the monetary value of the project or 5 % of the available

Contract Time. Schedules with activities of less than one Day or valued at less than 1% of the Contract will be considered too detailed and will not be accepted. Schedules lacking adequate detail, or unreasonably detailed, will be rejected. Included within the schedule are the following: Notice to Proceed, Substantial Completion, and Final Completion. Schedules will be updated monthly and submitted with the monthly payment application. Acceptance of the Schedule by the Owner does not constitute agreement by the Owner, as to the Contractor's sequencing, means, methods, or durations. Any positive difference between the Contractor's scheduled completion and the Contract completion date is float owned by the Owner. Owner reserves the right to negotiate the float if it is deemed to be in Owner's best interest to do so. In no case shall the Contractor make a claim for delays if the Work is completed within the Contract Time but after Contractor's scheduled completion.

H.3 PARTIAL OCCUPANCY OR USE

- H.3.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have reasonably accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, insurance or self-insurance, maintenance, heat, utilities, and damage to the Work, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents with respect to such portion of the Work. Approval by the Contractor to partial occupancy or use shall not be unreasonably withheld. Immediately prior to such partial occupancy or use, the Owner and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

**SECTION I
CORRECTION OF WORK**

I.1 CORRECTION OF WORK BEFORE FINAL PAYMENT

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects, and that the Work will conform to the requirements of the Contract Documents. Work failing to conform to these requirements shall be deemed defective. Contractor shall promptly remove from the premises and replace all defective materials and equipment as determined by the Owner's Authorized Representative, whether incorporated in the Work or not. Removal and replacement shall be without loss or expense to the Owner, and Contractor shall bear the cost of repairing all Work destroyed or damaged by such removal or replacement. Contractor shall be allowed a period of no longer than thirty (30) Days for completion of defective (punch list) work. At the end of the thirty-day period, or earlier if requested by the Contractor, Owner shall arrange for inspection of the Work by the Architect/Engineer. Should the work not be complete, and all corrections made, the costs for all subsequent reinspections shall be borne by the Contractor. If Contractor fails to complete the punch list work within the thirty (30) Day period, without affecting Contractor's obligations Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand.

I.2 WARRANTY WORK

- I.2.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of Substantial Completion by the Owner except for latent defects which will be remedied by the Contractor at any time they become apparent. The Owner shall give Contractor notice of defects with reasonable promptness. Contractor shall perform such warranty work within a reasonable time after Owner's demand. If Contractor fails to complete the warranty work within such period as Owner determines reasonable, or at any time in the event of warranty work consisting of emergency repairs, without affecting Contractor's obligations, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand. The Contractor shall perform the warranty Work by correcting defects within twenty-four (24) hours of notification by Owner, unless otherwise specified in the Contract Documents. Should the Contractor fail to respond within the specified response time, the Owner may, at its option, complete the necessary repairs using another contractor or its own forces. If Owner completes the repairs using Owner's own forces, Contractor shall pay Owner at the rate of one and one-half (1½) times the standard hourly rate of Owner's forces, plus related overhead and any direct non-salary costs. If Owner completes the repairs using another contractor, Contractor shall pay Owner the amount of Owner's direct costs billed by the other contractor for the work, plus the direct salary costs and related overhead and direct non-salary expenses of Owner's forces who are required to monitor that contractor's work. Work performed by Owner using Owner's own forces or those of another contractor shall not affect the Contractor's contractual duties under these provisions, including warranty provisions.
- I.2.2 This provision does not negate guarantees or warranties for periods longer than one year including without limitation such guarantees or warranties required by other sections of the Contract Documents for specific installations, materials, processes, equipment or fixtures.
- I.2.3 In addition to Contractor's warranty, manufacturer's warranties shall pass to the Owner and shall not take effect until affected Work has been accepted in writing by the Owner's Authorized Representative.
- I.2.4 The one-year period for correction of Work shall be extended with respect to portions of Work performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work, and shall be extended by corrective Work performed by the Contractor pursuant to this Section, as to the Work corrected. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.
- I.2.5 Nothing contained in this Section I.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the period for correction of Work as described in this Section I.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

- I.2.6 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Price will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

SECTION J **SUSPENSION AND/OR TERMINATION OF THE WORK**

J.1 OWNER'S RIGHT TO SUSPEND THE WORK

- J.1.1 The Owner and/or the Owner's Authorized Representative has the authority to suspend portions or all of the Work due to the following causes:
- (a) Failure of the Contractor to correct unsafe conditions;
 - (b) Failure of the Contractor to carry out any provision of the Contract;
 - (c) Failure of the Contractor to carry out orders;
 - (d) Conditions, in the opinion of the Owner's Authorized Representative, which are unsuitable for performing the Work;
 - (e) Time required to investigate differing site conditions;
 - (f) Any reason considered to be in the public interest.
- J.1.2 The Owner shall notify Contractor and the Contractor's Surety shall be notified in writing of the effective date and time of the suspension and shall notify Contractor and its surety in writing to resume Work.

J.2 CONTRACTOR'S RESPONSIBILITIES

- J.2.1 During the period of the suspension, Contractor is responsible to continue maintenance at the project just as if the Work were in progress. This includes, but is not limited to, protection of completed Work, maintenance of access, protection of stored materials, temporary facilities, and clean-up.
- J.2.2 When the Work is recommenced after the suspension, the Contractor shall replace or renew any Work damaged during the suspension, remove any materials or facilities used as part of temporary maintenance, and complete the project in every respect as though its prosecution had been continuous and without suspension.

J.3 COMPENSATION FOR SUSPENSION

- J.3.1 Depending on the reason for suspension of the Work, the Contractor or the Owner may be due compensation by the other party. If the suspension was required due to acts or omissions of Contractor, the Owner may assess the Contractor actual costs of the suspension in terms of administration, remedial work by the Owner's forces or another contractor to correct the problem associated with the suspension, rent of temporary facilities, and other actual costs related to the suspension. If the suspension was caused by acts or omissions of the Owner, the Contractor shall be due compensation which shall be defined using Section D, Changes in Work. If the suspension was required through no fault of the Contractor or the Owner, neither party owes the other for the impact.

J.4 OWNER'S RIGHT TO TERMINATE CONTRACT

J.4.1 The Owner may, without prejudice to any other right or remedy, and after giving Contractor seven (7) Days' written notice and an opportunity to cure, terminate the Contract in whole or in part under the following conditions:

- (a) If Contractor should voluntarily or involuntarily, seek protection under the United States Bankruptcy Code and Contractor as debtor-in-possession or the Trustee for the estate fails to assume the Contract within a reasonable time;
- (b) If Contractor should make a general assignment for the benefit of Contractor's creditors;
- (c) If a receiver should be appointed on account of Contractor's insolvency;
- (d) If Contractor should repeatedly refuse or fail to supply an adequate number of skilled workers or proper materials to carry on the Work as required by the Contract Documents, or otherwise fail to perform the Work in a timely manner;
- (e) If Contractor should repeatedly fail to make prompt payment to Subcontractors or for material or labor, or should disregard laws, ordinances or the instructions of the Owner or its Authorized Representative; or
- (f) If Contractor is otherwise in material breach of any part of the Contract.

J.4.2 At any time that any of the above occurs, Owner may exercise all rights and remedies available to Owner at law or in equity, and in addition, Owner may take possession of the premises and of all materials and appliances and finish the Work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive further payment until the Work is completed. If the Owner's cost of finishing the Work exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to the Owner.

J.5 TERMINATION FOR CONVENIENCE

J.5.1 Owner may terminate the Contract in whole or in part whenever Owner determines that termination of the Contract is in the best interest of the public.

J.5.2 The Owner will provide the Contractor with seven (7) Days' prior written notice of a termination for public convenience. After such notice, the Contractor shall provide the Owner with immediate and peaceful possession of the premises and materials located on and off the premises for which the Contractor received progress payment under Section E. Compensation for Work terminated by the Owner under this provision will be according to Section E. In no circumstance shall Contractor be entitled to lost profits for Work not performed due to termination.

J.6 ACTION UPON TERMINATION

J.6.1 Upon receiving a notice of termination, and except as directed otherwise by the Owner, Contractor shall immediately cease placing further subcontracts or orders for materials, services, or facilities. In addition, Contractor shall terminate all subcontracts or orders to the extent they relate to the Work terminated and, with the prior written approval of the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts and orders.

J.6.2 As directed by the Owner, Contractor shall, upon termination, transfer title and deliver to the Owner all Record Documents, information, and other property that, if the Contract had been

completed, would have been required to be furnished to the Owner.

SECTION K CONTRACT CLOSE OUT

K.1 RECORD DOCUMENTS

As a condition of final payment (refer also to section E.6), Contractor shall comply with the following: Contractor shall provide to Owner's Authorized Representative, Record Documents of the entire project. Record Documents shall depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction. Record Documents are part of the Work and shall be provided prior to the Owner's issuance of final payment. Record Documents include all modifications to the Contract Documents unless otherwise directed.

K.2 OPERATION AND MAINTENANCE MANUALS

As part of the Work, Contractor shall submit two completed operation and maintenance manuals ("O & M Manuals") for review by the Owner's Authorized Representative prior to submission of any pay request for more than 75% of the Work. No payments beyond 75% will be made by the Owner until the O & M Manuals have been received. The O & M Manuals shall contain a complete set of all submittals, all product data as required by the specifications, training information, phone list of consultants, manufacturers, installer and suppliers, manufacturer's printed data, record and shop drawings, schematic diagrams of systems, appropriate equipment indices, warranties and bonds. The Owner's Authorized Representative shall review and return one O & M Manual for any modifications or additions required. Prior to submission of its final pay request, Contractor shall deliver three (3) complete and approved sets of O & M Manuals to the Owner's Authorized Representative.

K.3 AFFIDAVIT/RELEASE OF LIENS AND CLAIMS

As a condition of final payment, the Contractor shall submit to the Owner's Authorized Representative a notarized affidavit/release of liens and claims form, in a form satisfactory to Owner, which states that all Subcontractors and suppliers have been paid in full, all disputes with property owners have been resolved, all obligations on the project have been satisfied, all monetary claims and indebtedness have been paid, and that, to the best of the Contractor's knowledge, there are no claims of any kind outstanding against the project. The Contractor shall indemnify, defend (with counsel of Owner's choice) and hold harmless the Owner from all claims for labor and materials finished under this Contract. The Contractor shall furnish complete and valid releases or waivers, satisfactory to the Owner, of all liens arising out of or filed in connection with the Work.

K.4 COMPLETION NOTICES

K.4.1 Contractor shall provide Owner notice of both Substantial and Final Completion. The certificate of Substantial Completion shall state the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and the time within which the Contractor shall finish all items on the punchlist accompanying the Certificate. Both completion notices must be signed by the Contractor and the Owner to be valid. The Owner shall provide the final signature on the notices. The notices shall take effect on the date they are signed by the Owner.

K.4.2 Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that has provided a minimum of thirty (30) continuous Days of successful, trouble-free operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the Owner's Authorized Representative. All equipment contained in the Work, plus all

other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the Substantial Completion date. The Contractor may request that a punch list be prepared by the Owner's Authorized Representative with submission of the request for the Substantial Completion notice.

K.5 TRAINING

As part of the Work, and prior to submission of the request for final payment, the Contractor shall schedule with the Owner's Authorized Representative, training sessions for all equipment and systems, as required in the individual specifications sections. Contractor shall schedule training sessions at least two weeks in advance of the date of training to allow Owner personnel adequate notice. The O & M Manual shall be used as a basis for training. Training shall be a formal session, held after the equipment and/or system is completely installed and operational in its normal operating environment.

K.6 EXTRA MATERIALS

As part of the Work, Contractor shall provide spare parts, extra maintenance materials, and other materials or products in the quantities specified in the specifications, prior to final payment. Delivery point for extra materials shall be designated by the Owner's Authorized Representative.

K.7 ENVIRONMENTAL CLEAN-UP

As part of the Final Completion notice, or as a separate written notice submitted with or before the notice of Final Completion, the Contractor shall notify the Owner that all environmental pollution clean-up which was performed as a part of this Contract has been disposed of in accordance with all applicable rules, regulations, laws, and statutes of all agencies having jurisdiction over such environmental pollution. The notice shall reaffirm the indemnification given under Section F.5.1 above.

K.8 CERTIFICATE OF OCCUPANCY

The Contractor shall not be granted Final Completion or receive final payment if the Owner has not received an unconditioned certificate of occupancy from the appropriate state and/or local building officials, unless failure to obtain an unconditional certificate of occupancy is due to the fault or neglect of Owner.

K.9 OTHER CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for returning to the Owner all items issued during construction such as keys, security passes, site admittance badges, and all other pertinent items. The Contractor shall be responsible for notifying the appropriate utility companies to transfer utility charges from the Contractor to the Owner. The utility transfer date shall not be before Substantial Completion and may not be until Final Completion, if the Owner does not take beneficial use of the facility and the Contractor's forces continue with the Work.

K.10 SURVIVAL

All warranty and indemnification provisions of this Contract, and all of Contractor's other obligations under this Contract that are not fully performed by the time of Final Completion or termination, shall survive Final Completion or any termination of the Contract.

APPENDIX A Contents

Instructions to Bidder

Bid Bond

Bid Form

Payment Bond

Performance Bond

OUS Public Improvement Agreement Form

OREGON UNIVERSITY SYSTEM
STANDARD PUBLIC IMPROVEMENT CONTRACT
INSTRUCTIONS TO BIDDERS

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Instructions to Bidders

Article 1. Scope of Work

The work contemplated under this contract with the Oregon State Board of Higher Education, hereinafter referred to as the Owner, includes all labor, materials, transportation, equipment and services necessary for, and reasonably incidental to, the completion of all construction work in connection with the project described in the Project Manual which includes, but is not necessarily limited to, the Advertisement for Bids, Instructions to Bidders, Supplemental Instructions to Bidders, Bid Form, Bid Bond, Public Improvement Agreement Form, Performance Bond, Payment Bond, OUS General Conditions, Supplemental General Conditions, Plans and Specifications.

Article 2. Examination of Site and Conditions

Before making a bid, the bidder shall examine the site of the work and ascertain all the physical conditions in relation thereto. The bidder shall also make a careful examination of the Project Manual including the plans, specifications, and other contract documents, and shall be fully informed as to the quality and quantity of materials and the sources of supply of the materials. Failure to take these precautions will not release the successful bidder from entering into the contract nor excuse the bidder from performing the work in strict accordance with the terms of the contract.

The Owner will not be responsible for any loss or for any unanticipated costs which may be suffered by the successful bidder as a result of such bidder's failure to be fully informed in advance with regard to all conditions pertaining to the work and the character of the work required. No statement made by an officer, agent, or employee of the Owner in relation to the physical conditions pertaining to the site of the work will be binding on the Owner, unless covered by the Project Manual or an Addendum.

Article 3. Interpretation of Project Manual and Approval of Materials Equal to Those Provided in the Specifications

If any bidder contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications or forms of contract documents, or detects discrepancies or omissions, such bidder may submit to the Architect (read "Engineer" throughout as appropriate) a written request for an interpretation thereof at least 10 calendar days prior to the date set for the bid closing.

When a prospective bidder seeks approval of a particular manufacturer's material, process or item of equal value, utility or merit other than that designated by the Architect in the Project Manual, the bidder may submit to the Architect a written request for approval of such substitute at least 10 calendar days prior to the date set for the bid closing. The prospective bidder submitting the request will be responsible for its prompt delivery.

Requests of approval for a substitution from that specified shall be accompanied by samples, records of performance, certified copies of tests by impartial and recognized laboratories, and such other

information as the Architect may request.

To establish a basis of quality, certain processes, types of machinery and equipment or kinds of materials may be specified in the Project Manual either by description of process or by designating a manufacturer by name and referring to a brand or product designation or by specifying a kind of material. Whenever a process is designated or a manufacturer's name, brand or item designation is given, or whenever a process or material covered by patent is designated or described, it shall be understood that the words "or approved equal" follow such name, designation or description, whether in fact they do so or not.

Any interpretation of the Project Manual or approval of manufacturer's material will be made only by an Addendum duly issued. A copy of each Addendum will be mailed or delivered to each bidder receiving a Project Manual and becomes a part thereof. The Owner will not be responsible for any other explanation or interpretation of the Project Manual nor for any other approval of a particular manufacturer's process or item.

When the Architect approves a substitution by Addendum, it is with the understanding that the Contractor guarantees the substituted article or material to be equal or better than the one specified.

Article 4. Security to Be Furnished by Each Bidder

Each bid must be accompanied by either 1) a cashier's check or a certified check drawn on a bank authorized to do business in the State of Oregon, or 2) a bid bond described hereinafter, executed in favor of the State of Oregon and the Oregon State Board of Higher Education, for an amount equal to 10 percent of the total amount bid as a guarantee that if awarded the contract the bidder will execute the contract and give a performance bond and payment bond as required. The successful bidder's check or bid bond will be retained until the bidder has entered into a satisfactory contract and furnished a 100 percent performance bond and 100 percent payment bond. The Owner reserves the right to hold the bid security as described in Article 10 hereof. Should the successful bidder fail to execute and deliver the contract as provided for in Article 12, including a satisfactory performance bond and payment bond within 20 calendar days after the bid has been accepted by the Owner, then the contract award made to such bidder may be considered canceled and the bid security may be forfeited as liquidated damages at the option of the Owner. The date of the acceptance of the bid and the award of the contract as contemplated by the Project Manual shall mean the date of acceptance specified in the Notice of Award.

Article 5. Execution of Bid Bond

Should the bidder elect to utilize a bid bond as described in Article 4 in order to satisfy the bid security requirements, such form must be completed in the following manner:

- A. Bid bonds must be executed on Oregon University System forms, which will be provided to all prospective bidders by the Owner.

- B. The bid bond shall be executed on behalf of a bonding company licensed to do business in the State of Oregon.
- C. In the case of a sole individual, the bond need only be executed as principal by the sole individual. In the case of a partnership, the bond must be executed by at least one of the partners. In the case of a corporation, the bond must be executed by stating the official name of the corporation under which is placed the signature of an officer authorized to sign on behalf of the corporation followed by such person's official capacity, such as president, etc. This signature shall be attested by the secretary or assistant secretary of the corporation. The corporation seal should then be affixed to the bond.
- D. The name of the surety must be stated in the execution over the signature of its duly authorized attorney-in-fact and accompanied by the seal of the surety corporation.

Article 6. Execution of the Bid Form

Each bid shall be made in accordance with the sample Bid Form accompanying these instructions; the appropriate signatures for a sole individual, partnership, corporation or limited liability corporation shall be added as noted in Article 5C above; numbers pertaining to base bids shall be stated both in writing and in figures; the bidder's address shall be typed or printed.

The Bid Form relates to bids on a specific Project Manual. Only the amounts and information asked for on the Bid Form furnished will be considered as the bid. Each bidder shall bid upon the work exactly as specified and provided in the Bid Form. The bidder shall include in the bid a sum to cover the cost of all items contemplated by the Contract. The bidder shall bid upon all alternates that may be indicated on the Bid Form. When bidding on an alternate for which there is no charge, the bidder shall write the words "No Charge" in the space provided on the Bid Form. If one or more alternates is shown on the Bid Form, the bidder shall indicate whether each is "add" or "deduct."

The Bid Form included in the Project Manual is a sample. One additional copy of the Bid Form may be furnished with the Project Manual. One additional copy of the Bid Bond form may also be provided with the Project Manual. Only one copy needs to be submitted with the bid.

Article 7. Prohibition of Alterations to Bid

Bids which are incomplete, or contain ambiguities or conditions not provided for in the Bid Form, may be rejected.

Article 8. Submission of Bid

Each bid shall be sealed in an envelope, properly addressed to the appropriate project Owner within the Oregon University System, showing on the outside of the envelope the name of the bidder and the name of the project. Bids will be received at the time and place stated in the Advertisement for Bids.

Article 9. Bid Closing and Opening of Bids

All bids must be received by the Owner at the place and time set for

the bid closing. Any bids received after the scheduled closing time for receipt of bids will be returned to the bidder unopened.

To allow sufficient time for bidders to comply with the Affirmative Action requirements of the Oregon State Board of Higher Education, when specified for that purpose the bid opening shall be 24 hours after the time of bid closing. At the time of opening and reading of bids, each bid received will be publicly opened and read aloud, irrespective of any irregularities or informalities in such bids.

Article 10. Acceptance or Rejection of Bids by Owner

Unless all bids are rejected, the Owner will award a contract based on the lowest responsive bid from a responsible bidder. If that bidder does not execute the contract, it will be awarded to the next lowest responsible bidder or bidders in succession.

The Owner reserves the right to reject all bids and to waive minor informalities. The procedures for contract awards shall be in compliance with the provisions of Oregon Administrative Rules adopted by the Owner.

The Owner reserves the right to hold the bid and bid security of the three lowest bidders for a period of 30 calendar days from and after the time of bid opening pending award of the contract. Following award of the contract the bid security of the three lowest bidders may be held 20 calendar days pending execution of the contract. All other bids will be rejected and bid security will be returned.

In determining the lowest bidder, the Owner reserves the right to take into consideration any or all authorized base bids as well as alternates or combinations indicated in the Bid Form.

If such bid has not been accepted within 30 calendar days after the opening of the bids, each of the three lowest bidders may withdraw the bid submitted and request the return of the bid security.

Article 11. Withdrawal of Bid

At any time prior to the time and place set for the bid closing, a bidder may withdraw the bid. This will not preclude the submission of another bid by such bidder prior to the time set for the bid closing.

After the time set for the bid closing, no bidder will be permitted to withdraw its bid within the time frames specified in Article 10 for award and execution, except as provided for in that Article.

Article 12. Execution of Contract, Agreement, Performance Bond and Payment Bond

The Owner will provide the successful bidder with contract forms within 10 calendar days after the award of the Contract. The bidder is required to execute the contract forms as provided, including a performance bond and a payment bond from a surety company licensed to do surety business in the State of Oregon, within 20 calendar days after the award of the contract. The contract forms shall be delivered to the Owner in the number called for and to the location as noted in the Notice of Award.

**OREGON UNIVERSITY SYSTEM
STANDARD PUBLIC IMPROVEMENT CONTRACT**

BID FORM

OUS CAMPUS: Portland State University
PROJECT: Campus Wide Loop – Phase 1, Steam & Chiller Water Improvements - BP-2

BID CLOSING: June 26, 2008 @ 3:00 PM

FROM: _____
Name of Contractor

TO: Oregon State Board of Higher Education
Portland State University
University Services Building, 617 SW Montgomery #202
Portland, OR
P.O. Box 751, Portland, OR 97207

1. The Undersigned (*check one of the following and insert information requested*):

- ___ a. An individual doing business under an assumed name registered under the laws of the State of _____; or
- ___ b. A partnership registered under the laws of the State of _____; or
- ___ c. A corporation organized under the laws of the State of _____; or
- ___ d. A limited liability corporation organized under the laws of the State of _____;

hereby proposes to furnish all material and labor and perform all work hereinafter indicated for the above project in strict accordance with the Contract Documents for the Basic Bid as follows:

_____ Dollars (\$_____)

and the Undersigned agrees to be bound by the following documents:

- Notice to Bidders
 - Supplemental Instructions to Bidders
 - Public Improvement Agreement Form
 - OUS General Conditions
 - Prevailing Wage Rates
 - Plans and Specifications
 - Affirmative Action Requirements (if made applicable in this procurement)
 - Instructions to Bidders
 - Bid Bond
 - Performance Bond and Payment Bond
 - Supplemental General Conditions
 - Payroll and Certified Statement Form
 - Drawings and Details
- ADDENDA numbered ____ through ____, inclusive (*fill in blanks*)

2. The project is funded by Energy Conservation funding requests. Provide basic bid breakdown as follows with overhead and profit in each line item. Total should equal Basic Bid total in item 1 above.

- a. Cramer Chiller Plant: Including controls, piping, electrical controls, concrete and all accessories, not including VFDs noted in “d”, and not including chilled water insulation noted in “e” below.

- b. Well water/condenser water, heat exchanger system Including pumps, heat exchanger, piping, controls, electrical, concrete and all accessories.
- c. Chilled water extension from Cramer to Shattuck: Including piping, valves, and supports.
- d. Variable Speed Drives: For pumps #ECP-5A, ECP-4, ECP-8.
- e. Chilled water piping insulation in Cramer Chilled Water Plant..
- f. Extension of steam and chilled water to ASRC including piping, supports, architectural and structural improvements.
- g. Seismic valve installation at Peter Stott and Cramer.
- h. Metering of steam and chilled water including instruments and interface panels with Siemens BCS. Not including Chiller controls in Cramer.
- i. High efficiency moters for ECP-6, ECP-5A, ECP-11.

3. The Undersigned proposes to add to the Basic Bid indicated above the items of work relating to the following Alternates as designated in the Specifications and Drawings:

ABI-1	Injection Well System ,vault, piping and controls – Note: See Appendix A: Well Driller Breakdown for Injection Well System at the end of this section. ABI 1-A, 1B, 1-C to be added to other components.	\$ _____
ABI-2	Chilled Water Insulation PVC Jacketing inside Cramer Basement	\$ _____
ABI-3	Condenser Water Standby filter and pump (see MP40)	\$ _____
ABI-4	Boiler No. 5 economizer and feed water changes (see MP8.2, M30)	\$ _____
ABI-5	Reinstall existing walkway underpanel system for pipeway to ASRC	\$ _____
ABI-6	North Loop chilled water extension	\$ _____
Total Add		\$ _____

4. The work shall be completed within the time stipulated and specified in Request for Proposal.

5. Accompanying herewith is Bid Security which is equal to ten (10) percent of the total amount of the Basic Bid.

6. The Undersigned agrees, if awarded the Contract, to execute and deliver to the Oregon State Board of Higher Education, within twenty (20) calendar days after receiving the Contract forms, an Agreement Form, and a satisfactory Performance Bond and Payment Bond each in an amount equal to one hundred (100) percent of the Contract sum, using forms provided by the Owner. The surety requested to issue the Performance Bond and Payment Bond will be _____.
(Name of Surety Company - not insurance agency)

The Undersigned hereby authorizes said surety company to disclose any information to the Owner concerning the Undersigned's ability to supply a Performance Bond and Payment Bond each in the amount of the Contract.

7. The Undersigned further agrees that the Bid Security accompanying the Bid is left in escrow with the Board; that the amount thereof is the measure of liquidated damages which the Owner will sustain by the failure of the Undersigned to execute and deliver the above-named Agreement Form, Performance Bond and Payment Bond, and that if the Undersigned defaults in either executing the Agreement Form or providing the Performance Bond and Payment Bond within twenty (20) calendar days after receiving the Contract forms, then the Bid Security may become the property of the Owner at the Owner's option; but if the Bid is not accepted within thirty (30) calendar days of the time set for the opening of the Bids, or if the Undersigned executes and timely delivers said Agreement Form, Performance Bond and Payment Bond, the Bid Security shall be returned.

8. The Undersigned certifies that: (1) This Bid has been arrived at independently and is being

submitted without collusion with and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment or services described in the invitation to bid designed to limit independent bidding or competition; and (2) The contents of the Bid have not been communicated by the Undersigned or its employees or agents to any person not an employee or agent of the Undersigned or its surety on any Bond furnished with the Bid and will not be communicated to such person prior to the official opening of the Bid.

9. The undersigned **HAS, HAS NOT** (*circle applicable status*) paid unemployment or income taxes in Oregon within the past twelve (12) months and **HAS, HAS NOT** (*circle applicable status*) a business address in Oregon.

10. The Undersigned **HAS, HAS NOT** (*circle applicable status*) complied with any Affirmative Action Requirements included within the procurement documents.

11. The Undersigned agrees, if awarded a contract, to comply with the provisions of ORS 279C.800 through 279C.870 pertaining to the payment of the prevailing rates of wage.

12. Contractor's CCB registration number is _____. As a condition to submitting a bid, a Contractor must be registered with the Oregon Construction Contractors Board in accordance with ORS 701.035 to 701.055, and disclose the registration number. Failure to register and disclose the number will make the bid unresponsive and it will be rejected, unless contrary to federal law.

13. The successful Bidder hereby certifies that all subcontractors who will perform construction work as described in ORS 701.005(2) were registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time the subcontractor(s) made a bid to work under the contract.

14. The successful Bidder hereby certifies that, in compliance with the Worker's Compensation Law of the State of Oregon, its Worker's Compensation Insurance provider is _____, Policy No. _____, and that Contractor shall submit Certificates of Insurance as required.

15. The Undersigned, pursuant to OAR 580-061-0030(3), also certifies that the Bidder has not discriminated against Minority, Women or Emerging Small Business Enterprises in obtaining any required subcontracts.

NAME OF FIRM _____

ADDRESS _____

FEDERAL TAX ID _____

TELEPHONE NO _____

FAX NO _____

SIGNATURE 1) _____

Sole Individual

or 2) _____

Partner

or 3) _____

Authorized Officer of Corporation

(SEAL)

Attested: Secretary of Corporation

Payment information will be reported to the IRS under the name and taxpayer ID # provided above.
 Information not matching IRS records could subject Contractor to 31 percent backup withholding.

Appendix A Bid Form
Cramer Hall Injection Well System
WELL INSTALLER PORTION BID FORM – ABI-1, 1A,1B,1C

Item Number	Items of Work and Materials	Approximate Total Quantity		Unit Price	Total Amount
General					
1	Mobilization and Demobilization including all equipment and incidental items for installing the new injection well, and Site Prep	1	Lump Sum	\$	\$
2	Erosion Control	1	Lump Sum	\$	\$
3	Water Management	1	Lump Sum	\$	\$
Well Drilling and Installation					
4	Drill 20-inch borehole from 0 to 250 feet below ground surface and furnish, install and remove temporary casing as needed	250	Linear Feet	\$ /foot	\$
5	Install 16-inch 0.375-inch thick low carbon steel casing	250	Linear Feet	\$ /foot	\$
6	Install cement grout seal	250	Linear Feet	\$ /foot	\$
7	Drill 16-inch borehole from 250 to 650 feet below ground surface and furnish, install and remove temporary casing as needed	400	Linear Feet	\$ /foot	\$
8	Provide support and necessary equipment during planned falling head tests during drilling and complete an airlift test within the borehole after reaching total depth, if requested	12	Hours	\$ /hour	\$
9	Conduct well development	16	Hours	\$ /hour	\$
10	Video log	1	Lump Sum	\$	\$
11	Standby Time	5	Hours	\$ /hour	\$
12	Preauthorized Drilling Rig Time	5	Hours	\$ /hour	\$
13	Preauthorized Pump Rig Hourly Work (alignment survey or other)	10	Hours	\$ /hour	\$
Injection Testing					
14	Furnish, install necessary equipment including temporary discharge line, flow meter, valves and appurtenances for injection testing	1	Lump Sum	\$	\$
15	Run injection step test	4	Hours	\$ /hour	\$
16	Run constant rate injection test	48	Hours	\$ /hour	\$
Miscellaneous					
17	Well Disinfection	1	Lump Sum	\$	\$
Total Items 1 through 17:					ABI – 1A \$

Additive Bid Items

ABI No. 1B	Furnish and install 12-inch nominal 0.375-inch thick low carbon steel casing as part of the screen and liner assembly from 240 to 650 feet below ground surface, with a reverse thread Setting Sub (Addco or equal)	350	LF	\$ /foot	\$
ABI No 1B	Furnish and install 12-inch SS wire wrap screen as part of the screen and liner assembly (provide manufacturer's specifications for the screen)	60	LF	\$ /foot	\$
ABI No 1C	Complete injection well installation including injection line, control valve and all control valve components	1	Lot		\$
Grand Total Injection Well Portion Additive Alternative No. 1					\$

***** *END OF BID* *****

OREGON UNIVERSITY SYSTEM
STANDARD PUBLIC IMPROVEMENT CONTRACT

BID BOND

We, _____, as "Principal,"
(Name of Principal)

and _____, an _____ Corporation,
(Name of Surety)

authorized to transact Surety business in Oregon, as "Surety," hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns to pay unto the State of Oregon and the Oregon State Board of Higher Education ("Obligee") the sum of (\$ _____)

_____ dollars.

WHEREAS, the condition of the obligation of this bond is that Principal has submitted its proposal or bid to an agency of the Obligee in response to Obligee's procurement document (No. _____) for the project identified as:

Campus Wide Loop – Phase 1, Steam & Chilled Water Improvements – BP2, which proposal or bid is made a part of this bond by reference, and Principal is required to furnish bid security in an amount equal to ten (10%) percent of the total amount of the bid pursuant to the procurement document.

NOW, THEREFORE, if the proposal or bid submitted by Principal is accepted, and if a contract pursuant to the proposal or bid is awarded to Principal, and if Principal enters into and executes such contract within the time specified in the procurement document and executes and delivers to Obligee its good and sufficient performance and payment bonds required by Obligee within the time fixed by Obligee, then this obligation shall be void; otherwise, it shall remain in full force and effect.

IN WITNESS WHEREOF, we have caused this instrument to be executed and sealed by our duly authorized legal representatives this _____ day of _____, 20____.

PRINCIPAL: _____

SURETY: _____

By _____
Signature

BY ATTORNEY-IN-FACT:

Official Capacity

Name

Attest: _____
Corporation Secretary

Signature

Address

City State Zip

Phone Fax

OREGON UNIVERSITY SYSTEM

STANDARD PUBLIC IMPROVEMENT CONTRACT

PAYMENT BOND

Bond No. _____
Solicitation _____

Project Name: Campus Wide Loop – Phase 1, Steam & Chilled Water Improvements – BP-2
Portland State University

_____ (Surety #1)	Bond Amount No. 1:	\$ _____
_____ (Surety #2)*	Bond Amount No. 2:*	\$ _____
* <i>If using multiple sureties</i>	Total Penal Sum of Bond:	\$ _____

We, _____, as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto the State of Oregon, Oregon State Board of Higher Education (OSBHE), the sum of (Total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a contract with the State of Oregon, the plans, specifications, terms and conditions of which are contained in above-referenced Solicitation;

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Payment Bond by reference, whether or not attached to the contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and schedule of contract prices which are set forth in the Contract and any attachments, and all authorized modifications of the Contract which increase the amount of the work, or the cost of the Contract, or constitute authorized extensions of time for performance of the Contract, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things by it undertaken to be performed under said Contract and any duly authorized modifications that are made, upon the terms set forth therein, and within the time prescribed therein, or as extended therein as provided in the Contract, with or without notice to the Sureties, and shall indemnify and save harmless the State of Oregon, OSBHE and Portland State University, and members

thereof, its officers, employees and agents, against any claim for direct or indirect damages of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Contractor or its subcontractors, and shall promptly pay all persons supplying labor, materials or both to the Principal or its subcontractors for prosecution of the work provided in the Contract; and shall promptly pay all contributions due the State Industrial Accident Fund and the State Unemployment Compensation Fund from the Principal or its subcontractors in connection with the performance of the Contract; and shall pay over to the Oregon Department of Revenue all sums required to be deducted and retained from the wages of employees of the Principal and its subcontractors pursuant to ORS 316.167, and shall permit no lien nor claim to be filed or prosecuted against the State on account of any labor or materials furnished; and shall do all things required of the Principal by the laws of this State, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond nor shall the State of Oregon, or the above-referenced agency(ies), be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 351, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES:

Dated this _____ day of _____, 20__.

PRINCIPAL: _____

By _____
Signature

Official Capacity

Attest: _____
Corporation Secretary

SURETY: _____

[Add signatures for each if using multiple bonds]

BY ATTORNEY-IN-FACT:
[Power-of-Attorney must accompany each bond]

Name

Signature

Address

City State Zip

Phone Fax

OREGON UNIVERSITY SYSTEM
STANDARD PUBLIC IMPROVEMENT CONTRACT
PERFORMANCE BOND

Bond No. _____
Solicitation _____

Project Name: Campus Wide Loop – Phase 1, Steam & Chilled Water Improvements – BP-2
Portland State University

_____ (Surety #1)	Bond Amount No. 1:	\$ _____
_____ (Surety #2)*	Bond Amount No. 2:*	\$ _____
	Total Penal Sum of Bond:	\$ _____

** If using multiple sureties*

We, _____ as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto the State of Oregon, Oregon State Board of Higher Education (OSBHE), the sum of (Total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a contract with the State of Oregon, the plans, specifications, terms and conditions of which are contained in the above-referenced Solicitation;

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Performance Bond by reference, whether or not attached to the contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and all authorized modifications of the Contract which increase the amount of the work, the amount of the Contract, or constitute an authorized extension of the time for performance, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal herein shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things undertaken by Contractor to be performed under the Contract, upon the terms set forth therein,

and within the time prescribed therein, or as extended as provided in the Contract, with or without notice to the Sureties, and shall indemnify and save harmless the State of Oregon, OSBHE, and Portland State University, and members thereof, its officers, employees and agents, against any direct or indirect damages or claim of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Principal or its subcontractors, and shall in all respects perform said contract according to law, then this obligation is to be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond nor shall the State of Oregon, or the above-referenced agency(ies), be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 351, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this _____ day of _____, 20__.

PRINCIPAL: _____

By _____
Signature

Official Capacity

Attest: _____
Corporation Secretary

SURETY: _____

[Add signatures for each surety if using multiple bonds]

BY ATTORNEY-IN-FACT:

[Power-of-Attorney must accompany each surety bond]

Name

Signature

Address

City State Zip

Phone Fax

OREGON UNIVERSITY SYSTEM

PUBLIC IMPROVEMENT AGREEMENT FORM

CONTRACT NUMBER: _____

This Agreement for the _____ (the "Contract"), made by and between the State of Oregon, acting by and through the Oregon State Board of Higher Education on behalf of **Portland State University** (hereinafter called "OWNER"), and _____ (hereinafter called the "CONTRACTOR") (collectively the "Parties"), shall become effective on the date this Contract has been signed by all the Parties and all required State of Oregon governmental approvals have been obtained, whichever is later (the "Effective Date").

WITNESSETH:

1. Contract Price, Contract Documents and Work.

The CONTRACTOR, in consideration of the sum of _____ (\$ _____) (the "Contract Price"), to be paid to the CONTRACTOR by OWNER in the manner and at the time hereinafter provided, and subject to the terms and conditions provided for in the Instructions to Bidders and other Contract Documents (as defined in the OUS General Conditions referenced within the Instructions to Bidders), all of which are incorporated herein by reference, hereby agrees to perform all Work described and reasonably inferred from the Contract Documents. The Contract Price is the amount contemplated by the Basic Bid. Also, the following documents are incorporated by reference in this Contract and made a part hereof if checked for inclusion [X]:

- Affirmative Action Requirements
- Specifications and Drawings provided by OWNER or OWNER's Representative
- _____
- Exhibit(s)

2. Representatives.

CONTRACTOR has named _____ its Authorized Representative to act on its behalf. OWNER designates, or shall designate, its Authorized Representative as indicted below (check one):

- Unless otherwise specified in the Contract Documents, the OWNER designates _____ as its Authorized Representative in the administration of this Contract. The above-named individual shall be the initial point of contact for matters related to Contract performance, payment, authorization, and to carry out the responsibilities of the OWNER.

3. Key Persons.

The CONTRACTOR'S personnel identified below shall be considered Key Persons and shall not be replaced during the project without the written permission of OWNER, which shall not be unreasonably withheld. If the CONTRACTOR intends to substitute personnel, a request must be given to OWNER at least thirty (30) days prior to the intended time of substitution. When replacements have been approved by OWNER, the CONTRACTOR shall provide a transition period of at least ten (10) working days during which the original and replacement personnel shall be working on the project concurrently. Once a replacement for any of these staff members is authorized, further replacement shall not occur without the written permission of OWNER. The CONTRACTOR'S project staff shall consist of the following personnel:

Senior Project Manager: _____, shall be the CONTRACTOR's project manager and will participate in all meetings throughout the project term.

Senior Project Manager: _____ shall be the CONTRACTOR's project executive, and will provide oversight and guidance throughout the project term.

Job Superintendent: _____, shall be the CONTRACTOR's on-site job superintendent throughout the project term.

[_____]: _____, shall be the CONTRACTOR's _____, [e.g., providing assistance to the project manager, and subcontractor and supplier coordination throughout the project term.]

4. Contract Dates.

COMMENCEMENT DATE: _____

SUBSTANTIAL COMPLETION DATE: _____

FINAL COMPLETION DATE: _____

5. Liquidated Damages.

Failure to complete the Work by the time specified in this Contract will result in actual damages to the OWNER. Since actual damages will be difficult or impossible to determine, it is agreed that the CONTRACTOR shall pay OWNER, not as a penalty but as liquidated damages **ONE THOUSAND DOLLARS (\$1,000.00)** per Day for each Day elapsed in excess of the Substantial Completion Date.

6. Tax Compliance.

The individual signing on behalf of CONTRACTOR hereby certifies and swears under penalty of perjury that s/he is authorized to act on behalf of CONTRACTOR s/he has authority and knowledge regarding CONTRACTOR's payment of taxes, and to the best of her/his knowledge, CONTRACTOR is not in violation of any Oregon tax laws. For purposes of this certification, "Oregon tax laws" means a tax imposed by ORS 401.792 to 401.816, ORS Chapters 118, 314, 316, 317, 318, 320, 321 and 323; the elderly rental assistance program under ORS 310.630 to

310.706; and local taxes administered by the Department of Revenue under ORS 305.620. Examples include the state inheritance tax, personal income tax, withholding tax, corporation income and excise taxes, amusement device tax, timber taxes, cigarette tax, other tobacco tax, 9-1-1 emergency communications tax, the homeowners and renters property tax relief program and local taxes administered by the Department of Revenue.

7. Integration

The Contract documents constitute the entire agreement between the Parties. There are no other understandings, agreements or representations, oral or written, not specified herein regarding this Contract. CONTRACTOR, by the signature below of its authorized representative, hereby acknowledges that it has read this Contract, understands it, and agrees to be bound by its terms and conditions.

IN WITNESS WHEREOF, the STATE OF OREGON, acting by and through the Oregon State Board of Higher Education on behalf of _____ executes this Contract and the CONTRACTOR does execute the same as of the Effective Date.

CONTRACTOR DATA:

CONTRACTOR NAME: _____

CONTRACTOR ADDRESS: _____

CONTRACTOR FEDERAL ID # _____

CONTRACTOR CCB # _____ Expiration Date: _____

[Payment information will be reported to the IRS under the name and taxpayer ID # provided above. Information must be provided prior to contract approval. Information not matching IRS records could subject CONTRACTOR to 31 percent backup withholding.]

CONTRACTOR SIGNATURE

By _____
Name Date

By _____
Name (Typed or Printed) Title

STATE OF OREGON acting by and through the
OREGON STATE BOARD OF HIGHER EDUCATION
on behalf of **Portland State University**

By _____
Robyn K. Pierce Date
Director, Facilities & Planning

APPENDIX B Contents – PSU DIVISION 1 DOCUMENTS

Section 01010 – Summary of Work

01027 – Application for Payment

01030 – Alternates

01040 – Project Coordination

01040.1 – Project Information

01040.2 – Construction Project Safety Form Instructions

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01410 – Testing Laboratory Services

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01780 – Contract Closeout

01910 - Commissioning

SECTION 01010 SUMMARY OF WORK

PART 1 -GENERAL

1.01 WORK COVERED BY THE PROJECT MANUAL AND DRAWINGS

- A. Work covered by the Project Manual and Drawings consists of: Steam & Chilled Water Improvements – BP-2 (The terms "Owner", "PSU", and "University" are interchangeable)
- B. The work includes:
 - 1. Extension of steam & chilled water from Cramer Hall to ASRC
 - 2. Extension of chilled water to Shattuck Hall from Cramer Chiller Plant
 - 3. Addition of new chiller in Cramer Chiller Plant
 - 4. Addition of new condenser cooling water heat exchanger and reinjection well
 - 5. Addition of boiler feedwater economizer for Boiler #5 in Cramer Hall
 - 6. Metering of steam & chilled water throughout campus
 - 7. Seismic valves for Campus and Cramer heating plants natural gas supply
 - 8. Extension of chilled water and replacement of condensate return in existing north tunnel to Science Building 1 & 2 from Cramer Hall.
- C. The Contractor shall supply all labor, transportation, parking, apparatus, scaffolding, tools and other items necessary for the completion of the work in conformance with OUS General Conditions for Public Improvements Contracts, Section A.2.
- D. The Work shall be started within ten (10) calendar days following approval of the Contractor's Certificate of Insurance and the Execution of Contract by PSU Facilities, attention (contract coordinator). All work shall be final completed within the time frames established in the Public Improvement Agreement Form (OUS Contract Form B-7, Item 4). *Time is of an essence on this project.* Failure to complete the project within the time specified will result in damages to the Owner. The Contractor will be charged liquidated damages in accordance with Item 5 of the Public Improvement Agreement Form (OUS Contract Form B-7). Liquidated damages will be deducted from the Contractor's Final Payment Request.

1.02 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit use of the Premises for Work and storage to allow for:
 - 1. Owner and tenant occupancy of adjacent spaces, day and night
 - 2. Public use, day and night
 - 3. Security
 - 4. Safe entry and exit for vehicles and pedestrians
- B. Access through the interior of the building will be coordinated with the Owner's Authorized Representative.

1.03 PROTECTIONS

- A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from spillage of materials used in carrying out the Work. Prevent materials from clogging sinks, catch basins and yard drains; maintain drains clean and in proper working conditions. Dumping of plaster, solvents, or other injurious materials in PSU plumbing systems is not permitted. Costs of cleaning or repair will be withheld from Contractor as required.
- B. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.
- C. The Contractor shall be responsible for any and all damages as specified in OUS General Conditions for Public Improvement Contracts Section G.1.1.
- D. The Owner will not be responsible for protection of materials or equipment from vandalism or theft. Security is the responsibility of the Contractor. See Section 01500 Temporary Facilities.
- E. The Contractor will verify that all drains in the construction area are in working order and notify the Owner's Representative, in writing, of any drains that are plugged, prior to the Start of Work. Start of Work will be considered as acknowledgement that all drains are clear and in good working order.
- F. Debris shall not be allowed to remain around the buildings during performance of Work, and shall be disposed of daily and/or as directed by Owner's Authorized Representative.
- G. The Contractor shall manage a safe job environment for both the safety of all people around the Premises as well as the safety of the Owner's and general public's property.
- H. Do not store materials where they will interfere with operations of Owner. Storage areas must be approved by the Owner's Authorized Representative prior to start of the Work.

1.04 OWNER OCCUPANCY

- A. The Owner and building tenants will occupy the Premises during the entire period of construction for the conduct of normal operations. Cooperate and coordinate with Owner's Authorized Representative in construction operations to minimize conflict and to facilitate the Owner's usage, especially in the following areas:
 - 1. Restricted access and parking
 - 2. Use of elevators and stairs
 - 3. Temporary storage space availability
 - 4. Provide a written schedule of Work specifying where and when Work will be accomplished
 - 5. Notify Owner's Authorized Representative a minimum of seventy-two (72) hours prior to performing any work that will release strong odors or fumes, causes noise, or requires windows to be closed during hot weather. See Section 01734 for additional Indoor Air Quality requirement, which includes coordination of noise abatement.

- B. Conduct operations in such a way to ensure the least inconvenience to University staff, students and the general public.
- C. To maintain continual operations by the Owner and building tenants, evening and/or weekend work by the Contractor will be required for short durations at various stages of the Project. Coordinate with the Owner's Authorized Representative at least seventy-two (72) hours in advance to performing evening or weekend work.

1.05 SALVAGE

- A. All material indicated to be removed shall become the property of the Contractor except those items noted on the drawings and in the specifications as being retained by the Owner.
- B. All locksets, cylinders and strikes removed shall be returned to Owner. Coordinate with Owners Authorized Representative.
- C. The City of Portland has mandated the recycling of demolition materials. See Section 01732 of these Specifications for Waste Management requirements, which includes recycling documentation to be provided to the Architect and Owner by the Contractor.

PART 2 -PRODUCTS

2.01 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, materials and equipment removed from existing construction shall not be used in the completed Work.
- B. For material and equipment specifically indicated or specified to be reused in the Work or salvaged to Owner:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require off-site storage, restoration or renovation. Pay all costs for such Work.
 - 3. Contractor shall be responsible for removing and reinstalling mechanical units, vents, guys, antennae, and electrical and grounding wires or conduits.

PART 3 -EXECUTION

3.01 PREPARATION

- A. Inspect existing conditions, Work requirements, and the Contract Documents. Verify that materials and equipment being furnished meet requirements specified. Report any discrepancies to the Owner's Authorized Representative prior to proceeding with work.

3.02 MATERIAL HANDLING

- A. If, in the opinion of the Contractor, cranes, hoists, towers, or other lifting devices are

necessary for the proper and efficient movement of materials, comply with these requirements:

1. Use only experienced personnel
2. Remove equipment as soon as possible after task is ended
3. Coordinate the placement of such equipment with the Owner's Authorized Representative to ensure that utility tunnels, utilities, and surfaces are not damaged.
4. Obtain required permits and meet the requirements of governing authorities regarding street and sidewalk closures, safety, noise, and other applicable regulations.
5. Provide barricades and warning ribbons to close off areas temporarily for loading and unloading, to insure public safety.

B. Contractor shall not allow any materials or debris to free-fall from the building.

3.03 WORKMANSHIP

- A. Unless otherwise specified, perform the Work using workers skilled in the particular type of Work involved.
- B. Should the Owner or the Architect, in writing, deem anyone on the Work incompetent or unfit for the assigned duties, dismiss the worker immediately or reassign that worker to a different task requiring a lesser degree of competence.
- C. Workmanship shall be first class in every respect as determined by the Owner's Authorized Representative and Architect, and all Work performed shall be performed in accordance with standard industry practice.
- D. The Contractor shall maintain effective supervision on the project at all times Work is being performed. The Superintendent shall be the same person throughout the course of the Work, and shall attend the pre-construction conference.

3.04 TESTING

- A. The Owner reserves the right to perform any testing as may be required to determine compliance with the Project Manual and Drawings. Costs for such testing will be the Owner's responsibility unless testing indicates noncompliance. Costs for testing which indicates noncompliance shall be borne by the Contractor. Non-complying Work shall be corrected and testing will be repeated until the Work complies with the Project Manual and Drawings. Contractor will pay costs for retesting non-complying Work.
- B. The Contractor shall cooperate in every respect with the activities of the testing agency.

END OF SECTION

SECTION 01027
APPLICATIONS FOR PAYMENT

PART 1 -GENERAL

1.01 DESCRIPTION

- A. Work of this Section includes procedures for progress payments.
- B. Related work specified elsewhere:
 - 1. For the primary discussion of payments, refer to Article E of OUS General Conditions for Public Improvement Contracts and Supplemental General Condition SG-3.

PART 2 -PRODUCTS

2.01 APPLICATION FORMS

- A. For applications for payment, use AIA Document G702, Application and Certificate for Payment, supported by AIA Document G702a, Continuation Sheet.
- B. Prepare the Schedule of Values in such a manner that each major item of Work and each subcontracted item of Work is shown as a line item costs broken down to correspond to the project construction schedule as detailed in Article H.2.1 of the OUS General Conditions for Public Improvement Contracts on AIA Document G702a, Application and Certification of Payment, Continuation Sheet. The Continuation Sheet shall be the minimum Schedule of Values breakdown.

PART 3 -EXECUTION

3.01 PAYMENTS

- A. The Owner will make progress payments on the account of the Contract once a month, based on the value of Work accomplished or materials on the Premises, as stated in the Schedule of Values on the Application and Certificate for Payment. Complete and forward three (3) copies of the Application and Certificate for Payment to the Architect by the 20th day of each month.
- B. Payments will be made on protected materials on hand on the Premises properly stored, protected, and insured. Estimated quantities shall be subject to the Architect's review and judgment.

END OF SECTION

SECTION 01030 ALTERNATES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work of the Section includes administrative and procedural requirements to the Bid Alternates of the OUS Bid Form (OUS Form B-6).

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional information regarding bid alternates and changes in scope may be found in the follows:
 - 1. OUS Bid Form
 - 2. Instructions to Bidders
 - 3. OUS General Conditions
 - 4. Other Sections of these specifications.

1.03 DEFINITION

- A. An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Project Manual that may be added or deducted from the Basic Bid amount if the Owner decides to accept a corresponding change in the amount of construction to be completed, or in the products, materials, equipment, systems, or installation method.
- B. The cost change for each alternate is the net addition to or deletion from the Basic Bid to incorporate the alternate into the work. No other adjustments are made to the Basic Bid, unless stipulated in the Instructions to Bidders or the OUS General Conditions for Public Improvement Contracts.

PART 2 - ACCEPTANCE OF ALTERNATIVES

- 3.01 The Owner's initial intent is to contract for all work of the Basic Bid. All required bonding, deposits, securities or guarantees required by the Contract Documents shall be based on the Basic Bid amount.
- 3.02 Alternates quoted on the Bid Form will be reviewed and may be rejected, accepted individually, in combination or entirely at the Owner's Option.
- 3.03 Alternates to the Basic Bid will be executed by a Change Order, in accordance with Division 1 Section 01300 and the OUS General Conditions for Public Improvement Contracts Section D.
- 3.04 Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required to complete the alternative work and surrounding modifications whether or not mentioned as part of the work.
- 3.05 Coordinate related work and modify surrounding work to integrate the work of each alternative.
- 3.06 A "Schedule of Bid Alternates" is provided at the end of this Section. Refer to other Specification Sections of this Project Manual for materials necessary to achieve the Work described under each alternate.

PART 3 - SCHEDULE OF BID ALTERNATES

4.1 The following Alternates may added to the Work of the Base Bid:

- ABI-1 Condenser water injection well system, vault, associated piping and controls.
- ABI-2 PVC jacketing at chilled water lines where indicated in piping and insulation schedule.
- ABI-3 Condenser water standby supply pump and pressure filter.
- ABI-4 Boiler #5 economizer installation.
- ABI-5 Reinstallation of existing walkway underpanel for pipeway to ASRC
- ABI-6 North Loop chilled water and condensate return and replacement of condensate return in existing tunnel from Cramer to points of connection near Science Buildings 1 & 2.

END OF SECTION

**SECTION 01040
PROJECT COORDINATION**

PART 1 -GENERAL

1.01 DESCRIPTION:

- A. This Section includes administrative and supervisory requirements necessary for coordinating contract documentation, communications and construction operations. The requirements of this Section relate to all work by the Contractor and Sub-contractors performing work under these Contract documents including, but not limited to, the following:

1. Pre-construction Coordination
2. Identification of Owner's Authorized Representatives
3. Identification of Architect
4. Listing of Sub-contractors
5. Contractor Emergency Contact Information
6. Safety & Emergency Procedures
7. Unforeseen Hazardous Materials
8. Permits and Fees
9. Key Requests
10. Progress Meetings
11. Requests for Clarifications & Information
12. Construction Directives
13. Construction Change Orders

1.02 RELATED WORK IN OTHER SECTIONS:

- A. Additional requirements related to Project Coordination may be found in the following:
1. Instructions to Bidders
 2. OUS General Conditions
 3. Other Sections of these specifications.

PART 2 -PRODUCTS

NOT USED

PART 3 -EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. A pre-construction conference shall predate the Work and shall include but not be limited to the following agenda:
1. Contract management and communication requirements
 2. Emergency phone numbers
 2. Record maintenance requirements
 3. Work schedule
 4. Schedule of values
 5. Submittal schedule
 6. Early purchase, long lead items and owner procurements
 7. Multiple contract coordination
 8. Maintenance of access and use of the premises

9. Traffic control, parking and contractor's use of the job site
 10. Hazardous materials
 11. Job site safety
 12. Job site inspection & observation requirements
 13. Review of contract documents
 14. Progress meetings
 15. Other subjects of interest desired by the Contractor, Architect, Owner's Authorized Representative(s), Manufacturer's Representatives, and other participants.
- B. Refer to Division 1, Section 01300 for submittals required prior to the pre-construction conference.
 - C. Coordinate all operations with the Owner's Authorized Representative during the construction period.
 - D. Submit to the Owner's Authorized Representative for approval, a schedule of Values for the Work to be performed; schedule of values shall include project and building name, when the Work is to begin, and estimated duration of the Work. The Schedule of Values is to be provided to the Owner's Authorized Representative in accordance with OUS Supplemental General Condition SG-3.
 - E. Submit to the Owner's Authorized Representative for approval, a schedule for the Work to be performed; schedule shall include project and building name, when the Work is to begin, and estimated duration of the Work. The Schedule is to be provided to the Owner's Authorized Representative in accordance with OUS Supplemental General Condition SG-5. The schedule shall be specific as to which portion of the Work is taking place on a particular day.
 - F. Prior to start of any work, Contractor shall provide at the pre-construction meeting an emergency responsible person/contact list on a 24-hour, "7 day a week" basis for any emergency issue that may arise in connection with this project. Contractor must reissue the list any time the responsible person(s) changes. Issue to Owner's Authorized Representative. See Project Information Sheet provided herein.
 - G. Parking will not be provided on the premises. See Section 01500 Temporary Facilities.
 - H. Schedule elevator usage with the Owner's Representative a minimum of 72 hours in advance so as not to inconvenience the public.

3.02 IDENTIFICATION OF OWNER'S AUTHORIZED REPRESENTATIVE

- A. The Owner's Project Manager and the Owner's Field Construction Manager (Jointly the Owner's Authorized Representative or his designee) will be appointed by the Owner and identified at the Pre-construction meeting. The Owner's Authorized Representative in conjunction with the Architect will provide coordination during construction and on-site observation. See Project Information Sheet provided herein.

3.03 IDENTIFICATION OF ARCHITECT

- A. The Owner has contracted with Winzer & Kelly to prepare construction documents and assist in Owner's Authorized Representative in the coordination of the construction project. See Project Information Sheet provided herein.

3.04 LISTING OF SUB-CONTRACTORS

- A. Provide to the Owner's Authorized Representative at the pre-construction conference three (3) copies of list of sub-contractors anticipated to perform work on the project. Provide on the list of sub-contractors: subcontractor's name, contact person, mailing address and telephone number. Substitution shall be permitted only with the approval of the Owner's Authorized Representative.

3.05 CONTRACTOR EMERGENCY CONTACT INFORMATION

- A. Provide to the Owner's Authorized Representative at the pre-construction conference Contractor Emergency Contact telephone numbers. See Project Information Sheet provided herein.

3.06 SAFETY AND EMERGENCY PROCEDURES

- A. The Contractor shall be responsible for maintaining a safe job site at all time, until the Owner takes possession. The Contractor shall comply with all safety regulations, and for enforcing compliance with all safety regulations and procedures by all workers, sub-contractors and visitors on the site.
- B. Refer to Division 1, Section 01500 for minimal temporary facilities required for job site safety. The Contractor shall provide procedures and additional temporary facilities as required.
- C. The Contractor shall maintain indoor air quality and noise control standards specified in Division 1, Section 01734.
- D. The Contractor shall complete and submit the Owner's Authorized Representative, at the pre-construction conference the "Construction Project Safety Form" provided herein.

3.07 UNFORESEEN HAZARDOUS MATERIAL

- A. Asbestos: The Owner has exercised due diligence in the identification and removal of asbestos containing materials from the work area. Prior to each phase of construction the Contractor shall confirm the non-existence of asbestos containing materials in the work area prior to proceeding. If the Contractor identifies materials suspected of containing asbestos, he shall immediately stop work in that area of the job site and proceed in accordance with Division 1, Section 01732, Item 3.01(F).
- B. Lead Paint: The Owner has exercised due diligence in the identification and removal of lead paint from the work area. Prior to each phase of construction the Contractor shall confirm the non-existence of materials coated with lead based paint in the work area prior to proceeding, as required in accordance with OSHA Directive CPL 2-2.58. If lead based paint materials are suspected, the contractor shall immediately notify the Owner's Authorized Representative and proceed in accordance with OSHA Standards and Directives. If required an adjustment in the Contract Sum and Contract Time will be made through Execution of a Contract Change Order in Accordance with OUS General Conditions for Public Improvement Contracts Section D.1.3(c).

3.08 PERMITS & FEES

- A. The Campus Loop project is enrolled in the city of Portland's Facilities Permit Program. See OUS Standard General Conditions and Supplementary General Conditions.

- B. The Owner shall provide Building, Electrical, Mechanical and Plumbing permits for buildings in accordance with OUS Supplemental Condition SG-2. If the Contractor needs to block a portion of the right-of-way, the Contractor must secure the proper permits from the City of Portland and shall give all requisite notices to public authorities. The Contractor shall be responsible for all violations of the law for any cause in connection with the Work or caused by obstructing streets or sidewalks.
- C. The Contractor shall provide proper notice to all governing jurisdictions including but not limited to the Oregon Department of Environmental Quality prior to beginning work.
- D. Contractor shall pay for and document Oregon Bureau of Labor and Industries fees as required by Bureau of Labor & Industry.

3.09 KEY REQUESTS

- A. Keys will be provided to the Contractor as required for access to buildings and work areas. There is a deposit of \$100.00 required for each key given to the Contractor. Contractor shall fill out Contractor's key request form and deliver for approval to Project Manager a minimum of 48 hours in advance. This deposit will be refunded upon return of the key(s.) Keys will not be provided to sub-contractors, nor will Facilities open locked doors for Contractor's employees or sub-contractors. Contractor shall provide and coordinate all such requirements.

3.10 PROGRESS MEETINGS

- A. The contractor shall schedule for the contractor's Project Manager and Field Superintendent to attend weekly Progress Meetings with the Architect and the Owner's Authorized Representative. The contractor shall coordinate and assure the attendance of sub-contractors as required by the agenda and the Owner's Authorized Representative.
- B. Weekly Progress Meetings shall be held each(day and time), following the pre-construction conference and continuing through substantial completion and until final completion. The Owner's Authorized Representative may require additional on-site 'tail-gate' meetings as necessary to resolve construction related issues and facilitate continued progress.
- C. Progress meetings shall be held at:

PSU, Office of Facilities
202 University Services Building
617 SW Montgomery
- D. The progress meeting minutes serve as the official communication between all parties involved in the Project. The Contractor shall:
 1. Prepare agendas.
 2. Record minutes and include decisions.
 3. Record attendance
 4. Distribute minutes to attendees within three (3) calendar days after meetings.
- E. Minimum agenda shall include:
 1. Review and approve minutes of previous meetings.
 2. Review work progress and work schedule since previous meeting.

3. Discuss field observations, problems, clarifications and information required.
4. Review delivery schedules. Identify problems that could impede planned progress.
5. Review proposed changes in construction or procedures.
6. Delivery and discussion of submittals.
7. Submittal of progress payment requests for review.
8. Other items as may be required.

3.11 REQUESTS FOR CLARIFICATIONS AND INFORMATION

- A. Throughout the course of work, the Contractor may require clarifications or additional information from the Architect or Owner's Authorized Representative. This information may include but not be limited to the following:
 1. Clarifications whether specific work is within the scope of an item of work and no Contract adjustment is anticipated.
 2. Clarifications or interpretations of information or directions provided in the Contract Documents, for which no Contract adjustment is anticipated.
 3. Clarifications or directions as a result of unforeseen conditions, which may or may not result in adjustments to the Contract Sum or days allowed for contract completion.
 4. Additional details or information needed for construction, which were not originally included in the contract documents, which may or may not result in adjustments to the Contract Sum or days allowed for contract completion.
- B. The contractor's field superintendent shall be the principle generator of requests for clarification and information (RFI's) as a result of field operations and conditions.
- C. Three copies of requests for clarifications and information (RFI) shall be typed and submitted in accordance with the communication process described in Section 01300.
- D. All RFI's shall be sequentially numbered and include the following information:
 1. Project item information as specified in Section 01300, Item 1.05.
 2. Reason for request, and clarification and information requested.
 3. Work impacted by request for clarification or information.
 4. Drawings or sketches as necessary.
 5. Contractors recommendations as appropriate.
 6. Signature and date by contractor's authorized representative.
- E. If the contractor anticipates that a change in the scope of work may be necessary in conjunction with a request for clarification or information, he may submit with the request a proposal to perform additional work as a Contract Change Order as specified herein. No changes in work shall commence without an approved RFI response, Construction Directive or Executed Contract Change Order.
- F. All RFI Responses will be by the Architect through and with the approval of the Owner's Authorized Representative.
- G. Response time to process RFI's shall be seven (7) calendar days from the date received by the Architect, to allow reasonable time for researching the question and preparing a response. If, due to unavoidable circumstances, information is needed immediately, coordinate with the Owner's Authorized Representative who will attempt to expedite a response by FAX or e-mail. When responses are expedited, an RFI must still be

submitted as a confirmation of the communication prior to submitting for progress payment for the related work.

- H. A log and copies of all RFI's shall be maintained in the jobsite office, for review or reference by the Contractor, Architect and Owner's Authorized Representative.

3.12 CONSTRUCTION DIRECTIVES

- A. Construction Directives may be initiated by the Owner's Authorized Representative, or the Architect on approval of the Owner's Authorized representative, and provides interpretations of the contract documents or orders minor changes in the work, which may require changes in the Contract Sum or Contract Time, which would be subsequently executed through a Construction Change Order. Interpretation of the Contract documents shall be in accordance with OUS General conditions for Public Improvement Contracts Section A.3, and as amended by the OUS Supplemental General Conditions. Construction Directives are not Construction Change Orders. If the Contractor believes the work described in a Construction Directive requires a change in Contract Sum or Contract Time, he shall submit a proposal to perform additional work as a Construction Change Order as specified herein. Do not proceed with Construction Order work until a proposal for Change Order work has been submitted and Contractor has been directed to proceed by the Owner's Authorized Representative. Proceeding without authorization waives the Contractor's claim for additional Contract Sum or Contract Time.
- B. Construction Directives shall be executed using the attached Construction Directive form.

3.13 CONSTRUCTION CHANGE ORDERS

- A. Contract Bid award is based on the Base Bid. Additional work may be authorized by amending the Contract based upon Unit Prices provided in the Bid Form, the Contractor's Schedule of Values, or other Contractor Proposals approved by the Owner's Authorized Representative, and in accordance with Section D of the OUS General Conditions for Public Improvement Contracts.
- B. A Construction Change Order is a written order issued after the execution of a contract, which authorizes and directs a change in scope of work and an adjustment in the Contract Sum, Contract Time or both. Change Orders will be processed using AIA Document 701, and is not complete until all signatures have been obtained and a signed copy is received by the Contractor.
- C. A Contract Change Order request can be initiated by the Owner's Authorized Representative through a proposal request to the Contractor, or by the Contractor through submittal of a proposal request in conjunction with a RFI response or Construction Directive.
- D. The Contractor's proposal for Contract Change Order Work shall include the following:
 - 1. Project item information as specified in Section 01305, Item 1.05.
 - 2. Reason for request
 - 3. Itemized statement of required materials and equipment, including adjustments to adjacent and dependent work.
 - 4. Itemized statement of required labor, including adjustments to adjacent and dependent work.
 - 5. Total Contract Sum adjustment required for the Change in Work.

6. Total Contract Time adjustment required for the Change in Work.
 7. Additional Documentation as required to support the request.
 8. Signature and date by contractor's authorized representative.
- E. Construction Change Order work shall be reviewed by the Architect and the Owner's Authorized Representative and executed in accordance with OUS General Conditions for Public Improvement Contracts Section D, and as amended herein.
- F. If a fair and reasonable Contract Change Order adjustment can not be agreed upon, the Owner's Authorized Representative may in writing direct the Contractor to proceed with the Change in Work on a 'Time and Materials' basis in accordance with OUS General Conditions for Public Improvement Contracts.

END OF SECTION

PORTLAND STATE UNIVERSITY
OFFICE OF FACILITIES
PROJECT INFORMATION

Project Name: Campus Wide Loop –Steam & Chilled Water Improvements – BP-2

Project No:

Project Description:

Project Address:

Work Start Date:

Project Manager:

Phone: (503) 725-

FAX: (503) 725-4329

Project Site Construction Manager:

Phone: (503) 725-

Design Consultant:

Phone:

Address:

E-Mail :

FAX:

Bid Opening Date:

Contract Bid Price:

Contract Execution Date:

Pre-Const. Meeting:

Notice to Proceed Date:

Contract Calendar Days:

Final Contract Completion Date:

Liquidated Damages: \$1,000 per D.

Contractor Name:

Office Phone:

Project Manager:

Cell:

Pager:

Contractor Office Address:

E-Mail:

Office FAX:

On Site Construction Office Address:

Site Phone:

Site E-Mail:

Site FAX:

Site Superintendent:

Cell:

Pager:

Contractor's Emergency & Weekend Phone:

1.

2.

3.

PORTLAND STATE UNIVERSITY
OFFICE OF FACILITIES
CONSTRUCTION PROJECT SAFETY FORM INSTRUCTIONS

The purpose of the Construction Project Safety Form is to allow contractors to plan the construction or remodeling project in such a way as to prevent injuries and protect the environment. **This form will need to be filled out by the Contractor and provided to the Owner's Authorized Representative at the preconstruction conference.**

The information provided on the form will be reviewed at the preconstruction conference.

All projects must be planned with safety consideration for people who will be in contact with the area; in particular, sight, hearing, or mobility impaired people who are not covered under OSHA regulations but are covered under general liability issues.

PSU requires that all contractors and subcontractors come to the job trained in all Occupational Safety and Health ACT (OSHA) Standards applicable to their work process. This information is outlined in the OR-OSHA document "Occupational Hazards Common to Construction & Remodeling Activities." This document can be obtained free of charge by contacting the OR-OSHA Resource Center at 1-800-922-2689 or on-line at www.ORSOSHA.org.

All construction and remodeling activities regardless of size and/or scope must be fenced, barricaded, or otherwise protected (isolated) to restrict entrance and to ensure the safety of those in the general area. **All building materials and equipment need to be placed within the isolation enclosure.** Any open trenches outside the isolated space will need to be fenced or covered with approved cover (contact the Owner's Authorized Representative for specifics).

REQUIRED PROJECT ISOLATION AND BARRICADING OPEN TRENCHES FOR OUTSIDE CONSTRUCTION SITES

Construction projects that involve building a facility, any exterior remodel, any excavation, or demolition, at a minimum, will install the following perimeter isolation:

A six foot chain-link fence, with controlled access points, extending in all directions around the excavation or building site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles. Note: At the University's option, other barricading plans may be accepted. These may apply to projects such as road resurfacing, parking lot striping, exterior building water proofing, etc.

Indoor projects which will create dust (cutting sheetrock, sanding, sawing etc.) are subject to the following:

1. Areas where existing doors can provide isolation will be labeled "Construction Area Authorized Personnel Only."
2. All other areas will be isolated by a solid barrier. The minimum barrier allowed is 4 mil poly sheeting.

Any excavation across or adjacent to sidewalks or pathways which must be left open overnight, must be identified with working, blinking, construction lights in addition to being covered.

The contractor will provide all trench covering and fencing material, PSU will not provide any materials.

Portland State University
OFFICE OF FACILITIES
CONSTRUCTION PROJECT SAFETY FORM

Complete and deliver with the Project Information sheet to the Owner's Authorized Representative at the Pre-Construction Conference.

Meeting Date: _____ Time: _____ Location: _____

Project: _____ Job #: _____

Contractor: _____ Start: _____ Completion: _____

Contractor Foreman: _____

PSU Project Mgr: _____

Emergency Fire/Medical/Security #: 911 Non-Emergency Campus Safety (503) 725-4404

Confined Space to be accessed? Y or N Location: _____

If yes, review confined space program with PSU Project Manager

Welding or hot work to be done? Y or N If yes, describe extinguisher, and fire watch, plan:

MSDS copies to be on the job site and copies available to PSU Project Manager.

Lead paint involved? Y or N Contact PSU Environmental Health & Safety Supervisor (503) 725-3738

Describe hazard mitigation plan: _____

Asbestos involved? Y or N If yes, Contact PSU Environmental Health & Safety Supervisor (503) 725-3738

Hazard Waste Plan developed? Y or N Containers: _____

_____ Storage Loc: _____

In the event of suspected hazardous materials or spill contact PSU Environmental Health & Safety Supervisor (503) 725-3738.

Describe hazmat spill plan: _____

Will there be any open trenches or holes? Y or N Describe plan to barricade: _____

Internal combustion engines? Y or N If yes, is CO monitoring required? Y N

Other air contaminates? Y or N If yes, describe: _____

Building air intake & return air locations: _____

(No chemical compounds to be used near functioning intake or return air locations.)

Material deliver or parking creating hazard? Y or N If yes, describe minimization plan: _____

No vehicle is allowed to park on sidewalk entrances/exits to steam tunnel (metal hatch cover).

Dust created? Y or N If yes, describe control plan: _____

Noise sources? List: _____

Describe noise control methods: _____

Crane to be used? Y or N If yes, describe plan: _____

(Loads will not be moved over or suspended above pedestrian occupied areas)

Exterior chute to be used? Y or N If yes describe plan: _____

Construction area to be fenced? Y or N Type & location: _____

Fence to be locked? Y or N Job Trailer on site? Y or N To be locked? Y or N All contractor lock keys to Security Services dispatch and PSU Project Manager

Building exitways to be blocked or restricted at any time? Y or N If yes, describe ADA alternate routes and overall egress plan: _____

Will project create interior hazards to building occupants? Y or N If yes, describe hazards and minimization plan: _____

Lock changes planned? Y or N If yes, describe location and responsible party: _____

PORTLAND STATE UNIVERSITY
OFFICE OF FACILITIES
REQUEST FOR INFORMATION

Project: Campus Wide Loop – Phase 1, Steam & Chilled Water Improvements – BP2

RFI No.: _____

Contractor: _____ Date submitted: _____

Subcontractor: _____ Date info req'd: _____

Supplier: _____

Provide all information required by Specification Division I Section 01040. Attach additional sheets as required.

Request:

Contractor _____ Date _____

Response:

Architect _____ Date _____

Acknowledgement by Owner's Rep. _____ Date _____

PORTLAND STATE UNIVERSITY
OFFICE OF FACILITIES
CONSTRUCTION DIRECTIVE

Project: Campus Wide Loop – Phase 1, Steam & Chilled Water Improvements – BP2

Directive No.: _____

Contractor: _____ Date submitted: _____

Subcontractor: _____ Date info req'd: _____

Supplier: _____

You are hereby directed to execute promptly this Directive which interprets the Contract Documents or orders minor changes in the work. If you consider that a change in Contract Sum or Contract Time is required, submit an itemized change order proposal as required by Specification Division I Section 01040. If your proposal is in order, this Directive will be superseded by a Change Order.

Description:

Architect: _____ Date: _____

Owner's Authorized Rep: _____ Date: _____

SECTION 01045 CUTTING AND PATCHING

PART 1 -GENERAL

1.01 DESCRIPTION

- A. Work of this Section includes administrative and procedural requirements for cutting and patching.

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional information regarding cutting and patching requirements may be found in the follows:
 - 1. OUS General Conditions
 - 2. Other Sections of these specifications.
 - 3. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

1.03 QUALITY ASSURANCE

- A. The Contractor shall perform all cutting and patching in conformance with OUS General Conditions for Public Improvements Section F.3 and as specified herein.
- B. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio. The Owner's Authorized Representative shall pre-approve all field modifications.
- C. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operation life or safety.
- D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. The contractor shall remove and replace construction cut and patched in a visually unsatisfactory manner at no expense to the owner.

PART 2 -PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 -EXECUTION

3.1 INSPECTION:

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

3.2 PREPARATION:

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cutting:
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
 - 2. Cut existing construction using methods least likely to damage elements retained or adjoining construction.
 - 3. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 4. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 5. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
 - 6. Comply with requirements of applicable Division 2 Sections where cutting and patching requires excavating and backfilling.
 - 7. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter.
- C. Patching:
 - 1. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

2. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
3. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
4. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance.
5. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
6. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

D. Cleaning:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01300 SUBMITTALS

PART 1 -GENERAL

1.01 DESCRIPTION:

A. The requirements specified in this Section relate to Submittal materials, Requests for Information and Requests for Clarification by all Contractors, Sub-contractors and Suppliers performing Work under these Contract Documents and includes:

1. Submittal Procedures
2. Submittals Schedule
3. Proposed Products List
4. Shop Drawings
5. Product Data
6. Samples
7. Manufacturer's Instructions
8. Manufacturer's Operations & Maintenance Manuals
9. Manufacturer's Certificates

1.02 RELATED WORK IN OTHER SECTIONS:

A. Additional submittal requirements may be provided as follows:

1. Instructions to Bidders
2. OUS General Conditions
3. Supplemental General Conditions
4. Other Sections of these specifications.

1.03 All Submittals, Shop Drawings, Product Data and Samples shall be in accordance with OUS General Conditions for Public Improvement Contracts Section B. and as specified herein.

1.04 Transmit six (6) copies of each submittal with sequentially numbered forms. Provide two (2) additional copies when submittal involves mechanical or electrical review. Re-submittals shall have original number and alphabetic prefix.

1.05 Identify Project, Contractor, Subcontractor and supplier; pertinent drawing sheet and detail number(s), and specification numbers, as appropriate.

1.06 Review of the submittals by the Architect and Owner's Authorized Representative shall not relieve the Contractor of its obligations as specified in OUS General Conditions for Public Improvement Contracts Section B.18.

1.07 The General Contractor shall sign certifying that review, verification of products required, field dimensions, adjacent construction work and coordination of information, is in accordance with the work of the Contract Documents.

1.08 Provide space for review approval by Architect and the Owner's Authorized Representative, as specified herein.

1.09 Schedule submittals to expedite Project; deliver to Architect and Owner's Authorized Representative as directed herein and coordinate submission of related items.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.01 Seventy-two (72) hours prior to the pre-construction conference and in all cases prior to the commencement of work, the Contractor shall submit the following to the Owner’s Authorized Representative:

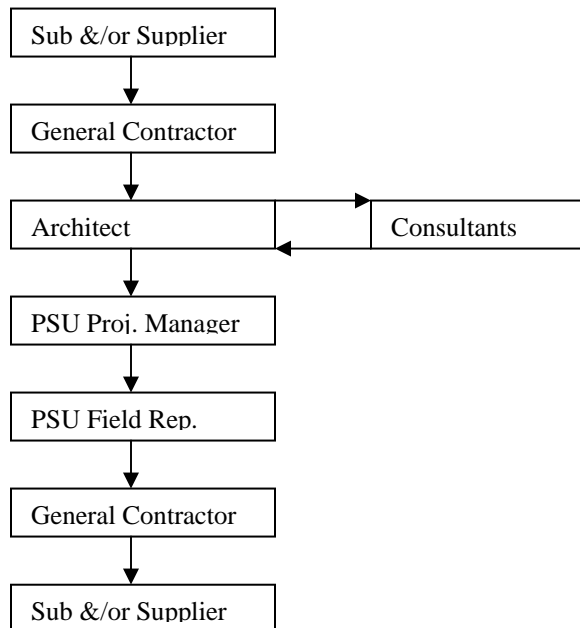
- A. Certificate of Insurance as required.
- B. Signed Public Improvement Agreement.
- C. Five (5) original copies of Performance & Payment Bonds.
- D. Schedule of Values.
- E. Project Construction Schedule.
- F. Submittal List and Schedule of Submittals, identifying long lead items.
- G. Contractor Emergency Contact Information.

3.02 Prepare Schedule of Submittals in chronological order by date of required submittal approval. Indicate the following:

- A. Category of submittal.
- B. Name of sub-contractor or supplier.
- C. Generic Description of Work covered.
- D. Related Specification Section Number.
- E. Activity or event number on the project construction schedule.
- F. Proposed submittal date for first submittal.
- G. Date material required for installation.
- H. Re-submittal dates and final release or approval by Architect and Owner’s Authorized Representative.

3.03 The general Submittal Review Procedure is illustrated in the following diagram.

- A. Sub-contractor and/or Supplier submits to General Contractor for review/ approval
- B. If approved, General Contractor submits to Architect for review/ approval.
- C. Architect submits to Design Team Consultants for review/ approval.
- D. If approved, Architect Submits to PSU Project Manager for review/ approval.



- E. If approved, PSU
Project Manager submits
To PSU Field Representative
for approval and delivery to
General Contractor's Project
Representative.
- 3.04 Allow fourteen (14) calendar days for submittal review by Architect and Owner's Authorized Representative. Allow (3) additional calendar days for mechanical and electrical reviews. The General Contractor shall be responsible for timely the submittal of materials approvals in order to satisfy required delivery dates and maintain the construction schedule.
- 3.05 ACTION BY ARCHITECT AND OWNER'S REPRESENTATIVE
- A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly through and with approval of the Owner's Authorized Representative. All unacceptable or rejected submittals shall be immediately corrected and resubmitted for review.
 - 1. Compliance with specified characteristics is the Contractor's responsibility.
 - B. Action Stamp: The Architect will stamp each submittal with a uniform action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:
 - 1. Final Unrestricted Release: When the Architect marks a submittal "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
 - 2. Final-But-Restricted Release: When the Architect marks a submittal "Make Corrections Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
 - 3. Returned for Resubmittal: When the Architect marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - 4. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.
- 3.06 The Owner's Representative may request additional information during the course of the project to monitor material and equipment deliveries as well as coordinate work and materials by others. The General Contractor may be required to submit and periodically update a Material Delivery Summary indicating material order dates, purchase order numbers, expected delivery dates and actual delivery dates.
- 3.07 SHOP DRAWINGS
- A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents as the basis of Shop Drawings.
 - B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

1. Dimensions.
 2. Identification of products and materials included by sheet and detail number.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
 6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches** but no larger than **30 by 42 inches**.
 7. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
- C. Subsequent to Substantial Completion and prior to Final Pay Request, Submit five (5) copies of As Built documentation of all shop drawings to the Architect for inclusion in Project Record Documents. See OUS General Conditions for Public Improvement Contracts Section K and Division 1 Section 01780 for Project Closeout requirements.

3.08 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Notation of dimensions verified by field measurement.
 - e. Notation of coordination requirements.
 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
 3. Submittals: Submit 6 copies of each required submittal; submit 2 additional copies where review is required by Architect's consultants. Up to four copies will be retained by Architect and Owner, plus copies by Architect's consultant, the remaining copies will returned marked with action taken and corrections or modifications required.
 4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities.
 - a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

3.09 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
 - 1. Mount or display Samples in the manner to facilitate review of qualities indicated. Prepare Samples to match the Architect's sample. Include the following:
 - a. Specification Section number and reference.
 - b. Product name or name of the manufacturer.
 - c. Compliance with recognized standards.
 - 2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.
 - b. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
 - 3. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit three sets. The Architect will return two sets marked with the action taken.
 - 4. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - b. Sample sets may be used to obtain final acceptance of the construction associated with each set.
 - c. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work.

3.10 QUALITY ASSURANCE SUBMITTALS

- A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
 - 1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

- C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

3.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual Specification Sections, submit manufacturer's printed instructions for delivery, storage, assembly, start-up, testing, adjusting and finishing.
- B. Submit any conflicts between the manufacturer's instructions and the Contract Documents for clarification by the Architect and Owner's Authorized Representative.

3.12 MANUFACTURER'S CERTIFICATE

- A. When specified in individual Specification Sections, submit manufacturer's certificate for review, in quantities specified.
- B. Indicate material or product conforms to or exceeds specific requirements. Submit supporting reference data, affidavits, and certificates as appropriate.
- C. Certificates may be recent or previous test results on materials or products, but must be acceptable to the Architect and the Owner's Authorized Representative.

END OF SECTION

SECTION 01400 QUALITY REQUIREMENTS

PART 1 -GENERAL

1.01 DESCRIPTION

- A. The requirements specified in this Section relate to general quality control of the Project and supplement the quality control requirements specified in the OUS General Conditions for Public Improvement Contracts and other Sections of these Specifications. The requirements of this Section relate to all work performed by all Contractors and Sub-contractors performing work under these Contract Documents and include:
1. References and standards.
 2. Quality assurance submittals.
 3. Mock-ups.
 4. Control of installation.
 5. Tolerances.
 6. Testing and inspection services.
 7. Manufacturers' field services.

1.02 RELATED SECTIONS

- A. Additional requirements related to Quality Requirements may be provided as follows:
1. OUS General Conditions
 2. Other Sections of the specifications.

1.03 REFERENCES

- A. ASTM C 1021 -Standard Practice for Laboratories Engaged in Testing of Building Sealants; 1997.
- B. ASTM C 1077 -Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2000.
- C. ASTM C 1093 -Standard Practice for Accreditation of Testing Agencies for Unit Masonry; 1995.
- D. ASTM D 3740 -Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 1999c.
- E. ASTM E 329 -Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction; 2000b.
- F. ASTM E 543 – Standard Practice for Agencies Performing Nondestructive Testing; 1999.
- G. ASTM E 548 – Standard Guide for General Criteria used for Evaluating Laboratory Competence; 1994.

1.04 SUBMITTALS

- A. Testing Agency Qualifications:

1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Design Data: Submit for Architect's knowledge as contract administrator or for the Owner, for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- C. Test Reports: After each test/inspection, promptly submit two copies of the report to the Contractor and additional copies to the Architect and Owner's Authorized Representative for processing through the procedure specified in Section 01305. All test reports shall include the following information:
1. Date issued.
 2. Project title and number.
 3. Name of inspector.
 4. Date and time of sampling or inspection.
 5. Identification of product and specifications section.
 6. Location In the Project.
 7. Type of test/inspection.
 8. Date of test/inspection.
 9. Results of test/inspection.
 10. Conformance with Contract Documents.
 11. When requested by Architect, provide interpretation of results.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect and Owner's Authorized Representative, in accordance with the procedure specified in Section 01305. All certificates shall include the following information:
1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to the Architect and Owner.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for review by Architect and Owner's Authorized Representative.
1. Submit report in duplicate within 30 days of observation to Architect for information.
 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

- G. Erection Drawings: Submit drawings for review and approval by Architect and Owner's Authorized Representative, in accordance with the procedure specified in Section 01305.
 - 1. Submit information for the limited purpose of assessing quality control, and conformance with the design concept and contract documents.

1.05 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

1.06 TESTING AND INSPECTION AGENCIES

- A. Unless otherwise directed in writing by the Owner's Authorized Representative, the Contractor shall make arrangements for all required testing and inspections in accordance with OUS General Conditions for Public Improvement Contracts Section B.7.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Employed Agency shall comply with the following criteria:
 - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 548, ASTM E 543, .ASTM C 1021, ASTM C 1077, and ASTM C 1093.
 - 2. Inspection agency: Comply with requirements of ASTM 03740, ASTM E329, and ASTM E548.
 - 3. Laboratory: Authorized to operate in State in which Project is located.
 - 4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
 - 5. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

PART 2- PRODUCTS

NOT USED

PART 3- EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. When required by other Sections of these specifications or the Architect provide mock-ups for review of conformance with quality, performance and design intent.
- B. Review of mock-ups will be performed under provisions identified in this section and identified in the respective product specification sections.
- C. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- D. Accepted mock-ups shall be a comparison standard for the remaining Work.
- E. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing required.

B. Testing Agency Duties:

1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests and inspections required by Architect or Owner's Authorized Representative.
7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of the Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:

1. Deliver to agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
4. To provide access to Work to be tested/inspected.
5. To obtain and handle samples at the site or at source of Products to be tested/inspected.
6. To facilitate tests/inspections.
7. To provide storage and curing of test samples.
8. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
9. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
10. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, as applicable, and to initiate instructions when necessary.

- B. Submit qualifications of observer to Architect and Owner's Authorized Representative 30 days in advance of required observations.
 - 1. Observer subject to approval of Architect.
 - 2. Observer subject to approval of Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Immediately replace Work or portions of the Work not conforming to the Contract Documents at no additional cost to the Owner.

END OF SECTION

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Coordinate sampling and testing with the Owner's selected testing laboratory and all others responsible for testing and inspecting the work. Provide other testing and inspecting as specified to be furnished by the contractor in this section and/or elsewhere in these specifications.

B. Related Sections

1. Section 02315 - Earthwork
2. Section 02316 - Trenching, Backfilling and Compaction

1.2 REFERENCES

- A. Not used in this section.

1.3 DEFINITIONS

- A. Not used in this section.

1.4 SUBMITTALS

- A. Not used in this section.

1.5 QUALITY ASSURANCE

- A. Qualifications of Testing Laboratory: The testing laboratory will be qualified to the Owner's approval.
- B. Codes and Standards: Testing, when required, will be in accordance with pertinent codes and regulations.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Promptly process and distribute required copies of test reports and related instructions to ensure the least possible delay in progress of the work.
- B. Completion of Test Results: The results of the laboratory and/or field control tests shall be the principal basis upon which the satisfactory completion of the work shall be judged. Upon completion of placement of materials, the results of the field and laboratory tests and other data regarding the quality of the work will be embodied in a written report to the engineers by the testing laboratory, including conclusions as to the compliance of completed work with the specifications.

- C. If the results of testing show that materials which are below the requirements called for by these specifications, that portion of the work will be subject to condemnation. Any work so condemned shall be removed and replaced as directed at the Contractor's expense, including A/E's extra supervision costs.

1.7 SCHEDULING AND SEQUENCING

- A. Not used in this section.

PART 2 PRODUCTS

2.1 PAYMENT FOR TESTING

- A. Initial Services: The Owner shall pay for initial testing services requested by the owner. When initial tests indicate noncompliance with the contract documents, the cost of initial tests associated with the noncompliance will be deducted by the owner from the contract sum.
- B. Retesting: When initial tests indicate noncompliance with the contract documents, all subsequent retesting occasioned by the noncompliance shall be performed by the same testing agency, and the costs thereof will be born by the contractor at no additional cost to the Owner.

2.2 CODE COMPLIANCE TESTING

- A. Inspection and tests required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the contractor, unless otherwise provided in the contract sum.

2.3 CONTRACTOR'S CONVENIENCE TESTING

- A. Inspection and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

2.4 INSPECTION BY OWNER'S PERSONNEL

- A. From time to time, personnel in the employ of the Owner may inspect the work where the work is in progress, but shall have no authority to direct the Contractor or request changes in the work except through the Owner's designated representative.

PART 3 EXECUTION

3.1 COOPERATION WITH TESTING LABORATORY

- A. Representatives of the testing laboratory shall have access to the work at all times. Provide facilities for such access in order that the laboratory may properly perform its function.

3.2 TAKING SPECIMENS

- A. Specimens and samples for testing, unless otherwise provided in the contract documents, will be taken by the testing personnel. Sampling equipment and personnel will be provided by the testing laboratory. Deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.3 SCHEDULES FOR TESTING

- A. Establishing the Schedule: By advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings.
- B. Revising the Schedule: When changes of construction schedule are necessary during construction, coordinate such changes of schedule with the testing laboratory as required.

3.4 ALTERNATIVE INSPECTION PROCEDURE

- A. The owner shall have the right to require alternative inspection procedures other than as specified when in the owner's judgment other inspections are required to demonstrate the compliance with the contract requirements. Costs of such alternative inspections will be borne by the Contractor.

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES AND CONTROLS

PART 1 -GENERAL

1.01 DESCRIPTION:

- A. The requirements specified in this Section relate to Temporary Facilities, Controls, Utilities and procedures required by all Sub-contractors through the General Contractor performing work under these Contract Documents and includes:
1. General Requirements for Temporary Facilities and Controls.
 2. Temporary Utilities.
 3. Temporary Electricity.
 4. Temporary Lighting.
 5. Temporary Heat.
 6. Temporary Ventilation.
 7. Temporary Telephone and Fax.
 8. Temporary Water Service.
 9. Temporary Sanitary Facilities.
 10. Temporary Fire Protection and Detection.
 11. Temporary Construction.
 12. Temporary Controls.
 13. Tree and Plant Protection.
 14. Security.
 15. Traffic Regulation and Parking.
 16. Project Identification.
 17. Field Office.
 18. Progress Cleaning
 19. Removal of Utilities, Facilities and Controls

1.02 RELATED WORK IN OTHER SECTIONS:

- A. Additional requirements related Temporary Facilities and Controls may be provided as follows:
1. OUS General Conditions
 2. Supplemental General Conditions
 3. Other Sections of these specifications.

1.03 GENERAL TEMPORARY FACILITIES AND CONTROL REQUIREMENTS

- A. This section specifies requirements for temporary services and facilities, including such items as temporary utility services, temporary construction and support facilities, temporary controls, traffic regulations, project security and protection.
- B. Cost or usage charges for temporary services or facilities are NOT chargeable to Owner, and will NOT be considered as basis for claim for change orders.
- C. Temporary utility services required for use at the Project Site include but are not limited to the following:

1. Water service and distribution.
 2. Temporary electric power and lighting.
 3. Telephone, Fax and e-mail service.
- D. Temporary construction and support facilities required for Project include but are not limited to the following:
1. Temporary heat.
 2. Temporary ventilation.
 3. Sanitary facilities.
 4. Waste disposal service.
 5. Construction aids and miscellaneous general services and facilities.
 6. Temporary enclosures.
 7. Project identification, bulletin boards and signs.
 8. Field office.
 9. Parking
- E. Security and protection facilities and services required for Project include but are not limited to the following:
1. Temporary fire protection.
 2. Barricades, warning signs and lights.
 3. Environmental protection.
- F. Comply with requirements of local laws and regulations as well as Owner's requirements governing construction, and local industry standards, in installation and maintenance of temporary services and facilities, including but not limited to the following:
1. Building codes, including local requirements for permits, testing and inspection.
 2. Health and safety regulations.
 3. Utility company regulations and recommendations for temporary services.
 4. Police and Fire Department rules and recommendations.
 5. Environmental Protection Agency regulations and requirements.
 6. Hazardous Materials Safety Regulations.
- G. Comply with requirements of NFPA Code 241, "Standards for Safeguarding Building Construction and Demolition Operations" and ANSI -A 10 Series standards for "safety Requirements for Construction and Demolition" and AGC/ASA/ASC Joint Guideline #5, "Temporary Job Utility and Services". Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services" as prepared jointly by AGC and ASC for industry recommendations
- H. Inspect and test each service before placing temporary utilities in use. Arrange for required inspections and tests by governing authorities, and obtain required certifications and permits for use.
- I. During progress of Work, submit copies of reports and permits required by governing authorities, or necessary for installation and efficient operation of temporary services and facilities.

- J. Provide each temporary service and facility ready for use at each location when service or facility is first needed to avoid delay in performance of Work. Maintain or expand as required and modify temporary services and facilities as needed throughout progress of Work. Do not remove until services or facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.
- K. Operate temporary services and facilities in safe and efficient manner. Do not overload temporary services or facilities, and do not permit them to interfere with progress of Work. Should services of independent engineer be required to survey existing or temporary utilities, it shall be at no cost to Owner. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist at the Site.
- L. Do not permit disruption of existing services, freezing of pipes, flooding or contamination of water sources.
- M. Maintain temporary facilities in such manner as to prevent discomfort to users. Take necessary fire protection measures. Maintain temporary support facilities in sanitary manner so as to avoid health problems and other deleterious effects.
- N. Maintain Site security and protection measures in safe, lawful and publicly acceptable manner. Take necessary measures to prevent site erosion, as applicable. At not time is Site to be without protective fence enclosure(s), as required to protect general public.

1.04 TEMPORARY UTILITIES

- A. Coordinate with the Owner's Authorized Representative and make connections to existing services to provide temporary services to the Project. Connections to the service shall be the responsibility of the Contractor.
- B. Coordinate with the Owner's Authorized Representative for acceptable time for service interruptions, where necessary to make connections for temporary services.
- C. Do not interrupt any utility service. Seventy-two (72) hours prior request and approval from the Owner's Authorized Representative is required to enable the Owner to shut down any utility required for the work. Contractor's employees shall **not** shut down utilities.

1.05 TEMPORARY WATER SERVICE

- A. Provide temporary water service and distribution piping of sizes and pressures adequate for construction purposes throughout the construction period and until permanent service is in use, including but not limited to following uses:
 - 1. Construction processes.
 - 2. Fire protection, as appropriate.
 - 3. Drinking water.
 - 4. Cleaning.

- B. Where water use is authorized by Owner's Authorized Representative, connect to Owner's metered source, usage will be paid by Owner. Contractor shall exercise water conservation measures, provide hoses with threaded connection and provide temporary pipe insulation to prevent freezing. Owner's Authorized Representative reserves the right to require the Contract to furnish and install a temporary flow meter during construction and pay for water use, if contractor does not exercise satisfactory water conservation measures.

1.06 TEMPORARY ELECTRICITY

- A. Provide weather proof, grounded temporary electric power service and distribution system of sufficient size, capacity and power characteristics to accommodate performance of Work during construction period.
- B. Install service and grounding in compliance with National Electric Code (NFPA 70). Include necessary meters, transformers, overload protected disconnect and main distribution switch gear.
- C. Provide metal conduit, tubing or armored cable for protection of temporary power wiring where exposed to possible damage during construction operations.
- D. Temporary service electrical wiring will be limited to 110-120 volt, 20-amp rating, and wiring of lighting circuits may be non-metallic sheathed cable in areas where located overhead and exposed for surveillance, where permitted by code. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors. Provide metal enclosures or boxes for wiring devices.
- E. For power hand tools and task lighting, provide temporary 4-gang outlets at each floor level, spaced so that 100-foot extension cord can reach each area of Work. Provide separate 110 120 volt, 20 amp circuit for each 4-gang outlet (4 outlets per circuit).

1.07 TEMPORARY LIGHTING

- A. Wherever overhead floor or roof deck has been completed, install temporary lighting adequate to provide sufficient illumination for safe Work and traffic conditions in every area of Work. Take precautions to limit glare or direct illumination into areas occupied after dark.
- B. Provide and maintain lighting for construction operations to achieve minimum lighting level of 2 watt/sq. ft.
- C. Provide and maintain 1 watt/sq. ft. lighting to staging and storage areas during periods of non-construction after dark for security purposes.
- D. Provide and maintain 0.25 watt/sq. ft. lighting to interior work areas during periods of non-construction after dark for security purposes.
- E. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- F. Maintain lighting and provide routine repairs.

1.08 TEMPORARY TELEPHONE, FAX AND E-MAIL

- A. The Owner will provide connection line(s) for temporary telephone, facsimile (FAX) machine and electronic mail service to the job site field office location. Telephone service will be local access limited. Coordinate location and setup with the Owner's Authorized Representative.
- B. The Contractor shall provide temporary on site telephone equipment, facsimile (Fax) machine and electronic mail access system on dedicated lines at field office. See Section 01300, Project Administration for off site emergency contact requirements.
- C. Maintain temporary telephone, facsimile and e-mail service from start of Work through Final Completion.

1.09 TEMPORARY HEAT

- A. Provide and pay for heat devices as required to maintain specified conditions for construction operations.

1.10 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. See Section 01734, Indoor Air Quality for addition temporary ventilation requirements.

1.11 TEMPORARY SANITARY FACILITIES

- A. The Contractor and subcontractors may use Owner designated restroom facilities located on the premises. The Contractor shall be responsible for maintaining the designated restroom facilities in a clean and sanitary condition or the privilege may be revoked. Coordinate restroom use with the Owner's Authorized Representative.
- B. Do not discharge liquid wastes into sewers or drainage facilities, containing excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways. The contractor shall bear the cost of any damages to the sewer system, caused directly or indirectly by his crews or subcontractors.

1.12 WASTE DISPOSAL SERVICE

- A. If existing sewers or drainage facilities cannot be lawfully used for discharge of liquid waste, provide containers to remove and dispose of waste off Site in a lawful manner. See Section 01732, Waste Management
- B. Provide solid waste disposal and recycling facilities for the removal of construction related materials, trash and debris, in accordance with Section 01732. No on-site area is available for a 'roll-off' dumpster location. Coordinate with the City of Portland and the Owner's Authorized Representative the 'hooding' of parking meters and the use of public right-of-way for rubbish disposal as required.
- C. Do not dispose of hazardous materials in a manner that could allow the materials to enter landfills, waterways or other unapproved facilities. The Contractor shall comply with the hazardous material provisions of OUS General Conditions for Public Improvements Section F, and Division 1 Section 1732.

1.13 CONSTRUCTION AIDS & GENERAL SERVICE FACILITIES

A. Construction Aids:

1. Design, construct and maintain construction aids and miscellaneous general services facilities as needed to accommodate performance of Work. Construction aids and miscellaneous general services and facilities include, but are not limited to the following:
 - 1) Temporary stairs and ladders.
 - 2) Guardrails and barriers.
 - 3) Walkways.
2. Provide temporary stairs where ladders are not adequate for proper, safe or efficient performance of Work.
3. Install and maintain temporary walkways around work and to field offices, toilets and other similar areas. Construct walkways of gravel or duckboard units.
4. Provide lifting devices necessary for the proper and efficient movement of materials; provide operating personnel for equipment as required. Provide for use of all hoisting equipment on the project during “off hours” as required to prevent impeding the project schedule.

B. Pollution Control:

1. Provide general protection facilities, operate temporary facilities, conduct construction activities, and enforce strict discipline for personnel on Site by methods which comply with environmental regulations, and that minimize possibility that air, water and subsoil may be contaminated or polluted, or that other undesirable effects may occur from performance of Work.

C. Noise Control:

1. Contractor shall provide and maintain adequate and effective mufflers, sound barriers and controls for all construction equipment so that noise from this equipment can be controlled to satisfaction of Owner. Coordinate with Owner’s Authorized Representative when construction work requires use of air hammers or other objectionable noisy equipment. Comply with all laws and regulations applicable the noise pollution abatement and workplace noise. See Section 01734.
2. Rotohammering, grinding, drilling or other excessively noisy operations shall be coordinated with Owner’s Authorized Representative and scheduled to avoid impacting building occupants. Jack hammering shall not be allowed at existing building interiors.

D. Dust Control:

1. All streets, roads or detours used for hauling materials shall be oil dust treated as required to prevent dust, or continually watered to prevent dust. Dust prevention measures, both indoors and outdoors shall be continuous until Final Acceptance by Owner.

2. Provide interior dust control measures, such as temporary partitions, taping of air spaces at doors, maintenance of filters and protection of ducts, etc., as required to control dust. Coordinate to prevent accidental activation of particulate-sensing fire detection system as described under requirements for Hot Work Permit.

E. Erosion and Sediment Control:

1. Follow city approved master erosion control plan, when applicable. Maintain copy on site.

1.14 TEMPORARY ENCLOSURES

A. Security:

1. The Contractor shall be responsible for any and all protections required during performance of the work, and shall be responsible for any and all damages as specified in OUS General Conditions for Public Improvement Contracts Section G1.1. 2. The Owner will not be responsible for protection of materials or equipment from vandalism or theft. Security is the responsibility of the Contractor.

B. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism or theft.

C. Maintain a security program continuously throughout Project, until Owner occupancy or Owner acceptance precludes, need for security program.

D. Barriers:

1. Comply with recognized standards and code requirements for erection of substantially adequate barriers where needed to prevent accidents and losses. Paint with appropriate colors, graphics and warning signs to inform construction personnel and public of hazard of concern. Provide lighting and flashing signals as required.
2. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
3. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
4. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

E. Fencing:

1. Where fencing is required, install general enclosure fence with suitable lock for gates. Locate where indicated on Drawings or as required to substantially complete enclosure around Site or staging/construction operations. Install in manner that will prevent unauthorized persons from easily entering Site. Except when otherwise directed, provide open-mesh, chain-link fencing with posts substantially set in ground, or in moveable concrete blocks.
2. Within five days of Commencement of Work, Contractor shall provide fencing plan for approval by Owner. Plan shall indicate existing fencing to remain, new fencing required and type, location and sequencing of temporary barriers or fencing required for fencing outside primary Site.

F. Protection of Installed Work:

1. Protect installed Work and provide special protection where specified in individual j Specification Sections.
2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
3. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
4. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

1.15 PROJECT IDENTIFICATION

A. Project Identification Signage:

1. Project Identification Signage will be furnished by Owner and installed by Contractor. Coordinate signage placement with the Owner's Authorized Representative.
2. Project Identification Signage shall be installed by the Contractor within five (5) days of delivery by the Owner and shall be removed by the Contractor following notice of Substantial Completion and prior to Final Completion. Upon removal Project Identification Signage shall become the property of the contractor.
3. Project Identification Sign will consist of two signs, 4'x8' =32 sq ft area, 3/4" marine plywood mounted. Contractor to provide 4"x4" post or other materials and means to mount sign with bottom of sign 4 feet above ground.

B. Project Informational Signs:

1. Contractor shall provide temporary directional signs to direct traffic into and within site. Relocate as Work progress requires.

1.16 FIELD OFFICE

- A. Provide field office area, and storage and staging locations within the defined scope of work area and in a location approved by the Owner's Authorized Representative. Provide temporary lighting, heated and ventilation as specified herein.
- B. Provide plan table, notice boards and other furnishings as require for Contractor's daily operations and as required by the Owner's Authorized Representative.
- C. Provide on-site office equipment as specified herein.
- D. Relocate field office area, and storage and staging location as required to not impede work. At completion of Work, remove buildings, utility service and debris. Restore area to prior condition.

1.17 TRAFFIC REGULATION AND PARKING

A. Traffic Control:

- a. Comply with all rules and regulations of Owner, City, State and county authorities regarding closing of public streets to use by public traffic, including pedestrians. No road shall be closed to public except by expressed by permission by Owner and City. Control obstructions and hazards with approved signs, barricades and lights where necessary to protect safety of public. Convenience of general public adjacent to Project, protection of persons and property, and access of emergency vehicles are of prime importance and shall be provided for in satisfactory manner.

B. Flagging Services:

1. Contractor shall provide trained flaggers and barricade hazardous operations during construction activities requiring the use of street areas, as directed by the Owner's Authorized representative. Equip flaggers and guards on duty with approved red work apparel and stop/slow paddle kept clean and in good condition.
2. Utilize traffic control cones, drums, flares and lights which are approved by the city of Portland Bureau of Transportation. Use flares and lights during hours of low visibility to delineate traffic lanes and guide traffic.

C. Temporary Use of Roads:

1. Provide detours necessary for unimpeded traffic flow.
2. Provide and maintain unobstructed access to fire hydrants.
3. Maintain emergency vehicle top access to the premises.

D. Construction Related Parking Control:

1. Contractor, sub-contractor and employee parking will not be provided on the premises. The purchase of hoods for parking meters from the city of Portland is suggested.
2. Coordinate all construction deliveries with the Owner's Authorized Representative. Purchase and obtain a temporary parking permit from the Portland State University office of Transportation and Parking twenty-four (24) hours prior to anticipated delivery parking need. Temporary construction related parking shall be limited to an assigned staging area as approved in writing by the Owner's Authorized Representative. Designated for Contractor's use.
3. The Contractor shall be responsible for all contractor and sub-contractor parking citations by the City of Portland and the Portland State University office of Transportation and Parking. All citations must be paid prior to submission of Notice of Final Completion and Request for Final Payment.

1.18 TEMPORARY FIRE PROTECTION

A. Until fire protection needs may be fulfilled by permanent facilities, install and maintain temporary fire protection facilities of types needed to adequately protect against reasonably predictable and controllable fire losses.

1. Provide equipment of adequate capacity to extinguish minor fires in combustible material on the Premises during the construction period.

2. Comply with applicable recommendations of NFPA Standard 10 "Standard for Portable Fire Extinguishers".
 3. Maintain equipment in working condition with current inspection certificate attached to each.
 4. Locate fire extinguishers where they are most convenient, visible and effective for their intended purpose, but provide no less than one extinguisher on each floor or in each general Work area, at or near each usable stairwell.
 5. Store combustible materials in containers in recognized fire-safe areas.
- B. Develop and supervise overall fire prevention and first-aid fire protection program for personnel at Project Site.
1. Review needs with local fire department officials and establish procedures to be followed.
 2. Smoking is prohibited on the premises. Contractor's personnel are to abide by all rules and regulations regarding smoking and all other fire prevention regulations in force where the Work is to be performed. Smoking is not permitted in structures on the PSU campus.
 3. Post warning and information and enforce strict discipline.
 4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires.
 5. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of Ignition for fire.
 6. Contractor shall ensure that contractor's employees are familiar with Owner's fire procedures and location of fire hydrants and extinguishers in adjacent parts of building adjacent to the construction area.

1.19 PROGRESS CLEANING

- A. Dirt and debris of all nature caused by execution of Work shall be removed from the Site at end of each work day. Contractor shall be responsible for disposal of all scraps and materials that are relative to this Project.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing space.
- C. Hose all paved areas staged with construction material and generally prepare area of Work for occupancy with no further clean-up required by Owner.
- D. Clean all spilled dirt, gravel or other foreign material caused by construction operations from all streets and roads at conclusion of each day's operations. Cleaning of large areas shall be by grader and front-end loader supplemented by washing with water power brushing and hand labor.
- E. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- F. Remove waste materials, debris, and rubbish from Site daily and dispose off-site.

1.20 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

- B. Remove underground installations to a minimum depth of two (2) feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01565
TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work of this section includes preservation and protection of existing trees, shrubs, and lawn to remain.
- B. See Plans and Specification Section 32 90 00 – Planting for requirements for salvaging and replanting existing plants.

1.2 GENERAL WORK CONSTRAINTS

- A. Unless indicated otherwise on the documents all existing trees, shrubs, and lawn shall remain and be protected .
- B. No work shall occur within the area inside the protective fencing.

1.3 COMPENSATION FOR DAMAGE TO EXISTING TREES

- A. The Contractor is responsible for compensating the District for any and all damage to trees, shrubs, and lawn.
- B. Compensation action and amounts shall be as directed and calculated by a certified Arborist selected by the Owner.

PART 2 PRODUCTS

2.1 TREE PROTECTION AND WORK LIMIT FENCING

- A. Protective Fencing: 6 foot tall temporary chain link fencing with temporary concrete post bases.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide protective fencing at the limits for construction as indicated on the landscape drawings and as approved in the Field by the Owner.
- B. Prior to beginning construction, tour the site with the Owner and outline the location where protective fencing shall be installed.
- C. Fencing shall be installed plumb in locations identified in the field by the Owner.
- D. Fencing used to define the edge of construction, where it coincides with the location approved by the Owner for plant protection fence, is acceptable for protection fencing.

3.2 MAINTENANCE

Maintain all protective fencing plumb, tight, at full height, and where located in the field by District. Replace damaged fencing with new materials as needed.

3.3 REMOVAL

Remove protective fencing just prior to the site review for Substantial Completion.

END OF SECTION

SECTION 01630
PRODUCT REQUIREMENTS AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The requirements specified in this section relate to general product requirements substitutions by the Contractor, Sub-contractors and Suppliers performing Work under these Contract Documents and includes:
1. Contractor's Responsibilities
 2. Product Options
 3. Substitution Requests during the Bidding Process
 4. Substitution Requests after the Award of Contract
 5. Substitutions not permitted
 6. Product Delivery, Storage & Handling
 7. Product Installation

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional Product Option and Substitution Request Information may be provided as follows:
1. OUS General Conditions
 2. Other Sections of these specifications.

1.03 DEFINITIONS

- A. "Products" are materials, machinery, components, equipment, fixtures and other systems incorporated into the Project, regardless of whether they were purchased for the Project or taken from the Contractor's previously purchased inventory. It does not include machinery and equipment used in preparation, fabrication, conveying and erection of the Work.
- B. "Materials" are products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form units of Work.
- C. "Substitutions" includes proposed changes in products, materials, equipment, and methods of construction required by the Contract Documents.

1.04 REQUESTS FOR SUBSTITUTIONS

- A. Requests for substitution of products in place of those specified shall be in accordance with the Public Improvement Agreement, OUS General Conditions, with Supplemental Conditions, and as specified herein. The Contractor assumes responsibility for the requirements as set forth herein. Any cost or time impact shall be at the Contractors expense.

1.05 CONTRACTOR'S RESPONSIBILITIES

- A. In requesting substitution, the Contractor shall be comply with OUS General Conditions for Public Improvement Contracts, This includes but is not limited to the following:
1. Investigate proposed products and determine that they are equal or superior in all respects to products specified.
 2. Provide same guarantee for accepted substitutions as for products specified.
 3. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects and within original time constraints.
 4. Waive all claims for additional costs related to substitutions, which consequently become apparent.

PART 2 -PRODUCTS

2.01 PRODUCT OPTIONS

- A. Contractor's Options in selecting products is limited by the requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Where products or manufactures are specified by name or manufacturer, they shall be assumed accompanied by the term, "or approved equal". Comply with the Contract Document requirements for Substitutions and submittals to obtain review from Architect and Owner's Authorized Representative for use of substitute products.

PART 3 -EXECUTION

3.01 SUBSTITUTION REQUESTS DURING THE BIDDING PROCESS

- A. Substitution requests shall meet the following criteria for review by the Architect and Owner's Authorized Representative:
1. Submit five (5) copies of each request for substitution using the submittal process specified in Division 1, Section 01305, Item 3.01.
 2. Substitutions shall be requested using the Substitution Request Form provided herein.
 3. Itemized comparison of proposed substitution with product or method specified.
 4. Complete data on each material and system for this project only, substantiating compliance of proposed substitution with the Contract Documents.
 5. Complete evidence including test numbers and supporting reports indicating compliance with referenced standards.
 6. A statement from the Manufacturer(s) of the proposed substitution materials stating that any and all warranties required by the contract documents for the originally specified materials can and will be provided for the substitution materials, and that required warranties shall be issued upon successful completion of the Work.
- B. Substitutions shall be requested prior to the Deadline for Request for Change and Protests, and accepted by Addendum prior to the date and time bid materials are due at the PSU Office of Facilities.

3.02 SUBSTITUTION REQUESTS AFTER AWARD OF CONTRACT

- A. Substitutions will normally not be considered after date of Contract, except when required due to unforeseen circumstances. Within a period of thirty (30) days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein. Substitution requests shall meet the following criteria for review by the Architect and Owner's Authorized Representative:
 - 1. Submit five (5) copies of each request for substitution using the submittal process specified in Division 1, Section 01305, Item 3.01.
 - 2. Substitutions shall be requested using the Substitution Request Form provided herein.
- B. To receive consideration, one or more of the following conditions must be documented in any such request:
 - 1. The substitution is required for compliance with final interpretation of code requirements or insurance regulations.
 - 2. The substitution is required due to unavailability of a specified product, through no fault of the Contractor.
 - 3. The substitution is required because subsequent information disclosed the inability of the specified product to perform properly or to fit in the designated space.
 - 4. The substitution is required because it has become clearly evident, in the judgment of the Owner that a substitute would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.
- C. For products specified only by referenced standards, provide products by any Manufacturer meeting standards specified.
- D. For products specified by naming one or more products, provide any product named. If certain conditional requirements are stipulated, each product must comply with these requirements. Requests for approval of substitutions are subject to meeting requirements stipulated above.
- E. For products specified by naming a product to match existing products or systems, provide product of the same name. There is no option and no substitution is allowed.
- F. For each substitution that is accepted, the Contractor shall coordinate the work of all other trades and modify surrounding conditions as required to complete the work to the satisfaction of the Owners Authorized Representative at no additional cost to the Owner.

3.03 SUBSTITUTIONS NOT PERMITTED

- A. Submitted without first requesting approval thereof in accordance with requirements of this Section.
- B. Acceptance will require substantial revision of the Contract Documents, except as allowed by Paragraph 3.02 above.

3.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations,

using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and- other losses.
3. Deliver, handle and store products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss. Control delivery schedules to ensure timely delivery for incorporation into the Work, while minimizing long-term storage at the site and preventing overcrowding of the construction area.
4. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
5. Promptly inspect shipments to assure that products comply with requirements, quantities are correct and products are undamaged.
6. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

3.05 PRODUCT INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
- B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

**SECTION 01732
WASTE MANAGEMENT**

PART 1 -GENERAL

1.01 PROJECT GOALS

- A. The Owner requires that this project generate the least amount of waste and trash possible.
- B. This project has been designed to comply with SEED (State Energy Efficient Design) criteria. The Contractor, sub-contractors and suppliers shall work with the design team and Owner's Authorized Representative to achieve as sustainable of a project as possible from initial control of the site through final completion.

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional waste management requirements may be found in the following:
 - 1. OUS General Conditions
 - 2. Other Sections of these specifications.

1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid wasted and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.4 WASTE MANAGEMENT REQUIREMENTS

- A. The contractor shall familiarize himself with the relevant requirements, provide the necessary documentation and instruct all sub-contractors and suppliers regarding energy efficiency, air quality, demolition, recycling, waste management and final cleaning.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Methods of trash/waste disposal that are not acceptable are:
 1. Burning on the project site.
 2. Burying on the project site.
 3. Dumping or burying on other property, public or private.
 4. Other illegal dumping or burying.

- E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.
 - 1. The city of Portland requires all building projects with a permit value of \$50,000 or more to separate and recycle certain materials from the job site. The contractor shall be responsible for assuring recycling at the job site and for completing the pre-construction recycling plan form.

PART 2 -PRODUCTS

- 2.01 Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues. See Division 1 Section 01300 for submittal procedures.
- 2.02 Submit Waste Disposal Reports with each application for progress payment, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report. Failure to submit Report will delay payment. Prepare Waste Disposal Reports as follows:
 - A. Submit Report on a form acceptable to Owner.
 - B. Landfill Disposal: Include the following information:
 - 1. Identification of material.
 - 2. Amount, in tons or cubic yards, or trash/waste material from the project disposed of in landfills.
 - 3. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - 4. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - C. Incinerator Disposal: Include the following information:
 - 1. Identification of material.
 - 2. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - 3. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - 4. Included manifest, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - D. Recycled and Salvaged Materials: Include the following information for each:
 - 1. Identification of material, including those retrieved by installer for use on other projects.

2. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 3. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 4. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 5. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
- E. Material Reused on Project: Include the following information for each:
1. Identification of material and how it was used in the project.
 2. Amount, in tons or cubic yards.
 3. Include weight tickets as evidence of quantity.
- F. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 -EXECUTION

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Designate an on-site person or persons responsible for instructing workers and overseeing documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Architect, and Owner's Authorized Representative.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
1. Pre-bid meeting
 2. Pre-construction meeting
 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
1. Provide containers as required.
 2. Provide adequate space for pick-up and delivery and convenience to contractors.
 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

- F. Hazardous Materials: If, during the course of the Work, the Contractor observes or suspects the existence of Hazardous Materials in the structure or components within the defined scope of work area, the Contractor shall immediately stop Work in the immediate area and notify the Owner's Authorized Representative, who will, under separate contract, facilitate the remove of the hazardous material. The Contractor will be required to schedule ten (10) days of slack or "down" time for the removal of potential unforeseen materials. Any delay caused by asbestos abatement that lasts less than ten (10) days shall not constitute a delay as defined in Section D.2 of the OUS General Conditions for Public Improvement Contracts and shall not result in any additional compensation to the contractor. If removal of the material takes more than ten (10) days, the Contractor shall be entitled to an extension of the completion date for the Work equal to the number of days required for removal, plus reimbursement for Contractor's cost of the Work for only those days in excess of ten (10).
1. Hazardous Material abatement in the defined scope of work area was performed in January 2003. A copy of the Asbestos Abatement Inspection Report shall be provided to the contractor prior to beginning work and shall be maintained on the job site throughout the course of work.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

**SECTION 01734
INDOOR AIR QUALITY**

PART 1 -GENERAL

1.01 PROJECT GOALS

- A. The owner and building tenants will occupy adjacent areas of the premises during the entire period of construction. The Contractor shall maintain indoor air quality of occupied spaces throughout the construction period to permit normal operations and upon substantial completion provide premises and building systems that meet minimal indoor air quality standards as described herein.

- B. Dust and Airborne Particulates: Prevent dust and other particulates from entering HVAC ducts and equipment, and from migrating into occupied spaces.
 - 1. Cleaning of existing ductwork to remain is not contemplated under this contract. Verify the condition of existing ducts and equipment prior to starting work.
 - 2. The Contractor shall bear the cost of duct and equipment cleaning required due to failure to protect ducts and equipment from construction dust.
 - 3. The Contractor shall coordinate with the Owner's Authorized Representative and provide adequate barriers, taping, ventilation and filters to prevent dust, fumes, odors, vapors or other agents from impacting normal operations in adjacent occupied spaces. Failure to do so may result in suspension of Work at the Contractors expense.
 - 4. Procedures and products have been specified to minimize indoor air pollutants:
 - A) Furnish Products meeting or exceeding the specifications.
 - B) Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional information related to Indoor Air Quality management requirements, temporary facilities required and Owner's remedies for non-compliance may be found in the following:
 - 1. OUS General Conditions
 - 2. Other Sections of these specifications.

1.03 REFERENCES

- A. ASHRE 62 – Ventilation For Acceptable Indoor Air Quality; 1999 and Addenda.

- B. ASHRAE Std. 129 – Measuring Air-Change Effectiveness; 1997.

- C. Oregon Administrative Rules Sections; 437-002—0081, 437-002-0107, 437-002-0382.
- D. Oregon Administrative Rules Section 437-003-0027.

1.04 DEFINITIONS

- A. Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminates: Gases, vapors, smoke, airborne mold and mildew, and other regulated pollutants including but not limited to construction related noise.
- C. Particulates: Dust, dirt and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, adhesives and other products that emit water vapor or volatile organic compounds during the installation, drying, or curing processes.

PART 2 -PRODUCTS

NOT USED

PART 3 -EXECUTION

3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by absorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivering and storing such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying of wet work without impacting delivery schedules.
- B. Begin temporary construction heating and ventilation as soon as the work limits are substantially enclosed.
- C. If extremely dusty or dirty work must be performed, coordinate the temporary shut down of HVAC systems with the Owner's Authorized Representative. The Owner's Authorized Representative may require work by the Contractor outside of normal business hours (8:00 AM through 5:00 PM) if HVAC systems serving occupied areas are required to be shut down for extended periods.

- D. When working in a portion of an occupied building, provide barriers necessary to prevent movement of air from the construction area to occupied areas.
- E. HVAC equipment and ductwork SHALL NOT be used for ventilation during construction:
 - 1. Provide minimum temporary ventilation equivalent to 1.5 air changes per hour. Increase as required for wet work.
 - 2. Exhaust directly to outside. The Owner's Authorized Representative shall approve the Contractors exhaust venting plan including; equipment, routing and outlet prior to installation.
 - 3. Seal HVAC air inlets and outlets immediately after duct installations.
- F. Do not store construction materials or waste in mechanical rooms, electrical rooms or exit ways. Coordinate all materials storage with the Owner's Authorized Representative.
- G. Prior to use of return air ductworks without intake filters, remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grills, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduits.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms where work is performed, including the tops of pipes, ducts, conduits, equipment and supports.
 - 5. Clean return plenums of air handling units.
 - 6. Remove intake filters last, after all cleaning operations are complete.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. Use other relevant recommendations of SMACNA IAQ Guidelines for Occupied Buildings Under Construction to avoid unnecessary contaminants due to the construction process.
- J. Perform Air Contaminant Testing as specified herein.

3.02 AIR CONTAMINANT TESTING:

- A. Perform air contaminate testing before starting construction, as a baseline for evaluating post-occupancy test results, as specified herein.
- B. Perform air contaminate testing prior to submitting for substantial completion.
- C. Do not start air contaminant testing until:

1. All other construction operations are substantially complete.
 2. HVAC systems have been tested adjusted, and balanced for proper operation.
 3. New HVAC unit air filters have been installed.
- D. Collect the following indoor air samples from representative spaces of the work areas:
1. Collect samples while windows and exterior doors are closed, HVAC system is in normal operation and the building premises are unoccupied.
 2. Collect samples in each space served by the new air handling system.
 3. Collect air samples between a height of 48 inches and 72 inches above finished floor.
 4. Collect samples from same locations on three separate days and average the results of the three samples.
- E. Submit a report analyze the air samples and compare them against the pre-construction baseline (See Section 01300 for submittal procedure).
- F. Air Contamination Concentrations and Limits shall be as set forth in the Oregon Administrative Rules and as follows (the most restrictive shall apply):
1. Carbon Monoxide: Measure in ppm, in relation to outside air, at air intake; not more then outside air.
 2. Airborne Mold and Mildew: Measure in relation to outside air, at air intake, but in no case less then 48 inches above finish grade; not more then outside air.
 3. Formaldehyde: Measure in micrograms per cubic meter in relation to outside air, at air intake. Not more then 20 micrograms per cubic meter higher then outside air.
 4. Total Volatile Organic Compounds (TVOC): Measure in micrograms per cubic meter, in relation to outside air, at air intake. Not more than 200 micrograms per cubic meter higher than outside air.
 5. Total Particulate Matter: Measure in micrograms per cubic meter, in relation to air, at air intake, not more then 20 micrograms per cubic meter higher then outside air.

3.03 VENTILATION EFFECTIVENESS TESTING:

- A. Perform ventilation effectiveness testing prior to substantial completion.
- B. Do not begin ventilation effectiveness testing until:
1. HVAC systems have been tested adjusted, and balanced for proper operation.
 2. Air contamination testing has been completed satisfactorily.
 3. New HVAC unit air filter have been installed.

- C. Test each air handler zone in accordance with ASHRAE 129.
- D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust and retest at no additional cost to the Owner.

END OF SECTION

**SECTION 01780
CONTRACT CLOSEOUT**

PART 1 -GENERAL

1.01 DESCRIPTION:

- A. The requirements specified in this Section relate to all Contractors individually performing Work under these Contract Documents and include:
 - 1. Final Cleaning
 - 2. System Start-up, Testing & Adjusting
 - 3. Operations & Maintenance Manuals
 - 4. Warranties & Bonds
 - 5. Training
 - 6. Spare Parts & Extra Quantities
 - 7. Project Record Documents
 - 8. Final Review and Payment
- B. Project closeout is a term used to describe certain collective project requirements, indicating Work under this Contract that is fulfilled near the end of the Contract time in preparation for Final Completion, as well as Final Payment to the Contractor.
- C. Special requirements for individual units of work may be included in appropriate Specification Sections of this Project Manual.

1.02 RELATED WORK IN OTHER SECTIONS

- A. Additional Contract closeout requirements may be provided as follows:
 - 1. OUS General Conditions
 - 2. Supplementary General Conditions
 - 3. Section 01300, Submittals
 - 4. Other Sections of these Specifications

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 – EXECUTION

3.01 GENERAL DESCRIPTION:

- A. Substantial Completion shall be defined per OUS General Conditions for Public Improvement Contracts Section A.1, and Notification of Substantial Completion by the Contractor to the Owner shall be through the Owner’s Representative as specified in Section K.4 of the same and as supplemented by OUS Supplemental General Condition SG-6. See Division 1, Section 01300 for general Submittal Review Procedure.
- B. Submit Certificate of Substantial Completion with accompanying ‘punchlist’ and date for punchlist completion to the Owner’s Authorized Representative once the Contract Documents have been reviewed, Work has been inspected and all prerequisites to substantial competition have been addressed.

- C. Prior to signing the Certificate of Substantial Completion, the Owner's Authorized Representative will perform one Substantial Completion review of the Work. The Contractor shall pay the cost of additional Substantial Completion reviews of the Work.

3.02 FINAL CLEANING

- A. Perform final cleaning of all items of Work prior to Substantial Completion review of the Work. Employ professional cleaners for final cleaning. Clean each surface or unit of work to condition expected from normal commercial building cleaning and maintenance program. Comply with all manufacturer's recommendations. Complete the following prior to requesting Owner's Authorized Representative review of the Work for Substantial Completion certification:
 - 1. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
 - 2. Vacuum all carpeted, fabric and other soft surfaces.
 - 3. Clean all Contractor and Owner provided equipment and fixtures.
 - 4. Clean or replace all filters of operating equipment.
 - 5. Clean debris from roofs, gutters, downspouts and drainage systems impacted by the Work.
 - 6. Clean the Project Site and adjacent areas impacted by the Work, including landscaped and parking areas, or rubbish, litter and other foreign substances. Sweep paved areas to broom clean condition. Remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted to smooth, even-textured surface.
 - 7. Re-clean areas and equipment prior to inspection for Final Completion, if dirtied in completion of punchlist work.
- B. Unless otherwise directed by the Owner's Authorized Representative, remove temporary protective devices and facilities, which were installed during the course of the Work to protect previously completed work from the remainder of the construction to be completed, or to protect the public.
- C. Comply with all safety standards and governing regulations for cleaning and disposal of waste materials in accordance with Division 1, Section 01732 and the OUS General Conditions for Public Improvement Contracts.

3.03 SYSTEM START-UP, TESTING & ADJUSTING

- A. The project has been designed to comply with SEED (State Energy Efficient Design) criteria. Coordinate with the Owner's Authorized Representative the system start-up, testing, adjusting and balancing to comply with the Owner's Commissioning requirements.
- B. The Contractor shall coordinate the scheduling for the start-up and testing of various equipment and systems provided by the Contractor and Owner with the Owner's Authorized Representative.
- C. Notify the Owner's Authorized Representative a minimum of fourteen (14) calendar days prior to the start-up or testing of each item.
- D. The Contractor shall submit to the Owner's Authorized Representative for review and approval, a minimum of fourteen (14) calendar days prior to the start-up or testing, five (5) copies of the following:

1. A paragraph-by-paragraph program of the Contractor's proposed testing procedure, developed to demonstrate compliance with the contract documents.
 2. Check off sheets for the review of each item of equipment and system.
 3. Each program and check off sheet shall provide the following information:
 - 1) Project information required by Division 1, Section 01300, Item 1.05.
 - 2) Product information required by Division 1, Section 01300, Item 3.06.
 - 3) Other information as required the fully describe the item.
 - 4) Provide spaces for testing "Review" sign off by Owner's Authorized Representatives.
- E. Verify that each piece of equipment or system has been checked for proper connection of services, lubrication, drive rotation, belt tension, control sequencing or other conditions that could cause damage.
- F. Verify that tests, meter readings and specified electrical characteristics agree with those required by equipment or system manufacturers.
- G. Verify that wiring, piping and support components for equipment are complete and tested.
- H. Execute start-up under the supervision of the Owner's Authorized Representative(s), the responsible manufacturer's representative, Contractor's personnel in accordance with the manufacturer's recommendations.
- I. Submit five (5) copies of all Installation, Adjustment and Balancing and Testing Reports for each piece of equipment and system in accordance with the Submittal Review Procedures, specified in Division 1, Section 01300, Item 3.01.
- J. Operating equipment and systems shall be tested in the presence of the Owner's Authorized Representatives and demonstrate compliance with the Contract Documents and the manufacturer's recommendations:
 1. Testing shall be conducted under operating conditions as specified by the Owner's Authorized Representatives.
 2. Copies of all test reports shall be included in the Project Record Documents.
- K. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of the Contract Documents. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by interfaces with other major systems.
- L. The Contractor shall provide all materials and equipment required for equipment and system testing.
- M. The Contractor shall perform the following minimal tests and additional tests as required by the Owner's Authorized Representative:
 1. System shall be checked for proper installation, and shall be adjusted and calibrated to verify that it is ready to function as specified.
 2. All system elements shall be checked to verify that they have been properly installed and that all connections have been made correctly.

3. All discrete elements and sub-systems shall be adjusted and balanced and shall bechecked for proper operation.

3.04 OPERATIONS & MAINTENANCE MANUALS

- A. The Contractor shall provide Operations and Maintenance Manuals for review and project record documentation in accordance with OUS General Conditions for public Improvement Contract Section K.2, in accordance with the Submittal Review Procedures, specified in Division 1, Section 01300, Item 3.01.
- B. Include Operation and Maintenance instructions complete with technical information, required warranties & bonds and name, address and phone number of the Contractor(s) and Manufacturer(s) of each material and product. Bind in separate three-ring binders. Label similar to Project Documents binder with dividers by Specification section and supplier.

3.05 WARRANTIES & BONDS

- A. Provide all warranties and bonds specified in other Sections of this project manual.
- B. Include all required warranties and bonds in the Operations and Maintenance Manuals in accordance with Item 2.04 herein.
- C. List Subcontractor, supplier and manufacturer, with address and telephone number of responsible principles.
- D. Verify that documents are in proper form, contain all information, and are notarized as applicable.
- E. Co-execute documents as required.

3.06 TRAINING

- A. The Contractor shall coordinate with the Owner's Authorized Representative training sessions for all equipment and systems in accordance with OUS General Conditions for Public Improvement Contract Section K.5.

3.07 SPARE PARTS & EXTRA QUANTITIES

- A. The Contractor shall provide spare parts and extra quantities in accordance with OUS General Conditions for public Improvement Contract Section K.5.
- B. The Contractor shall submit in accordance with Division 1 Section 01300 Item 3.01, five (5) copies of the following:
 1. Check off sheets for the review of each item of material or product for which extra quantities are required.
 2. Each check off sheet shall provide the following information:
 - 1) Project information required by Division 1, Section 01300, Item 1.05.
 - 2) Product information required by Division 1, Section 01300, Item 3.06.
 - 3) Amount of extra parts or quantity required.
 - 4) Provide spaces for testing "Review" sign off by Owner's Authorized Representatives.

- C. Coordinate delivery to the Owner with the Owner's Authorized Representative and submit receipts of delivery corresponding to spare parts and extra quantities check off sheet.

3.08 PROJECT RECORD DOCUMENTS

- A. Submit three (3) copies of the Project Record Documents for review in accordance with Division 1 Section 01300 Item 3.01. The Project Record Documents shall be organized to include the following information:
 - 1. Title and date of Project, Owner's Project Number
 - 2. Table of Contents
 - 3. Specifications
 - 4. As-Built Drawings (blueprints or photocopies)
 - 5. Inspection Reports, as applicable
 - 6. Warranty(ies), as applicable
 - 7. Operations and Maintenance Instructions
 - 8. Approved and stamped Shop Drawings, Product Data and Samples (Provide 1 set of reproducible copies for Owner's file, in Microsoft Word or AutoCAD 2000 electronic formats, or on 3 MIL thick double sided and toothed Mylar.)
 - B. Bind each copy of the Project Record Documents in a black, hard cover, three-ring binder with each Section clearly indexed with tabbed divider pages.
 - C. The project team list shall include the address and phone number of the Owner, Contractor, inspectors, subcontractors, and the materials manufacturers.
 - D. Legibly mark each Specification Section to indicate actual as-built conditions. The as-built Specifications shall clearly indicate changes in the Work made by Addendum(a) and/or Change Order(s), actual materials used, and actual Manufacturer(s) used.
 - E. Legibly mark the drawings to indicate actual "as-built conditions." The drawings shall clearly indicate changes in the Work made by Addendum(a) and/or Change Order(s). The Owner shall to modify CAD documents into a "recorded as-built" base for Owner's usage, based on information provided by Contractor.
 - F. Include inspection reports and field reports, if applicable.
 - G. Include a copy of required Warranty(ies) clearly marked to identify the Owner's responsibilities under the terms of the Warranty(ies).
 - H. Make corrections to all Project Record Documents and resubmit as part of Final Completion Review.
- 3.09. The Contractor shall comply with all terms of OUS General Conditions for Public Improvement Contract Sections E.6 and I.1, unless otherwise amended herein, prior to filing Notice of Final Completion or requesting Final Payment.
- 3.10. The Contractor shall return all keys requested for access to buildings and work areas and obtain a deposit refund, as specified in Division 1, Section 01040, Item 1.09.

- 3.11. The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items and the anticipated filing of Final Completion. Notify far enough in advance of the completion date that the Work can be completed on schedule. Said Work shall be immediately corrected.
- 3.12. Submit to the Owner's Authorized Representative Lien Releases in accordance with OUS General Conditions for Public Improvement Contract Section K.8.
- 3.13. The Contractor shall provide the Owner with an unconditional Certificate of Occupancy from the local building officials, in accordance with OUS General Conditions for Public Improvement Contract Section K.8.
- 3.14. Notify the Owner or Owner's Authorized Representative in writing that all items are complete and ready for Final Completion review and that the Work product is fully usable.
- 3.15. Submit three (3) copies of all record documents for Final Completion review at this time.
- 3.16. The Owner's Authorized Representative will review all documents. The Owner's Authorized Representative will review all Work that has been certified as complete to the best knowledge of the Contractor. The Owner or Owner's Representative will also list all remaining incomplete punchlist Work and assign a probable value and time to complete such uncompleted Work.
- 3.17. The Owner's Authorized Representative will review the Work for conformance. Time is of the essence on this project. If the Work is found to be in nonconformance, the Owner's Representative will notify the Owner of the nonconforming items and probable value and time for completion. Nonconforming items will require retainage of monies to ensure that the Contractor will complete all Work within the time established by the Public Improvement Contract and as amended by executed Change Orders.
- 3.18. The Contractor shall make the required corrections to the Work expeditiously. Sufficient retainage monies will be held to pay for uncompleted Work, should the Contractor fail to perform. A letter will be addressed to the Contractor noting the project status and the monies available for a partial-final payment upon receipt of billing.
- 3.19. When Contract closeout procedures are completed and all Punchlist deficiencies have been corrected, final acceptance by the Owner will be documented. The Contractor will receive written notice of acceptance of the Work and notification that final payment may be billed and released. Note that final wage rate submittal and documentation of all BOLI fees are required prior to final payment.
- 3.20. The Contractor shall be responsible for all parking citations received in relation with the project from the City of Portland and the Portland State University office of Transportation and Parking. All citations must be paid prior to submission of notice of Final Completion and Request for final Payment.
- 3.21. All warranties shall commence and become effective in accordance with Section I of the OUS General Conditions for Public Improvement.

END OF SECTION

SECTION 01910
COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Commissioning description.
 2. Submittals.
 3. Commissioning services.
 4. Commissioning responsibilities.
 5. Commissioning meetings.
 6. Commissioning reports.
 7. Test equipment.
 8. Verification check and startup procedures.
 9. Functional performance test procedures.
 10. Function performance test methods.
 11. Deficiencies and test approvals.
 12. Demonstration.
- B. Related Sections:
1. Section 23 08 00 - Commissioning of HVAC: Mechanical systems commissioning requirements.

1.2 REFERENCES

- A. Associated Air Balance Council:
1. AABC - AABC Commissioning Guideline.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE Guideline 1 - The HVAC Commissioning Process.
- C. National Environmental Balancing Bureau:
1. NEBB - Procedural Standards for Building Systems Commissioning.

1.3 COMMISSIONING DESCRIPTION

- A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.

- B. Commissioning Intent:
 - 1. Verify equipment and systems are installed in accordance with manufacturer's instructions, industry accepted minimum standards, and Contract Documents.
 - 2. Verify equipment and systems receive adequate operational checkout by Contractor.
 - 3. Verify and document proper performance of equipment and systems.
 - 4. Verify complete operation and maintenance documentation is delivered to Owner.
 - 5. Verify Owner's operating personnel are adequately trained.

- C. Equipment and Systems to Be Commissioned: Refer to Section 23 08 00 and project drawing for equipment and system lists.

- D. Commissioning does not relieve Contractor of responsibility to provide finished and fully functioning Project.

- E. Commissioning Process Overview and General Order of Commissioning Tasks:
 - 1. Commissioning begins with initial commissioning meeting.
 - 2. Conduct progress commissioning meetings throughout construction, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. Equipment documentation is submitted to Commissioning Authority during normal submittals, with detailed start-up procedures.
 - 4. Commissioning Authority works with Contractor and equipment and system installers to develop startup plans and startup documentation formats, including verification checklists to be completed by installers, during verification check and startup process.
 - 5. In general, checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with verification checklists being completed before functional testing.
 - 6. Equipment and system installers execute and document verification checklists and perform verification check and startup. Commissioning Authority documents checklists and startup were completed according to approved plans.
 - 7. Commissioning Authority develops specific equipment and system functional performance test procedures. Contractor and equipment and system installers review procedures.
 - 8. Equipment and system installers execute procedures under direction of, and documented by Commissioning Authority.
 - 9. Items of non-compliance in material, installation or setup are corrected at Contractor's expense and system retested.
 - 10. Commissioning Authority reviews operation and maintenance documentation for completeness.
 - 11. Commissioning is completed before Substantial Completion.
 - 12. Commissioning Authority reviews, approves and coordinates training provided by equipment and system installers and verifies training was completed.
 - 13. Deferred testing is conducted, as specified.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Requirements for submittals.

1.5 COMMISSIONING SUBMITTALS

- A. Furnish one copy copies of Contract Documents including addenda, change orders, requests for interpretation, and meeting minutes to Commissioning Authority.
- B. Furnish one copy of submittals directly to Commissioning Authority for review and approval in accordance with procedures specified in Section 01300 - Submittals.
1. Make submittals for each piece of equipment or system indicated to be commissioned.
 2. Make submittals to Commissioning Authority concurrent with submittals to Architect/Engineer.
 3. Distribute one copy of approved submittals to Commissioning Authority.
- C. Furnish one copy of preliminary operation and maintenance data manuals to Commissioning Authority for each piece of equipment or system indicated to be commissioned.
1. Submit required manuals within 30 days after submittals for each piece of equipment or system required under Section 01300 – Submittals are approved.
- D. Make additional submittals requested by Commissioning Authority for each piece of equipment or system indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals. Include the following:
1. Manufacturer's printed detailed installation and start-up, operating, troubleshooting and maintenance procedures.
 2. Equipment performance curves.
 3. Factory test reports.
 4. Full sequence of operation and control diagrams.
 5. Proposed testing, adjusting, and balancing procedures.
 6. Complete warranty information, with Owner responsibilities to keep warranty in force identified.
 7. Lists of installation and checkout materials shipped with equipment.
 8. Manufacturer's field checkout forms to be used by factory or field technicians.
 9. Other documentation necessary for commissioning process.
- E. Furnish one copy of verification check and startup plan to Commissioning Authority for review and approval. Include the following as minimum:
1. Commissioning Authority's verification checklists with party responsible for each item indicated.
 2. Manufacturer's standard startup procedures copied from installation manuals.
 3. Manufacturer's standard field checkout sheets.
 4. Supplemental procedures and checklists prepared by equipment and system installers to accommodate Project conditions.
 5. Sensor and actuator calibration procedures.
 6. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block at end of plan.

- F. Submit written training plan to Commissioning Authority for review and approval prior to conducting training including the following:
 - 1. Equipment included in training session.
 - 2. Intended audience.
 - 3. Location of training.
 - 4. Objectives.
 - 5. Subjects covered.
 - 6. Duration of training on each subject.
 - 7. Instructor for each subject.
 - 8. Instructional methods to be used.
- G. Commissioning Authority will review and approve submittals for conformance to Contract Documents as related to commissioning process for primary purpose of aiding development of functional testing procedures and secondarily to verify compliance with equipment specifications.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout
- B. Operation and Maintenance Data: Submit operation and maintenance manuals as specified in individual equipment and system specifications.
 - 1. Submittals made to Commissioning Authority do not constitute compliance with operation and maintenance manual documentation.
- C. Commissioning Record: Commissioning Authority will submit one copy of commissioning record for inclusion in operation and maintenance manuals. Furnish records in following format, arranged by system, with each part separated by tabbed flyleaves:
 - 1. Commissioning Plan.
 - 2. Final Commissioning Report.
 - 3. System 1: Provide the following separated by tabbed flyleaves:
 - a. Design narrative and criteria, sequences, approvals.
 - b. Startup plan and report, approvals, corrections, and blank verification checklists. Separate data for each equipment type with colored separators.
 - c. Completed, functional tests, trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms, and recommended recommissioning schedule.
 - 4. System 2: As specified for System 1.
- D. Final Commissioning Report: Commissioning Authority will submit one copy of final commissioning report including the following:
 - 1. Executive summary with list and roles of participants, brief Project description, overview of commissioning and testing scope, and general description of testing and verification methods.

2. For Each Piece of Commissioned Equipment: Include statement regarding compliance with Contract Documents in the following areas:
 - a. Equipment specifications.
 - b. Equipment installation.
 - c. Functional performance and efficiency.
 - d. Equipment documentation and design intent.
 - e. Operator training.
3. Include recommendations for improvement to equipment or operations, future actions, and commissioning process changes.
4. List outstanding deficiencies referenced to specific functional test, inspection, trend log, or other record where deficiency is documented.
5. Include brief description of verification method used, observations and conclusions from testing for each commissioned piece of equipment and system.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC.

1.8 COMMISSIONING SERVICES

- A. Owner will employ and pay for specified services of an independent firm as Commissioning Authority.**

1.9 COMMISSIONING RESPONSIBILITIES

- A. Responsibilities indicated for Owner, Architect/Engineer, and Commissioning Authority are provided only to clarify commissioning process.
- B. Architect/Engineer Responsibilities:
 1. Perform site observation of each system just before system startup.
 2. Furnish design narratives and sequences documentation requested by Commissioning Authority.
 3. Clarify operation and control of commissioned equipment when specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
 4. Coordinate resolution of design issues affecting system performance identified during commissioning.
 5. Coordinate resolution of system deficiencies identified during commissioning, according to Contract Documents.
 6. Prepare and submit final design intent documentation, reflecting installed conditions, for inclusion in operation and maintenance manuals.
 7. Review and approve operation and maintenance manuals.
 8. Make presentation at one training session for Owner's personnel.
 9. Witness tests for the following equipment and systems:
 - a. Chilled water system
 - b. Boiler economizer system
 - c. Condenser water/reinjection system

- C. Commissioning Authority Responsibilities:
1. Basic Responsibilities:
 - a. Coordinate, direct, and approve commissioning work.
 - b. Develop and coordinate execution of commissioning plan. Revise commissioning plan to suit Project conditions.
 - c. Schedule commissioning work with Contractor for inclusion in Project schedule.
 - d. Plan and conduct commissioning meetings.
 - e. Request and review commissioning submittals required to perform commissioning tasks.
 - f. Write and distribute verification tests and checklists.
 - g. Develop verification check and startup plan in cooperation with Contractor and equipment and system installers.
 - h. Write functional performance test procedures in cooperation with Contractor and equipment and system installers.
 - i. Review test and balance execution plan.
 - j. Attend selected Project progress and preinstallation meetings. Review meeting minutes. Resolve potential conflicts with commissioning activities.
 - k. Observe equipment and system installations.
 - l. Document equipment and systems are installed and perform in accordance with design intent and Contract Documents.
 - m. Notify Owner of deficiencies.
 - n. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
 - o. Oversee and approve content and adequacy of Owner's personnel training.
 - p. Review and approve operation and maintenance manuals.
 - q. Compile commissioning record and testing data manual.
 - r. Provide final commissioning report.
 2. Commissioning Authority may not:
 - a. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - b. Approve or accept any portion of the Work.
 - c. Assume duties of Contractor or Architect/Engineer.
 - d. Stop the Work.
- D. Owner Responsibilities:
1. Arrange for Owner's personnel to attend commissioning activities and training sessions according to commissioning plan.
 2. Approve commissioning work completion.
 3. Ensure seasonal or deferred testing and deficiency issues are addressed.

- E. Contractor Responsibilities:
1. Include requirements for commissioning submittal data, operation and maintenance data, commissioning tasks and training in each purchase order and subcontract for equipment and systems indicated to be commissioned.
 2. Facilitate coordination of commissioning work by Commissioning Authority.
 3. Attend commissioning meetings.
 4. Cooperate with Commissioning Authority, and provide access to the Work and to manufacturers' facilities.
 5. Require equipment and system installers to execute test to review and provide comments on functional test procedures.
 6. Require manufacturers to review commissioning test procedures for equipment installed by manufacturer.
 7. Furnish proprietary test equipment required by manufacturers to complete equipment and system tests.
 8. Provide temporary facilities as specified in Section 01500 - Temporary Facilities and Controls for Commissioning Authority's exclusive use for documentation and instrument storage and preparation of reports.
 9. Furnish qualified personnel to assist in completing commissioning.
 10. Furnish manufacturer's qualified field representatives as specified in Section 01400 - Quality Requirements and individual specification sections to assist in completing commissioning.
 11. Ensure equipment and system installers execute commissioning responsibilities according to Contract Documents and schedule.
 12. Coordinate Owner's personnel training.
 13. Prepare operation and maintenance manuals specified in Section 01780 – Contract Closeout. Update original sequences of operation reflecting actual installation.
 14. Ensure equipment and system installers execute seasonal and deferred functional performance testing, witnessed by Commissioning Authority.
 15. Ensure equipment and system installers correct deficiencies and make necessary adjustments to operation and maintenance manuals and Record Documents for issues identified in seasonal testing.

1.10 COMMISSIONING MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Commissioning Authority will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Initial Commissioning Meeting:
1. Commissioning Authority will schedule meeting within 60 days after Notice of Award.
 2. Attendance Required: Commissioning Authority, Owner, Owner's facility operating personnel, Architect/Engineer, Contractor, subcontractors, test, adjust and balance agency. Require attendance by installers of the following equipment and systems indicated to be commissioned including:
 - a. Mechanical equipment and systems.
 - b. Controls equipment and systems.

3. Agenda:
 - a. Designation of personnel representing parties for commissioning activities.
 - b. Review commissioning process and responsibilities.
 - c. Review commissioning plan development procedures.
 - d. Review required commissioning submittals.
 - e. Present initial commissioning schedule.
- D. Progress Commissioning Meetings:
 1. Commissioning Authority will schedule meetings throughout progress of the Work at maximum monthly intervals.
 - a. Beginning 3 months before Substantial Completion, meetings will be scheduled at maximum monthly intervals.
 2. Attendance Required: As specified for initial commissioning meeting.
 3. Agenda:
 - a. Coordination of commissioning activities.
 - b. Commissioning deficiency resolution.
 - c. Commissioning schedule.
 - d. Planning for future commissioning activities.
- E. Commissioning Authority will record meeting minutes and distribute copies within two days after meeting to participants and those affected by decisions made.

1.11 COMMISSIONING REPORTS

- A. Commissioning Authority Reports: Submit reports regularly to Owner, Architect/Engineer, and Contractor. Include the following.
 1. Progress reports.
 2. Scheduling changes.
 3. Observation reports of specific commissioning activities.
 4. Testing progress and approvals.
 5. Deficiency and deficiency resolution reports.
- B. Commissioning Authority Functional Performance Test Procedures: Develop test procedures including forms with following information. Include completed documentation in operation and maintenance manuals.
 1. System and equipment or component names.
 2. Equipment location and identification number.
 3. Unique test identification number, and reference to unique verification checklist and startup documentation identification numbers for piece of equipment.
 4. Date.
 5. Project name.
 6. Participating parties.
 7. Copy of specification section describing test requirements.
 8. Copy of specific sequence of operations or other specified parameters being verified.
 9. Formulas used in calculations.
 10. Required pre-test field measurements.

11. Instructions for setting up test.
12. Special cautions, alarm limits, and safety concerns.
13. Specific step-by-step procedures to execute test, in clear, sequential and repeatable format.
14. Acceptance criteria of proper performance with Yes / No check box to allow for marking whether or not proper performance of each part of test was achieved.
15. Section for comments.
16. Signatures and date block for Commissioning Authority.

1.12 SEQUENCING

- A. Section 01010 – Summary of Work.
- B. Sequence work to complete commissioning, except for functional testing and Owner's personnel training, before Substantial Completion.
- C. Sequence work to achieve Functional Completion before Final Completion. Complete the following for each piece of equipment and system indicated to be commissioned to achieve Functional Completion:
 1. Complete and sign startup and verification checklist documentation.
 2. Submit trend log data.
 3. Submit final approved test and balance report.
 4. Complete functional testing.
 5. Complete training of Owner personnel.
 6. Submit approved operation and maintenance data manuals.
 7. Correct identified deficiencies or obtain approval by Owner to exclude deficiencies from Functional Completion.
- D. For equipment or systems requiring seasonal operation, perform commissioning for other season within six months of Substantial Completion.
- E. For equipment or systems where commissioning is delayed by Owner occupancy requirements or other unforeseen conditions, perform commissioning as specified for seasonal operation equipment.

1.13 SCHEDULING

- A. Section 01040 – Project Coordination.
- B. Schedule work to allow adequate time for commissioning activities.
- C. Identify commissioning milestones, activities, and durations on Project schedule.
 1. Identify the following for each piece of equipment and system including:
 - a. Operation and maintenance manual submittal.
 - b. Verification check and startup.
 - c. Functional performance test.
 - d. Functional completion.
 - e. Demonstration and training sessions.
 - f. Commissioning completion.

1.14 MAINTENANCE MATERIALS

- A. Section 01780 – Contract Closeout: Requirements for maintenance materials.
- B. Furnish one set of manufacturer's proprietary test equipment, tools, and instruments required to complete commissioning.
 - 1. Deliver test equipment to Owner after completion of functional performance test. Obtain signed receipt.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Testing Equipment: Calibrated within last year; of sufficient quality and accuracy to test and measure system performance within the following tolerances unless otherwise specified for individual equipment or systems.
 - 1. Temperature Sensors and Digital Thermometers: 0.5 degrees F accuracy and plus or minus 0.1 degrees F resolution.
 - 2. Pressure Sensors: Accuracy of plus or minus 2.0 percent of measured value range.
- B. Recalibrate test equipment according to manufacturer's recommended intervals and when dropped or damaged.
 - 1. Affix calibration tags to test equipment or furnish certificates upon request.
- C. Equipment Furnished by Contractor and Remaining Property of Contractor:
 - 1. Standard testing equipment required to perform verification check and startup and required functional performance testing.
 - 2. Two way radios for personnel performing commissioning.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify equipment and systems are installed in accordance with individual specification sections.
- C. Verify utility and power connections are complete and services operational.

3.2 VERIFICATION CHECK AND STARTUP PROCEDURES

- A. Notify Commissioning Authority and schedule verification check and startup activities with each party required to complete verification check and startup minimum 4 weeks in advance.

- B. Allow Commissioning Authority to witness verification check and startup.
 - 1. Primary Equipment: Commissioning Authority will witness procedures for each piece of equipment.
 - 2. Secondary Equipment: Commissioning Authority will witness sampling of each type unit as specified in Commissioning Plan.

- C. Verification Check and Startup:
 - 1. Perform verification check and startup in accordance with approved verification check and startup plan.
 - 2. Complete entire plan for each piece of equipment or system indicated to be commissioned.
 - 3. Complete each procedure in sequence performed by party assigned to each procedure.
 - 4. Record completion of each procedure. Indicate results of procedure where required. Sign and date plan by individual performing procedure.
 - 5. Identify items not completed successfully.
 - 6. Sign and date plan indicating completion of entire plan.
 - 7. Submit executed plan to Commissioning Authority within 7 days of completion.

- D. Deficiencies and Approvals:
 - 1. Commissioning Authority will review verification check and startup reports and issue deficiency report or approval.
 - 2. Correct deficiencies and resubmit updated verification check and startup report with statement indicating corrections made for Commissioning Authority approval.
 - 3. Repeat process until verification check and startup report is approved.
 - 4. Costs for incomplete verification check and startup items that later cause deficiencies or delays during functional tests may will be charged to party responsible for incomplete item.

3.3 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Complete the following before performing functional tests:
 - 1. Verification check and startup.
 - 2. Control system testing with approval by Commissioning Authority for use for test and balance operations.
 - 3. Air system balancing and water system balancing.

- B. Notify Commissioning Authority of completion of verification check and startup activities.

- C. Commissioning Authority will direct, witness, and document results of functional performance tests.

- D. Conduct functional performance tests as specified in Section 23 08 00.

- E. Demonstrate each piece of equipment and system is operating according to documented design intent and Contract Documents.
 - 1. Conduct testing proceeding from components to subsystems, to systems.
 - 2. Bring equipment and systems to condition capable full dynamic operation.
 - 3. Verify performance of individual components and systems.
 - 4. Verify performance of interactions between systems.
 - 5. Identify and correct areas of deficient performance.
- F. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warm up, cool down, partial load and full load conditions.
 - 1. Verify each sequence in sequences of operation.
 - 2. Test for proper responses to power failure, freezing, overheating, low oil pressure, no flow, equipment failure, and other abnormal conditions.

3.4 FUNCTIONAL PERFORMANCE TEST METHODS

- A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by stand-alone data loggers as specified for each piece of equipment or system.
 - 1. Commissioning Authority may require alternate or additional method, other than specified method.
 - 2. Commissioning Authority will determine test method when method is not specified.
- B. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.
- C. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.
- D. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers automatic temperature controls is generally recommended over using sensors as signal generators with simulated conditions or overwritten values.
- E. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.
- F. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.

- G. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
 - 1. Provide materials, system modifications, and other things necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
 - 2. At completion of test, return modified equipment and systems to pretest condition.

3.5 DEFICIENCIES AND TEST APPROVALS

- A. Deficiencies:
 - 1. Commissioning Authority will record and report deficiencies to Owner.
 - 2. Minor deficiencies may be corrected during tests at Commissioning Authority's discretion. Deficiency and resolution will be documented on procedure form.
 - 3. Failure to attend scheduled verification check, startup, or functional performance test will be considered deficiency.
 - 4. When deficiency is identified, Commissioning Authority will discuss issue with party executing test.
 - a. When party executing test accepts responsibility to correct deficiency:
 - 1) Commissioning Authority documents deficiency and executing party's response.
 - 2) Commissioning Authority submits deficiency report to Owner, Contractor, and party executing test.
 - 3) Party executing test corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready retesting and submits form to Commissioning Authority.
 - 4) Commissioning Authority reschedules test and test is repeated until satisfactory performance is achieved.
 - b. When party executing test disputes deficiency or responsibility for deficiency:
 - 1) Commissioning Authority documents deficiency and executing party's response.
 - 2) Commissioning Authority submits deficiency report to Owner, Contractor, and party executing test and party believed to be responsible for deficiency.
 - 3) Commissioning Authority negotiates resolution with parties involved and refers continuing disputes to Architect/Engineer for resolution in accordance with Contract Documents.
 - 4) Commissioning Authority documents resolution process.
 - 5) When resolution is decided, appropriate party corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting and submits form to Commissioning Authority.
 - 6) Commissioning Authority reschedules test and test is repeated until satisfactory performance is achieved.

- B. Retesting Costs:
 - 1. When verification check and startup or functional performance test deficiency is discovered requiring rescheduling or retesting:
 - a. Owner will compensate Commissioning Authority, and Architect/Engineer, for attending and directing additional testing.
 - b. Owner will deduct additional testing compensation from final payment due to Contractor.
- C. Provide written report to Commissioning Authority before each scheduled commissioning meeting concerning status of each deficiency. Include explanations of disagreements with resolution proposals for each discrepancy.
 - 1. Commissioning Authority will retain original deficiency forms until end of Project.
- D. Manufacturing Defects: When identical pieces of equipment or equipment with only small size or capacity differences fail to perform to Contract Document requirements due to manufacturing defect, all identical units may be considered defective by Owner.
 - 1. Within one week of notice from Owner, examine all other identical units and record findings. Submit findings to Owner within two weeks of original notice.
 - 2. Within two weeks of original notification, provide signed and dated, written explanation of problem, cause of defect, and proposed solutions meeting Contract Document requirements. Include equipment submittals supporting solution.
 - 3. Owner will determine whether replacement or repair of all identical units is required.
 - 4. Install two examples of proposed solution. Owner will test installations for up to one week, before deciding solution is acceptable.
 - 5. Upon acceptance, replace or repair all identical items, at Contractor's expense. Extend warranty accordingly, when original equipment warranty had begun.
 - 6. Complete repairs or replacements with reasonable speed beginning within one week from when parts can be obtained.
- E. Test Approval: Commissioning Authority notes each satisfactorily demonstrated function on functional performance test form.
 - 1. Commissioning Authority recommends acceptance of each test to Owner using standard form.
 - 2. Owner gives final approval for each test using same form, providing signed copy to Commissioning Authority and Contractor.

3.6 DEMONSTRATION

- A. Section 01780 – Contract Closeout: Requirements for demonstration and training.
- B. Demonstrate equipment and systems and train Owner's personnel as specified in individual equipment and system specifications.
 - 1. Commissioning Authority will interview Owner's personnel to determine special needs and areas where training will be most valuable.
 - 2. Owner and Commissioning Authority will determine type and extent of training for each commissioned piece of equipment and system.

3. Commissioning Authority will communicate training requirements to Contractor for benefit of equipment and system installers and manufacturers with training responsibilities.
- C. Commissioning Authority will develop criteria for determining training was satisfactorily completed, including attending some training sessions.
1. Commissioning Authority will make recommendation to Owner regarding approval of training.
- D. Initial Equipment Training Session:
1. Engineer will make a presentation of overall system design concept and design concept of each equipment section.
 2. Presentation will include review of the following systems using simplified system schematics:
 - a. Chilled water system.
 - b. Well/condenser water reinjection system.
 - c. Boiler economizer system.
 - d. Fuel gas seismic valves system.
 - e. Instrumentation and controls system for chilled water and steam
- E. For primary controls equipment training:
1. Require controls contractor to provide short discussion of equipment control as part of training session.
- F. At one training session, Commissioning Authority will make a presentation discussing use of blank functional test forms for re-commissioning equipment.

END OF SECTION

SECTION 02 41 23

MECHANICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated equipment, piping and insulation.
 - 2. Cutting and alterations for completion of the Work.
 - 3. Removing designated items.
 - 4. Protecting items designated to remain.
 - 5. Removing demolished materials.

1.2 SUBMITTALS

- A. Section 01300 - Submittal: Requirements for submittals.
- B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.
- C. Shop Drawings:
 - 1. Indicate demolition and removal sequence.
 - 2. Indicate location of items designated for reuse and Owner's retention.
 - 3. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01780 - Contract Closeout: Closeout Procedures.
- B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, subsurface obstructions, etc.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

- A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Perform Work in accordance with State standard.

- E. Maintain one copy of each document on site.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.6 SEQUENCING

- A. Section 01040 – Project Coordination
- B. Sequence activities to avoid extended shutdowns of building systems.
- C. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.

1.7 SCHEDULING

- A. Section 01040 – Project Coordination: Work Schedules
- B. Schedule Work to coincide with new construction.
- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation.
- D. Perform noisy, malodorous, dusty, or other work:
 - 1. During times approved by the Owner – Submit a schedule for approval.
- E. Coordinate utility and building service interruptions with Owner.
 - 1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.
 - 2. Schedule tie-ins to existing systems to minimize disruption.
 - 3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.8 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Mark location and termination of utilities.
- C. Erect, and maintain temporary barriers and security devices at locations indicated, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.
- D. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.
- E. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
- F. Provide appropriate temporary signage including signage for exit or building egress.
- G. Do not close or obstruct building egress path.
- H. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

3.2 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Maintain protected egress from and access to adjacent existing buildings at all times.
- C. Do not close or obstruct roadways sidewalks without permits.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.
- E. Disconnect and remove designated utilities within demolition areas.
- F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

- G. Demolish in orderly and careful manner. Protect existing improvements, supporting structural members and piping and insulation.
- H. Carefully remove building components indicated to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled.
- I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- K. Remove temporary Work.

3.3 SCHEDULES

- A. Protect the materials and equipment remaining.
- B. Demolish the following materials and equipment:
 - 1. Piping and associated specialties and supports.
 - 2. Chiller.
 - 3. Insulation.
 - 4. Heat exchanger.

END OF SECTION

SECTION 02 41 26

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain as scheduled at end of section as indicated on Drawings.
 - 7. Relocate existing equipment to accommodate construction.

1.2 SUBMITTALS

- A. Section 01300 - Submittals: Requirements for submittals.
- B. Shop Drawings: Indicate demolition location and construction of temporary work. Describe demolition removal procedures and schedule.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Municipality of Portland, OR standard.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.

1.6 SEQUENCING

- A. Section 01010 – Summary of Work

1.7 SCHEDULING

- A. Section 01040 – Project Coordination: Construction Coordination
- B. Perform noisy, malodorous, dusty, or work:
 - 1. During times approved by the Owner – Submit schedule for approval.
- C. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.8 COORDINATION

- A. Section 01040 Project Coordination: Construction Coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- D. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by.
 - 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.
- E. Identify salvage items in cooperation with Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 - Project Coordination: Construction Coordination.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation. Remove conduit and wire from demolished equipment back to panelboard or MCC source.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Reconnect equipment being disturbed by renovation work and required for continue service to or nearest available panel.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain or to be reinstalled.
- M. Protect and retain power to existing active equipment remaining.
- N. Cap abandoned empty conduit at both ends.

3.4 EXISTING PANELBOARDS, SWITCHBOARDS, OR MOTOR CONTROL CENTERS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where more than three circuits have been modified or rewired.

3.5 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.6 CLEANING

- A. Section 01780 – Contract Closeout: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 05 50 00 - Metal Fabrications.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
 - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- E. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Requirements for submittals.
- B. Shop Drawings: Signed and sealed by professional engineer.
 - 1. Submit formwork, shoring, and reshoring shop drawings.
 - 2. Indicate the following:
 - a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Means of leakage prevention for concrete exposed to view in finished construction.
 - c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
 - d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
 - e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
 - f. Procedure and schedule for removal of shores and installation and removal of reshores.
- C. Product Data: Submit data on void form materials and installation requirements.
- D. Design Data: Signed and sealed by professional engineer.
 - 1. Indicate design data for formwork shoring.
 - 2. Indicate loads transferred to structure during process of concreting, shoring and reshoring.
 - 3. Include structural calculations to support design.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347, ACI 301, ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.
- C. Perform Work in accordance with State of Oregon standards.
- D. Maintain one copy copies of each document on site.

1.6 QUALIFICATIONS

- A. Design formwork under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Oregon.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section: Products storage and handling requirements.
- B. Deliver void forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.8 COORDINATION

- A. Section: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.
- B. Softwood Plywood: APA/EWA PS 1, C Plugged Grade, Group 3.
- C. Lumber Forms:
 - 1. Application: Use for edge forms and unexposed finish concrete.
 - 2. Boards: 6 inches or 8 inches in width, shiplapped or tongue and groove, "Standard" Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.
- D. Plywood Forms:
 - 1. Application: Use for exposed finish concrete.
 - 2. Forms: Conform to PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
 - 3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8 inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.
 - 4. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4 inch thick.

2.2 PREFABRICATED FORMS

- A. Furnish materials in accordance with State of Oregon standards.

2.3 FORMWORK ACCESSORIES

- A. Form Ties: Removable Snap-off type, galvanized metal, fixed adjustable length, cone type, with waterproofing washer, inch back break dimension, free of defects capable of leaving holes larger than 1-1/4 inch in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
 - 1. Manufacturers:
 - a. Arcal Chemical Corporation Arcal-80.
 - b. Industrial Synthetics Company Synthex.
 - c. Nox-Crete Company Nox-Crete Form Coating.
- E. Corners: Chamfer, rigid plastic, or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.
- F. Vapor Retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.
- G. Bituminous Joint Filler: ASTM D1751.
- H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- I. Water Stops: Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on Drawings.
 - 2. Trim sides and bottom of earth forms.
 - 3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
 - 4. Form sides of footings where earth sloughs.
 - 5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.
- B. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
 - 1. Use steel, plywood or lined board forms.
 - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full size sheets of form lines and plywood wherever possible.
 - 5. Tape joints to prevent protrusions in concrete.
 - 6. Use care in forming and stripping wood forms to protect corners and edges.
 - 7. Level and continue horizontal joints.
 - 8. Keep wood forms wet until stripped.

- D. Architectural Form Liners:
 - 1. Erect architectural side of formwork first.
 - 2. Attach form liner to forms before installing form ties.
 - 3. Install form liners, square with joints and pattern aligned.
 - 4. Seal form liner joints to prevent grout leaks.
 - 5. Dress joints and edges to match form liner pattern and texture.
- E. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.
- F. Framing, Studding and Bracing:
 - 1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
 - 2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Construct beam soffits of material minimum of 2 inches thick.
 - 4. Distribute bracing loads over base area on which bracing is erected.
 - 5. When placed on ground, protect against undermining, settlement or accidental impact.
- G. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301, ACI 318.
- H. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- I. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.
- J. Install chamfer strips on external corners of columns.
- K. Install void forms in accordance with manufacturer's recommendations.
- L. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Position recessed reglets for brick veneer masonry anchors in accordance with spacing and intervals indicated on Drawings.
- E. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- I. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1 inch away from finished surface of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- K. Construction Joints:
 - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 - 4. Arrange joints in continuous line straight, true and sharp.

- L. Embedded Items:
 - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 - 2. Do not embed wood or uncoated aluminum in concrete.
 - 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 - 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 - 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

- M. Openings for Items Passing Through Concrete:
 - 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 - 2. Coordinate work to avoid cutting and patching of concrete after placement.
 - 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

- N. Screeds:
 - 1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 - 2. Slope slabs to drain where required or as shown on Drawings.
 - 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

- O. Screenshot Supports:
 - 1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
 - 2. Staking through membrane is not permitted.

- P. Cleanouts and Access Panels:
 - 1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 - 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301, ACI 318.

3.8 FIELD QUALITY CONTROL

- A. Section: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars.
 - 2. Welded wire fabric.
 - 3. Reinforcement accessories.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI SP-66 - ACI Detailing Manual.
- B. ASTM International:
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - 3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 4. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 6. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - 7. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 - 8. ASTM D3963 - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.
- C. American Welding Society:
 - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
 - 1. CRSI - Manual of Standard Practice.
 - 2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

- A. Section: Submittal procedures.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - 1. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.
- C. Perform Work in accordance with Municipality of Portland Public Work's standards.
- D. Maintain one copy.

1.5 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

- A. Section: Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Deformed and Plain Reinforcement: ASTM A615; 60 ksi yield strength, steel bars, unfinished, galvanized finish, epoxy coated finish.
- B. Deformed Bar Mats: ASTM A184; fabricated from ASTM A615.
- C. Plain Wire: ASTM A82; unfinished.
- D. Welded Plain Wire Fabric: ASTM A185.

2.2 ACCESSORY MATERIALS

- A. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.
- B. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice, ACI 318.
- B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form spiral column reinforcement from minimum 3/8 inch diameter continuous plain bar or wire.
- F. Form ties and stirrups from the following:
 - 1. For bars No. 10 and Smaller: No. 3 deformed bars.
 - 2. For bars No. 11 and Larger: No. 4 deformed bars.
- G. Weld reinforcement in accordance with AWS D1.4.
- H. Galvanized Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.
- I. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

2.4 SHOP FINISHING

- A. Galvanized Finish for Steel Bars: ASTM A767, Class I, hot dip galvanized after fabrication.
- B. Epoxy Coated Finish for Steel Bars: ASTM A775.
- C. Epoxy Coated Finish for Steel Wire: Class A using ASTM A775.

2.5 SOURCE QUALITY CONTROL

- A. Section 01400: Testing, inspection and analysis requirements.

- B. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify Architect/Engineer at least seven days before inspection is allowed.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
 - 1. Do not weld crossing reinforcement bars for assembly except as permitted by Architect/Engineer.
- B. Do not displace or damage vapor retarder.
- C. Accommodate placement of formed openings.
- D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318 of one bar diameter, but not less than 1 inch.
 - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- E. Maintain concrete cover around reinforcement in accordance with ACI 318:

Footings and Concrete Formed Against Earth		3 inches
Concrete exposed to earth or weather	No. 6 bars and larger	2 inches
	No. 5 bars and smaller	1-1/2 inches
Supported Slabs, Walls, and Joists	No. 14 bars and larger	1-1/2 inches
	No. 11 bars and smaller	3/4 inches
Beams and Columns		1-1/2 inches
Shell and Folded Plate Members	No. 6 bars and larger	3/4 inches
	No. 5 bars and smaller	1/2 inches

- F. Splice reinforcing where indicated on Drawings in accordance with splicing device manufacturer's instructions.

3.2 ERECTION TOLERANCES

- A. Section 01400: Quality Requirements: Tolerance.
- B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

- C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

3.3 FIELD QUALITY CONTROL

- A. Section 01400: Quality Requirements: Testing & Inspection.
- B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Reinforcement Inspection:
 - 1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
 - 2. Welding: Inspect welds in accordance with AWS D1.1.
 - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
 - 4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
 - 5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
 - 6. Periodic Weld Inspection: Other welded connections.

3.4 SCHEDULES

- A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.
- B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and wire fabric, galvanized finish.

END OF SECTION

SECTION 03 21 00
FIBER REINFORCED POLYMER STRENGTHENING SYSTEM

PART 1 GENERAL

- 1.1 This specification is intended for use in defining the requirements of reinforced concrete strengthening using fiber reinforced polymer systems.
- 1.2 The contractor or sub-contractor shall furnish all submittals, materials, tools, equipment, transportation, necessary storage, labor, and supervision required for the application of the composite system.
- 1.3 REFERENCES
- A. General
1. The publications listed below form a part of this specification to the extent referenced.
 2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.
- B. American Standard for Testing and Materials (ASTM)
1. ASTM D3039 (1995a), Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials.
- C. International Code Council (ICC)
1. ICC AC125 (2003), Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems.
 2. ICC AC178 (2001), Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber Reinforced Polymer Composite Systems.
- D. American Concrete Institute (ACI)
1. ACI 440.2R-02, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.
- 1.4 SUBMITTALS
- A. The following items must be submitted by the contractor or sub-contractor for the proposed composite system:
1. An approved ICC Evaluation Report in the name of the proposed system and the system's manufacturer. Evaluation report must cover the type of strengthening proposed on the project.
 2. Provide fire resistance rated assembly (if required) as per ASTM E84 and ASTM E119.

3. A material list of items proposed to be provided under this section, including MSDS for each material component.
4. Manufacturer's product data for both the proposed fiber and epoxy to be supplied, specifications, and recommended application procedures showing compliance with the specified requirements. Specifications shall include procedures to properly mix the individual components of the proposed product as well as the proper mix ratios.
5. Certification from the manufacturer of the system's material properties including previously completed ASTM D3039 test results of the proposed system.
6. Complete shop drawings containing details of the number and thickness of layers, joint and end details and locations to satisfy project requirements.
7. Design calculations for the composite system submitted for approval by the engineer of record, shall be stamped by a registered civil engineer. (See Section 1.05 below.)
8. Applicator project references from at least twenty five (25) previously completed projects using the proposed FRP system in the last two-years.
9. Supply the names of at least four individuals who have been certified and trained by the FRP system manufacturer and who will be on site during all phases of the project.
10. Written certification from the composite system manufacturer showing the names of at least three trained personnel who will be on the jobsite during all phases of the installation (see Section 3.01 of this specification).
11. A list of at least two different qualified testing laboratories who can perform the required ASTM D3039 tests as per section 3.07 of this specification.

1.5 PERFORMANCE

- A. Design the composite system, ICC ES AC 125 design criteria, to achieve the structural performance shown on the structural drawings. Design calculations for the composite system shall be submitted for approval by the engineer of record, and shall be stamped by a registered civil engineer.
- B. Calculations shall conform to requirements set forth in ICC ES Acceptance Criteria (AC 125) and be based on the design modulus and associated area of the composite to be installed. Design values must be lower than the calculated mean determined from the test results received from the ASTM D3039 field test specimens (see Section 3.07 of this specification).

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver epoxy materials in factory-sealed containers with the manufacturer's labels intact and legible with verification of date of manufacture and shelf life.
- B. Store materials in a protected area at a temperature between 40° and 100° F.
- C. Products shall be stored according the manufacturer's requirements and shall avoid contact with moisture.

PART 2 PRODUCTS

2.1 Acceptable Manufacturers

- A. Fyfe Co. LLC
- B. Nancy Ridge Technology Center, 6310 Nancy Ridge Drive, Suite 103, San Diego, CA 92121. Tel: 858-642-0694, Fax: 858-642-0947, email: info@fyfeco.com.
- C. Engineer-of-record approved equal that satisfies all of the requirements of Section 1.04 and shows equality to materials defined in Section 2.03. Proposed alternate composite system must be approved in an addendum to these specifications by the engineer of record two-weeks prior to the project bid date.

2.2 Composite Strengthening System

- A. Approved TYFO® Fibrwrap® System to be supplied by Fyfe Company, Nancy Ridge Technology Center, 6310 Nancy Ridge Drive, Suite 103, San Diego, CA 92121. Tel: 858-642-0694, Fax: 858-642-0947. Products include:
 - 1. Composite fabric: SCH fiber – primary carbon fiber, unidirectional.
 - 2. SEH fiber – primary glass fiber, unidirectional.
 - 3. Epoxy saturant: Tyfo® S epoxy to be combined with the fiber to form the TYFO® Fibrwrap® composite.
 - 4. Primer/Filler: Tyfo® WS thickened epoxy for protective seal coat, filling voids and primer where needed.
 - 5. Anchorage: System compatible anchors shall be provided as detailed on submitted construction drawings.
 - 6. Finish: Tyfo® A, Tyfo® U, Tyfo® HS, or Tyfo® G paint to be color matched by architect. Alternate finishes must be approved by the system manufacturer.
 - 7. Fire Protection (if required): Tyfo® AFP (Advanced Fire Protection) System, Tyfo® AFP, FC/F System or Tyfo® RR finish.

2.3 Other Materials

- A. Provide other materials as needed for the proper installation of the complete composite system, as selected by the contractor in conformance with these specifications.

PART 3 EXECUTION

- 3.1 The work specified under this specification shall be performed by an applicator with proven past experience applying the approved composite system for a minimum of 75 projects with over 200 elements strengthened within the last two-years. The applicator must supply the names of at least three individuals who have been certified and trained by the FRP system manufacturer and who will be on site during all phases of the project. The engineer of record shall have the right to approve or reject the personnel qualifications as submitted. The engineer may suspend the work if the contractor substitutes unauthorized personnel for authorized personnel during construction.
- 3.2 The composite system applicator shall submit a written description of the proposed epoxy and a complete written description of the application procedures for review by the engineer-of-record. The applicator company must be certified by the manufacturer/supplier and provide a quality control procedure in accordance with section 3.07 of this specification.
- 3.3 The supply and installation of the composite system is to meet the performance criteria of this specification and as stated on the contract drawings. Calculations to determine the installed composite thickness are to be supplied for approval by the engineer-of-record and the City/County.
- 3.4 Surface Preparation:
- A. Columns:
1. The surface to receive the composite shall be free from fins, sharp edges and protrusions that will cause voids behind the installed casing or that, in the opinion of the Engineer, will damage the fibers. Existing uneven surfaces to receive composite shall be filled with the system epoxy filler or other material approved by the Engineer. Filling of large voids in surfaces to receive composite shall be paid as an extra to the contract work of installing the composite system (small pinholes or micro-bubbles in the concrete surface or resin do not require special detailing). The contact surfaces shall have no free moisture on them at the time of application. If moisture is present, use the manufacturer suggested wet prime epoxy, if available.
 2. Repair all damaged concrete, spalls, and irregular surfaces to create a flat, or slightly convex, surface. Sack, or fill with thickened epoxy, surfaces as necessary to eliminate large air surface voids, greater than 0.5" diameter. Well-adhered paint and concrete do not require removal.
 3. Round off sharp and chamfered corners to a radius of .75 inch ($\pm 0.25''$) by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the vertical edge shall not exceed 1/2" for each 12" of column height.
- B. Walls/Diaphragms/Slabs/Beams:
1. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to achieve a 1/16" minimum amplitude. All contact surfaces shall then be cleaned by hand or compressed air. One prime coat of the manufacturer's epoxy shall be applied and allowed to cure for a minimum of one hour. Prior to the application of the saturated composite fabric, fill any uneven surfaces with the

manufacturer's thickened epoxy. Provide anchorage as detailed on construction drawings.

2. Round off sharp and chamfered corners to a radius of 1 inch ($\pm 0.25''$) by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the edge shall not exceed 1/2'' for each 12'' of length.
3. Bond critical surface preparation techniques can be verified by means of adhesion testing as per ASTM D4541.

3.5 Procedures for Applications

A. Approved Applicator:

Contech Services, Inc.
Attn: Don Ellsworth
6917 NE 39th Court
Vancouver, WA 98661
503.223.9817

Contech Services, Inc.
Attn: Pete Barlow/Roger Runacres
P.O. Box 84886
Seattle, WA 98124
206.763.9877

- B. Preparation work for project: Visit site to insure that all patch work is complete and cured. Review project specifications in detail.
- C. Verify ambient and concrete temperatures. No work shall proceed if the temperature of the concrete surface being repaired is less than 40° F or greater than 100° F. The temperature of the epoxy components shall be between 40 and 100° F at the time of mixing or as specified on the component labels. When air temperature is outside the prescribed range, other measures must be employed to ensure components' temperature is maintained within this range.
- D. Prepare the epoxy matrix by combining components at a ratio specified by the system manufacturer, with an allowable tolerance of $\pm 10\%$. The components of epoxy resin shall be mixed with a mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm. Components that have exceeded their shelf life (as designated on the material label) shall not be used.
- E. Both epoxy resin and fabric shall be measured accurately, combined, and deposited uniformly at the rates shown on the approved working drawings and per manufacturer's recommendations. The composite system shall be comprised of fibers completely saturated with epoxy resin per proper ratio.
- F. Quality control procedures: Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to special inspector and system manufacturer. See section 3.07 of this specification.
- G. Fabric sampling procedure: On a smooth, flat, level surface covered with polyethylene sheeting, or 16 mil plastic film, prime with epoxy saturant, then prepare sample by placing two layers of saturated fabric oriented in the same direction and allow to cure. Apply additional topping of epoxy as required to ensure complete saturation. Samples shall be stored in a sample box and not moved for a minimum 48 hours after casting. The

prepared, identified samples shall be given to a preapproved testing laboratory from the submitted list. (see Section 3.07.C for testing procedures and requirements).

H. Installation Procedures:

1. Prepare surface as required, including corner preparation.
2. Remove dust and debris by hand or with compressed air as per specification.
3. Clean up and protect area adjacent to element.
4. Using a roller or trowel, apply one prime coat of thickened epoxy resin to the concrete surface (2 mil. min.). Allow primer to become tacky to the touch.
5. Fill any uneven surfaces or recesses with thickened epoxy.
6. Saturate fabric with epoxy matrix as per manufacturers specifications.
7. Apply saturated fabric to concrete surface by hand lay-up, using methods that produce a uniform, constant tensile force that is distributed across the entire width of fabric. Under certain application conditions, the system may be placed entirely by hand methods assuring a uniform, even final appearance. Gaps between composite bands may not exceed ½" width in the fabric's transverse joint unless otherwise noted on project drawings. A lap length of at least 6" is required at all necessary overlaps in the primary fiber direction of the fabric.
8. Apply subsequent layers, continuously or spliced, until designed number of layers is achieved, per project drawings.
9. Using a roller or hand pressure, insure proper orientation of fibers, release or roll out entrapped air, and ensure that each individual layer is firmly bedded and adhered to the preceding layer or substrate.
10. Detail all fabric edges, including butt splice, termination points, and jacket edges, with thickened epoxy.
11. Finish: All edges and seams must be feathered with thickened epoxy. Use system as directed by manufacturer. Apply protective coatings as specified between 24 and 72 hours after final application of epoxy. If after 72 hours the epoxy is cured, the surface must be roughened by sanding or brush blasting.
12. System may incorporate structural fasteners but limitations and detailing must be verified with composite system manufacturer.

3.6 Procedure Modification

- A. Installation procedures may be modified to achieve maximum results, subject to approval of the City/County and the engineer-of-record. Procedure modifications shall be discussed with the City/County and engineer-of-record prior to implementing the modifications.

3.7 Field Quality Control

- A. The field quality control procedures shall be in accordance with the following details in addition to ICC AC178, "Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber Reinforced Polymer Composite Systems."
1. Installers:
 - a. Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of

epoxy used each day. Complete report and submit to City/County, engineer-of-record and system manufacturer.

2. Inspection:
 - a. Certified Special Inspector, approved by the City/County, shall periodically observe all aspects of preparation, mixing, and application of materials, including the following:
 - 1) Material container labels
 - 2) Surface Preparation
 - 3) Mixing of epoxy
 - 4) Application of epoxy to the fiber
 - 5) Application of composite system
 - 6) Curing of composite material
 - 7) Preparation and labeling of test samples
 - a. The composite casing shall be completely inspected by the Special Inspector during and immediately following application of the composite. The contractor shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer's recommendations.
3. Laboratory Testing:
 - a. Record lot number of fabric and resin used, and location of installation. A "sample batch" shall consist of two 12" x 12" samples of cured composite. A minimum of two sample batches shall be made daily. The two sample batches will be taken at appropriate times during the day so as to ensure the maximum material deviance in the components of the composite. Testing laboratory shall pre-condition samples at 140° F for 48 hours before testing. Samples shall be tested, at random, at owner's discretion and cost.
 - b. Tested samples shall be tested per ASTM D3039. The 12" x 12" panel shall have 5 coupons, ¾" x 9", removed and tested for their material properties in the longitudinal (primary fiber) direction. Tests shall conform to ASTM procedures and manufacturer's published testing methods. Only pre-qualified testing laboratories shall be used.
 - c. Testing results shall be made available within 3 weeks of sample submission. The testing shall provide average values of the following:
 - 1) Ultimate tensile strength
 - 2) Tensile modulus
 - 3) Percent elongation
 - d. 15% of all sample batches are suggested to be tested. If one 12" x 12" sample fails (on average), specimens from the same sample will be tested. If these specimens also fail (on average), the other 12" x 12" from the same sample batch will be tested. In the extreme case that this sample also fails, the remaining sample batch for that day will be tested and appropriate remedial measures, per Section 3.07.E, will be taken to ensure integrity of the system from the failed sample batch. In addition, 25% of the remaining sample batches will then be tested by the same criteria.

4. Repairs:
 - a. All defects, including bubbles, delaminations, and fabric tears, spanning more than 5% of the surface area, or as specified by the owner or engineer, shall be repaired. Two types of repairs shall be performed:
 - 1) Small defects (on the order of 3" diameter) shall be injected or back filled with epoxy.
 - 2) Large defects shall be repaired as required by the consulting engineer's specifications and manufacturer's specifications.
 - b. Small entrapped air pockets and voids naturally occur in mixed resin systems and do not require repair or treatment. Defect repair shall be provided by the manufacturer and be submitted to the structural engineer of record for approval.

5. Remedial Measures:
 - a. In the event that material testing, per section 3.07.C, determines a sample batch to possess insufficient material properties, remedial measures shall be taken. If the tested composite system has material properties determined to be below the minimum specified values, additional layers shall be installed until the final composite thickness is increased by the same percentage as the deficiency of the material's elastic modulus. Any required additional material and labor for remedial repairs would not be paid for as an extra to the contracted work.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
 - 1. Foundation walls.
 - 2. Supported slabs.
 - 3. Slabs on grade.
 - 4. Control, expansion and contraction joint devices.
 - 5. Equipment pads.
 - 6. Trenches.
 - 7. Sumps.

- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories
 - 2. Section 03 20 00 - Concrete Reinforcing.
 - 3. Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305 - Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 - Standard Specification for Curing Concrete.
 - 5. ACI 318 - Building Code Requirements for Structural Concrete.

- B. ASTM International:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 3. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 5. ASTM C150 - Standard Specification for Portland Cement.
 - 6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 7. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - 8. ASTM C685 - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
 - 9. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

10. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum 1 perm when tested in accordance with ASTM E96, Procedure A.

1.4 SUBMITTALS

- A. Section: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories.
- C. Design Data:
 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 2. Identify mix ingredients and proportions, including admixtures.
 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 & ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section: Environmental conditions affecting products on site.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.8 COORDINATION

- A. Section: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Normal Weight Aggregates: ASTM C33.
 - 1. Coarse Aggregate Maximum Size: $\frac{3}{4}$ inches In accordance with ACI 318.
- B. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

- A. Furnish materials in accordance with Municipality of Portland Public Work's standards.
- B. Air Entrainment: ASTM C260.
- C. Chemical: ASTM C494.
- D. Fly Ash Calcined Pozzolan: ASTM C618
- E. Silica Fume: ASTM C1240.
- F. Slag: ASTM C989; Grade 100; ground granulated blast furnace slag.
- G. Plasticizing: ASTM C1017 Type I, plasticizing.

2.3 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion
 - 1. Substitutions: Section 01630
- B. Vapor Retarder: ASTM E1745; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
 - 1. Substitutions: Section 01630
- C. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi.
 - 1. Substitutions: Section 01630

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D1752; Closed cell molded vinyl foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.
- B. Sealant and Primer: As specified in Section 07 90 00.
- C. Sealant: ASTM D6690, Type I.
 - 1. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
 - 2. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.5 CONCRETE MIX

- A. Select proportions for normal weight concrete in accordance with ACI 301.
- B. Provide concrete to the following criteria:

Material and Property	Measurement
Compressive Strength (7 day)	1,700 psi
Compressive Strength (28 day)	3,000 psi

- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
 - 1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
 - 2. Do not use calcium chloride nor admixtures containing calcium chloride.
 - 3. Use set retarding admixtures during hot weather.
 - 4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing.
- D. Average Compressive Strength Reduction: Not permitted.
- E. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94.
- F. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040: Project Coordination.
- B. Verify requirements for concrete cover over reinforcement.

- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301 & ACI 318.
- B. Notify testing laboratory and Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
- D. Separate slabs on grade from vertical surfaces with 3/8 inch thick joint filler.
- E. Place joint filler in floor slab. Set top to required elevations. Secure to resist movement by wet concrete.
- F. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to Section 07 90 00 for finish joint sealer requirements.
- G. Install joint covers in one piece longest practical length, when adjacent construction activity is complete.
- H. Apply sealants in joint devices in accordance with Section 07 90 00
- I. Deposit concrete at final position. Prevent segregation of mix.
- J. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- K. Consolidate concrete.
- L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

- M. Place concrete continuously between predetermined expansion, control, and construction joints.

3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed, concrete walls.
- B. Finish concrete floor surfaces in accordance with ACI 301 & ACI 318.
- C. Steel trowel surfaces which are indicated to be exposed.
- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal as indicated on drawings.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 1. Protect concrete footings from freezing for minimum 5 days.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces in accordance with ACI 301 & ACI 318.
- D. Spraying: Spray water over floor slab areas and maintain wet for 5 days.

3.6 FIELD QUALITY CONTROL

- A. Section: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318 and applicable Oregon Structural Specialty Code.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
 - 1. Sampling Procedures: ASTM C172.
 - 2. Cylinder Molding and Curing Procedures: ASTM C31, cylinder specimens, standard cured.

3. Sample concrete and make one set of three cylinders for every 75 or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
 4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
 5. Make one additional cylinder during cold weather concreting, and field cure.
- G. Field Testing:
1. Slump Test Method: ASTM C143.
 2. Air Content Test Method: ASTM C173.
 3. Temperature Test Method: ASTM C1064.
 4. Measure slump and temperature for each compressive strength concrete sample.
 5. Measure air content in air entrained concrete for each compressive strength concrete sample.
- H. Cylinder Compressive Strength Testing:
1. Test Method: ASTM C39.
 2. Test Acceptance: In accordance with ACI 318.
 3. Test cylinder at 7 days.
 4. Test two cylinders at 28 days.
- I. Core Compressive Strength Testing:
1. Sampling and Testing Procedures: ASTM C42.
 2. Test Acceptance: In accordance with ACI 318.
 3. Drill three cores for each failed strength test from concrete represented by failed strength test.
- J. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218.
1. Maximum Concentration: As permitted by applicable code.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- 3.7 PATCHING
- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
 - B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
 - C. Patch imperfections as directed by Architect/Engineer in accordance with ACI 301, ACI 318.
- 3.8 DEFECTIVE CONCRETE
- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.9 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Foundation Walls: 3,000 psi 28 day concrete, form finish with honeycomb filled surface.
- B. Underside of Supported Floors and Structure Exposed to View: 4,000 psi 28 day concrete, sack rubbed finish.
- C. Exposed Portico Structure: 4,000 psi 28 day concrete, air entrained, smooth stone rubbed finish.

3.10 SCHEDULE - JOINT FILLERS

- A. Basement Floor Slab Perimeter: Joint filler Type A set 1/8 inch below floor slab elevation.
- B. Exterior Retaining Wall at Loading Dock: Joint filler Type F recessed 3/8 inch with sealant cover.

END OF SECTION

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finishing concrete floors and floor toppings.
 - 2. Floor surface treatment.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 07 90 00 - Joint Protection.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.

1.3 SUBMITTALS

- A. Section: Submittal procedures.
- B. Product Data: Submit data on concrete hardener, sealer, curing compounds, compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS

- A. Section: Closeout procedures.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum 2 years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section: Environmental conditions affecting products on site.
- B. Temporary Lighting: Minimum 200 W light source, placed 8 feet above floor surface, for each 425 sq ft of floor being finished.
- C. Temporary Heat: Ambient temperature of 50 degrees F minimum.
- D. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.8 COORDINATION

- A. Section: Coordination and project conditions.
- B. Coordinate the Work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. BASF Chemical Company
 - 2. L & M Construction Chemicals
 - 3. Sika Corp.
 - 4. Substitutions: Section 01630 – Product Requirements and Substitutions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section: Coordination and project conditions.
- B. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 TOLERANCES

- A. Section: Tolerances.
- B. Maximum Variation of Surface Flatness For Exposed Concrete Floors: 1/4 inch in 10 ft.
- C. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.

- D. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement grout.
 - 2. Non-shrink cementitious grout.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 6. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
 - 1. CRD C621 - Non-Shrink Grout.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Requirements for submittals.
- B. Product Data: Submit product data on grout.
- C. Manufacturer's Installation Instructions: Submit manufacturer's instructions for mixing, handling, surface preparation and placing epoxy type and non-shrink type grouts.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Municipality of Portland Public Work's standards.
- B. Maintain one copy of each document on site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver grout in manufacturer's unopened containers with proper labels intact.
- C. Store grout in a dry shelter, protect from moisture.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section: Environmental conditions affecting products on site.
- B. Do not perform grouting if temperatures exceed 95 degrees F.
- C. Maintain minimum temperature of 65 degrees F before, during, and after grouting, until grout has set.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I and II.
- B. Water:
 - 1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.
- C. Fine Aggregate:
 - 1. Washed natural sand.
 - 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
 - 3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:
 - 1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 NON-SHRINK CEMENTITIOUS GROUT

- A. Manufacturers:
 - 1. Sika
 - 2. L & M Construction Chemicals, Inc.
- B. Furnish materials in accordance with Municipality of Portland Public Work's standards.
- C. Non-shrink Cementitious Grout: Pre-mixed ready for use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.
- D. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

2.3 FORMWORK

- A. Refer to Section 03 10 00 - Concrete Forming and Accessories: For formwork requirements.

2.4 CURING

- A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01400: Project Coordination: Verification of existing conditions before starting work.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.3 INSTALLATION - FORMWORK

- A. Construct leakproof forms anchored and shored to withstand grout pressures.
- B. Install formwork with clearances to permit proper placement of grout.

3.4 MIXING

- A. Portland Cement Grout:
 - 1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
 - 2. Prepare grout with water to obtain consistency to permit placing and packing.
 - 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
 - 4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
 - 5. Do not add additional water after grout has been mixed.
 - 6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.
- B. Mix and prepare non-shrink cementitious grout in accordance with manufacturer's instructions.
 - 1. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.
- C. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.

3.5 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.

- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.6 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3 days.

3.7 FIELD QUALITY CONTROL

- A. Section 01400: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed in accordance with ACI 301 and ACI 318 and under provisions of Section.
- C. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of Work.
- D. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural shapes.
 - 2. Channels and angles.
 - 3. Hollow structural sections.
 - 4. Structural pipe.
 - 5. Structural plates and bars.
 - 6. Floor plates.
 - 7. Fasteners, connectors, and anchors.
 - 8. Grout.

- B. Related Sections:
 - 1. Section 03 60 00 – Grouting.
 - 2. Section 05 50 00 - Metal Fabrications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Structural Steel Framing:
 - 1. Basis of Measurement: By the ton.
 - 2. Basis of Payment: Includes structural members fabricated, installed, and anchored.

1.3 REFERENCES

- A. American Institute of Steel Construction:
 - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
 - 3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
 - 4. AISC Seismic Provisions for Structural Steel Buildings.
 - 5. AISC Specification for Allowable Stress Design of Single-Angle Members.
 - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
 - 7. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.

- B. ASTM International:
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 4. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 5. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 7. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 8. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 9. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 10. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 11. ASTM A992 - Standard Specification for Structural Steel Shapes.
 12. ASTM E94 - Standard Guide for Radiographic Examination.
 13. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
 14. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
 15. ASTM E709 - Standard Guide for Magnetic Particle Examination.
 16. ASTM F436 - Standard Specification for Hardened Steel Washers.
 17. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. Green Seal:
1. GC-03 - Anti-Corrosive Paints.
- E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
 2. SSPC Paint 15 - Steel Joist Shop Paint.
 3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
 4. SSPC SP 3 - Power Tool Cleaning.
 5. SSPC SP 6 - Commercial Blast Cleaning.
 6. SSPC SP 10 - Near-White Blast Cleaning.

1.4 SUBMITTALS

- A. Section 01300 – Submittals: Requirements for submittals
- B. Shop Drawings:
1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
 2. Connections. Connections not detailed.

3. Cambers, loads.
 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.
- D. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. AISC Code of Standard Practice for Steel Buildings and Bridges.
 2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
 3. AISC Seismic Provisions for Structural Steel Buildings.
 4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.

1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum 3 years documented experience with the following current AISC Certification:
1. Standard Steel Building Structures (STD).
 2. Conventional Steel Building Structures (SBD).
 3. Simple Steel Bridges (SBR) with fracture critical endorsement.
- B. Erector: Company specializing in performing Work of this section with minimum 3 years documented experience with the following current AISC Certification:
1. Certified Steel Erector (CSE).
- C. Shop Painter: Company specializing in performing Work of this section with minimum 3 years documented experience.
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.7 COORDINATION

- A. Section 01040 – Project Coordination: Requirements for coordination.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992. ASTM A-36

- B. Structural S-Shapes: ASTM A36.
- C. Structural T-Shapes: Cut from structural W-shapes, M-shapes, or S-shapes.
- D. Channels and Angles: ASTM A36.
 - 1. Round Hollow Structural Sections: ASTM A500, Grade B.
- E. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.
- F. Structural Pipe: ASTM A53, Grade B.
- G. Structural Plates and Bars: ASTM A36.
- H. Floor Plates: ASTM A786; raised pattern.
- I. Sliding Bearing Plates: Teflon coated.
- J. Furnish materials in accordance with Municipality of Portland Public Work's standards.

2.2 FASTENERS, CONNECTORS, AND ANCHORS

- A. Bolts: ASTM A307; Grade A or B.
 - 1. Finish: Hot dipped galvanized.
- B. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Hot dipped galvanized.
- C. Washers: ASTM F436; Type 1, circular. Furnish clipped washers where space limitations require.
 - 1. Finish: Hot dipped galvanized.
- D. Shear Connectors: ASTM A108; Grade, headed, unfinished and in accordance with AWS D1.1; Type B.
- E. Anchor Rods: ASTM A307; Grade A.
 - 1. Shape: Hooked
 - 2. Plate Washers: ASTM A36.
- F. Threaded Rods: ASTM A36.
 - 1. Finish: Unfinished.
- G. Forged Structural Steel Hardware:
 - 1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
 - 2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
 - 3. Sleeve Nuts: ASTM A108; Grade 1018.
 - 4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

2.3 WELDING MATERIALS

- A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ACCESSORIES

- A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days; manufactured by.
- B. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- C. Touch-Up Primer: Match shop primer.
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

2.5 FABRICATION

- A. Continuously seal joined members by intermittent welds and plastic filler. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

2.6 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete.
- C. Leave structural steel members un-primed.
- D. Galvanizing for Structural Steel Members: ASTM A123; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.
- E. Galvanizing for Fasteners, Connectors, and Anchors:
 - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.

2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Shop test bolted and welded connections as specified for field quality control tests.

- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Verification of existing conditions before starting work.
- B. Verify bearing surfaces are at correct elevation.
- C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; torque to required resistance tighten to snug tight for bearing type connections.
- D. Do not field cut or alter structural members without approval of Architect/Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

- A. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- B. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- C. Moist cure grout.
- D. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.

- E. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

3.6 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Bolted Connections: Inspect in accordance with AISC specifications.
 - 1. Visually inspect all bolted connections.
 - 2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
- C. Welding: Inspect welds in accordance with AWS D1.1.
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Visually inspect all welds.
- D. Correct defective bolted connections and welds.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes shop fabricated metal items.
 - 1. Lintels.
 - 2. Structural supports for miscellaneous attachments.
 - 3. Custom stainless steel fabrications.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing.
 - 2. Section 07 90 00 – Joint Protection: Sealants

1.2 REFERENCES

- A. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
 - 5. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
- D. American Welding Society:
 - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2. AWS D1.1 - Structural Welding Code - Steel.

3. AWS D1.6 - Structural Welding Code - Stainless Steel.

E. National Ornamental & Miscellaneous Metals Association:
1. NOMMA Guideline 1 - Joint Finishes.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
- C. Samples: Submit two stainless steel sheets 6 x 6 inch in size illustrating factory finishes.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

- A. Finish joints in accordance with NOMMA Guideline 1.
- B. Maintain one copy of each document on site.

1.5 MOCKUP

- A. Section 1400 - Quality Requirements: Mockup requirements.
- B. Construct mock-up, sample stainless steel enclosure, diameter shown on drawing x 4' high, including base inset detail and client.
- C. Locate where directed by Architect/Engineer.
- D. Remove mockup when directed by Architect/Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Accept metal fabrications on site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36.
- B. Steel Plate: ASTM A36/A36M.
- C. Hollow Structural Sections: ASTM A500, Grade B.
- D. Steel Pipe: ASTM A53, Grade B Schedule 40.
- E. Sheet Steel: ASTM A653, Grade 33 Structural Quality with galvanized coating.
- F. Bolts: ASTM A307; Grade A or B.
 - 1. Finish: Hot dipped galvanized. Mechanically galvanized.
- G. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Hot dipped galvanized.
- H. Washers: ASTM F436; Type 1.
 - 1. Finish: Unfinished. Hot dipped galvanized.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- K. Touch-Up Primer: Match shop primer.
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

2.2 MATERIALS - STAINLESS STEEL

- A. Plate, Sheet and Strip: ASTM A167; Type 316 16 gauge.
- B. Bolts, Nuts, and Washers: ASTM A354.
- C. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 LINTELS

- A. Lintels: Steel sections, size and configuration as indicated on Drawings, length to allow 8 inches minimum bearing on both sides of opening.
 - 1. Exterior Locations: Galvanized. Prime paint, one coat.

2.4 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.

- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish #1.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.5 FACTORY APPLIED FINISHES - STEEL

- A. Prime paint items with two coats except where galvanizing is specified.

2.6 FACTORY APPLIED FINISHES - STAINLESS STEEL

- A. Satin Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.

2.7 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/16 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
- B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
- C. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 05 50 86

ARCHITECTURAL METAL COLUMN COVERS

PART 1 GENERAL

1.1 General Requirements

- A. Drawings and general provisions of the Contract, including General and other Conditions and Division 1 - General Requirements sections, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

- A. Exterior self-aligning column covers without exposed fasteners or supports.

1.3 RELATED SECTIONS:

- A. Section 05 12 00 – Structural Steel: Steel structural columns.
- B. Section 05 50 00 – Metal Fabrications: Miscellaneous Fabrications required to support Architectural Metal Column Covers.
- C. Section 23 05 29 – Hangers and Pipe Supports for Piping and Equipment: Interface with piping.
- D. Section 23 21 13 – Hydronic Piping: Interface with pipe assemblies.

1.4 SUBMITTALS

- A. Section 01300 - Submittals.
- B. Product Data:
 - 1. Submit product data for specified column covers.
- C. Shop Drawings:
 - 1. Submit complete shop drawings detailing quantities, sizes, finish, configurations, and column attachment methods.
- D. Samples:
 - Submit three samples minimum 12-inches square of cover material with factory-applied finish for approval.
- E. Manufacturer's Installation Instructions:
 - 1. Submit manufacturer's printed installation instructions for each type of column cover prior to starting Work.
 - 2. Submit one copy to Architect and keep one copy at the site.

1.5 QUALITY ASSURANCE

- A. Manufacturer to have a minimum of ten years experience in the manufacturing of column covers.
- B. Manufacturer to inspect all aspects of the product to ensure that specifications have been met, and that they comply with approved shop drawings.

1.6 WARRANTY

- A. Manufacturer shall issue a one year limited warranty against defects in workmanship and materials.
- B. Provide five-year warranty on finish including fade resistance, chalking, blistering and peeling.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pittcon Industries – Series 1500 Exterior Architectural Metal Column Covers.
- B. Substitutions: Section 01630 – Product Requirement and Substitutions.

2.2 MATERIALS

- A. Series 1500:
 - 1. Column covers shall be of extruded aluminum 0.090-inch thickness and fabricated in two vertically divided sections attached with demountable interlock assembly.
 - 2. Fasteners: Stainless Steel, as recommended by manufacturer to suit application.
 - 3. Support Structure: Comply with requirements of Sections 05 12 00 Structural Steel and 05 50 00 – Metal Fabrications.
- B. Series 1500 Shapes:
 - 1. Provide Extended Half-Round Cover in sizes indicated on Drawings.
 - 2. Provide Full-Round Covers with intermediate horizontal reveal joints and factory-formed full-round beam transitions as indicated on Drawings. Vertical section of cover shall be provided in sections as detailed for field assembly.

2.3 FABRICATION

- A. Series 1500:
 - 1. Column covers shall be roll-formed to specific dimensions and tolerances, and accurately formed to radii shown on approved shop drawings.
 - 2. All fasteners shall be concealed.
 - 3. Full-Round Column covers shall be fabricated in vertically divided sections attached with a demountable interlock joint.

4. Extended Half-Round Column covers shall be fabricated in single length, heights as indicated on drawings. Field-verify finished height and indicate on Shop Drawings.

2.4 FINISH

- A. Material: Factory-applied Megafalon fluoropolymer coating.
- B. Color: Custom to match approved sample.

PART 3 EXECUTION

3.1 PREPARATION

- A. Contractor to inspect column covers upon receipt to ensure that no damage has occurred during shipment.

3.2 INSTALLATION

- A. Column cover to be correctly oriented and installed in accordance with manufacturer's shop drawings and installation instructions to ensure proper installation.
- B. Fasten support structure to main building and/or supporting steel structure and make column cover connections per approved shop drawings
- C. Erect Column covers plumb and level.
- D. Coordinate fittings with work installed by others.

3.3 CLEANING AND PROTECTION

- A. Contractor to remove protective material supplied by column cover manufacturer.
- B. Contractor to clean all visible surfaces after installation.
- C. Contractor to protect column covers from damage by other trades.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes blocking in wall openings; wood furring and grounds; and preservative treatment of wood.

1.2 REFERENCES

- A. American Wood-Preservers' Association:
 - 1. AWWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
 - 2. AWWPA C20 - Structural Lumber - Fire-Retardant Treatment by Pressure Processes.
- B. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- E. U.S. Department of Commerce National Institute of Standards and Technology:
 - 1. DOC PS 1 - Construction and Industrial Plywood.
 - 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
 - 3. DOC PS 20 - American Softwood Lumber Standard.
- F. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.
- G. Western Wood Products Association:
 - 1. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit technical data on wood preservative and fire retardant treatment materials and application instructions.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Lumber Grading Agency: Certified by DOC PS 20.
 - 2. Wood Structural Panel Grading Agency: Certified by EWA - The Engineered Wood Association.
 - 3. Lumber: DOC PS 20.
 - 4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
- B. Surface Burning Characteristics:
 - 1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84 NFPA 255 UL 723.
- C. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire retardant treated material.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lumber Grading Rules: WCLIB. WWPA G-5.
- B. Miscellaneous Framing: #2 Grade Doug Fir 19 percent maximum moisture content after treatment, pressure preservative treat.
- C. Plywood: APA/EWA Rated Sheathing Structural I, Grade C-D ¾ inch Exposure Durability 1; sanded.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Hot dipped Electro galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - 2. Nails and Staples: ASTM F1667.

2.3 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWWA C1 using water borne preservative with 0.25 percent retainage.
- B. Fire Retardant Treatment: Pressure treatment, AWWA C20 for lumber and AWWA C27 for plywood, exterior type, chemically treated and pressure impregnated.
- C. Moisture Content after Treatment: Kiln dried (KDAT).
 - 1. Lumber: Maximum 19 percent.
 - 2. Structural Panels: Maximum 15 percent.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040- Project Coordination: Verification of existing conditions before starting work.
- B. Verify substrate conditions are ready to receive blocking, curbing and framing.

3.2 PREPARATION

- A. Coordinate placement of blocking, curbing and framing items.

3.3 INSTALLATION

- A. Set members level and plumb, in correct position.
- B. Place horizontal members, crown side up.
- C. Space framing and furring 16 inches oc.
- D. Secure sheathing to framing members with ends over firm bearing and staggered.

END OF SECTION

SECTION 07 27 00

AIR BARRIERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes air leakage criteria for primary air seal building enclosure materials and assemblies; materials and installation methods supplementing other primary air seal materials and assemblies; and air seal materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.
- B. Related Sections:
 - 1. Section 07 90 00 - Joint Protection.

1.2 REFERENCES

- A. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International:
 - 1. (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 3. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- C. Sealant, Waterproofing and Restoration Institute:
 - 1. SWRI - Sealant Specification.

1.3 DEFINITIONS

- A. Air Barrier: Continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of single material or combination of materials to achieve performance requirements.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit data on material characteristics, performance criteria, and limitations.
- C. Manufacturer's Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SWRI - Sealant and Caulking Guide Specification requirements for materials and installation.
- B. Maintain one copy of each document on site.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements and Substitutes.
- B. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.7 SEQUENCING

- A. Section 01010 – Summary of Work: Work sequence.
- B. Sequence Work to permit installation of materials in conjunction with related materials and seals.

1.8 COORDINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Coordinate the Work of this section with sections referencing this section.

PART 2 PRODUCTS

2.1 AIR BARRIERS

- A. Manufacturers:
 - 1. Dupont Tyvek Commercial Wrap.
 - 2. Grace Construction Products.
 - 3. Rubber Polymer Corporation.
 - 4. Substitutions: Section 01630 - Product Requirements Not Permitted.

2.2 COMPONENTS

- A. Sheet Seal Type 1: Butyl, white color, 70 mil thick; flex wrap manufactured by Dupont.
- B. Primer: Recommended by sealant manufacturer's Appropriate to application.
- C. Substrate Cleaner: Non-corrosive, type recommended by sealant manufacturer, compatible with adjacent materials.

2.3 ACCESSORIES

- A. Thinner and Cleaner for Butyl Sheet: As recommended by sheet material manufacturer.
- B. Tape: Tyvek-type self adhering type, mesh reinforced, 3” wide, compatible with sheet material.
- C. Attachments: Galvanized steel bars and anchors, Manufacturer standard.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean and prime substrate surfaces to receive adhesive and sealants.

3.2 INSTALLATION

- A. Install air barrier to maintain continuity across different substrates.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01780 – Contract Closeout: Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage work of this section.

3.4 SCHEDULES

- A. Wall Air Seal Over Exterior Surface of Plywood Sheathing: Place sheet seal over sheathing surfaces, fasten per manufacturer’s instructions. Seal with tape.

END OF SECTION

SECTION 07 42 43

COMPOSITE WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes preformed metal panel system for walls and soffits, related flashings and accessory components.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing.
 - 2. Section 07 62 00 - Sheet Metal Flashing and Trim.
 - 3. Section 07 27 00 – Air Barriers

1.2 REFERENCES

- A. Aluminum Association:
 - 1. AA ADM 1 - Aluminum Design Manual.
 - 2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.
- B. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 - 1. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 2. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 - 3. ASTM D2482 - Standard Test Method for Surface Strength of Paper (Wax Pick Method).
 - 4. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 5. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
- D. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 2. NFPA 285 - Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus.

- E. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SYSTEM DESCRIPTION

- A. System: Preformed and prefinished composite metal building panel system of smooth profile; shop fabricated for site assembly; with subgirt framing assembly; thermoplastic compound manufacturer's standard core; with concealed fasteners.

1.4 PERFORMANCE REQUIREMENTS

- A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with ASCE 7.
 - 1. Design Pressure: Minimum 20 lb/sq ft.
- B. Maximum Allowable Deflection of Panel: 1/180.
- C. Movement: Accommodate movement within system without damage to system, components, or deterioration of seals; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing, shortening of building concrete structural columns, creep of concrete structural members, and mid-span slab edge deflection of inch.
- D. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
- E. Tolerances: Accommodate tolerances of building structural framing.
- F. Air Seal: Provide continuity of air barrier seal at building enclosure elements in conjunction with air seal materials specified in Section 07 27 00.

1.5 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions, panel profile and layout, spans, joints, expansion joints, construction details, methods of anchorage, method and sequence of installation and interface with adjacent materials.
 - 2. Shop drawings shall be prepared from field measurements and coordinated with structural steel framing to determine final panel joint pattern.
- C. Product Data:
 - 1. Submit panel profile characteristics and dimensions, and structural properties.
 - 2. Submit data on assembled panel structural capabilities.

- D. Samples: Submit two samples of panel, 8 x 8 inch in size illustrating finish color, sheen, and texture.
- E. Manufacturer's Installation Instructions: Submit special handling criteria, installation sequence, and cleaning procedures.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AA ASM-35. AISI.
- B. Surface Burning Characteristics:
 - 1. Composite Panels: Maximum 25/450 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84 NFPA 255 UL 723.
- C. Perform Work in accordance with State of Oregon Public Work's standard.
- D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 MOCKUP

- A. Section 01400 - Quality Requirements: Requirements for mockup.
- B. Construct mockup, 4 feet long by 4 feet wide, including siding system, attachments to building frame, associated vapor retarder and air seal materials, sealants and seals, and related insulation, flashings and accessory components. Include corner detail.
- C. Demonstrate component assembly including panel materials, weep drainage system, attachments, anchors, and perimeter sealant.
- D. Locate where directed by Architect/Engineer.
- E. Remove mockup when directed by Architect/Engineer.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- C. Store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- D. Prevent contact with materials capable of causing discoloration or staining.

1.11 COORDINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Coordinate Work with placement of anchors.
- C. Coordinate Work for installation of vapor retarder and air barrier seals.
- D. Coordinate Work with installation of firestopping, windows, louvers, and adjacent components and materials.

1.12 WARRANTY

- A. Section 01780 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for composite panels.
- C. Furnish 20 year warranty on panel finish to include: No chalking per ASTM D1424; color retention in accordance with ASTM D2244.

PART 2 PRODUCTS

2.1 COMPOSITE METAL BUILDING PANELS

- A. Manufacturers:
 - 1. Citadel Architectural Products: Model Envelope 2000.
 - 2. Substitutions: Section 01630 - Product Requirements.

2.2 COMPONENTS

- A. Exterior Panel and Other Sheet Materials: Minimum 0.024 inch thick pre-coated aluminum stock; smooth profile as indicated on Drawings.

- B. Precoated Aluminum: Manufacturer's standard alloy and temper; shop precoated with fluorocarbon Kynar 500 coating. Exposed Exterior Surfaces: Color from manufacturer's custom color.
- C. Liner: Minimum 0.10 inch thick aluminum primed sheet finish.
- D. Non-Insulated Core: Manufacturer's standard thermoset phenolic resin; 0.105 inch thick.
- E. Subgirts: Aluminum alloy, manufacturer's standard profile as indicated on Drawings; to attach panel system to structural frame. Thickness as required to support specified loads within specified deflection limitations. Concealed R & R system.
- F. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered.
- G. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed concealed type, of profile to suit system as detailed.
- H. Trim, Closure Pieces, Caps, Flashings, Facias and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles. Provide manufacturer's standard "Route & Return" system.
- I. Anchors: Aluminum.
- J. Air Barrier: Specified in Section 07 27 00.

2.3 ACCESSORIES

- A. Sealants: Specified in Section 07 90 00 Manufacturer's standard type suitable for use with installation of panel system; non-staining, skinning, non-shrinking and non-sagging; ultra-violet and ozone resistant; color as selected to match panels.
- B. Fasteners: Manufacturer's standard concealed type to suit application.
- C. Field Touch-up Paint: As recommended by panel manufacturer.
- D. Bituminous Paint: Asphalt base.

2.4 FABRICATION

- A. Fabrication of primary component profiles on site is not permitted.
- B. Form sections to shape indicated on Drawings, accurate in size, square, and free from distortion or defects. Conform with field measurements prior to fabrication.
- C. Form pieces in longest practicable lengths.
- D. Panel Profile: Manufacturer's standard profile as indicated on Drawings for specified system.

- E. Fabricate corners in one continuous piece as detailed in drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Verify framing members are ready to receive panel system.

3.2 INSTALLATION

- A. Protect panel surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- B. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.
- C. Locate panel joints over supports.
- D. Install control joints where indicated.
- E. Use concealed fasteners.
- F. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.3 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Maximum Offset from Indicated Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- C. Maximum Variation from Plane or Location Indicated on Drawings: 1/8 inch.

3.4 CLEANING

- A. Section 01780 – Contract Closeout: Final cleaning.
- B. Remove site cuttings from finish surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes flashings and counterflashings and fabricated sheet metal items.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry.

1.2 REFERENCES

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM International:
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- C. Federal Specification Unit:
 - 1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.
- D. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - Architectural Sheet Metal Manual.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

- C. Product Data: Submit data on manufactured components metal types, finishes, and characteristics.
- D. Samples:
 - 1. Submit two samples, 6 x 6 inch in size illustrating typical material and finish.

1.4 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal work with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials causing discoloration or staining.

1.6 COORDINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Coordinate with Work of Related Sections

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

- A. Pre-Finished Coil-Coated Steel Sheet: ASTM A446; steel sheet, G90 zinc coating in accordance with ASTM A525; 24 GA thick core steel, shop pre-coated with three coat fluoropolymer top coat; custom color.
- B. Stainless Steel: ASTM A240/240M; Type 304, dead soft fully annealed, 0.015 inch thick; smooth surface, Number 4 finish.

2.2 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal.
- B. Underlayment: ASTM D226; Type I, No. 15 unperforated asphalt felt.
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc Chromate type.
- E. Protective Backing Paint: Zinc molybdate alkyl.

- F. Sealant: Sealant specified in Section 07 90 00.

2.3 FABRICATION

- A. Form sections shape indicated on Drawings, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
- C. Form pieces in longest possible lengths, in single length sheets.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Seal metal joints.

2.4 FACTORY FINISHING

- A. Fluoropolymer Coating: Multiple coat as specified for sheet metal system, thermally cured, conforming to AAMA 2604 AAMA 2605.
- B. Washcoat: Finish concealed side of metal sheets with washcoat compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.

3.2 INSTALLATION

- A. Secure flashings in place using concealed fasteners.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sealants and joint backing, precompressed foam sealers, hollow gaskets, and accessories.
- B. Related Sections:
 - 1. Section 04 20 19 – Masonry Veneer.
 - 2. Section 07 42 13 – Composite Wall Panels.
 - 3. Section 07 27 00 - Air Barriers.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 3. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 4. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 5. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
- B. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples: Submit two samples illustrating sealant colors for selection. (Manufacturers colors card/samples acceptable as color selector.)
- D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- E. Warranty: Include coverage for installed sealants and accessories failing to achieve watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience, and approved by manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 COORDINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. GE Silicones
 - 3. Pecora Corp.
 - 4. Sika Corp.
 - 5. Tremco Spectrum II Basis of Specification
 - 6. Substitutions: Section 1630 - Product Requirements Not Permitted.
- B. Products Description:
 - 1. High Performance General Purpose Exterior (Nontraffic) Sealant (Sealant Type A): Silicone; ASTM C920, Grade NS, Class 50, single component.
 - a. Type: Spectrum II manufactured by Tremco.
 - b. Color: Standard colors matching finished surfaces Colors as selected.
 - c. Applications: Use for:
 - 1) Control, expansion, and soft joints in masonry.
 - 2) Joints between concrete and other materials.
 - 3) Joints between metal frames and other materials.
 - 4) Other exterior nontraffic joints for which no other sealant is indicated.
 - 2. Exterior Metal Lap Joint Sealant (Sealant Type B): Butyl, non-drying, non-skinning, non-curing.
 - a. Type: General purpose butyl sealant manufactured by Tremco.

- b. Applications: Use for concealed sealant bead in sheet metal work and concealed sealant bead in siding overlaps.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber D1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.
- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 - 1. Width/depth ratio of 2: 1.
 - 2. Neck dimension no greater than 1/3 of joint width.

- 3. Surface bond area on each side not less than 75 percent of joint width.
 - C. Install bond breaker where joint backing is not used.
 - D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
 - E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
 - F. Tool joints concave.
- 3.4 CLEANING
- A. Section 01780 - Execution and Closeout Requirements: Final cleaning.
 - B. Clean adjacent soiled surfaces.
- 3.5 PROTECTION OF INSTALLED CONSTRUCTION
- A. Protect sealants until cured.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes metal stud wall framing; gypsum board and joint treatment.
- B. Related Sections:
 - 1. Section 09 24 00 – Portland Cement Plastering
 - 2. Section 09 90 00 - Painting

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 2. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
 - 3. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 4. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
 - 5. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - 6. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
 - 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Gypsum Association:
 - 1. GA 214 - Recommended Levels of Gypsum Board Finish.
 - 2. GA 216 - Application and Finishing of Gypsum Board.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
- E. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Product Data: Submit data on metal framing, gypsum board, joint tape and finishing of gypsum board.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C840, GA-216 and GA-600.
- B. Surface Burning Characteristics:
 - 1. Textile Wall Coverings: Comply with one of the following:
 - a. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
 - b. Comply with requirements of applicable code when tested in accordance with NFPA 265 Method A or Method B test protocols.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Manufacturers:
 - 1. BPB Americas Inc. Model.
 - 2. G-P Gypsum Corp. Model.
 - 3. National Gypsum Co. Model.
 - 4. United States Gypsum Co. Model.
 - 5. Model.
 - 6. Substitutions: Section 1630 - Product Requirements Not Permitted.

2.2 COMPONENTS

- A. Framing Materials:
 - 1. Studs and Tracks: ASTM C645; galvanized sheet steel, 0.030 inch thick, C shape, with knurled faces.
 - 2. Fasteners: ASTM C1002; Type S GA-216; length to suit application.
- B. Gypsum Board Materials: ASTM C1396/C1396M; Type X fire resistant where indicated on Drawings.

1. Standard Gypsum Board: 5/8 inch thick, maximum available length in place; ends square cut, tapered tapered and beveled square round edges.

2.3 ACCESSORIES

- A. Gypsum Board Accessories: ASTM C1047; metal plastic; corner beads, edge trim, and expansion joints.
 1. Metal Accessories: Galvanized steel Aluminum coated steel Zinc.
- B. Joint Materials: ASTM C475; GA-216; reinforcing tape, joint compound, and water.
- C. Gypsum Board Screws: ASTM C954 ASTM C1002; length to suit application.
 1. Screws for Steel Framing: Type S.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Verify site conditions are ready to receive work and opening dimensions are as indicated on project drawings.

3.2 EXISTING WORK

- A. Extend existing gypsum board installations using materials and methods as specified.
- B. Repair and remodel existing gypsum board assemblies which remain or are to be altered.

3.3 INSTALLATION

- A. Metal Stud Installation:
 1. Install studs in accordance with ASTM C754. Metal Stud Spacing: 16 inches on center.
 2. Extend stud framing to ceiling only. Attach ceiling runner securely to ceiling framing in accordance with details indicated.
- B. Gypsum Board Installation:
 1. Install gypsum board in accordance with ASTM C840, GA-216, and GA-600.
 2. Erect single layer standard gypsum board in most economical direction horizontal vertical, with ends and edges occurring over firm bearing.
 3. Use screws when fastening gypsum board to metal furring or framing.
 4. Place corner beads at external corners as indicated on Drawings. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated on Drawings.
- C. Joint Treatment:

1. Finish in accordance with GA-214 Level5.

3.4 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Portland cement plaster system, for repairs to existing plaster soffits.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies Gypsum Board Assemblies.
 - 2. Section 09 90 00 – Painting: Field Painting of Cement Plaster Work

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C150 - Standard Specification for Portland Cement.
 - 2. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
 - 3. ASTM C847 - Standard Specification for Metal Lath.
 - 4. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
 - 5. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster.
 - 6. ASTM C932 - Standard Specification for Surface-Applied Bonding Agents for Exterior Plastering.
 - 7. ASTM C933 - Standard Specification for Welded Wire Lath.
 - 8. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
 - 9. ASTM C1032 - Standard Specification for Woven Wire Plaster Base.
 - 10. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 - 11. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Federal Specification Unit:
 - 1. FS UU-B-790 - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant).
- C. Portland Cement Association:
 - 1. PCA - Portland Cement Plaster (Stucco) Manual.
- D. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Fabricate horizontal elements to limit finish surface to 1: 360 deflection under superimposed dead load and wind uplift loads.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit data on plaster materials, characteristics and limitations of products specified.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C926. PCA Portland Cement Plaster (Stucco) Manual.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements.
- B. Exterior Plaster Work: Do not apply cement plaster when ambient temperature is less than 40 degrees F.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT PLASTER

2.2 COMPONENTS:

- 1. Cement: ASTM C150, Type I Portland cement.
 - 2. Lime: ASTM C206, Type S.
 - 3. Aggregate: In accordance with ASTM C897.
 - 4. Water: Clean, fresh, potable and free of mineral or organic matter capable of affecting plaster.
 - 5. Fibers: 1/2 inch nominal length glass fibers meeting requirements of ASTM C1116.
- B. Furring And Lathing:
 - 1. Expanded Metal Lath: ASTM C847, galvanized, diamond mesh, paper backed.

2. Casing Bead: Formed sheet steel, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges, with square edges; galvanized.
3. Corner Bead: Formed sheet steel, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges with square edge; galvanized.
4. Base Screed: Formed sheet steel, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges, with square edge; galvanized.
5. Control and Expansion Joint Accessories: Formed sheet steel, accordion profile, 2 inch expanded metal flanges each side, galvanized ; manufactured by Western Metal.
6. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized. unfinished.
7. Fasteners: ASTM C1002, self drilling, self tapping screws.

C. Suspension System:

1. Main Runners: 1 1/2" inch by 16 gauge cold-rolled channels, galvanized.
2. Cross Runner: 3/4 inch square by 16 gauge cold –rolled channels.
3. Hansen Wire: 8 gauge soft annealed steel wire, galvanized.

2.3 MIXES

- A. Base Coats: Mix and proportion cement plaster base coat in accordance with ASTM C926.
1. Fiber Reinforcement: Add glass fibers to base coats at rate of 2 pounds per 94 lb sack of cement.
- B. Finish Coat: Mix and proportion cement plaster finish coat in accordance with ASTM C926.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.
1. Provide grounds and casing beads when repair work meets other building elements.
 2. Ensure that hanger system is level and matches up with existing system.
- C. Mechanical and Electrical: Verify services within walls have been tested and approved.

3.2 PREPARATION

- A. Dampen adjoining plaster surfaces to reduce excessive suction.

3.3 EXISTING WORK

- A. Extend existing Portland cement plaster installations using materials and methods as specified.
- B. Repair existing damaged Portland cement plaster which remains or is to be remodeled.

3.4 INSTALLATION

- A. Installation of Lathing Materials:
 - 1. Install metal lath in accordance with ASTM C1063.
- B. Installation of Accessories:
 - 1. Install accessories in accordance with ASTM C1063.
 - 2. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- C. Control And Expansion Joints:
 - 1. Install interior control and expansion joints every 20 feet.
 - 2. For horizontal exterior surfaces, install control and expansion joints not to exceed 100 sq. ft. as indicated on Drawings.
 - 3. Establish control and expansion joints with specified joint device.
- D. Plastering:
 - 1. Apply plaster in accordance with ASTM C926. .
 - 2. Prepare juncture with existing soffit by field – cutting to a straight line. Install control joint on new lath and seal at existing plaster.
 - 3. Apply base coat to nominal thickness of 0.375 inch, brown coat to nominal thickness of 0.375 inch, and finish coat to nominal thickness of 0.125 inch over metal lath.
 - 4. Moist cure base and brown coats. Apply brown coat immediately following initial set of scratch coat.
 - 5. After curing, dampen previous coat prior to applying finish coat.
 - 6. Apply finish coat to match existing soffit.
 - 7. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
 - 8. Moist cure finish coat for minimum period of 48 hours.

3.5 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes suspended metal grid ceiling system and perimeter trim; acoustic tile panels.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 2. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 5. ASTM E580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
 - 6. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- B. Ceilings and Interior Systems Construction Association:
 - 1. CISCA - Acoustical Ceilings: Use and Practice.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 2. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- D. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1: 360.

1.4 SUBMITTALS

- A. Section 01300 - Submittal Procedures: Submittal procedures.

- B. Product Data: Submit data on metal grid system components, acoustic units and.
- C. Samples: Submit two full size samples 6 x 6 inch in size illustrating material and finish of acoustic units.

1.5 QUALITY ASSURANCE

- A. Conform to Cisca requirements.
- B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84, NFPA 255.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.
- C. Provide seismic design of suspended ceiling under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Oregon.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements.
- B. Maintain uniform temperature of minimum 60 degrees F and maximum humidity of 40 percent prior to, during, and after acoustic unit installation.

1.8 SEQUENCING

- A. Section 01010 - Summary: Requirements for sequencing.
- B. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- C. Install acoustic units after interior wet work is dry.

PART 2 PRODUCTS

2.1 SUSPENDED ACOUSTICAL CEILINGS

- A. Manufacturers:
 - 1. Armstrong
 - 2. United States Gypsum Company
 - 3. Substitutions: Section 01600 - Product Requirements.

2.2 COMPONENTS

- A. Acoustic Panels: ASTM E1264, conforming to the following:
 - 1. Size: 24 x 48 inches.
 - 2. Thickness: 5/8 inches.
 - 3. Composition: Fiber
 - 4. Light Reflectance: 0.82 percent.
 - 5. Edge: Square. .
 - 6. Surface Color: White
 - 7. Armstrong Cortega or equal

- B. Grid:
 - 1. Non-fire Rated Grid: ASTM C635, light; exposed T.
 - 2. Fire Rated Grid: ASTM C635, light intermediate heavy duty, listed by UL for use in hour assembly, two directional concealed exposed T exposed T/one direction; components die cut and interlocking.
 - 3. Grid Materials: Commercial quality cold rolled steel with galvanized coating. Cold rolled aluminum. Extruded aluminum.
 - 4. Exposed Grid Surface Width: 15/16 inch with reveal.
 - 5. Grid Finish: White
 - 6. Accessories: Stabilizer bars, clips, splices, perimeter moldings, and hold down clips required for suspended grid system.
 - 7. Support Channels and Hangers: Galvanized Primed steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.3 ACCESSORIES

- A. Touch-up Paint: Type and color to match acoustic and grid units.
 - 1. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.

- B. Verify layout of hangers will not interfere with other work.

3.2 INSTALLATION

- A. Lay-In Grid Suspension System:
 - 1. Install suspension system in accordance with ASTM C635, ASTM C636 and as supplemented in this section.
 - 2. Install system in accordance with ASTM E580.
 - 3. Install system capable of supporting imposed loads to deflection of 1/360 maximum.

4. Lay out system to balanced grid design with edge units no less than 50 percent of acoustic unit size. Arrange system with long dimension of tile parallel perpendicular to long dimension of the space.
5. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
6. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
7. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
8. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability.
9. Do not eccentrically load system, or produce rotation of runners.
10. Perimeter Molding:
 - a. Install edge molding at intersection of ceiling and vertical surfaces.
 - b. Use longest practical lengths.
 - c. Overlap and rivet corners.
 - d. Install at junctions with other interruptions.

B. Acoustic Units:

1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
2. Lay directional patterned units one way with pattern parallel to longest room axis. Fit border trim neatly against abutting surfaces.
3. Install units after above ceiling work is complete.
4. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
5. Cutting Acoustic Units:
 - a. Cut to fit irregular grid and perimeter edge trim.
 - b. Cut square reveal edges to field cut units.

3.3 ERECTION TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Shop primed items.
- C. ASTM International:
 - 1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- E. Painting and Decorating Contractors of America:
 - 1. PDCA - Architectural Painting Specification Manual.
- F. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1113 - Architectural Coatings.
- G. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
- H. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.2 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.

- B. Samples:
 - 1. Submit two paper chip samples, 8 x 8 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
 - 2. Match samples to be furnished by Architect.
- C. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 – Project Closeout: Closeout procedures.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Fire Retardant Finishes: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84 NFPA 255 UL 723.
- B. Perform Work in accordance with State of Oregon Public Work's standard.
- C. Maintain one copy copies of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.9 WARRANTY

- A. Section 01780 – Project Closeout: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for paints and coatings.

1.10 EXTRA MATERIALS

- A. Section 01780 – Project Closeout: Spare parts and maintenance products.
- B. Supply 1 gallons of each color, type, and surface texture; store where directed.
- C. Label each container with color, type, texture, room locations, and in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers: Paint, Transparent Finishes, Stain, Primer, Sealers, Field Catalyzed Coatings.
 - 1. Devoe Paint Co.
 - 2. ICI Paint Stores
 - 3. PPG Architectural Finishes
 - 4. Miller Paint
 - 5. Rhodda
 - 6. Tnemec
- B. Substitutions: Section 01630 - Product Requirements: Substitutions Not Permitted.

2.2 COMPONENTS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
 - 4. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.

- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordinations: Coordination and project conditions.
- B. Verify surfaces substrate conditions are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.

3.2 PREPARATION

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- G. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by [hand] [power tool] wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid

solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items. Coordinate primer with finish. Coating per manufacturers instructions.

3.3 EXISTING WORK

- A. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

3.4 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- D. Finishing Mechanical and Electrical
 1. Refer to Section 22 05 53, Section 23 05 53, Section 26 05 53, and Section 27 05 53 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.
 2. Paint shop finished items occurring at exposed areas.
 3. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and except where items are shop finished or galvanized or provided with insulation jacket unless otherwise noted.
 4. Color code equipment, piping, and conduit in accordance with requirements indicated. color schedule. Color band and identify with flow arrows, names, and numbering.

3.5 CLEANING

- A. Section 01780 – Project Closeout: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.6 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Metal Fabrications (Section 05 50 00): Exposed surfaces of metal pipe supports, filter platform, structural supports and pipe supports.

3.7 SCHEDULE - EXTERIOR SURFACES

- A. Cement Plaster Soffits:
 - 1. One coat of primer sealer latex.
 - 2. Two coats of latex flat.
- B. Steel - Shop Primed:
 - 1. Touch-up with zinc chromate zinc rich primer.
 - 2. Two coats of high performance alkyd enamel. 1.5 mils DFT per coat. Semi-gloss.
- C. Steel Unprimed:
 - 1. Zinc chromate rich red oxide primer.
 - 2. Two coats high performance alkyd enamel. 1.5 mils DFT per coat. Semi-gloss.
- D. Miscellaneous Steel Concealed Spaces:
 - 1. Zinc chromate rich red oxide primer.

3.8 SCHEDULE - INTERIOR SURFACES

- A. Gypsum Board:
 - 1. One coat of latex primer sealer.
 - 2. Two coats of latex enamel, eggshell.
- B. Miscellaneous Steel Unprimed:
 - 1. Zinc chromate rich red oxide primer.
 - 2. Two coats high performance alkyd enamel. 1.5 mils DFT per coat. Semi-gloss.
- C. Miscellaneous Steel Primed:
 - 1. Touch-up with zinc chromate zinc rich primer.
 - 2. Two coats of high performance alkyd enamel. 1.5 mils DFT per coat. Semi-gloss.
- D. Miscellaneous Steel Concealed Spaces:
 - 1. Prime only with zinc chromate rich red oxide primer. 1.5 mil DFT per coat.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sump pumps.
- B. Related Sections:
 - 1. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
 - 2. Section 23 05 23 – General Duty Valves and Accessories
 - 3. Section 23 21 13 – Hydronic Piping

1.2 DESIGN REQUIREMENTS

- A. Design Criteria:
 - 1. Refer to schedule on contract drawings.

1.3 SUBMITTALS

- A. Section 01300 - Submittal: Submittal Procedures
- B. Shop Drawings:
 - 1. Submit installation details for pumps, piping, controls and accessories including wiring schematics.
- C. Product Data: Submit data for specified Products.
- D. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State, Local, and National codes, standards, and regulations.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section approved by manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01630 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 COORDINATION

- A. Section 01040 – Project Coordination.
- B. Coordinate work with State Municipality of Portland standards and utilities within construction area.

PART 2 PRODUCTS

2.1 SUMP PUMPS

- A. See schedule on project drawings.
- B. Section 01630 - Product Requirements and Substitutions: Substitutions.
- C. Casing: Completely submersible and resistant to solution pumped.
- D. Designed for continuous operation.

2.2 PUMP MOTORS

- A. Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

- B. Power Cable: Severe duty rated, oil and water resistant, epoxy seal on motor end, 10 foot minimum length.
- C. Built-in overload with automatic reset.
- D. Class B insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify connections, size, and location are as indicated on Drawings.

3.2 INSTALLATION

- A. Install sump pumps in accordance with Drawings and manufacturer's instructions.
- B. Provide necessary piping, fittings, and valves as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01780 – Project Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Upon completion of installation, examine, adjust and test each pump for proper operation.
- C. Test each pump with clean water through minimum of four complete cycles.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01400 - Quality Requirements: Manufacturer's field services.
- B. Provide services of manufacturer's representative for period of not less than 1 man day to inspect installations and for performance testing.

3.5 SCHEDULES

- A. Sump Pumps: On project drawing schedule

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS

- A. General:
 - 1. Acceptable Manufacturers:
 - a. U.S. Motor.
 - b. Reliance Electric.
 - c. Baldor.
 - d. Marathon.
 - e. Substitutions: Section 01630 - Product Requirements.
 - 2. Motors 1/2 hp and Larger: Three-phase motor as specified below.
 - 3. Motors Smaller Than 1/2 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
 - 4. Service factor: 1.15
 - 5. Efficiency: Premium efficiency design.
 - 6. Motors on driven equipment: Torque characteristics and speed specified shall be the responsibility of the driven equipment vendor. Motors shall be matched to and submitted with the driven equipment.
 - 7. Motor Duty: Continuous-duty operation unless otherwise noted.
 - 8. Motor speed/torque: NEMA Design B unless otherwise noted. Motors shall exceed the speed-torque requirements of the driven equipment over its entire operating range by at least 10% at the rated voltage.
 - 9. Starting: Motors shall be designed for full-voltage starting.
 - a. Motors shall be able to overcome starting load inertia as well as accelerating the load to rated speed under both rated and reduced (905) voltage conditions during starting without injurious heating.
 - b. Unless otherwise specified, motors shall be designed for across-the-line starting and for the minimum number of consecutive starts from rest with the initial temperature of windings at 40 deg C ambient level, per NEMA MG-1.
 - 10. All motors are for coupled or belted service unless otherwise indicated.
 - 11. Temperature rise of motors shall be limited to Class B rise.
 - 12. All electric motors supplied in accordance with their specification shall meet the requirements of the area classification in which it is to be installed as defined by National Electrical Code, latest edition.

13. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.
- B. Construction:
1. Fans: Suitable for rotation in either direction. Fans shall be of non-sparking, corrosion resistant material, accurately balanced before assembly on rotor. Plastic, fiberglass, or other nonmetallic fan housings are not acceptable.
 2. Screens or louvers shall be provided on drip-proof and weatherproof enclosures and shall be constructed of corrosion resistant material.
 3. All motors shall be equipped with a grounding lug on the motor frame on same side as main terminal box.
 4. Sound power levels shall be in accordance with the requirements of NEMA MG-1.
 5. Motor Frame: TEFC construction in wet areas (including boiler rooms and air compressor rooms). Open-Drip-Proof in dry areas. TENV with powder coated or stainless steel exterior for wet food processing areas subject to daily washdown. All frames, fan covers, and terminal boxes on NEMA frame motors shall be cast iron.
 6. Motor Junction Boxes
 - a. Adequately sized to accommodate the cable types and devices specified on the individual motor data sheet. For motors 4 kV and above: boxes shall be adequately sized for making up stress cones on shielded cable.
 7. Main motor lead junction box:
 - a. Cast iron or fabricated steel not less than 1/8 inch in thickness.
 - b. Heavy-duty class, weather-tight or explosion-proof as specified on the individual motor data sheet.
 - c. Boxes shall be able to be rotated in 90 degree increments.
 8. Protective equipment boxes for RTD leads, heater leads, etc.
 - a. Cast iron or fabricated steel not less than 1/8 inch in thickness.
 - b. Heavy-duty class, weather-tight or explosion-proof as specified on the individual motor data sheet.
 - c. Boxes shall be able to be rotated in 90 degree increments.
 9. All motor terminal and protective equipment boxes shall be thoroughly coated internally and externally with corrosion-resistant paint. Match paint of motor frame.
 10. Insulation Systems
 - a. Minimum Class F, or better, insulation system for stators and rotors.
 - b. Insulation system: Sealed, consisting of a complete encapsulation with an epoxy resin-mica compound impervious to moisture.
 11. Bearings
 - a. Anti-friction bearings shall be in accordance with the Anti-friction Bearing Manufacturer's Association Standards.
 - b. Bearings shall have an L-10 rating of 50,000 hours belted and 150,000 hours direct coupled.
 - c. Bearing life shall be based on continuous operation with maximum radial and axial loads in any direction.
- C. VFD Rated Motors
1. Shall meet the requirements of NEMA MG-1, Part 31.

2. Shall have 1600 volt rated insulation.
 3. Bearings: Insulated to prevent pitting.
- D. Horizontal and Vertical In-Line Motors through 200 HP
1. All bearings for horizontal and vertical in-line motors shall be designed for 2 years, B-10, minimum life in the specified services as defined by AFBMA Standards.
- E. Horizontal Motors Above 200 HP
1. Oil lubricated sleeve bearings with reservoirs of generous capacity effectively covered so no dust or other foreign materials can enter the bearing.
 2. Oil slingers and catchers shall be designed to prevent the escape of oil from bearing and creepage along the shaft.
 3. Reservoirs shall be provided with gauge glasses. A permanent oil level indicator shall be provided.
 4. Sleeve bearing motors shall have a shaft end float of 1/2 inch minimum.
- F. Vertical Motors
1. Thrust bearings shall be LP rated per API 610 for pumps and similar applications.
- G. Balancing and Vibration
1. Motors shall be dynamically balanced.
 2. No solder or similar balancing deposits are acceptable.
 3. Parent metal removed to effect the balance shall be removed so as not to affect the structural strength or rotating equipment.
 4. The maximum vibration:
 - a. Amplitude (peak-to-peak) as measured on the rotor shaft shall not exceed 0.0015 inches for 1,800 rpm machines and 0.001 inches for 3,600 rpm machines.
 - b. For vibration measurements, motors shall be operated at rated speed and frequency and with one-half of a standard key in the key seat.
 - c. Motor shall be mounted on isolators in accordance with NEMA MG-a-12.06, paragraph A.

2.2 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical bearing and alignment tests.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

- A. Install securely on firm foundation.
- B. Install engraved plastic nameplates in accordance with Section 26 05 53.
- C. Ground and bond motors in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01780 - Project Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Field test with the driver equipment during start-up and commissioning.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gate valves.
 - 2. Ball valves.
 - 3. Plug valves.
 - 4. Butterfly valves.
 - 5. Check valves.
 - 6. Balance Valves.

- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 2. Section 23 07 00 – Mechanical Insulation.
 - 3. Section 23 11 23 - Natural-Gas Piping.
 - 4. Section 23 21 13 - Hydronic Piping.
 - 5. Section 23 21 16 - Hydronic Piping Specialties.
 - 6. Section 23 22 13 - Steam and Condensate Heating Piping.
 - 7. Section 23 22 16 - Steam and Condensate Piping Specialties.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 2. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

- B. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 67 - Butterfly Valves.
 - 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - 6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 - 7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

- C. Underwriters Laboratories Inc.:
 - 1. UL 842 - Valves for Flammable Fluids.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittals Procedure.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 - Contract Closeout: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves on as-built drawings.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State, Local, and National Codes, Standards, and Regulations.
- B. Maintain one copy copies of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience and/or approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- C. Provide temporary protective coating on cast iron and steel valves.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install valves underground when bedding is wet or frozen.

1.10 WARRANTY

- A. Section 01780 – Contract Closeout: Requirements for Warranties and Bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.11 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare Parts and Extra Quantities
- B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide valves of same manufacturer throughout, where possible.
- B. Types of valves and manufacturers should be as noted on the schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install 3/4 inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- C. Install valves with clearance for installation of insulation and allowing access.
- D. All valves shall be installed in a manner that makes them fully accessible for operation and maintenance.
- E. Refer to Section 23 05 29 for pipe hangers.
- F. Refer to Section 23 07 00 for insulation requirements for valves.

- G. For installation of valves in steam and steam condensate piping systems refer to Section 23 22 13.
- H. For installation of valves in natural gas systems refer to Section 23 11 23.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Flashing.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Formed steel channel.
 - 7. Firestopping relating to HVAC work.
 - 8. Firestopping accessories.
 - 9. Equipment bases and supports.

- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 07 90 00 - Joint Protection.
 - 4. Section 09 90 00 - Painting and Coating.
 - 5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 6. Section 23 11 23 - Facility Natural-Gas Piping.
 - 7. Section 23 21 13 - Hydronic Piping.
 - 8. Section 23 22 13 - Steam and Condensate Heating Piping.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.9 - Building Services Piping.

- B. ASTM International:
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 - 3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 2. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 3. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 or UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Surface Burning: ASTM E84 or UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Section 01300 - Submittals: Submittals procedures.

- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
 - 3. Sleeves.
 - 4. Anchors and Anchorage.
 - 5. Flashing.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods calculations sealed by a registered professional engineer.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

- D. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- E. Perform Work in accordance with local and national codes, standards and regulations.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.13 WARRANTY

- A. Section 01780 - Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
1. Anvil
 2. PT&P
 3. Carpenter & Paterson Inc.
 4. Creative Systems Inc.
 5. Flex-Weld, Inc.
 6. Glope Pipe Hanger Products Inc.
 7. Michigan Hanger Co.
 8. Superior Valve Co.
 9. Substitutions: Section 01630 - Product Requirements and Substitutions
- B. All hangers, rods, clamps, protective shields, components, and hanger accessories shall be hot-dipped-galvanized unless noted otherwise. Strap type hangers shall not be used on any piping system; use only clevis type.
- C. Piping:
1. Conform to ASME B31.9, MSS SP58, MSS, and SP69.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes 3 inches and Smaller: steel channel with pipe clamp.
 9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 10. Vertical Support: Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- D. Steam and Steam Condensate Piping:
1. Conform to ASME B31.1, ASME B31.9, MSS SP58, and MSS SP69.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.

5. Multiple or Trapeze Hangers for Pipe Sizes 4 inches and Smaller: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods; cast-iron roll and stand.
7. Wall Support for Pipe Sizes 3 inches and Smaller: Steel channel with pipe clamp.
8. Wall Support for Pipe Sizes 4 to 5 inches: Welded steel bracket and wrought steel clamp.
9. Wall Support for Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand steel screws, and concrete pier or steel support.
13. Guide for Pipe Sizes 1 to 24": Spider type, carbon steel, adjustable.
14. Anchor for Pipe Sizes to 12": Carbon steel, with bottom base welded to pipe and support steel to prevent pipe movement

2.2 ACCESSORIES

- A. Hanger Rods: All galvanized steel or stainless steel threaded both ends, threaded on one end, or continuous threaded.
- B. Anchors and Bolts: Bolts and studs shall conform with A260 or A493, as applicable. Nuts shall conform to ASTM F524 and washers shall conform to ASTM A240, A260, or 493 as applicable. Bolts and studs, nuts and washers shall be AISI Type 316 stainless steel.
- C. Fasteners and Accessories: Provide anchors and fasteners, washers, straps, and accessories required for a complete and finished installation. Fasteners shall be AISI Type 316 stainless steel.

2.3 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 1. Waterproofing: 5 lb./sq. ft sheet lead.
 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic; See Section 07 90 00.
- D. Escutcheons:
 - 1. Public Areas: Solid plate stainless steel with satin finish.
 - 2. Non-Public Areas: Split ring chrome plated with set screws.
 - 3. Size: Minimum one inch annulus shall be provided except at building seismic joints. Building seismic joint pipe sleeves shall be minimum of 5 inches greater than the normal diameter of the pipe, or as indicated.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
 - 3. Substitutions: Section 01630 - Product Requirements and Substitutions
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
 - 5. Substitutions: Section 01630 - Product Requirements and Substitutions
- B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products
 - 6. Specified Technology, Inc.
 - 7. Substitutions: Section 01630 - Product Requirements and Substitutions

- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.9 SEISMIC REQUIREMENTS

- A. Seismic restraints, anchorage and reinforcements shall be provided for all piping. Equipment and piping shall be anchored to withstand forces generated by earthquake movements. As a minimum, pipe seismic restraints, supports and anchors shall be designed to withstand a force of 100 percent of the weight of the pipe, full of water, plus weight of valves and fittings attached and 250 pounds with the force acting at the pipe center of gravity in any direction.
- B. All piping shall be seismic braced, as a minimum as follows:
 - 1. At all changes in direction provide transverse and longitudinal braces.
 - 2. Provide transverse braces maximum of 40 feet on center.
 - 3. Provide longitudinal braces maximum of 80 feet on center.

- C. Braces shall consist of components specifically designed for intended service, galvanized (except pipe hanger in contact with copper pipes) and complete with galvanized pipe chord member.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION - INSERTS

- A. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of or recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, MSS SP 58, or MSS SP 69.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor. Use approved steel brackets to prevent swaying, sagging, vibration, and resonance; however, allow for thermal expansion between supports or anchors.

- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.
- L. Pipe guides and anchors shall be provided at horizontal and vertical locations where necessary to keep pipes in acceptable alignment, to direct the expansion movement, and to prevent buckling and swaying due to gravity, seismic, wind and thermal loads.
- M. Do not support piping by wire, rope, strap, chain, wood, or similar makeshift devices.
- N. Hose faucets, compressed air outlets, and similar fixtures at ends of pipe branches shall be supported within 3 inches.
- O. When piping to equipment is mounted on vibration isolators, provide spring cushion or other approved type of isolation hanger on the nearest pipe support and on each side of the equipment.
- P. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- Q. Provide field fabricated, heavy-duty steel trapezes fabricated from steel shapes selected for loads required and welded in accordance with applicable requirements of Section 05 05 22 – Metal Welding.
- R. Support fire protection systems piping independently from other piping systems.
- S. The necessary hangers and supports, including beam and purlin clamps, rods, pipe rolls, angles, channels and plates, and any changes from indicated design, shall be approved by the Engineer before installation.
- T. Use of building structural steel for supporting hangers will not be permitted unless indicated or approved by the Engineer.
- U. Support for Insulated Piping:
 - 1. For insulated hot and cold water lines, unless otherwise indicated, use insulation inserts as required for supporting piping from exterior of insulation.
 - 2. Pipe less than 2 inches may be supported from insulation with galvanized steel half round protective shields.

3. For vertical piping 4 inches and larger, provide angle or plate type insulation supports welded to pipe at approximately 12 foot intervals. Fabricate these supports of same material as pipe that they are attached to, and of widths less than thickness of insulation covering.
4. Install hangers around outside of low temperature insulation. Insert section of one inch long by 180 degree cellular glass, minimum eight pounds per cubic foot density, with vapor barrier jacket plus 18 gage by 10 inch by 180 degree galvanized steel shield. Special hangers equipped with equivalent insulating material and vapor barrier may be used.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

3.7 INSTALLATION – SLEEVES

- A. General Requirement:
 1. Provide a pipe sleeve where each pipe passes through an exterior or interior wall, floor, ceiling, or roof, and at other locations indicated.
 2. Set pipe sleeves parallel to the pipes that pass through them.
 3. Do not install sleeves in structural members except where indicated or approved.
 4. Secure sleeves to concrete forms to prevent displacement during placement of concrete.
- B. Exterior watertight entries: Seal with mechanical sleeve seals.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel, stainless steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway, trough, and penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons, floor plates, or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 FIELD QUALITY CONTROL

- A. Section 01780 – Project Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Section 01780 - Project Closeout: Final cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8
14	22	25	7/8	1
16	23	27	7/8	1
18	25	28	1	1

20	27	30	1	1-1/4
24	28	32	1-1/4	1-1/4

B. For grooved end piping systems refer to manufacturers recommendations.

END OF SECTION

SECTION 23 05 33

HEAT TRACING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Furnish and install all electrical resistance heat tracing (ERHT) to maintain pipe temperature at 50°F 40°F in an ambient temperature of O°F.
- B. Related Sections
 - 1. Section 23 07 00 - Mechanical Insulation
 - 2. Section 26 05 00 – Electrical General Requirements
 - 3. Section 26 05 19 – Low-Voltage Electrical Power Wire and Cable
 - 4. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.2 REFERENCES

- A. Not used in this section.

1.3 DEFINITIONS

- A. Not used in this section.

1.4 SUBMITTALS

- A. Self-regulating heating tape.

1.5 QUALITY ASSURANCE

- A. Not used in this section.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Not used in this section.

1.7 SCHEDULING AND SEQUENCING

- A. Not used in this section.

PART 2 PRODUCTS

2.1 GENERAL

- A. Cable shall be automatic self-regulating type with an output of five watts per foot at 50°F.
- B. Furnish cable with tinned copper braid to protect cable and provide grounding path, and furnish overall jacket to protect braid. Include all accessories (i.e., plug and end seal) for connection to electrical outlet.
- C. Service voltage for tape shall be 120 Vac, single phase.
- D. Manufacturer:
 - 1. Chemelex self-regulating heating tape Catalog No. 5BTV
 - 2. Chromalox self-regulating heating tape Catalog No. STW
 - 3. Section 01630 – Project Requirements and Substitutions: Substitutions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Apply in lengths as required, spiral wrapped along length of piping, or following manufacturer's directions to achieve freeze protection for ambient air conditions of 0°F.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vibration isolators.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for Piping and Equipment.
 - 2. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI S1.4 - Sound Level Meters.
 - 2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - 3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 - 4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- B. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
- C. American Society of Heating, Refrigerating and:
 - 1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 2. ASHRAE Handbook - HVAC Applications.
- D. ASTM International:
 - 1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - 3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping where indicated.

- B. Provide minimum static deflection of isolators for equipment as follows:
 - 1. Basement, Under 20 hp
 - a. 400 - 600 rpm: 1 inch
 - b. 600 - 800 rpm: 0.5 inch
 - c. 800 - 900 rpm: 0.2 inch
 - d. 1100 - 1500 rpm: 0.14 inch
 - e. Over 1500 rpm: 0.1 inch
 - 2. Basement, Over 20 hp
 - a. 400 - 600 rpm: 2 inch
 - b. 600 - 800 rpm: 1 inch
 - c. 800 - 900 rpm: 0.5 inch
 - d. 1100 - 1500 rpm: 0.2 inch
 - e. Over 1500 rpm: 0.15 inch

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Shop Drawings: Indicate isolation pads and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations of cross-talk silencers. acoustic housings. ductwork lagging. Record actual locations of hangers including attachment points.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, and ANSI S12.36 standards and recommendations of ASHRAE 68.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for inertia bases.

PART 2 PRODUCTS

2.1 EQUIPMENT BASES

- A. Structural Bases:
 - 1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - 2. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.

2.2 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. Substitutions: Section 01630 - Product Requirement and Substitutions.

- B. Neoprene Pad Isolators:
 - 1. Rubber or neoprene-waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs: not to exceed 0.7 times width.
 - 2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

- C. Seismic Snubbers:
 - 1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 - 2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
 - 3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
 - 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 EXISTING WORK

- A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.
- B. Extend existing piping installations using materials and methods compatible with existing installations.

3.3 INSTALLATION

- A. Install isolation for motor driven equipment.
- B. Bases: Set steel bases for 1 inch clearance between housekeeping pad and base.
- C. Adjust equipment level.
- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- G. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.
- H. Support piping connections to isolated equipment resiliently as follows:
 - 1. Up to 4 inch Diameter: First three points of support.
 - 2. 5 to 8 inch Diameter: First four points of support.
 - 3. 10 inch Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements
- B. 01780 - Contract Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect isolated equipment after installation and submit report. Include static deflections.
- D. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.
- E. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

3.5 SCHEDULES

- A. Equipment Isolation Schedule:

Isolated Equipment	Base	Isolator	
	Type	Type	Deflection
Chiller		Neoprene Pads	

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Samples: Submit two tags, labels, pipe markers, for size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish one container of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
 - 4. Brady
 - 5. Substitutions: Section 01630 - Product Requirements and Substitutions.
- B. Engraved stainless steel or laminated 1/8" thick three-layer plastic with engraved white letters on colored background color. Form letters by exposing center ply.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers:
 - a. Brady
 - b. Seton
 - c. Marking Systems
 - d. Substitutions: Refer to Section 01630 - Product Requirements and Substitutions
 - 2. Laminated three-layer plastic with engraved white letters on contrasting background color. Tag size minimum 1-1/2 inches diameter.
- B. Metal Tags:
 - 1. Manufacturers:
 - a. Brady
 - b. Seton
 - c. Substitutions: Refer to Section 01630 - Product Requirements and Substitutions
 - 2. Stainless Steel with stamped letters; tag size minimum 1-1/2 inches square with finished edges.
- C. Information Tags:
 - 1. Manufacturers:
 - a. Brady
 - b. Seton
 - c. Marking Systems
 - d. Substitutions: Refer to Section 01630 - Product Requirements and Substitutions
 - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.3 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Pipe Markers:
 - 1. Manufacturers:
 - a. Brady
 - b. Seton
 - c. Marking Systems
 - d. Substitutions: Refer to Section 01630 - Product Requirements and Substitutions
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

- C. Underground Pipe Markers:
 - 1. Manufacturers:
 - a. Brady
 - b. Seton
 - c. Marking Systems
 - d. Substitutions: Refer to Section 01630 - Product Requirements and Substitutions
 - 2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 90 00.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with nameplates. Identify in-line pumps and other small devices with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with tape pipe markers, stenciled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and

pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

- M. Identify ductwork with plastic nameplates, or stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting and balancing of steam systems.
 - 2. Sound measurement of equipment operating conditions.
 - 3. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Section 23 22 13 - Steam and Condensate Piping.
 - 2. Section 23 09 93 - Sequence of Operations for Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- B. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms prepared following ASHRAE 111 NEBB Report forms containing information indicated in Schedules. Submit data in S.I. units.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty and Copy of NEBB Certificate of Conformance Certification.
- F. Submit draft copies of report for review prior to final acceptance of Project.

- G. Furnish reports in 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for Submittals
- B. Project Record Documents: Record actual locations of flow measuring stations balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Oregon standard.
- B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance ASHRAE 111 NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- C. Maintain one copy of each document on site.
- D. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC or Certified by NEBB.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor and/or registered professional engineer experienced in performance of this Work and licensed in State of Oregon.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

- A. Section 01040 – Project Coordination: Construction Coordination.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 1. Systems are started and operating in safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Hydronic systems are flushed, filled, and vented.
 5. Pumps are rotating correctly.
 6. Proper strainer baskets are clean and in place or in normal position.
 7. Service and balancing valves are open.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Section 01780 – Contract Closeout: System start-up testing and adjusting.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Steam Condensate Pumps.
 - 2. HVAC Pumps.
 - 3. Water Chillers.
 - 4. Heat Exchangers.
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
 - 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
 - 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date

4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
7. Chillers:
 - a. Identification/number
 - b. Manufacturer
 - c. Capacity
 - d. Model number
 - e. Serial number
 - f. Evaporator entering water temperature, design and actual
 - g. Evaporator leaving water temperature, design and actual
 - h. Evaporator pressure drop, design and actual
 - i. Evaporator water flow rate, design and actual
 - j. Condenser entering water temperature, design and actual
 - k. Condenser pressure drop, design and actual
 - l. Condenser water flow rate, design and actual
8. Heat Exchanger:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Model number

- f. Serial number
- g. Steam pressure, design and actual
- h. Primary water entering temperature, design and actual
- i. Primary water leaving temperature, design and actual
- j. Primary water flow, design and actual
- k. Primary water pressure drop, design and actual
- l. Secondary water leaving temperature, design and actual
- m. Secondary water leaving temperature, design and actual
- n. Secondary water flow, design and actual
- o. Secondary water pressure drop, design and actual
- 9. Flow Measuring Station:
 - a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Design Flow rate
 - h. Design pressure drop
 - i. Actual/final pressure drop
 - j. Actual/final flow rate
 - k. Station calibrated setting
- 10. Sound Level Report:
 - a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
 - d. RC level - equipment on
- 11. Vibration Test:
 - a. Location of points:
 - 1) Motor bearing, center (when applicable)
 - 2) Motor bearing, drive end
 - 3) Motor bearing, opposite end
 - 4) Casing (bottom or top)
 - 5) Casing (side)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
 - c. Normally acceptable readings, velocity and acceleration
 - d. Unusual conditions at time of test
 - e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 07 00

MECHANICAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Piping insulation, jackets and accessories.
 2. Ductwork insulation, jackets, and accessories.

1.2 REFERENCES

- A. ASTM International:
1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 2. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
 3. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 4. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 5. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 6. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 7. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 8. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 9. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 10. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 11. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 12. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 13. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 14. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- B. Sheet Metal and Air Conditioning Contractors':
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Samples: Submit one sample of representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with Local, State, and National Codes, standards, and regulations.
- E. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
 - 5. Substitutions: Section 01630 - Product Requirements and Substitutions
- B. Manufacturers for Polyisocyanurate Foam Insulation Products:
 - 1. Dow Chemical Company.

2. Dyplast Products
 3. Substitutions: Section 01630 - Product Requirements and Substitutions.
- C. Manufacturers for Sodium Potassium Aluminum Silicate Insulation with Calcium Carbonate Filler:
1. Gilsulate

2.2 PIPE INSULATION

- A. TYPE A: ASTM C547, molded glass fiber pipe insulation, with aluminum jacket.
1. Thermal Conductivity: 0.23 BTU in/hr ft. squared degrees F at 75 degrees F.
 2. Operating Temperature Range: 0 to 850 degrees F.
 3. Jacketed Calsil inerts at supports.
 4. Jacket: ASTM B209 Aluminum
 - a. Thickness: 0.020 inch thick sheet.
 - b. Finish: Smooth or Embossed.
 - c. Joining: Longitudinal slip joints and 2 inch laps.
 - d. Fittings: 0.020 inch thick die shaped fitting covers with factory attached protective liner.
 - e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- B. **Type B: Alternate:** ASTM C547, Molded glass fiber with aluminum clad jacket. (Knauf Redi-Clad 1000 degrees F.)
1. Thermal Conductivity: .29-.30 BTU in/hr ft. squared degrees F.
 2. Operating Temperature Range: 0 to 1000 degrees F
 3. Jacketed Calsil inserts at supports.
 4. Jacket for Fittings: ASTM B209 Aluminum as in Type A
- C. TYPE C: ASTM C547, molded glass fiber pipe insulation, with stainless steel jacket.
1. Thermal Conductivity: 0.23 BTU in/hr ft. squared degrees F at 75 degrees F.
 2. Operating Temperature Range: 0 to 850 degrees F.
 3. Jacketed Calsil inserts at supports.
 4. Jacket: ASTM B209 Stainless Steel.
 - a. Thickness: 0.032 inch thick sheet.
 - b. Finish: Smooth
 - c. Joining: Longitudinal slip joints and 2 inch laps.
 - d. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
 - e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick stainless steel
- D. Type E: ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation except at supports. (Trymer 2000)
1. Density: 2.0 lbs/cu. ft.
 2. Thermal Conductivity: 180 days aged value of 0.19 BTU in/hr ft. squared degrees F at 75 degrees F.
 3. Operating Temperature Range: -297 to -300 degrees F.
 4. All Service Jacket Vapor retarder (as required): Polyvinylidene chloride (PVDC) file and tape; 4.0 perms per inch.
 5. Aluminum jacket as in 2.2.A.4

- E. TYPE E: At Supports, ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation at supports. (Trymer 4000)
1. Density: 4.0 pounds per cubic foot.
 2. Thermal Conductivity: 180 day aged value of 0.19 BTU in/hr ft. squared degrees F at 75 degrees F.
 3. Operating Temperature Range: Range: Minus 297 to 300 degrees F.
 4. All Service Vapor Jacket Retarder with permeance of 3.0 perms per inch
 5. Compressive Strength: 80psi.
- F. **Type D, Alternate Bid Item #4 for CWS/R System:** ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation except at supports (Trymer 2000) with PVC jacket.
1. Density: 2.0 lbs/cu. ft.
 2. Thermal Conductivity: 180 days aged value of 0.19 BTU in/hr ft. squared degrees F at 75 degrees F.
 3. Operating Temperature Range: -297 to -300 degrees F.
 4. PVC Jacket
 - a. ASTM D1784 one piece molded type fitting covers and sheet material.
 - b. Thickness: 30 mil.
 - c. Connections: Brush on adhesive
 - d. Color as specified on drawing schedule for indicated service.

AND

ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation at supports (Trymer 4000) and PVC jackets.

1. Density: 4.0 pounds per cubic foot.
 2. Thermal Conductivity: 180 day aged value of 0.19 BTU in/hr ft. squared degrees F at 75 degrees F.
 3. Operating Temperature Range: Range: Minus 297 to 300 degrees F.
 4. Compressive Strength: 80psi.
 5. PVC jacket as in 2.2.E.5.
- G. TYPE H: Inorganic Granular Insulation: Engineered inorganic non-toxic, non-flammable, Sodium Potassium Aluminum Silicate insulation with Calcium Carbonate filler. The insulation shall be chemically treated to render it hydrophobic. The insulation shall be free of Asbestos. Insulation shall have the following properties
1. Density: 40-42 lb/cu. ft. consolidated use density
 2. Load Bearing: 12,000 psf at consolidated density. Prior to backfill the insulation must support a man's weight.
 3. Thermal Conductivity: K = 0.60 BTU/hr ft squared degrees F at consolidated density and mean temperature of 175 degrees F.
 4. Temperature Range: 35 degrees F to 800 degrees F.
- H. Type K: ASTM C612: Glass fiber, rigid board, noncombustible with aluminum foil jacket.
1. Thermal Conductivity: 0.24 Btu in/hr ft. sq. degrees F at 75 degrees F.
 2. Operating Temperature Range: 0 to 650 degrees F.
 3. Jacket Temperature Limit: -20 to 150 degrees F.

2.3 PIPE INSULATION ACCESSORIES

- A. Covering Adhesive Mastic: Compatible with insulation.
- B. Piping: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- C. Provide reusable insulation covers for pumps, valves and piping specialties. Insulation shall be encased in an inner and outer jacket of Teflon impregnated fiberglass fabric rated at a temperature exceeding the pipe system design temperature.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Adhesives: Compatible with insulation.
- F. Calsil Inserts : ASTM C533, Type I: Hydrous Calcium Silicate formed to match OD of pipe, white, asbestos free.
 - 1. Thermal Conductivity: 0.45 Btu in/hr ft sq. degrees F at 200 degrees F.
 - 2. Operating Temperature Range: 140 – 200 degrees F.
 - 3. Use at all glass fiber insulated pipe supports.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- B. Verify surfaces of pipe and concrete trench are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.

3. Insulate fittings and joints with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
 4. Provide reusable insulation covers for valves and pumps.
- D. Glass Fiber Board Insulation:
1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems greater than 140 degrees F:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings and joints with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 3. Insulate flanges and unions at equipment.
 4. Insulate valves with reusable insulation cover with insulation of the like thickness.
- F. Elbows, Tees, and Fittings:
1. Provide mitered or nesting pre-formed insulation, wired in place with 20 gauge stainless steel wire.
 2. Insulation shall be of the same type and thickness as required for the pipe. No substitution allowed. Failure to provide the same insulation at elbows and fittings will require replacement by the contractor at no cost to the Owner.
 3. Joints or voids shall be filled and smoothed with insulating cement or tape as recommended by the manufacturer.
 4. Deformation of insulation jackets by voids is not allowed and subject to replacement by the contractor at no cost to the owner.
 5. Wrap elbows and fitting with vapor retarder tape.
 6. Seal butt joints with vapor retarder tape.
- G. Inserts and Shields:
1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket and shield between jacket and support or hanger.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

- H. Insulation Terminating Points:
 - 1. Chilled Water Piping: Insulate chilled water piping and associated components up to equipment or removable jacket connection. Provide PVC end caps at terminations.
 - 2. Well Water/Condenser Supply Piping: Insulate condenser supply piping system and components to prevent condensation.
 - 3. All insulation ends shall be capped and sealed waterproof.
- I. High Temperature Pipe Insulation:
 - 1. Install in multiple layers to meet thickness scheduled.
 - 2. Attach each layer with bands. Secure first layer with bands before installing next layer.
 - 3. Stagger joints between layers.
 - 4. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with jacket and fitting covers per schedule.
- K. Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
- L. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.
- M. Underground Piping in Trench: After pipe and fittings are installed in trench, install insulation following manufacturer's instructions by pouring over piping using a rod-type vibrator along the sides and between pipes.

3.3 SCHEDULES

- A. See piping schedules on drawings.
- B. Granular Insulation where indicated on drawings in underground trench system.

END OF SECTION

SECTION 23 08 00

COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project commissioning description.
 - 2. Project commissioning responsibilities.
- B. Related Sections:
 - 1. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
 - 2. Section 23 09 00 - Instrumentation and Control for HVAC.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC - AABC Commissioning Guideline.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE Guideline 1 - The HVAC Commissioning Process.
- C. National Environmental Balancing Bureau:

1.3 NEBB - Procedural Standards for Building Systems Commissioning.

1.4 COMMISSIONING DESCRIPTION

- A. Project commissioning process includes the following tasks:
 - 1. Testing and startup of chiller, boiler economizer, metering equipment and systems.
 - 2. Equipment and system verification checks.
 - 3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
 - 4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
 - 5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
 - 6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
 - 7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
 - 8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.

9. Provide training for systems specified in this Section with coordination by Commissioning Authority.
- B. Equipment and Systems to Be Commissioned:
1. Chillers and chiller system.
 2. Pumps.
 3. Boiler economizer & boiler feed pump changes.
 4. Piping systems.
 5. Variable frequency drives.
 6. Condenser cooling system and heat exchanger.
 7. Injection well system.
 8. Chilled water metering.
 9. Steam metering.
 10. Equipment vibration control.
 11. Automatic monitoring and control systems.
 12. Testing, Adjusting and Balancing work.
- C. Perform seasonal function performance tests for the following equipment and systems:
1. Steam system in winter.
 2. Chilled water system in summer.

1.5 COMMISSIONING SUBMITTALS

- A. Draft Forms: Submit draft of system verification form and functional performance test checklist.
- B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
- C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC.

1.8 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Ensure controls installer performs assigned commissioning responsibilities as specified below.
 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
 4. Provide instructions and demonstrations for Owner's personnel.
 5. Ensure subcontractors perform assigned commissioning responsibilities.
 6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
 7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
 8. During verification check and startup process, execute Project related portions of checklists for equipment and systems to be commissioned.
 9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
 10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
 11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
 12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
 13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
 14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
 15. Provide factory supervised startup services for equipment and systems specified in Divisions 22, 23, 26, 32 & 33. Coordinate work with manufacturer and Commissioning Authority.
 16. Perform verification checks and startup on equipment and systems as specified.
 17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
 18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
 19. Conduct Project system orientation and inspection.

- B. Instrumentation and Controls Installer Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exist to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.
 - c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
 - d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
 - e. Confirm sensors selected are within device ranges.
 - f. Review sequences of operation and obtain clarification from Engineer.
 - g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
 - h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
 3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other Project sections.
 4. Submit proposed procedures for performing automatic system control system point-to-point checks to Commissioning Authority and Engineer.
 5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
 6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section 23 09 00.
 7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
 8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
 9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
 10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.
- C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 10 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Authority.
 3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.9 COMMISSIONING MEETINGS

- A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.10 SCHEDULING

- A. Prepare schedule indicating anticipated start dates for the following:
 1. Piping system pressure testing.
 2. Piping system flushing and cleaning.
 3. Ductwork cleaning.
 4. Ductwork pressure testing.
 5. Equipment and system startups.
 6. Automatic control system checkout.
 7. Testing, adjusting, and balancing.
 8. HVAC system orientation and inspections.
 9. Operation and maintenance manual submittals.
 10. Training sessions.
- B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.
- C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.11 COORDINATION

- A. Notify Commissioning Authority minimum of 8 weeks in advance of the following:
 1. Scheduled equipment and system startups.
 2. Scheduled automatic control system checkout.
 3. Scheduled start of testing, adjusting, and balancing work.
- B. Coordinate programming of automatic control systems with construction and commissioning schedules.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install additional balancing valves, and pressure and temperature taps required by Commissioning Authority.

- B. Place Project systems and equipment into full operation and continue operation during each working day of commissioning.
- C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.
- D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

3.2 COMMISSIONING

- A. Seasonal Sensitive Functional Performance Tests:
 - 1. Test heating equipment at winter design temperatures.
 - 2. Test cooling equipment at summer design temperatures.
 - 3. Participate in testing delayed beyond Final Completion to test performance at peak seasonal conditions.
- B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

END OF SECTION

SECTION 23 09 00

HVAC INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. General – Building Management System (BMS) Contractor shall provide and install:
1. A fully integrated Building Automation System (BAS), incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.
 2. Complete temperature control system to be DDC with electric actuation as specified herein.
 3. All wiring, conduit, panels, and accessories for a complete operational system.
 4. BMS Contractor shall be responsible for all electrical work associated with the BMS.
 - a. Perform all wiring in accordance with all local and national codes.
 - b. Install all line voltage wiring, concealed or exposed, in conduit in accordance with the division 26 specifications, NEC and local building code.
 - c. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.
 - d. All systems requiring interlock wiring shall be hardwired interlocked and shall not rely on the BMS to operate (e.g. emergency generator to fuel oil pump interlock, emergency generator damper interlock, etc.) Interlock wiring shall be run in separate conduits from BMS associated wiring.
 5. All wells for water monitoring devices, flow switches and alarms, as required.
 - a. All installation kits for turbine flow meters, allow service and removal under pressure Air vents.
 6. Provide open communications system. The system shall be an open architecture with the capabilities to support a multi-vendor environment. To accomplish this effectively, system shall be capable of utilizing standard protocols as follows as well as be able to integrate third-party systems via existing vendor protocols.
 - a. System shall seamlessly integrate with the PSU campus building automation system, data acquisition system, remote notification system and historical data archiving system.
 - b. System shall be capable of high speed Ethernet communication using TCP/IP protocol.
 - c. System shall be capable of BACnet communication according to ANSI/ASHRAE 135-2004.
 - d. System shall be capable of OPC server communications according to OPC Data Access 2.0 and Alarms and Events 1.0.

- e. System shall be capable of using the LonTalk protocol.
 - f. The system shall be capable of supporting both standard and vendor specific protocols to integrate a wide variety of third-party devices and legacy systems.
 - g. The system shall be capable of supporting wireless field level networks and sensor communications using a MESH topology and IEEE 802.15.4 network.
7. Provide hardware, software, and wiring to provide communication interfaces with each of the systems listed below.
 - a. Chiller Controls
 - b. Building Steam and Chiller Water Metering
 - c. Boiler Feedwater Sequencing Boiler's 4 & 5
 - d. Well Water/Condenser Supply Controls
 8. Provide system graphics for each controlled device and/or integrated systems as required by the owner. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.
- B. General Product Description:
1. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.
 2. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project.
 3. The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, and operator devices.
 4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.
 5. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to any other DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC Controllers shall also be able to send alarms to multiple operator workstations without dependence upon a central or intermediate processing device.
 6. DDC Controllers shall be able to assign password access and control priorities to each point individually. The Logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust or control only the points that the operator is authorized for. All other points shall not be displayed

at the PC workstation or portable terminal. Passwords and priority levels for every point shall be fully programmable and adjustable.

1.2 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. Section 01010 – Summary of Work
 - 2. Section 01300 - Submittals
 - 3. Section 23 64 16 – Centrifugal Chiller
 - 4. Section 26 05 53 – Identifications for Electrical System
 - 5. Section 23 08 00 - Commissioning

1.3 APPROVED CONTROL SYSTEM CONTRACTORS

- A. Approved Control System Contractor and Manufacturer:
 - 1. Siemens Building Technologies APOGEE System to match existing campus BAS.
 - 2. No other acceptable manufacturers.

1.4 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by factory trained personnel. BMS contractor shall have an in-place support facility within 20 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BMS contractor shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BMS. The Bidder shall be regularly engaged in the installation and maintenance of BMS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BMS systems similar in size and complexity to this project.
- B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- C. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- D. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment).

- E. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network. Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

1.5 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
1. National Electric Code (NEC)
 2. Uniform Building Code (UBC)
 3. Uniform Mechanical Code (UMC)
 4. ANSI/ASHRAE Standard 135- 2004, BACnet- Data Communication Protocol for Building Automation and Control Networks

1.6 SUBMITTALS

- A. Product Submittal Requirements. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2008 (or newer) compatible files on optical disk or hard copies on 11" x 17" prints of each drawing. When manufacturer's specification sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means.
- B. Provide submittals within 12 weeks of contract award (project specific)
- C. Submittal data shall consist of the following:
1. Direct Digital Control System Hardware:
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data, such as product specification sheets, installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct Digital Controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (including accuracy data)
 - 4) Valves
 - 5) Dampers
 - 6) Relays and Switches
 - 7) Control Panels
 - 8) Power Supplies
 - 9) Operator Interface Equipment

- c. Wiring diagrams and layouts for each control panel. Show all termination numbers.
 - d. Floor plan schematic diagrams indicating control panel and space temperature sensor locations.
2. Central System Hardware and Software:
- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications for items listed below and for relevant items furnished under this contract not listed below:
 - 1) Central Processing Unit (CPU)
 - 2) Monitors
 - 3) Keyboards
 - 4) Power Supply
 - 5) Battery Backup
 - 6) Interface Equipment Between CPU and Control Panels
 - 7) Operating System Software
 - 8) Operator Interface Software
 - 9) Color Graphic Software
 - 10) Third-Party Software
 - c. Schematic diagrams of all control, communication, and power wiring for central system installation. Show interface wiring to control system.
 - d. Provide a list of BMS point naming convention. Indicate format, structure and standards of typical point names. Follow PSU's established point naming convention for the Siemens APOGEE network.
3. Controlled Systems:
- a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic use the same name.
 - d. Instrumentation list for each controlled system. List control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system.
 - f. Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.

4. Description of process, report formats and checklists to be used in Part 3: “Control System Demonstration and Acceptance.”
5. Contractor shall submit documentation in the following phased delivery schedule:
 - a. Valve and damper schedules
 - b. Point Naming Convention
 - c. Sample Graphics
 - d. System schematics, including:
 - 1) System Riser Diagrams
 - 2) Sequence of Operations
 - 3) Mechanical Control Schematics
 - 4) Electrical Wiring Diagrams
 - 5) Control Panel Layouts
 - 6) Product Specification Sheets
 - e. As-Built drawings
- D. Project Record Documents: Submit three copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
 1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD 2004 (or newer) compatible files on optical media and as 11” x 17” prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3: “Control System Demonstration and Acceptance.”
 3. Operation and Maintenance (O & M) Manual.
 - a. As-built versions of the submittal product data.
 - b. Operator’s Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
 - c. Programming manual or set of manuals with description of programming language and of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - d. Documentation of all programs created using custom programming language, including set points, tuning parameters, and object database.
 - e. Graphic files, programs, and database on magnetic or optical media.
 - f. List of recommended spare parts with part numbers and suppliers.
 - g. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware, including computer equipment and sensors.
 - h. Complete original original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
 - i. Licenses, guarantees, and warranty documents for equipment and systems.

1.7 WARRANTY

- A. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
- B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
- C. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
- D. Provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve Contractor identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with the above-mentioned items.
- E. Contractor shall not be required to warrant reused devices, except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.
- F. Contractor shall not be required to warrant systems, equipment and devices or software if the damages and/or failures were caused by lack of training, unauthorized use, negligence or deliberate action of other parties, or job site conditions.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project specific software and documentation shall become Owner's property. This includes, but not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
- B. Documentation
 - 1. General
 - a. Submit two (2) electronic copies of complete as-built documentation on CD ROM. All drawings shall be in standard AutoCad 2004 format, other documentation shall be in standard MS Office format.
 - b. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above for "as built" manuals.

- c. Assemble owner's manuals into multi-volume sets as necessary and required by the owner.
 - d. Protect each volume with a heavy duty binder. Volumes to have plastic printed dividers between major sections and have oversized binders to accommodate up to ½ inch thick set of additional information.
 - e. Each binder to be printed with project name and volume title on front cover and binder.
 - f. On the first page of each manual identify with project name, manual title, owner's name, engineer's name, contractor's name, address and service phone number, and person who prepared manual.
- C. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:
- 1. Sequence of operation for automatic and manual operating modes for all building systems. The sequences shall cross reference the system point names.
 - 2. Description of manual override operation of all control points in system.
 - 3. BMS system manufacturers complete operating manuals.
- D. Provide Programming Manual to serve as training and reference manual for all aspects of system programming. As a minimum include the following:
- 1. Complete programming manuals, and reference guides.
 - 2. Details of any custom software packages and compilers supplied with system.
 - 3. Information and access required for independent programming of system.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All products used in this project installation shall be new and currently manufactured and shall have been applied in similar installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. The design of the BMS shall support networking of operator workstations and Building Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers along with secondary Floor Level Networks (FLN) for terminal equipment application specific controllers.
- B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
- C. Operator Workstation Communication:
- 1. All color graphic operator workstations shall reside on the Ethernet network and the consoles shall be set up in a client/server configuration.

2. The servers will act as the central database for system graphics and databases to provide consistency throughout all system workstations.
 3. The network shall allow concurrent use of multiple BMS software site licenses.
- D. Management Level Network Communication (MLN)
1. All PCs shall simultaneously direct connect to the Ethernet Management Level Network without the use of an interposing device.
 2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet/IP, OPC and TCP/IP corporate level networks without the use of interposing devices.
 3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
 4. Any controller residing on the primary building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
 5. Any PC on the Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet.
 6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in a notification at the PC.
 7. The standard client and server workstations on the Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
 8. System software applications will run as a service to allow communication with Primary Network Controllers without the need for user log in. Closing the application or logging off shall not prevent the processing of alarms, network status, panel failures, and trend information.
 9. Any break in Ethernet communication between the standard client and server workstations on the Management Level Network shall result in a notification at each workstation.
 10. Access to the system database shall be available from any standard client workstation on the Management Level Network.
- E. Primary Network - Panel to Panel Communication:
1. All Building Controllers shall directly reside on the primary Ethernet network such that communications may be executed directly between Building Controllers, directly between server and Building Controllers on a peer-to-peer basis.
 2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable.
 3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
 4. The primary network shall use TCP/IP over Ethernet. All devices must:
 - a. Auto-sense 10/100 Mbps networks.
 - b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.

- c. Resolve Name to IP Addresses for devices using a Domain Name Service (DNS) Server on the Ethernet network.
 - d. Allow MMI access to an individual Primary Network Controller using industry standard Telnet software to view and edit entire Primary Network.
5. The primary network shall provide the following minimum performance:
- a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any Building Controller is displayed at any PC workstations, all Building controllers, and other alarm printers within 15 seconds.
 - b. Message and alarm buffering to prevent information from being lost.
 - c. Error detection, correction, and re-transmission to guarantee data integrity.
 - d. Synchronization of real-time clocks between Building Controllers, including automatic daylight savings time corrections.
 - e. The primary network shall allow the Building Controllers to access any data from, or send control commands and alarm reports directly to, any other Building Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. Building Controllers shall send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device. The network shall also allow any Building controller to access, edit, modify, add, delete, back up, restore all system point database and all programs.
 - f. The primary network shall allow the Building Controllers to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (e.g. all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.
 - g. Devices containing custom programming must reside on the Primary Network
- F. Secondary Network – Application Specific Controller Communication:
- 1. Communication over the secondary network shall be the manufacturer's standard protocol.
 - 2. This level communication shall support a family of application specific controllers for terminal equipment and shall support wireless communication capability.
 - 3. The Application Specific Controllers shall communicate bi-directionally with the primary network through Building Controllers for transmission of global data.

4. A maximum of 30 terminal equipment controllers may be configured on individual secondary network trunks to insure adequate global data and alarm response times.
 5. Wireless communication over the secondary network shall utilize a wireless MESH topology based on an IEEE 802.15.4 network. Point to point communication shall not be unacceptable.
 6. Wireless communications shall take place using modular wireless transceivers at each device that eliminate the need for a physical network communication cable.
- G. Remote Notification Paging System:
1. Workstations shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), SMS (Simple Messaging Service, text messaging) Devices, and email accounts based on a point's alarm condition.
 2. There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.
 3. On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
 4. Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
 5. System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.
 6. Message detail shall be configurable on a per user basis.
 7. During a "flood" of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.
 8. Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
 9. Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

2.3 OPERATOR INTERFACE

- A. Workstation hardware:
1. Personal computer operator workstations shall be provided for command entry, information management, system monitor, alarm management and database management functions. All real-time control functions shall be resident in the Building Controllers to facilitate greater distribution, fault tolerance and reliability of the building automation control.
 - a. Provide workstation(s) of equal capability as located on plans.
 - b. Workstation shall consist of a personal computer with minimum 512MB RAM, hard drive with 80 GB available space, video card with 64 MB RAM capable of supporting a minimum of 1280 × 1024 resolution with a minimum of 32 Bit color, CD-RW, and DVD-ROM Drive, mouse and 101-key enhanced keyboard. Personal computer shall be a Windows XP,

- 2000 or comparable operating system and shall include a minimum 3.0 GHz Pentium processor.
 - c. The PC monitor shall be of flat panel type and shall support a minimum display resolution of no less than 1280×1024 pixels. The display shall have a minimum of 17" visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.
 - d. Provide an Epson FX-870 or equivalent printer at each workstation location or on the network (Ethernet) for recording alarms, operator transactions and systems reports.
 - e. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.
- B. Operator Interface Software:
- 1. Basic Interface Description
 - a. Operator interface software shall minimize operator training through the use of user-friendly and interactive graphical applications, 30-character English language point identification, on-line help, and industry standard Windows application software. Interface software shall simultaneously communicate with and share data between Ethernet-connected building level networks.
 - b. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device, with a "point and click" approach to menu selection and a "drag and drop" approach to inter-application navigation.
 - c. The navigation shall be user friendly by utilizing "forward & back" capability between screens and embedded hyperlinks to open graphics, documents, drawings, etc.
 - d. Selection of applications within the operator interface software shall be via a graphical toolbar menu – the application toolbar menu shall have the option to be located in a docked position on any of the four sides of the visible desktop space on the workstation display monitor, and the option to automatically hide itself from the visible monitor workspace when not being actively manipulated by the user.
 - e. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BMS software shall run on a Windows XP, 2000, or comparable 32 bit operating system. System database parameters shall be stored within an object-oriented database. Standard Windows applications shall run simultaneously with the BMS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BMS alarms and monitoring information

- f. The software shall provide, as a minimum, the following functionality:
- 1) Real-time graphical viewing and control of the BMS environment
 - 2) Reporting
 - 3) Scheduling and override of building operations
 - 4) Collection and analysis of historical data
 - 5) Point database editing, storage and downloading of controller databases.
 - 6) Utility for combining points into logical Point Groups. The graphs and reports in order to streamline the navigation and usability of the system.
 - 7) Alarm reporting, routing, messaging, and acknowledgment
 - 8) “Collapsible tree,” dynamic system architecture diagram application :
 - a) Showing the real-time status and definition details of all workstations and devices on a management level network
 - b) Showing the real-time status and definition details of all Building Controllers at the Primary Network.
 - c) Showing the definition details of all application specific controllers
 - 9) Definition and construction of dynamic color graphic displays.
 - 10) Online, context-sensitive help, including an index, glossary of terms, and the capability to search help via keyword or phrase.
 - 11) On-screen access to User Documentation, via online help or PDF-format electronic file.
 - 12) Automatic database backup at the operator interface for database changes initiated at Building Controllers.
 - 13) Display dynamic trend data graphical plot.
 - a) Must be able to run multiple plots simultaneously
 - b) Each plot must be capable of supporting 10 pts/plot minimum
 - c) Must be able to command points directly off dynamic trend plot application.
 - d) Must be able to plot both real-time and historical trend data
 - 14) Program editing
 - 15) Transfer trend data to 3rd party spreadsheet software
 - a) Scheduling reports
 - b) Operator Activity Log
 - c) Open communications via BACnet Client & Server

- g. Enhanced Functionality:
 - 1) Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via adjustable user-sized windows. Operator shall be able to drag and drop information between the following applications, reducing the number of steps to perform a desired function (e.g., Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend on the desired point):
 - a) Dynamic color graphics application
 - b) Alarm management application
 - c) Scheduling application
 - d) Dynamic trend graph data plotter application
 - e) Dynamic system architecture diagram application
 - f) Control Program and Point database editing applications
 - g) Reporting applications
 - 2) Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.
- h. Security: Operator-specific password access protection shall be provided to allow the administrator/manager to limit users' workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported). The administrator or manager shall be able to grant discrete levels of access and privileges, per user, for each point, graphic, report, schedule, and BMS workstation application. And each BMS workstation user account shall use a Windows Operating System user account as a foundation.
- i. The operator interface software shall also include an application to track the actions of each individual operator, such as alarm acknowledgement, point commanding, schedule overriding, database editing, and logon/logoff. The application shall list each of the actions in a tabular format, and shall have sorting capabilities based on parameters such as ascending or descending time of the action, or name of the object on which the action was performed. The application shall also allow querying based on object name, operator, action, or time range.
- j. Dynamic Color Graphics application shall include the following:
 - 1) Must include graphic editing and modifying capabilities
 - 2) A library of standard control application graphics and symbols must be included
 - 3) Must be able to command points directly off graphics application
 - 4) Graphic display shall include the ability to depict real-time point values dynamically with animation, picture/frame control, symbol association, or dynamic informational text-blocks

- 5) Navigation through various graphic screens shall be optionally achieved through a hierarchical “tree” structure
 - 6) Graphics viewing shall include zoom capabilities
 - 7) Graphics shall be capable of displaying the status of points that have been overridden by a field HAND switch, for points that have been designed to provide a field HAND override capability.
 - 8) Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls, etc.), Internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
- k. Reports shall be generated on demand or via pre-defined schedule, and directed to CRT displays, printers or file. As a minimum, the system shall allow the user to easily obtain the following types of reports:
- 1) A general listing of all or selected points in the network
 - 2) List of all points currently in alarm
 - 3) List of all points currently in override status
 - 4) List of all disabled points
 - 5) List of all points currently locked out
 - 6) List of user accounts and access levels
 - 7) List all weekly schedules and events
 - 8) List of holiday programming
 - 9) List of control limits and deadbands
 - 10) Custom reports from 3rd party software
 - 11) System diagnostic reports including, list of Building panels on line and communicating, status of all Building terminal unit device points
 - 12) List of programs
 - 13) List of point definitions
 - 14) List of logical point groups
 - 15) List of alarm strategy definitions
 - 16) List of Building Control panels
 - 17) Point totalization report
 - 18) Point Trend data listings
 - 19) Initial Values report
 - 20) User activity report
- l. Scheduling and override
- 1) Provide a calendar type format for simplification of time and date scheduling and overrides of building operations. Schedule definitions reside in the PC workstation and in the Building Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection, graphical mouse action

or function key. Provide the following capabilities as a minimum:

- a) Weekly schedules
- b) Zone schedules
- c) Event schedules – an event consists of logical combinations of equipment and/or zones
- d) Report schedules
- e) Ability to schedule for a minimum of up to ten (10) years in advance.

2) Additionally, the scheduling application shall:

- a) Provide filtering capabilities of schedules, based on name, time, frequency, and schedule type (event, zone, report)
- b) Provide sorting capabilities of schedules, based on name, time and type of schedule (zone, event, report)
- c) Provide searching capabilities of schedules based on name – with wildcarding options

m. Collection and Analysis of Historical Data

- 1) Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals (up to four time-based definitions per point) or change of value, both of which shall be user-definable. Trend data shall be collected stored on hard disk for future diagnostics and reporting. Automatic Trend collection may be scheduled at regular intervals through the same scheduling interface as used for scheduling of zones, events, and reports. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
- 2) Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of selected points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. BMS contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. BMS contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.
- 3) Provide additional functionality that allows the user to view real-

time trend data on trend graphical plot displays. A minimum of ten points may be plotted, of either real-time or historical data. The dynamic graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the display and take "snapshots" of plot screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of ten (10) dynamic graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point. Operator shall be able to zoom in on a specific time range within a plot. The dynamic trend plotting application shall support the following types of graphs, with option to graph in 3D: line graph, area graph, curve graph, area-curve graph, step graph, and scatter graph. Each graph may be customized by the user, for graph type, graph text, titles, line styles and weight, colors, and configurable x- and y-axes.

- n. Dynamic Color Graphic Displays
 - 1) Capability to create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including, but not limited to, air handling units, chilled water systems, hot water boiler systems, and room level terminal units.
 - 2) The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands. Graphics software shall permit the importing of Autocad or scanned pictures for use in the system.
 - 3) Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations within the system schematics or graphic floor plan displays, and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.
 - a) Provide the user the ability to display real-time point values by animated motion or custom picture control visual representation. Animation shall depict movement of mechanical equipment, or air or fluid flow. Picture Control shall depict various positions in relation to assigned point values or ranges. A library (set) of animation and picture control symbols shall be included within the operator interface software's graphics application. Animation shall reflect, ON or OFF conditions, and shall also be optionally configurable for up to five rates of animation speed.

- b) Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
 - c) Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
 - d) Equipment state or values can be changed by clicking on the associated point block or graphic symbol and selecting the new state (on/off) or setpoint.
 - e) State text for digital points can be user-defined up to eight characters.
- 4) Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
 - 5) Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls, etc.), Internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
 - 6) The Windows environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - 7) Off the shelf graphic software shall be provided to allow the user to add, modify or delete system graphic background displays.
 - 8) A clipart library of HVAC application and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library. The clipart library shall include a minimum of 400 application symbols. In addition, a library consisting of a minimum of 700 graphic background templates shall be provided.
 - 9) The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.
- o. System Configuration & Definition
 - 1) A "Collapsible tree," dynamic system architecture diagram/display application of the site-specific BMS architecture

showing status of controllers, PC workstations and networks shall be provided. This application shall include the ability to add and configure workstations, Building Controllers, as well as 3rd-party integrated components. Symbols/Icons representing the system architecture components shall be user-configurable and customizable, and a library of customized icons representing 3rd-party integration solutions shall be included. This application shall also include the functionality for real-time display, configuration and diagnostics connections to Building Controllers.

- 2) Network wide control strategies shall not be restricted to a single Building Controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.
- 3) Provide automatic backup and restore of all Building controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate Building Controller. Changes made at the user-interface of Building Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
- 4) System configuration, programming, editing, graphics generation shall be performed on-line.
- 5) Point database configuration shall be available to the user within a dedicated point database editor application included in the operator interface software. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database.
- 6) The point editor shall have the capability to assign “informational text” to points as necessary to provide critical information about the equipment.
- 7) The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the Building Controllers.
- 8) The operator interface software shall also provide the capability to perform bulk modification of point definition attributes to a single or multiple user-selected points. This function shall allow the user to choose the properties to copy from a selected point to another point or set of points. The selectable attributes shall include, but are not limited to, Alarm management definitions and Trend definitions.
- 9) Control program configuration shall be available to the user within a dedicated control program editor application included in the operator interface software. The editor shall allow for creation, modification and deletion of control programs. The editor shall include a programming assistance feature that

interactively guides the user through parameters required to generate a control program. The editor shall also include the ability to automatically compile the program to ensure its compatibility with the Building Controllers. The editor shall provide the option for editing the control programs in an online or offline mode, and also the ability to selectively enable or disable the live program execution within the Building Controllers.

- p. Alarm Management
- 1) Alarm Routing shall allow the user to send alarm notification to selected printers or workstation location(s) based on time of day, alarm severity, or point type.
 - 2) Alarm Notification shall be presented to each workstation in a tabular format application, and shall include the following information for each alarm point: name, value, alarm time & date, alarm status, priority, acknowledgement information, and alarm count. Each alarm point or priority shall have the ability to sound a discrete audible notification.
 - 3) Alarm Display shall have the ability to list & sort the alarms based on alarm status, point name, ascending or descending alarm time.
 - 4) Directly from the Alarm Display, the user shall have the ability to acknowledge, silence the alarm sound, print, or erase each alarm. The interface shall also have the option to inhibit the erasing of active acknowledged alarms, until they have returned to normal status. The user shall also have the ability to command, launch an associated graphic or trended graphical plot, or run a report on a selected alarm point directly on the Alarm Display.
 - 5) Each alarm point shall have a direct link from the Alarm Display to further user-defined point informational data. The user shall have the ability to also associate real-time electronic annotations or notes to each alarm.
 - 6) Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm. Alarm messages shall also have the optional ability to individually enunciate on the workstation display via a separate pop-up window, automatically being generated as the associated alarm condition occurs. The system shall have the ability to modify the priority text based on operator preference.
 - 7) Alarm Display application shall allow workstation operators to send and receive real-time messages to each other, for purposes of coordinating Alarm and BMS system management.

2.4 BUILDING CONTROLLER SOFTWARE

A. General:

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification. The software programs specified in this Section shall be provided as an integral part of Building Controllers and shall not be dependent upon any higher level computer or another controller for execution.
2. All points, panels and programs shall be identified by a 30 character name. All points shall also be identified by a 16 character point descriptor. The same names shall be displayed at both Building Controller and the Operator Interface.
3. All digital points shall have a user defined two-state status indication with 8 characters minimum (e.g. Summer, Enabled, Disabled, Abnormal).
4. Building Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating / cooling interlock, supply temperature reset, priority load shedding, and power failure restart.
5. The Building Controllers shall have the ability to perform the following pre tested control algorithms:
 - a. Two position control
 - b. Proportional control
 - c. Proportional plus integral control
 - d. Proportional, integral, plus derivative control
 - e. Automatic tuning of control loops
6. Each controller shall be provided with an interactive HELP function to assist operators using POTs and remote connected operators.
7. Building Controllers shall not be susceptible to Microsoft Windows operating systems based viruses.

B. System Security

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
3. User Log On / Log Off attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
5. Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.

C. User Defined Control Applications:

1. Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
2. It shall be possible to use any system measured point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.

3. Any process shall be able to issue commands to points in any and all other controllers in the system.
4. Processes shall be able to generate operator messages and advisories to other operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
5. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.
6. Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task oriented information from the user manual.

D. Alarm Management:

1. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each Building Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the Building Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.
2. Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.
3. An Alarm "shelving" feature shall be provided to disable alarms during testing. (Pull the Plug, etc.).
4. Binary Alarms. Each binary object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
5. Analog Alarms. Each analog object shall have both high and low alarm limits. Alarming must be able to be automatically and manually disabled.
6. All alarm or point change reports shall include the point's user defined language description and the time and date of occurrence.
7. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, Building Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each Building Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
8. Alarm reports and messages shall be routed to user-defined list of operator workstations, or other devices based on time and other conditions. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display graphics.
9. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.

- a. Each Building Controller shall be capable of storing a library of at least 50 alarm messages. Each message may be assignable to any number of points in the Controller.
10. Operator-selected alarms shall be capable of initiating a call to a remote operator device.
- E. Scheduling:
1. Provide a comprehensive menu driven program to automatically start and stop designated object or group of objects in the system according to a stored time.
 2. Schedules shall reside in the building controller and shall not rely on external processing or network.
 3. It shall be possible to define a group of objects as a custom event (i.e. meeting, athletic activity, etc.). Events can then be scheduled to operate all necessary equipment automatically.
 4. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start and/or stop within that group.
 5. The operator shall be able to define the following information:
 - a. Time, day
 - b. Commands such as on, off, auto, etc.
 - c. Time delays between successive commands.
 - d. There shall be provisions for manual overriding of each schedule by an authorized operator.
 6. It shall be possible to schedule calendar-based events up to one year in advance based on the following:
 - a. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. When a group of objects are scheduled together as an Event, provide the capability to adjust the start and stop times for each member.
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
 - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
- F. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
- G. Night setback control. The system shall provide the ability to automatically adjust setpoints for night control.
- H. Enthalpy switchover (economizer). The Building Controller Software (BCS) shall control the position of the air handler relief, return, and outside air dampers. If the outside air dry

bulb temperature falls below changeover set point the BCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.

- I. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, set point, and PID gains shall be user-selectable.
- J. Sequencing. Provide application software based upon the sequences of operation specified to properly sequence equipment.
- K. Staggered Start:
 - 1. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, shall be user definable.
 - 2. Upon the resumption of power, each Building Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.
- L. Totalization:
 - 1. Run-Time Totalization. Building Controllers shall automatically accumulate and store run-time hours for all digital input and output points. A high runtime alarm shall be assigned, if required, by the operator.
 - 2. Consumption totalization. Building Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.
 - 3. Event totalization. Building Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for all points. The event totalization feature shall be able to store the records associated with events before reset.
- M. Data Collection:
 - 1. A variety of historical data collection utilities shall be provided to manually or automatically sample, store, and display system data for all points.
 - 2. Building Controllers shall store point history data for selected analog and digital inputs and outputs:
 - a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each Building Controllers point group.
 - 3. Trend data shall be stored at the Building Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in 3rd party personal computer applications.

4. Loop Tuning. Building Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for a minimum of 36 operator-selected PID control loops. Provide capability to view or print trend and tuning reports.
 - a. In automatic mode, the controller shall perform a step response test with a minimum one-second resolution, evaluate the trend data, calculate the new PID gains and input these values into the selected LOOP statement.
 - b. Loop tuning shall be capable of being initiated either locally at the Building Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

2.5 AUXILLARY CONTROL DEVICES

A. MOTORIZED ISOLATION VALVES

1. Butterfly Valves.
 - a. Furnish automatic butterfly valves for isolation requirements as shown on the drawings or required herein. All butterfly valves shall have body ratings in accordance with the piping specifications. Valves shall be high performance, fully lugged with carbon steel body ANSI 150/300. Valves shall be rated for bubble tight dead end closure, with 316 stainless steel disc, stainless steel shaft and reinforced Teflon seat and seals.
 - b. Motorized valves located outdoors or in areas subject to outdoor air conditions provide fail in place, electric operators with water proof enclosure, crankcase heater, and open and closed position limit switches. Valve and all accessories shall be constructed for outdoor use. All electrical devices shall be weather proof and NEMA 4 rated.
 - c. All valves shall be provided with external position indicators and a speed control device to prevent to rapid closure.
 - d. All valves shall be provided with manual override hand wheels for operating the valve.
 - e. The valves shall be line size as shown on plans.

B. BALL VALVES.

1. Furnish automatic full port ball valves for isolation requirements on line sizes up to 2' as shown on the drawings or required herein. All ball valves shall have ANSI 250 body rating. Valves shall bronze body and stainless steel trim.
2. Valves shall close against a differential pressure equal to the design pump head pressure plus 10%.
3. The valves shall fail to their safe position upon power loss as specified in the sequence of operation.
4. All valves shall be provided with manual override.
5. Provide valve position indicator end switches with the actuator.
6. The valves shall be line size as shown on plans.

C. AUTOMATIC CONTROL VALVES.

1. General:

- a. Control valves shall be two-way or three-way type single seated globe type for two-position or modulating service as shown. Valves shall meet ANSI Class IV leakage rating.
- b. Body pressure rating and connection type construction shall conform to pipe, fitting and valve schedules. Where pressure and flow combinations exceed ratings for commercial valves and operators, industrial class valves and operators shall be provided.
- c. Valve operators shall be of electric type.
- d. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position, as shown in the drawings, in the event of power failure.
- e. Control valve operators shall be sized to close against a differential pressure equal to the design pump head plus 10 percent.
- f. Furnish differential pressure control valves for all water systems as shown on plans and/or specified in the sequence of operations.
- g. Provide valves 2" and smaller with screwed end bronze bodies and stainless steel trim. Provide valves 2-1/2" and larger with flanged ends, cast iron body and stainless steel trim.
- h. Butterfly or v-port ball valves are allowed for modulating services that require large valve sizes (above 6"), such as cooling tower temperature bypass, chiller head pressure ,etc. where proper control with globe type control valve cannot be achieved or the application is not economical

2. Water Valves:

- a. Control valves shall be of equal percentage flow characteristics for modulating service.
- b. Sizing Criteria: As shown on drawings.

3. Steam Valves:

- a. Control valves shall be of linear flow characteristics for modulating service.
- b. Sizing Criteria: As shown on drawings.

D. TEMPERATURE SENSORS.

1. Provide the following instrumentation as required by the monitoring, control and optimization functions. All temperature sensor shall use platinum RTD elements only, nickel or silicon are not acceptable. All control signals shall be via a 4-20 mA loop.
2. Liquid Immersion Temperature
 - a. Temperature monitoring range +20/+120 F or +70/+220 F
 - b. Output signal 4-20 mA
 - c. Installation adjustment none required
 - d. Calibration adjustments zero & span
 - e. Factory calibration point 70 deg F
 - f. Accuracy at calibration point +0.5 F

- E. WATER DIFFERENTIAL PRESSURE SENSOR
1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
 4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Overrange limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and three valve manifold.
 5. Provide industrial grade differential pressure sensors for all differential pressure bypass valves. Sensor shall be factory calibrated for operating range and rated for system pressure. Provide manufacturers standard 316 stainless steel, 3 valve manifold and pressure gauges for supply and return pressures. Output shall be 4-20 ma.
- F. DIFFERENTIAL PRESSURE SWITCHES.
1. Water Differential Pressure Switch
 - a. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
 - b. The differential switches shall meet the following requirements:

1)	Range	8 to 70 psi
2)	Differential	3 psi
3)	Maximum differential pressure	200 psi
4)	Maximum pressure	325 psi
- G. ANALOG WATER LEVEL SENSORS
1. Furnish and install full height, analog level sensors for each location as specified. Sensor shall provide 4-20ma signal in proportion to basin water level. Provide waterproof enclosure and mounting hardware as required.
- H. WATER BTU METERS
1. Provide insertion type water flow meters designed to mount through a fully open 1 inch full bore ball valve supplied by flow meter manufacturer. Meter flow range shall be 2-40 feet/second for liquid service. Meter linearity shall be +/-1% for a 10:1 range. Repeatability shall be .10%. All wetted parts shall be constructed of stainless steel, bearings shall be tungsten carbide. Housing and flange shall be carbon steel. Housing pressure rating shall be 350 psig. A D.C. powered transmitter shall be mounted on the flow meter. Flow transmitter output shall be 4-20 mA linear with flow. Transmitter input shall be from magnetic pickup. Transmitter accuracy shall be .25% of span. The water flow meter shall be Onicon F 1220 or equal.

2. Provide supply and return temperature sensors for "Delta-T" calculation of BTU consumption. Monitor total accumulated BTUs, current BTUs, monthly total BTUs, and yearly total BTUs for each location specified or shown.
3. Provide isolation valve kit to allow removal and servicing of meter while system is operating.
4. All devices associated with the BTU meters serving the chilled water and ice storage system shall be suitable for the extreme environmental conditions. The devices shall properly operate with the specified accuracy and shall not be affected by the media, or by the environment that includes but not limited to low temperatures (10 Deg F), temperature fluctuations and condensation. Control panel enclosures and electronics shall meet the aforementioned requirements or located strategically to ensure proper operation.

I. VORTEX SHEDDING FLOW METERS

1. Provide insertion vortex shedding flow meter for steam metering locations. Meter shall be temperature compensated, rated for service conditions and is manufactured by Sierra Instruments or approved equal. Provide remote readout of pressure, flow, MLb/Hr and total MLb.
2. Coordinate location to provide proper straight run of pipe, pipe size, etc.
3. Power 24VDC power supply as required from Emergency source.
4. BMS system shall monitor Mlb/Hr, Mlb total, and temperature values.

J. INDOOR AIR QUALITY SENSORS (Refrigeration and Natural Gas)

1. Refrigeration: Infrared sensing, microprocessor controlled digital transmitting Carbon Dioxide gas monitor suitable for duct or wall mounting.
 - a. Detection Range: 0-2000 PPM, *0-2% OR *0-5%
 - b. Accuracy: $\pm 3\%$
 - c. Response Time: 35 sec. (for 90% of the reading)
 - d. Sensor Life Expectancy: > 10 years
 - e. Outputs: 4-20 mA, 0-5 Vdc or 0-10 Vdc
 - f. Relay Output Rating: 5A, 30 Vdc or 250 Vac resistive load)
 - g. Power Requirement: 17-27 Vac or 24-38 Vdc, 200 mA
 - h. Operating Temperature Range: 32°F to 100°F (0°C to 40°C)
 - i. Operating Humidity Range: 0% - 95% RH, Non-Condensing
 - j. Manufacturer: Backorach, Model HGM 300, with RDM 800
2. Natural Gas: Solid state, electrochemical sensing Natural gas monitor with 4-20mA output signal.
 - a. Power Requirements 90 - 270 Vac
 - b. Operating Temperature Range 32F - 100F (0 - 40C)
 - c. Operating Humidity Range 0 to 95% RH, (non-condensing)
 - d. Outputs 4-20mA (1 DPDT optional relay)
 - e. Manufacturer Scott Model Sentinel II

K. RELAYS.

1. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

L. LOCAL CONTROL PANELS.

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable sub panels. A single key shall be common to all field panels and sub panels.
2. Interconnections between internal and face mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

M. SEISMIC SENSOR / ACTUATOR

1. Triaxial accelerometer seismic sensor, Model MSC-4.
 - a. Power Requirements: 120 vac, 15A
 - b. Operating Temperature Range: -25degrees celsius to 75 degrees celsius.
 - c. Operating Humidity Range: 0-100% RH (non-condensing)
 - d. Outputs: 3DPDT

2.6 COMMUNICATION AND CONTROL WIRING

A. General:

1. Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16 unless otherwise noted herein.
2. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

B. Wire Sizing and Insulation

1. Wiring shall comply with minimum wire size and insulation based on services listed below:

a.	Service	Minimum Gage/Type	Insulation Class
b.	AC 24V Power	12 Ga Solid	600 Volt
c.	DC 24V Power	10 Ga Solid	600 Volt
d.	Class 1	14 Ga Stranded	600 Volt
e.	Class 2	18 Ga Stranded	300 Volt
f.	Class 3	18 Ga Stranded	300 Volt

2. Provide plenum-rated cable when open cable is permitted in supply or return air plenum where allowed per execution specifications defined in Paragraph 3.07

C. Power Wiring:

1. 115V power circuit wiring above 100 feet distance shall use minimum 10 gage.
2. 24V control power wiring above 200 feet distance shall use minimum 12 gage.

- D. Control Wiring:
 - 1. Digital Input/Output wiring shall use Class 2 twisted pair, insulated.
 - 2. Analog inputs shall use Class 2 twisted shielded pair, insulated and jacketed and require a grounded shield.
 - 3. Actuators with tri-state control shall use 3 conductor with same characteristics
- E. Communication Wiring
 - 1. Ethernet Cable shall be minimum CAT5
 - 2. Secondary level network shall be 24 gage, TSP, low capacitance cable
- F. Approved Cable Manufacturers:
 - 1. Wiring from the following manufacturers which meet the above criteria shall be acceptable:
 - a. Anixter
 - b. Belden

PART 3 EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

3.2 COORDINATION

- A. Site
 - 1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner's representative as applicable.
 - 2. The controls contractor shall follow prime contractor's job schedule and coordinate all project related activities through the prime contractor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.
 - 3. Where the work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment.
 - 4. If the contractor deviates from the job schedule and installs work without coordinating with other trades, so as to cause interference with work of other trades, the contractor shall make the necessary changes to correct the condition without extra charge.
 - 5. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

- B. Submittals.
 - 1. Refer to the "Submittals" article in Part 1 of this specification for requirements.
- C. Test and Balance
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- D. Coordination with controls specified in other sections or divisions.
 - 1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - a. All communication media and equipment shall be provided as specified in Part 2, "Communication" of this specification.
 - b. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
 - c. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

3.3 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- C. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.4 EXISTING EQUIPMENT

- A. Unless otherwise directed, the contractor is not responsible for the repairs or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the engineer is to be notified immediately.
- B. Electronic Sensors and Transmitters: Unless specifically noted otherwise, remove and deliver to the Owner.
- C. Controllers and Auxiliary Electronic Devices: Salvage, recondition, and reuse.
- D. Pneumatic Controllers, Relays and Gauges: Deliver to owner.
- E. Damper Actuators, Linkages, and Appurtenances: Salvage, recondition, and reuse.
- F. Control Valves: Salvage, recondition, and reuse.

- G. Control Compressed Air System: Salvage, recondition, and reuse.

3.5 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ from those in Division 16, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Division 16 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage— shall be installed in conduit.
- F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in conduit containing tubing.
- H. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.
- I. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- J. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.
- K. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points
- L. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.
- M. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.
- N. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

- O. Include one pull string in each conduit 3/4 in. or larger.
- P. Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- Q. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- R. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.
- S. Adhere to this specification's Division 16 requirements where conduit crosses building expansion joints.
- T. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- U. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than 1/2 in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.
- V. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.6 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.7 INSTALLATION OF SENSORS

- A. General:
 - 1. Install sensors in accordance with the manufacturer's recommendations.
 - 2. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - 3. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- B. Instrumentation Installed in Piping Systems
 - 1. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.
 - 2. All pipe-mounted temperature sensors shall be installed in wells.
- C. Water Differential pressure sensors
 - 1. Differential pressure sensors shall be installed with valved taps into the piping to ensure serviceability without draining the system
 - 2. Sensors shall be mounted with bleed valves. After sensor installation any air shall be eliminated using the bleed valves to ensure reading accuracy
 - 3. The sensors shall be located to ensure accessibility
 - 4. Flow meters
 - 5. The minimum straight unobstructed piping for the flowmeter installation shall be at least 10 pipe diameters upstream and at least 5 pipe diameters downstream and/or in accordance with the manufacturer's installation instructions.

3.8 WARNING LABELS AND IDENTIFICATION TAGS

- A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows: "C A U T I O N This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing."
- B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.

2. Warning labels shall read as follows: "C A U T I O N This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing."

C. Equipment and Device labeling:

1. Labels and tags shall be keyed to the unique identifiers shown on the As-Built drawings.
2. All Enclosures and DDC Hardware shall be labeled.
3. All sensors and actuators not in occupied areas shall be tagged.
4. Airflow measurement arrays shall be tagged to show flow rate range for signal output range, duct size, and pitot tube AFMS flow coefficient.
5. Duct static pressure taps shall be tagged at the location of the pressure tap.
6. Tags shall be plastic or metal and shall be mechanically attached directly to each device or attached by a metal chain or wire.
7. Labels exterior to protective enclosures shall be engraved plastic and mechanically attached to the enclosure or DDC Hardware.
8. Labels inside protective enclosures may be attached using adhesive, but shall not be hand written.
9. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
10. Identify room sensors relating to terminal box or valves with nameplates.
11. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.

D. Identification of Tubing and Wiring

1. All wiring and cabling including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
2. Permanently label or code each point of field terminal strips to show the instrument or item served.
3. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. See Section 26 05 53 – Identification for Structural System
- B. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
- C. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- D. Permanently label or code each point of field terminal strips to show the instrument or item served.

- E. Identify control panels with laminated plastic nameplates, as per Section 26 05 53.
- F. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
- G. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
- H. Identifiers shall match record documents.

3.10 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets that shall be submitted prior to acceptance testing. Commissioning work that requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required. The commissioning must be coordinated with the owner and construction manager to ensure systems are available when needed. Notify the operating personal in writing of the testing schedule so that authorized personnel from the owner and construction manager are present throughout the commissioning procedure.
- B. Phase I – Field I/O Calibration and Commissioning
 - 1. Verify that each control panel has been installed according to plans, specifications and approved shop drawings. Calibrate, test, and have signed off each control sensor and device. Commissioning to include, but not be limited to:
 - a. Sensor accuracy at 10, 50 and 90% of range.
 - b. Sensor range.
 - c. Verify analog limit and binary alarm reporting.
 - d. Point value reporting.
 - e. Binary alarm and switch settings.
 - f. Actuator and positioner spring ranges if pneumatic actuation is utilized.
 - g. Fail safe operation on loss of control signal, pneumatic air, electric power, network communications, etc.
- C. Phase II – System Commissioning
 - 1. Each BMS program shall be put on line and commissioned. The contractor shall, in the presence of the owner and construction manager, demonstrate each programmed sequence of operation and compare the results in writing.
 - 2. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracy.
 - 3. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be rectified and re-tested.
- D. Phase III - Integrated System Program Commissioning
 - 1. Tests shall include, but not be limited to:
 - a. Data communication, both normal and failure modes.

- b. Fully loaded system response time.
 - c. Impact of component failures on system performance and system operation.
 - d. Time/Date changes.
 - e. End of month/ end of year operation.
 - f. Season changeover.
 - g. Global application programs and point sharing.
 - h. System backup and reloading.
 - i. System status displays.
 - j. Diagnostic functions.
 - k. Power failure routines.
 - l. Battery backup.
 - m. Testing of all electrical and HVAC systems with other division of work.
2. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracy and the system performance does not degrade over time.
 3. Using the commissioning test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate 100 percent of the system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.

3.11 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
5. Demonstrate compliance with sequences of operation through all modes of operation.
6. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

- B. Acceptance
 - 1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion.
 - 2. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
 - 3. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.12 TRAINING

- A. Provide a minimum of four (4) on-site, on-line, or classroom training sessions throughout the contract period for personnel designated by the owner. Each session shall be a minimum of four (4) hours each
- B. Provide 40 hours of site specific training for Owner's operating personnel. Training shall include:
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Operate the workstation and peripherals
 - e. Log on and off the system
 - f. Access graphics, point reports, and logs
 - g. Adjust and change system set points, time schedules, and holiday schedules
 - h. Recognize malfunctions of the system by observation of the graphical visual signals
 - i. Understand system drawings and Operation and Maintenance manual
 - j. Understand the job layout and location of control components
 - k. Access data from DDC controllers
 - 2. Advanced Operators:
 - a. Make and change graphics on the workstation
 - b. Create, delete, and modify alarms, including annunciation and routing of these
 - c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - d. Create, delete, and modify reports
 - e. Add, remove, and modify system's physical points
 - f. Create, modify, and delete programming
 - g. Add panels when required
 - h. Add operator interface stations
 - i. Create, delete, and modify system displays, both graphical and others
 - j. Perform DDC system field checkout procedures
 - k. Perform DDC controller unit operation and maintenance procedures

- l. Perform workstation and peripheral operation and maintenance procedures
 - m. Perform DDC system diagnostic procedures
 - n. Configure hardware including PC boards, switches, communication, and I/O points
 - o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
 - p. Adjust, calibrate, and replace system components
 3. System Managers/Administrators:
 - a. Maintain software and prepare backups
 - b. Interface with job-specific, third-party operator software
 - c. Add new users and understand password security procedures
- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor. If such training is required by the Owner, it will be contracted at a later date. Provide description of available local and factory customer training if requested by owner.

END OF SECTION

SECTION 23 09 90

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sequence of operation for:
 - 1. Chilled water systems.
 - 2. Boiler Feedwater Control Sequence
- B. Related Sections:
 - 1. Section 23 09 00 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.
 - 2. Section 23 09 23 - Direct-Digital Control System for HVAC: For equipment, devices, system components, and software to implement sequences of operation.
 - 3. Section 23 09 53 - Pneumatic and Electric Control System for HVAC: For equipment, devices, and system components to implement sequences of operation.
 - 4. Section 25 50 00 - Integrated Automation Facility Controls: For equipment, devices, system components, and software to implement sequences of operation.

1.2 SUBMITTALS

- A. Section 01300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
 - 2. Submit flow diagrams for each control system, graphically depicting control logic.
 - 3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 - 4. Coordinate submittals with information requested in Section 23 09 00 23 09 23 23 09 53.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01780 – Project Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CHILLED WATER SYSTEM OPERATION DESIGN INTENT

A. Chilled Water System

1. This system consists of three water-cooled chillers, a heat exchanger, three primary pumps, a campus wide primary loop and secondary loops at each of the buildings. The system is intended to operate as follows:
 - a. The new plate and frame heat exchanger will act as the first stage of cooling. It will start when the campus wide control system calls for cooling and run until it can not deliver the cool water required. A dedicated primary pump will maintain pressure in the primary loop based on the most demanding differential pressure sensors. This pump will be off and isolated while in the chiller mode.
 - b. The three water cooled chillers vary in age and efficiency. WC-1 will be a new 750 nominal ton chiller with a variable drive with the best efficiency. WC-2 is an existing 500 ton nominal chiller with a variable drive and the next best efficiency. WC-3 is an older chiller that was recently converted to R-123 with significantly lower efficiency than the others. It is intended that Siemens system will optimally select chillers to start and stop based on the system energy use considering part load efficiencies and primary pump energy. Soft starting the chillers is intended.
 - c. Three primary chilled water pumps with variable speed drives. One pump is dedicated to each chiller. Each pump will maintain minimum required evaporator flow and will increase speed up to design flow based on the most demanding differential pressure sensors.
 - d. Two bypass valves will maintain the minimum flow to chiller evaporators while in the chiller mode. These by pass valves will be closed while in the heat exchanger mode
 - e. The chilled water set point is intended to be reset based on the supply and return temperature differential to maximum of 12 F.
 - f. The secondary systems vary in there age, size and configuration. All have pumps. Existing systems typically consist of a pump and three-way valves at each of the coils causing chilled water delta temperature degradation. For some of these systems a new three-ways are being added to limit this condition. These valves will limit the secondary system to discharge higher temperature return to the primary loop. Newer system will have a variable speed drive and only two-way valves in their systems.

B. Well Water Condenser System

1. The condenser water system consists of three well water pumps, a settling tank, two primary pumps, a filter and three re-circulating pumps at each chiller. The intended operation is as follows:
 - a. Three well water pumps supply a settling tank with well water that is used as the condenser water for the entire system. Level controls are used to maintain the water level in this tank and to alarm if the water level is to low.
 - b. Two condenser water pumps with variable speed pumps that supply water to cool either heat exchanger or the chillers. One pump is back-up and they run lead lag. The speed is controlled by tracking the chilled water pump associated with heat exchanger while in that mode and a pressure sensor in the chiller mode.
 - c. This condenser water is run through a filter prior to sending it to any equipment. This filter has differential pressure sensors that will alarm the user to clean the filter.
 - d. Each chiller has a dedicated condenser water pump that maintains minimum required condenser water flow. Due the limited well water available a control valve discharges water to maintain this re-circulating water temperature.

C. Injection Well

1. Well water drawn from settling tank for use as chilled water system condenser water is injected into a deep aquifer.
2. Control of flow into injection well is by a self-contained in well control valve and control system to maintain 10 psig at the well head. .
3. Local control panel includes a PLC.
4. Injection well level and control status will be transmitted to the facility control system.
5. Injection quantity to the aquifer may be limited. The balance of the flow will be diverted to the City and metered for discharge fees.

3.2 CHILLED WATER SUPPLY (CWS) - HEAT EXCHANGER START-UP/RUN MODE

A. When cooling is required, it will be indicated by the Facility Control System (FCS). The FCS facility integration software receives a signal from the Building Management System (BMS) of the various buildings on the campus chilled water loop.

1. Buildings on Loop:
 - a. Cramer Hall
 - b. University Services Building
 - c. ASRC
 - d. Smith Memorial
 - e. Library East
 - f. Neuberger,Shattuck
 - g. Lincoln
 - h. School of Extended Studies
 - i. Science I & II.

2. Chilled Water Supply system is started. Valve FV-030 (inlet to pump P11) OPENS.
 - a. Pump ECP-P11 turns ON to circulate Chilled Water Supply (CWS).
3. Pump P11 speed controlled by CWS system pressure. Minimum CWS loop pressure of 20 PSI maintained by primary pump, P11 speed. Pressure of CWS is monitored by PT-038 (near Neuberger Hall) and PT-036 (near ASRC).
 - a. As building cooling systems require CWS to provide cooling, system pressure will fluctuate (when building requires cooling, the secondary pump will pump chilled water from the CWS, dropping the system pressure). See building CWS secondary system description below.
 - b. When pressure drops, pump P11 will increase speed to maintain system pressure.
 - c. System pressure maintained to provide at least 20 PSI drop through any building. Additional pressure is required to supply and return the CWS/CWR at Cramer. Note: System pressure may be 30-50 PSI. Choose lowest pressure, PT-036 or PT-038 for control.
 - d. No minimum flow rate is required. Pump P11 should be able to maintain system pressure for flows up to 1400 GPM.
4. Note: Well condenser water Pumps P5A and P5B shall operate as a lead-lag duplex system for the heat exchanger primary loop. If system pressure or flow cannot be maintained by one (1) pump, start the second. Provide an alarm 'Pump Failure'. Change 'lead' pump daily.
 - a. Note: the following will use either "P5A" or "P5B" to simplify discussion. It is understood that statements applicable to P5A are also applicable to P5B when the lead switches or as conditions dictate.
5. If CWS temperature at HX-1 (Heat Exchanger) discharge, TT-029, exceeds 59F, turn ON condenser water pump P5A.
 - a. OPEN valve FV-011 - to allow flow through HX-1 primary side.
 - b. Flow rate of condenser water measured by FT-010 (after filters).
 - c. Flow rate (via pump speed) from P5A is controlled by CWS pump P11 speed.
 - d. NOTE: Pump P5A speed will track pump P11. CWS flow from P11 is a calculated value (there is no flow meter for this loop).
 - e. Monitor flow rate of P5A with FT-010. Maximum flow rate for Heat Exchanger primary loop is 1400 GPM. This is slightly less than maximum well water flow into settling tank (Well flow: $750 + 250 + 450 = 1450$).
 - f. Pump P5A flow rate shall not exceed 1400 GPM. This will be a modification of the maximum speed determined by speed of P11.
 - g. Pump P5A speed will track pump P11 unless this speed causes the flow through FT-010 to exceed 1400 GPM flow rate.
6. In Heat Exchanger Mode, the CWS (TT-029) temperature is maintained between 55-59F.
7. If CWS temperature (TT-029) from HX-1 discharge exceeds 59F for a nominal twenty (20) minutes -- change CWS to chiller mode.

3.3 CHILLED WATER SUPPLY (CWS) - SECONDARY SYSTEMS IN HEAT EXCHANGER MODE.

- A. CWS is provided at a nominal 57 F from heat exchanger HX-1.
 - 1. Buildings with 3-Way valve CWS/CWR control are: Cramer Hall East and West, Neuberger, and Smith Memorial.
 - 2. Secondary use systems, such as Cramer Hall West, pump CH-P2 circulate CWS via three-way valves (e.g., TCV-001).
 - 3. This example will use Cramer Hall West, other buildings will use a similar modular programming.
- B. When temperature returning from building system exceeds 58 F at TT-001B, TCV-001 will modulate to return 'warm' water to the CWR. This will allow 'colder' CWS (57 F) to be mixed into the building loop.
- C. Note: return temperature from building system may go higher than 58 F.
 - 1. At 65 F, (TT-001B) valve TCV-001 will be fully open, returning 350 GPM to the CWR piping system.

3.4 CHILLED WATER SUPPLY (CWS) - HEAT EXCHANGER STOP MODE

- A. CWS Temperature (TT-029) \geq 59 F for a nominal twenty (20) minutes.
- B. Stop pump P11.
 - 1. Close valve FV-030.
- C. Close valve FV-011. Stops flow through primary side of HX-1.
- D. Stop pump P5A.
 - 1. Note: Pump P5A speed will be controlled by condenser system pressure (PT-034).

3.5 CHILLER START-UP - CONDENSER AND PRIMARY CWS.

- A. CHILLER #1 (WCU-1).
 - 1. Note: Chiller #2 and #3 similar.
 - 2. Typically, Chillers will be turned on when cooling load exceeds 500 T, the limit of the Heat Exchanger, HX-1.
- B. Start Well Water (Condenser water) pump P5A (if applicable).
 - 1. Speed of P5A controlled by condenser cooling water loop pressure (PT-034), and loop flow rate (FT-010).
 - 2. Minimum pressure shall be maintained at nominal 20 PSI. In Chiller mode, condenser water pressure is determined by Chillers 1, 2, and 3 requirements. (Pump P5A speed will be reduced to minimum required to maintain nominal 20 PSI.
 - 3. Adjust system condenser cooling water loop pressure as required.

4. Maximum flow rate shall be ≤ 1400 GPM (Max.).
 - a. NOTE: P5A may not need to be turned off to switch from HX to Chiller modes.
 - C. Start Condenser (Chiller #1) recirculation pump, ECP-P7.
 1. When flow established in condenser recirculation loop (chiller control panel), open Chilled Water Supply recirculation valve FV-015. (Located at discharge of Chiller Evaporator.)
 2. Start Primary Chilled Water Supply (CWS) pump, ECP-P6.
 3. CWS flow rate measured by Flow transmitter, FT-036, on chiller discharge. Minimum flow rate of 480 GPM maintained by Flow Balancing valves FCV-038 (near Neuberger) and FCV-036 (near ASRC).
 4. Chiller #2 (WCU-2) flow rate measured by FT-040.
 5. Chiller #3 (WCU-3) flow rate measured by FT-038.
 6. Modulate both FCV-036 and FCV-038 at same time.
 7. If Sum of secondary flow rates for all of the buildings (Sum of flow transmitters on BTU meters) ≤ 480 GPM, modulate FCV-036, -038 to maintain minimum flow rate.
 - D. Minimum CWS loop differential pressure of 20 PSI maintained by primary pump, ECP-P6, speed. Pressure monitored by PT-038 (near Neuberger Hall) and PT-036 (near ASRC).
 1. Choose lowest pressure, PT-036 or PT-038 for control.
 - E. Start Chiller #1 (WCU-1).
 1. CWS temperature starting set-point should be 54 F.
 - a. NOTE: CWS temperature should be ≥ 57 -59 F, based on HX mode upper limits.
 - F. Reduce CWS temperature from chiller #1 upon demand from building(s).
- 3.6 CHILLED WATER SECONDARY CWS/CWR (USING 3-WAY VALVES) - CHILLER MODE.

- A. Secondary recirculation pump, e.g., CH-P2 turns ON. CWS is recirculated through building coils for air handlers.
 1. This sequence is similar for buildings using the three-way valve CWS control, such as:
 - a. Cramer Hall East
 - b. Neuberger Hall
 - c. Smith Hall.
 2. CWS temperature monitored by TT-001B (sensor a component of BTU meter). CWR-sec temperature shall be maintained at 56 F. Below 56 F shall be recirculated through TCV-001 back to pump CH-P2.
 3. Above 56 F, CWR shall be returned to the CWR system for return to the chiller(s). Note: bleeding off water to the CWR will supply cooler water to the building HVAC.

4. Modulate CWR/CWS recirculation using a step-and-hold method to prevent uncontrolled fluctuation of control valve and CWS temperatures. Use nominal steps of 25% and hold for 10 minutes.
 - a. For example: Open valve TCV-001 to maintain 25% flow (90 GPM). Hold for 10 minutes. Flow rate monitored by FT-001 (part of BTU sensor).
 - b. Modulation settings and time delay settings are determined by flow rate in each building.
5. If CWS-sec temperature, TT-001B, does fall below 56 F set point, modulate TCV-001 to maintain temperature set point.
6. If CWS-sec temperature does NOT fall below 56 F set point, repeat step 5, step-and-hold up to 100% open.
7. When CWR flow rate from TCV-001 is at maximum (350 GPM (for Cramer Hall west)), and temperature is greater than 56 F, then signal to chiller to provide colder CWS.

3.7 MULTIPLE CHILLER START-UP - CONDENSER AND PRIMARY CWS.

- A. Optimize chiller plant operation to provide most energy efficient supply of CWS via start and stop of the chillers.
- B. Similar start-up sequence:
 1. Start condenser recirculation pump.
 2. When recirculation flow is established, open CWS valve.
 3. Start CWS primary pump.
- C. Minimum flow rate is sum of the chiller(s), and is maintained by Flow Balancing valves FCV-038 (near Neuberger) and FCV-036 (near ASRC).
 1. If Sum of secondary flow rates for all of the buildings (Sum of flow transmitters on BTU meters) \leq Sum of GPM for operating chillers, modulate FCV-036, -038 to maintain minimum flow rate.
 2. Modulate both FCV-036 and FCV-038 at same time.
 3. If Ch#1 + Ch#2 \leq 800 GPM, then modulate to maintain minimum noted.
 4. If Ch#2 + Ch#3 \leq 700 GPM, then modulate to maintain minimum noted.
 5. If Ch#1 + Ch#3 \leq 780 GPM, then modulate to maintain minimum noted.
 6. If Ch#1 + Ch#2 + Ch#3 \leq 1180 GPM, then modulate to maintain minimum noted.
- D. Repeat above steps to add third chiller.

3.8 CHILLER SHUT-DOWN - CONDENSER AND PRIMARY CWS.

- A. CWS flow from chiller #1 evaporator = 480 GPM, system temperature differential \geq 12 F (44-56 F), and CWS system pressure \geq set point (at PT-036, or -038), shut down chiller.
 1. Multiple chillers - shut down Chiller #3 (WCU-3) first; Chiller #2 (WCU-2) next.

- B. Optimize chiller plant operation to provide most energy efficient supply of CWS.
- C. Shut down chiller evaporator. Maintain CWS primary pump for 10 minutes.
- D. Shut down CWS primary pump.
 - 1. Close CWS flow valve (e.g., FV-015).
 - 2. Maintain condenser recirculation pump for 10 minutes.
- E. Shut down condenser recirculation pump (e.g., P7).

3.9 SETTLING TANK LEVEL CONTROL.

- A. Settling tank level is controlled by level transmitter LT-008. (Note: existing level transmitter, identification unknown, confirm instrument identification with PSU).
 - 1. Settling tank level is maintained by well pumps, ECP-P1, -P2, and -P3.
 - 2. LT-008 = 12" Low Level Alarm. Shut down pump P5A.
 - 3. LT-008 = 45" High Level Alarm
 - 4. LT-008 = 48" High-High Level Alarm. Shut off P1, -2, and -P3.
- B. If LT-008 = 48", stop P1, -2, -3.
- C. If LT-008 \leq 30", and WWS flow < 250 GPM, start pump P2.
- D. If LT-008 \leq 30", and WWS flow > 250 and < 450 GPM, start pump P3.
- E. If LT-008 \leq 30", and WWS flow > 450 , start pump P1.
- F. If LT-008 \leq 30", and WWS flow > 750 gpm, start P1.
- G. If LT-008 \leq 30", and WWS flow < 1200 gpm and > 1000 gpm, start P1 and P2.
- H. If LT-008 \leq 30", and WWS flow > 1200 gpm, start all three well pumps - P1, P2, P3.
- I. If LT-008 \leq 24", and WWS flow > 1000 gpm, start pumps - P1, P3.
- J. If LT-008 \leq 24", and WWS flow > 1200 gpm, start all three pumps - P1, P2, P3.
- K. If LT-008 \geq 45", and WWS flow > 1000 and < 1200 gpm, pumps P1 and P3 run (P2 OFF).
- L. If LT-008 \geq 45", and WWS flow > 750 and < 1000 gpm, pumps P1 and P2 run (P3 OFF).
- M. If LT-008 \geq 45", and WWS flow > 450 and < 750 gpm, pump P1 ON.
- N. If LT-008 \leq 12", shut down pump P5A. Alarms "Well failure".
 - 1. Begin orderly shut down of Chilled Water Supply system.

3.10 BOILER FEEDWATER CONTROL

- A. Boiler 4 & 5 Feed water Pump Sequence of Operation Changes
 1. Explanation of change: Currently boiler feed water pumps BFP-4 and BFP-5 are assigned as primary and backup to boilers 4 & 5.
 2. Pump BFP-4 is the lead pump for #4 and Pump BFP-5 is the lag pump for #4 initiated by boiler water level
 3. Pump BFP-5 is the lead pump for #5 and Pump BFP-4 is the lag pump for #5 initiated by boiler water level
 4. Installation of a new economizer for Boiler #5 will change the lead/lag control to single dedicated feed water pump for each boiler with a manual crossover to allow either pump to be used for either boiler.

- B. Boiler #5 will be the lead boiler to allow the economizer to realize energy savings
 1. Selection of Boiler #5 will allow the Feed water pump BFP-5 to pressurize the feed water supply to the boiler #5 through the economizer.
 2. Existing boiler modulating controls do not need to be changed
 3. Upon Low water level from the existing water level controls on Boiler #5 an alarm will be relayed through the Siemens system and the boiler will shutdown

- C. Boiler #4 will be the lag boiler if chosen to be by the operator. Other choices are Boilers 1,2,3.
 1. Selection of Boiler #4 will allow the Feed water pump BFP-4 to pressurize the feed water supply to the boiler #4
 2. Existing boiler modulating controls do not need to be changed
 3. Upon Low water level from the existing water level controls on Boiler #4 an alarm will be relayed through the Siemens system and the boiler will shutdown.

- D. Confirm this sequence with owner's operators prior to any reconfigurations

END OF SECTION

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Natural gas piping above grade.
 2. Unions and flanges.
 3. Valves.
 4. Pipe hangers and supports.
 5. Seismic Valves.

1.2 REFERENCES

- A. American National Standards Institute:
1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
- B. American Society of Mechanical Engineers:
1. ASME B16.3 - Malleable Iron Threaded Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
 4. ASME B31.9 - Building Services Piping.
 5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- C. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- D. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
- E. American Water Works Association:
1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

- G. National Fire Protection Association:
1. NFPA 54 - National Fuel Gas Code.

- H. Underwriters Laboratories Inc.:
1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Use plug, valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

- D. Test Reports: Indicate results of piping system pressure test.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for Submittals.
- B. Project Record Documents: Record actual locations of valves, piping system, and system components.
- C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform work in accordance with applicable code and local gas company requirements.
- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with applicable code authority having jurisdiction AWS D1.1 for welding hanger and support attachments to building structure.
- E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.
- F. Perform Work in accordance with State Municipality of Highways Public Work's standard.
- G. Maintain one copy copies of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience or approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Section 01040 – Project Coordination.
- B. Coordinate trenching excavating bedding backfilling of buried piping systems with requirements of Section 31 23 17.

1.13 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.14 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish two packing kits for each type and size valve.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. See schedule on drawings.

2.2 VALVES

- A. See Section 23 05 23, “General Duty Valves and Accessories”

2.3 PIPE HANGERS AND SUPPORTS

- A. See Section 23 05 29, "Hangers & Pipe Supports for Piping and Equipment"

2.4 STRAINERS

- A. Manufacturers:
1. Mueller Steam Specialty
 2. O.C. Keckley Company
 3. Spirax Sarco, Inc.
 4. Substitutions: Section 01630 - Product Requirements and Substitutions.
- B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.5 NATURAL GAS SEISMIC VALVES AND SENSOR

- A. Manufacturers:
1. Earthquake Safety Systems, Inc.
 2. Substitutions: Section 01630 - Product Requirements and Substitutions.
- B. Seismic Valves
1. Manufacturer: Maxon Corp.
 2. Body: Iron
 3. Seat: Stainless Steel
 4. Gasket: BunaN
 5. Connections: Flanges
 6. Stem: Stainless Steel
 7. Max. Temperature: 125 degrees F
 8. Min. Temperature: -20 degrees F
 9. Motor Voltage: 115V
- C. Seismic Sensor
1. Manufacturer: Apollo Series 2100 Seismic Switch
 2. Sensors: Solid State, triaxial accelerometer
 3. Power Requirements: 120 VAC, 60 HZ with 24 V battery backup.
 4. Enclosure: NEMA 12 std.
 5. Provide 4 bolt attachment to concrete block base.
 6. Communications: See Specification Section 23 09 00.

2.6 PIPE COATING

- A. All natural gas piping shall be painted yellow and marked with appropriate labels.

1. Paint to be Carboline 890 or 893 – Yellow 6666 or DuPont 25p Safety Yellow 23663 with surface preparation per paint manufacturers requirement.
2. See Section 09 90 00 Painting and Coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install pipe hangers and supports in accordance with Section 23 05 29.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- J. Provide support for utility meters in accordance with requirements of utility company.
- K. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00.

- L. Install identification on piping systems including underground piping. Refer to Section 23 05 53.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

3.5 SEISMIC VALVES

- A. Install seismic valves in accordance with manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

- A. Section 01780 – Project Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Pressure test natural gas piping in accordance with NFPA 54.

3.7 SCHEDULES

- A. See schedules on drawings.

- B. Pipe Hanger Spacing:

PIPE SIZE Inches	STEEL PIPE PIPE MAXIMUM HANGER SPACING Feet	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches
1/2	6	3/8
3/4	7	3/8
1	7	3/8
1-1/4	7	3/8
1-1/2	9	3/8
2	10	3/8
2-1/2	10	1/2
3	10	1/2
4	10	5/8
5	10	5/8
6	10	3/4
8	10	3/4

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Well Water / Condenser water piping.
 2. Chilled water piping.
 3. Equipment drains and over flows.
 4. Unions and flanges.
 5. Pipe hangers and supports.
 6. Valves.
- B. Related Sections:
1. Section 23 05 23 - General-Duty Valves for HVAC Piping.
 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 4. Section 23 05 53 - Identification for HVAC Piping and Equipment.
 5. Section 23 07 00 - HVAC Insulation.
 6. Section 23 21 16 - Hydronic Piping Specialties.
 7. Section 23 21 23 - Hydronic Pumps.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
1. ASME B16.3 - Malleable Iron Threaded Fittings.
 2. ASME B16.4 - Gray Iron Threaded Fittings.
 3. ASME B31.1 - Power Piping.
 4. ASME B31.9 - Building Services Piping.
 5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 4. ASTM A536 - Standard Specification for Ductile Iron Castings.
 5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 6. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.

- D. American Water Works Association:
 - 1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 - 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 67 - Butterfly Valves.
 - 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 4. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 5. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

- B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

- C. Provide pipe hangers and supports in accordance with Section 23 05 29.

- D. Provide valves in accordance with Section 23 05 23.

- E. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

- F. Use lug end butterfly valves to isolate equipment.

- G. Use 3/4 inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.

- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of piping system pressure test.
- E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for Submittals.
- B. Project Record Documents: Record actual locations of valves, equipment and accessories.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.1 or ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Not Used

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Section 01040 – Project Coordination: Construction Coordination.

1.13 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.14 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish two packing kits for each size and valve type.

PART 2 PRODUCTS

2.1 CHILLED WATER PIPING, ABOVE GROUND

- A. See schedule on drawings

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
 - 1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
 - 2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

- B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, cut rolled grooved ends.
 - 1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, or ASTM A234/A234M carbon steel, grooved ends.
 - 2. Joints: Grooved mechanical couplings meeting ASTM F1476.
 - a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated hot dipped galvanized, compatible with steel piping sizes, rigid or flexible type.
 - b. Gasket: Elastomer composition for operating temperature range from -30 86 degrees F to 230 180 degrees F.
 - c. Accessories: Steel Stainless steel bolts, nuts, and washers.

2.3 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 VALVES

- A. See Section 23 05 23, "General Duty Valves and Accessories"

2.5 PIPE HANGERS AND SUPPORTS

- A. See Section 23 05 29, "Hangers & Pipe Supports for Piping and Equipment"

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.

- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install pipe hangers and supports in accordance with Section 23 05 29.

3.4 INSTALLATION - PIPING SYSTEMS

- A. Install piping in accordance with ASME B31.9.
- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 23 05 29.
- G. Install pipe identification in accordance with Section 23 05 53.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Provide access where valves and fittings are not exposed.
- J. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Insulate piping and equipment; refer to Section 23 07 00.

3.5 FIELD QUALITY CONTROL

- A. Section 01780: Contract Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Test piping system in accordance with ASME B31.9.

3.6 SCHEDULES

- A. See Section 23 05 23 for Valves and Section 23 05 29 for Hangers and Supports.

END OF SECTION

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressure gauges.
 - 2. Pressure gauge taps.
 - 3. Thermometers.
 - 4. Thermometer supports.
 - 5. Test plugs.(Pete's Plugs)
 - 6. Flexible connectors.
 - 7. Diaphragm type expansion joints
 - 8. Air vents.
 - 9. Strainers.
 - 10. Pump suction fittings.
 - 11. Combination pump discharge valves.
 - 12. Flow controls.
 - 13. Flow meters.
 - 14. Relief valves.
 - 15. Back pressure valve
 - 16. Bag Filters
 - 17. Air Separator

- B. Related Sections:
 - 1. Section 23 21 13 - Hydronic Piping: Execution requirements for piping connections to products specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - 2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

- B. ASTM International:
 - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
 - 2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
 - 3. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.3 PERFORMANCE REQUIREMENTS

- A. Flexible Connectors: Provide at or near motorized equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for Submittals.
- B. Project Record Documents: Record actual locations of actual locations of components and instrumentation.
- C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.

- B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

1.11 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and Bonds.
- B. Furnish five year manufacturer warranty for piping specialties.

1.12 MAINTENANCE SERVICE

- A. Section 01780 – Contract Closeout: Maintenance service.

1.13 MAINTENANCE MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and maintenance materials.
- B. Furnish two bottles of red gauge oil for static pressure gauges.

1.14 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and maintenance products.
- B. Furnish two pressure gauges with pulsation damper dial thermometers.

PART 2 PRODUCTS

2.1 LIQUID FLOW METERS

- A. See section 23 09 00 for flow meters installed in piping system under this section

2.2 PRESSURE GAUGES

- A. Gauge: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Steel.
 - 2. Bourdon Tube: Type 316 stainless steel.
 - 3. Dial Size: 2-1/2 inch diameter.
 - 4. Mid-Scale Accuracy: One percent.

2.3 PRESSURE GAUGE TAPS

- A. Ball Valve: Stainless Steel, 1/4 inch NPT for 250 psi.
- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- C. Siphon: Steel, Schedule 40 Stainless Steel, 1/4 inch NPT angle or straight pattern.

2.4 STEM TYPE THERMOMETERS

- A. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
 - 1. Size: 7 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: Brass, 3/4 inch NPT, long.
 - 4. Accuracy: 2 percent.
 - 5. Calibration: Degrees 100F.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEMPERATURE SENSOR/TRANSMITTER

- A. See Section 23 09 00 – HVAC Instrumentation and Controls” for temperature transmitters installed in piping systems.

2.7 TEST PLUGS (Pete’s Plugs)

- A. 1/2 inch NPT stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure and temperature probe with:
 - 1. Viton core for temperatures up to 400 degrees F.

2.8 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with flanged 150 lb ends; for maximum working pressure 300 psig.
- B. Braided Metal Hose Assembly
 - 1. Provide flexible stainless steel braided metal hose of size, material, end connections, and operating temperature and pressure to match the piping system to which the hose will be attached.
 - 2. Hose used for horizontal seismic deflection shall be of sufficient length to allow minimum horizontal axial and movement of 4 inches. This assembly shall consist of one section of metal hose with stainless steel braid and a 150 psi flange each end.

2.9 DIAPHRAGM – TYPE EXPANSION TANKS

- A. Manufacturer's:
 - 1. Wessels
 - 2. Bell and Gossett
 - 3. Substitutions: Section 01630 – Product Requirements and Substitutions.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig with flexible EPDM diaphragm sealed into tank and steel support stand.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure, double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass.

2.10 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- B. Float Type: (AAV)
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.11 STRAINERS

- A. Size 2 inch and Smaller:
 - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

C. Size 6 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.12 PUMP SUCTION FITTINGS

- A. Fitting: Angle pattern, cast-iron body. Threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger. Rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blow-down tapping in bottom, gauge tapping in side.

2.13 COMBINATION PUMP DISCHARGE VALVES

- A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.14 BACK PRESSURE VALVES

- A. Manufacturers:
 1. Cla-Val
 2. Substitutions: Section 01630 – Product Requirements and Substitutions
- B. Cast steel body, bronze trim
- C. Line pressure activated via pilot control system to maintain desired upstream pressure. Pressure setting to be easily changed.
- D. Sized to handle 1450 gpm with pressure drop of 1.6 psig at sustainable upstream pressure of 10 psig.

2.15 BAG FILTERS

- A. Manufacturer's:
 1. FSI Model RSPN 4000
 2. Eaton Maxline MBF
 3. Substitutions: Section 01630 – Product Requirements and Substitutions.
- B. Construction: CS body with 304SS internals and baskets, EPR gaskets and manual cover hydraulic lifting system.

- C. To handle 1500 gpm at differential pressure of 1.2 psig, having 10 micron screening capability.
- D. Two (2) required of 16 filter bags each.

2.16 AIR SEPARATOR

- A. Manufacturer:
 - 1. B & G Rolairtrol Model R-8G
 - 2. Substitutions: Section 01630 – Product Requirements and Substitutions.
- B. Construction: CS body designed, constructed and stamped for 125 psig @ 350 degrees F in accordance with Section VII Div. I of the ASME B & PV Code. The vessel diameter to be minimum 3 times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction.
- C. Centrifugal type to handle 1300 gpm having 8” inlet and outlet piping connections tangential to the vessel shell.
- D. The unit shall include an internal galvanized steel strainer and air separator with 3/16” perforations and 51% open area, designed to direct accumulated air to a vessel air vent.
- E. A blowdown connection with appropriate fittings shall be provided for manual blowdown and to facilitate routine cleaning.

PART 3 EXECUTION

3.1 INSTALLATION - METERS

- A. Install liquid flow meters with shutoff valve on insertion meter branch.

3.2 INSTALLATION - THERMOMETERS AND GAUGES

- A. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gauge.
- B. Install gauge taps in piping
- C. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- F. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.3 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs as indicated on Drawings.
- B. Where large air quantities accumulate, provide enlarged air collection standpipes.
- C. Install air vents at system high points.
- D. Install automatic air vents where indicated on drawings.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide drain and hose connection with valve on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.4 FIELD QUALITY CONTROL

- A. Section 01780 – Contract Closeout: Field inspecting, testing, adjusting, and balancing.

3.5 CLEANING

- A. Section 01780 – Contract Closeout: Requirements for cleaning

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01780 – Contract Closeout: Requirements for protecting installed construction.
- B. Do not install pressure gauges until after systems are pressure tested.

3.7 SCHEDULES

- A. Flow Meter Location:
 - 1. Chilled water system.

- B. Pressure Gauge Locations are indicated on P & ID and isometric drawings
 - 1. Pumps.
 - 2. Expansion tanks.
 - 3. Pressure tanks.
 - 4. Pressure reducing valves.

- C. Pressure Gauge Tapping Location:
 - 1. Control valves 3/4 inch & larger - inlets and outlets.
 - 2. Heat exchangers - inlets and outlets.
 - 3. Chiller - inlets and outlets.

- D. Stem Type Thermometer Locations are indicated on P & ID and isometric drawings.
 - 1. Headers to central equipment.
 - 2. Heat exchangers - inlets and outlets.
 - 3. Chiller - inlets and outlets.

- E. Thermometer Socket Location:
 - 1. Control valves 1 inch & larger - inlets and outlets.

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Base mounted pumps.
- B. Related Sections:
 - 1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 2. Section 23 05 23 - General-Duty Valves for HVAC Piping.
 - 3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 4. Section 23 21 13 - Hydronic Piping.
 - 5. Section 23 21 16 - Hydronic Piping Specialties.
 - 6. Section 26 05 03 - Equipment Wiring Connections.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

- A. Section 01300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and bonds.
- B. Furnish five year manufacturer warranty for pumps.

1.11 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish one set of mechanical seals for each pump.

PART 2 PRODUCTS

2.1 BASE MOUNTED PUMPS

- A. Manufacturers:
 - 1. See Schedule
 - 2. Substitutions: Section 01630 - Product Requirements and Substitutions.
- B. Type: Horizontal shaft, single stage, direct connected, radial or horizontal split casing, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- D. Impeller: Silicon bronze, fully enclosed, keyed to shaft. ASTM-B584
- E. Bearings: Permanently lubricated roller or ball bearings.
- F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- G. Seal: Carbon rotating against stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- H. Drive: Flexible coupling suitable for variable drive application with coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Performance:
 - 1. See schedule.
- K. Electrical Characteristics and Components:
 - 1. See schedule.
 - 2. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.
- B. Install flexible connectors at or near pumps where piping configuration does not absorb vibration where shown on drawings. Refer to Section 23 21 16.

- C. Provide line sized shut-off valve on pump suction, and line sized soft seat check valve, and shut-off valve on pump discharge. Refer to Section 23 05 23 and Section 23 21 16.
- D. Provide air cock and drain connection on horizontal pump casings.
- E. Provide drains for bases and seals.
- F. Check, align, and certify alignment of base mounted pumps prior to start-up.
- G. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.
- H. Lubricate pumps before start-up.

3.2 FIELD QUALITY CONTROL

- A. Section 01780 – Contract Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Inspect for alignment of base mounted pumps.

3.3 SCHEDULES

- A. See drawings for pump schedules.

END OF SECTION

SECTION 23 22 13

STEAM AND CONDENSATE HEATING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Low pressure steam piping.
 - 2. Low pressure steam condensate piping.
 - 3. Medium and high pressure steam piping.
 - 4. Medium and high pressure steam condensate piping.
 - 5. Equipment drains and over flows.
 - 6. Unions and flanges.
 - 7. Pipe hangers and supports.
 - 8. Valves.

- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating.
 - 2. Section 23 05 23 - General-Duty Valves and Accessories.
 - 3. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 4. Section 23 05 53 - Identification for Piping and Equipment.
 - 5. Section 23 07 00 – Mechanical Insulation.
 - 6. Section 23 22 16 - Steam and Condensate Piping Specialties.
 - 7. Section 23 22 23 - Steam Condensate Pumps.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Gray Iron Threaded Fittings.
 - 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B31.1 - Power Piping.
 - 6. ASME B31.9 - Building Services Piping.
 - 7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

- B. ASTM International:
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High- Temperature Service.
 - 3. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 4. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 5. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 6. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29.
- D. Provide valves in accordance with Section 23 05 23.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of piping system pressure test.

- E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX. AWS D1.1.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, equipment and accessories.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Design piping system hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Oregon.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.12 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish two packing kits for each size and valve type.

PART 2 PRODUCTS

SEE SCHEDULES ON DRAWINGS

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION - INSERTS

- A. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with Section 23 05 29.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install steam supply and steam condensate return piping in accordance with ASME B31.1.
- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 23 05 29.
- G. Install pipe identification in accordance with Section 23 05 53.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- I. Provide access where valves and fittings are not exposed.
- J. Slope steam supply piping one inch in 40 feet in direction of flow when space is available. Use eccentric reducers to maintain bottom of pipe aligned.
- K. Slope steam condensate piping one inch in 40 feet when space is available. Use eccentric reducers to maintain bottom of pipe aligned.
- L. Provide drip trap assembly at low points, risers, and changes in elevation and before control valves.
- M. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.
- P. Install valves with stems upright or horizontal, not inverted.
- Q. Insulate piping and equipment; refer to Section 23 07 00.

3.5 FIELD QUALITY CONTROL

- A. Section 01780 – Contract Closeout: Field inspecting, testing, adjusting and balancing.
- B. Test low pressure steam supply piping, low pressure steam condensate piping, medium and high pressure steam supply piping, and medium and high pressure steam condensate piping in accordance with ASME B31.9 & ASME B31.1.

3.6 SCHEDULES

- A. See valve schedule in Section 23 05 23.
- B. Pipe Hanger Spacing: See Section 23 05 29.

END OF SECTION

SECTION 23 22 16

STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flexible connectors.
 - 2. Pressure gauges.
 - 3. Pressure gauge taps.
 - 4. Strainers.
 - 5. Steam traps.
 - 6. Steam air vents.
 - 7. Expansion bellows

- B. Related Sections:
 - 1. Section 23 22 13 - Steam and Condensate Heating Piping.
 - 2. Section 23 22 23 - Steam Condensate Pumps.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - 2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

- B. ASTM International:
 - 1. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.
 - 2. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

1.3 PERFORMANCE REQUIREMENTS

- A. Steam Traps:
 - 1. Select to handle minimum of two times maximum condensate load of apparatus or pipeserved.
 - 2. Pressure Differentials:
 - a. Low Pressure Systems (15 psi maximum): 2 psi.
 - b. High Pressure Steam (150 psi maximum): 40 psi.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.

- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
 - 5. Indicate by marking clearly on submittal what is intended to be used.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and instrumentation, flow controls, flow meters, and any other inline device.
- C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

- C. Provide temporary protective coating on cast iron and steel valves.
- D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

1.11 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and bonds.
- B. Furnish five year manufacturer warranty for piping specialties.

1.12 MAINTENANCE MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish two bottles of red gauge oil for static pressure gauges.

1.13 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish pressure gauges with pulsation damper and dial thermometers as listed in schedules.
- C. Furnish two service kits for each size and type of steam trap.

PART 2 PRODUCTS

2.1 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Metraflex Metraloop.
 - 2. Hyspan
 - 3. Unisource Manufacturing
- B. Flexible horizontal expansion loops of size, material, and operating temperature and pressure to match the piping system to which the loop will be attached. The flexible loops shall be designed to impart no thrust loads on the anchors. The loop shall consist of

two flexible sections of hose and stainless steel braid, two rigid 90 degree elbows, and a rigid 180 degree return pipe section. End connections shall be flanged.

C. Braided Metal Hose Assembly

1. Provide flexible stainless steel braided metal hose of size, material, end connections, and operating temperature and pressure to match the piping system to which the hose will be attached.
2. Hose used for horizontal seismic deflection shall be of sufficient length to allow minimum horizontal axial and movement of 4 inches. This assembly shall consist of one section of metal hose with stainless steel braid and a 150 psi flange each end.

2.2 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft
2. Weksler

B. Gauge: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Brass Phosphor bronze Type 316 stainless steel.
3. Dial Size: 4 inch, 4-1/2 inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: Psi.
6. Isolators: TFE diaphragms for corrosive fluids.

2.3 PRESSURE GAUGE TAPS

A. Ball Valve: Stainless Steel, 1/4 inch NPT for 250 psi.

B. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections at pump discharges.

C. Siphon: Stainless Steel, 1/4 inch NPT loop pattern.

2.4 STRAINERS

A. Manufacturers:

1. Spirax/Sarco
2. Armstrong
3. Watson/McDaniel

B. Size 2 inch and Smaller:

1. Screwed iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

- C. Size 2-1/2 inch to 4 inch:
 - 1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Size 6 inch and Larger:
 - 1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.5 THERMODYNAMIC TRAPS

- A. Manufacturer:
 - 1. Spirax/Sarco Model TD Series
- B. Trap:
 - 1. Construction: Stainless steel body and disc, suitable for mainline drainage.
 - 2. Rating: 125 psig WSP.
 - 3. Features: Access to internal parts without disturbing piping, bottom drain plug.
 - 4. Accessories: Integral strainer.

2.6 STEAM AIR VENTS

- 1. Spirax/Sarco
- 2. Armstrong
- 3. Watson/McDaniel
- B. 125 psig WSP:
 - 1. Balanced Pressure Type: Cast brass body and cover; access to internal parts without disturbing piping; stainless steel bellows, stainless steel valve and seat.

2.7 EXPANSION BELLOWS

- A. Manufacturers:
 - 1. Adsko - PM
 - 2. Flexicraft – Model EP
 - 3. Hyspan – Series 3500
 - 4. Unisource – Series EP
- B. Externally pressurized, guided single bellows
- C. CS body with SS flexible bellows and flanges at each end.
- D. 150 psig construction with minimum 4” of axial travel.
- E. Drain with plug and lifting lug.

PART 3 EXECUTION

3.1 INSTALLATION - GAUGES

- A. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Install siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install gauges in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - STEAM SYSTEM SPECIALTIES

- A. Steam Traps:
 - 1. Provide minimum 3/4 inch size on steam mains and branches.
 - 2. Install with union or flanged connections at both ends.
 - 3. Provide gate valve and strainer at inlet, and gate valve and check valve at discharge.
 - 4. Provide minimum 10 inch long, line size dirt pocket between apparatus and trap.
- B. Install thermodynamic steam traps on:
 - 1. Main header drip legs.
- C. In high pressure and medium pressure mains, install 3/4 inch nipple in bottom of main, extending 3/4 inch into and above bottom of pipe.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01780 – Contract Closeout: Requirements for protecting installed construction.
- B. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- C. Do not install steam pressure gauges until after systems are pressure tested.

3.4 SCHEDULES

- A. See schedules on drawings

END OF SECTION

SECTION 23 22 23

STEAM CONDENSATE PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. High pressure condensate return units.
- B. Related Sections:
 - 1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
 - 2. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves used in steam and steam condensate piping systems.
 - 3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibrations isolators installed with pumps.
 - 4. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for connection to pumps specified by this section.
 - 5. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and execution requirements for piping specialties installed in steam systems.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate at system fluid temperatures less than 355° F without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Submittal procedures.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes. Include controls and NEMA IV control panel.

- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling requirements.
- B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and bonds.
- B. Furnish five year manufacturer warranty for pumps.

1.11 EXTRA MATERIALS

- A. Section 01780 – Contract Closeout: Spare parts and extra quantities.
- B. Furnish one set of mechanical seals for each pump.

PART 2 PRODUCTS

2.1 HIGH PRESSURE CONDENSATE RETURN UNITS

- A. Manufacturers:
 - 1. Paco
 - 2. Substitutions: Section 01630 - Product Requirements and Substitutions
- B. Condensate Return Units: Consisting of receiver, pumps float switches, control panel and accessories.
- C. Condensate Receiver:
 - 1. Horizontal welded steel, ASME Section VIII stamped construction.
 - 2. Working Pressure: 125 psig.
 - 3. Base: Elevated, fabricated steel.
- D. Accessories:
 - 1. Air vent valve.
 - 2. Water level gage glass.
 - 3. Pressure relief valve.
 - 4. Dial thermometer.
 - 5. Pressure gage.
 - 6. Corrosion inhibitor anode.
 - 7. Inlet baffle.
 - 8. Drain valve.
 - 9. Pressure gages on pump discharge.
 - 10. Double-pole float switches.
- E. Pumps:
 - 1. Single stage, vertical design, stainless steel fitted with mechanical shaft seal, close coupled to 3500 rpm motor.
- F. Control Cabinet:
 - 1. NEMA 4X enclosure, UL listed, with piano hinged door, grounding lug, terminal strip, and fusible control circuit transformer.
 - 2. Combination magnetic starters with overload relays, circuit breakers and cover interlock.
 - 3. Electric alternator, 'Auto-Off' switch.
 - a. Operate pump on high level, alternating after each cycle.
 - b. Operate second pump upon failure of first pump and alarm.
 - 4. Selector 'lead-off-lag' switches.
 - 5. Test buttons, high-level alarm light, acknowledge button, alarm horn.

- G. Unit Capacity: See schedule on drawings
- H. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: In accordance with Section 26 05 03.
 - 2. Motors: In accordance with Section 23 05 13.
 - 3. Disconnect Switch: Factory mount disconnect switch in control panel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings.
- C. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Section 23 22 16.
- D. Provide line sized check valve, and shut-off valve on pump discharge. Refer to Section 23 05 23 and Section 23 22 16.
- E. Provide drains for bases and seals.
- F. Install condensate units on concrete housekeeping base, with anchor bolts, set and level, and grout in place or fabricated galvanized steel stand as indicated on drawings. Refer to Section 03 30 00.
- G. Lubricate pumps before start-up.

3.2 FIELD QUALITY CONTROL

- A. Section 01780: Contract Closeout: Field inspecting, testing, adjusting, and balancing.
- B. Inspect for alignment of pumps.

3.3 SCHEDULES

- A. See schedules on drawings.

END OF SECTION

SECTION 23 57 00

HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes plate type heat exchangers and accessories and trim.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 2. Section 23 07 00 - HVAC Insulation.
 - 3. Section 23 21 13 - Hydronic Piping.
 - 4. Section 23 21 16 - Hydronic Piping Specialties.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.3 SUBMITTALS

- A. Section 01300 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate dimensions, locations, size of taps, and support frame.
- C. Product Data: Submit performance data.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01700 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit start-up and shut down instructions, assembly drawings, and spare parts lists.

1.5 QUALIFICATIONS

- A. Manufacturer: Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Accept heat exchangers on site in factory protective packaging. Inspect for damage.
- C. Protect openings with temporary caps to prevent entry of foreign material.

1.7 WARRANTY

- A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer's warranty for heat exchangers

1.8 EXTRA MATERIALS

- A. Section 01700 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two sets of replacement gaskets.
- C. Furnish one set of wrenches for disassembly of plate type heat exchangers.

PART 2 PRODUCTS

2.1 PLATE TYPE HEAT EXCHANGERS

- A. Manufacturers:
 - 1. Baltimore Aircoil Co. Model.
 - 2. ITT Bell & Gossett Model.
 - 3. Patterson-Kelley Co. Model.
 - 4. Substitutions: Section 01600 - Product Requirements.
- B. Frames: Carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
- C. Plates: Stainless steel Type 304, 0.0197 inch
- D. Gaskets: Nitrile rubber.
- E. Nozzles: 150 psig ASA rubber rated flange type.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with State of Oregon standards.
- B. Install with clearance to permit removal of plates with minimum disturbance to installed equipment and piping.
- C. Support heat exchangers and anchor to concrete base pad.

- D. Make connections to heat exchangers with unions or flanges.
- E. Install heat exchanger to allow draining and install drain connection at low point.
- F. Install piping from relief valve to nearest floor drain.
- G. Install valves and piping specialties in accordance with details as indicated on Drawings.

3.2 SCHEDULES

- A. Heat Exchangers: As Scheduled on Drawings

END OF SECTION

SECTION 23 57 01

BOILER FEEDWATER HEAT EXCHANGER

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes feedwater heat exchangers and accessories and trim.
- B. Related Sections:
 - 1. Section 02 41 19 – Mechanical Demolition
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 3. Section 23 07 00 - HVAC Insulation.
 - 4. Section 23 21 13 - Hydronic Piping.
 - 5. Section 23 21 16 - Hydronic Piping Specialties.
 - 6. Section 23 22 13 - Steam and Condensate Heating Piping.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- B. SMACNA

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Submittal Procedures
- B. Shop Drawings: Indicate dimensions, locations, size of taps, and support frame.
- C. Product Data: Submit performance data.
- D. Test Reports: Indicate shop test reports of tube bundle shop pressure tests.
- E. Manufacturer's Certificate: Certify Products meet or exceed ASME Code Requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01780 – Contract Closeout: Requirements for submittals.
- B. Operation and Maintenance Data: Submit start-up and shut down instructions, assembly drawings, and spare parts lists.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Oregon, City of Portland, and ASME standards.

- B. Maintain one copy copies of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years experience and/or approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 - Product Requirements: Product storage and handling.
- B. Accept heat exchangers on site in factory protective packaging. Inspect for damage.
- C. Protect openings with temporary caps to prevent entry of foreign material.

1.9 WARRANTY

- A. Section 01780 – Contract Closeout: Warranties and bonds
- B. Furnish five year manufacturer's warranty for heat exchangers

1.10 EXTRA MATERIALS

- A. Section 017810 – Contract Closeout: Spare parts and extra materials.
- B. Furnish two sets of replacement gaskets.

PART 2 PRODUCTS

2.1 FEEDWATER HEAT EXCHANGERS

- A. Manufacturers:
 - 1. Cannon Boiler Works Model FJ-10-DC5
 - 2. Substitutions: Section 01630 - Product Requirements and Substitutions.
- B. Tubes: Finned individual tubes suitable for 125 psig Working pressure. Tubes shall be carbon steel with carbon steel fins.

- C. Body: Steel with threaded or flanged piping connections and necessary taps for thermometer wells, safety relief valve and drains, steel saddle and attaching U-bolts, CS transition flanges, CL blind flange kit, and all CS prime painted.
- D. Water Chamber and Tube Bundle: Removable for inspection and cleaning.
- E. Design: Heating fluid in shell and heated fluid in tubes.
- F. Other Accessories: Safety relief valves.
- G. Performance and Load Conditions:

<u>100% Load</u>	<u>Water Side</u>	<u>Flue Gas Side</u>
Mass Flow (lbs/hr)	15,525	17,854
Inlet Temperature (F)	170	325
Outlet Temperature (F)	201	224
Specific Heat (btu/lb F)	1.0034	0.267
Pressure Drop	.98	0.09 in WC*
Fouling Factor	0.0005	0.001
Unit Duty (btu/hr)	482,747	
Hours of operation	320	

*not including transition losses. This unit is designed for a boiler with minimum of 0.25" WC flue gas pressure at the economizer.

<u>75% Load</u>	<u>Water Side</u>	<u>Flue Gas Side</u>
Mass Flow (lbs/hr)	11,644	13,391
Inlet Temperature (F)	170	300
Outlet Temperature (F)	198	210
Unit Duty (btu/hr)	321,419	
Hours of Operation	1,050	

<u>50% Load</u>	<u>Water Side</u>	<u>Flue Gas Side</u>
Mass Flow (lbs/hr)	7,763	8,927
Inlet Temperature (F)	170	275
Outlet Temperature (F)	194	197
Unit Duty (btu/hr)	185,817	
Hours of Operation	2,100	

<u>25% Load</u>	<u>Water Side</u>	<u>Flue Gas Side</u>
Mass Flow (lbs/hr)	3,881	4,464
Inlet Temperature (F)	170	250
Outlet Temperature (F)	190	184
Unit Duty (btu/hr)	78,137	
Hours of Operation	750	

2.2 DUCTWORK AND ACCESSORIES

- A. Transition ductwork between heat exchanger and exhaust duct as indicated on drawings.

- B. Flanges for welding on existing ductwork.
- C. Flexible Duct Connector
 - 1. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans to isolate vibration transfer. Connectors shall be attached in such a manner as to provide an airtight and waterproof seal.
 - 2. Connectors will comply with NFPA 90A, "Installation of Air Conditioning & Ventilation Systems" and NFPA 90B, "Installation of Warm Air Heating & Air Conditioning Systems."
 - 3. Metal to be galvanized steel, fabric to be Teflon.
 - 4. Rated to 300F
 - 5. Ductmate Industries, Inc., Proflex Flexible Connector.
 - a. Teflon commercial, 4" x 4" x 4" galvanized steel to be of 16 gauge.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with State of Oregon and SMACNA standards.
- B. Install with clearance to permit removal of tubes with minimum disturbance to installed equipment and piping.
- C. Remove existing ductwork and far side expansion joint in accordance with specification Section: 02 41 23 – Mechanical Demolition.
- D. Install ductwork, flanges, expansion joint, and other accessories as indicated on drawings to complete installation of heat exchange.
- E. Make connections to heat exchangers with unions or flanges.
- F. Install heat exchanger to allow draining and install drain connection at low point. Pitch shell to completely drain condensate.
- G. Install piping from relief valve to nearest floor drain.
- H. Install valves and piping specialties in accordance with details as indicated on Drawings.
- I. Install flue gas to water heat exchanger with the following trim:
 - 1. Pressure relief valve.
 - 2. Temporary gage on inlet and outlet of the water side..

END OF SECTION

SECTION 23 64 16

CENTIFUGAL WATER CHILLER

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Chiller package.
 - 2. Charge of refrigerant and oil.
 - 3. Controls and control connections.
 - 4. Chilled water connections.
 - 5. Condenser water connections.
 - 6. Auxiliary water connections.
 - 7. Starters.
 - 8. Electrical power connections.
 - 9. Heat recovery.
 - 10. Free cooling.

- B. RELATED SECTION
 - 1. Section 15510 - Hydraulic Piping.
 - 2. Section 15535 - Refrigeration Piping and Specialties.
 - 3. Section 15950 - Controls and Instrumentation.
 - 4. Section 16180 - Equipment Wiring Systems.

1.2 REFERENCES

- A. ANSI/ASHRAE STANDARD 15-2001 - Safety Code for Mechanical Refrigeration.
- B. ASHRAE 90.1 - Energy Conservation in New Building Design.
- C. ASME SEC VIII - Boiler and Pressure Vessel Code.
- D. ANSI/UL 465 - Central Cooling Air Conditioners.
- E. ARI STANDARD 550/590-2003 - Centrifugal, Helical rotary, scroll, and reciprocating water chillers.
- F. ARI Standard 575-94 Sound
- G. AFBMA 9 - Load Ratings and Fatigue Life of Roller Bearings.
- H. ASHRAE STANDARD 34 - Number Designation and Safety Classification of Refrigerants
- I. ANSI/ASHRAE Standard 147-2002 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

1.3 SUBMITTALS

- A. Section 01300 – Submittals.
- B. With the Bid: Confirm proposed chiller is capable of being handled through existing mechanical access ways and that any dismantling and reassembly will be accomplished by manufacturer approved technicians.
- C. Acceptable Refrigerants on which chiller performance is based are: HCFC-123, HFC-134a, HCFC-22. All proposals for chiller performance must include an ARI approved selection method for the specified refrigerants.
- D. Drawings: Indicating assembled dimensions, operating weight and load distribution, and required service and access clearances.
- E. Product Data: Indicating options and specialties, electrical requirements and wiring diagrams and connections. Indicate accessories, valves, strainers, and thermostatic valves required for complete system.
- F. Submit rigging, installation, and start-up procedures. Include operations and maintenance data for both the chiller and starter or variable speed drive. Include location, size and type of field piping connections.
- G. Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature.
- H. Submit compressor and product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound pressure level per ARI 575-1994 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lbs.), and amount of oil required (gallons).

1.4 VERIFICATION OF CHILLER CAPACITY AND EFFICIENCY

- A. One of each size chiller shall be factory performance tested with the proposed refrigerant under full load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified. Proper ARI certification documents for the test loop shall be made available upon request from the manufacturer for inspection.
- B. The factory test instrumentation shall be per ARI Standard 550/590-2003, and the calibration of all instrumentation shall be traceable to the National Institute of Standards and Technology (formerly NBS).
 - 1. Section 01410 – Testing Laboratory Services.
- C. The performance test shall be run with clean tubes in accordance with ARI 550/590-2003 to include the following:
 - 1. A downward temperature adjustment per ARI 550/590-2003 Section C6.3 shall be made to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.

2. An upward temperature adjustment per ARI550/590-2003 Section C6.3 shall be made to the design entering condenser water temperature to adjust from the design fouling to the clean tube condition.
3. There shall be no exceptions to conducting the performance test with clean tubes and with temperature adjustments in (1) and (2). The manufacturer shall clean tubes, if necessary, prior to test to obtain a test fouling factor of .0000 hr. sq. ft. F/BTU.

1.5 SOUND DATA

- A. The Centrifugal Chiller Sound Pressure Level (SPL), in decibels (dB), with a reference pressure of 20 micropascals, shall not exceed Sound Levels: All ratings shall be in accordance with ARI Standard 575-94.

Load %	Decibels (A Weighted)
100	85
50	85
25	89

- B. To represent the chiller's loudest operating condition and expose any sound problems, a reduction in the temperature of the entering condenser water and/or raising of the leaving chilled water temperature shall not be allowed when determining the Sound Pressure Levels.
- C. Sound Pressure Test - Chiller shall have a sound test conducted at the factory prior to shipment to confirm the submitted Sound Pressure Levels. All data must be measured and presented in strict accordance with ARI Standard 575-1994.
1. The sound data points shall be measured simultaneously during the verification of capacity and efficiency as outlined in Section 1.05.
 2. If liquid refrigerant injection is used for reducing the sound pressure level, then liquid injection is to be used when conducting the performance test, noting that liquid refrigerant injection penalizes the chiller performance.
 3. In the event that a chiller does not meet the submitted dBA sound pressure level, sufficient funds will be deducted from the purchase order to cover materials and labor for jobsite chiller attenuation, and to cover expenses of a retest to insure that the submitted levels are met. This attenuation shall be applied in such a manner that it does not hinder the operation or routine maintenance procedures of the chiller.

1.6 VARIABLE EVAPORATOR FLOW CAPABILITY

- A. Chillers applied in variable evaporator flow (VPF) system shall be able to withstand a chilled water flow rate-of-change of twenty five percent (25%) per minute while maintaining plus or minus two (+/- 2 F) of design supply chilled water temperature, and fifty percent (50%) per minute at any load above the compressor minimum without cycling "off" on low load (low leaving water temperature) or evaporator refrigerant temperature limit.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ARI Standard 550/590-2003 code for rating and testing of water chillers.
- B. Conform to UL 1995 for Safety for Heating and Cooling Equipment.
- C. Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.
- D. Conform to ANSI/ASHRAE STANDARD 15-2001 code for construction and operation of centrifugal chillers.

1.8 HANDLING AND EQUIPMENT ROOM REQUIREMENTS

- A. Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, rigging and final setting.
- B. Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation.

1.9 WARRANTY

- A. Provide a complete unit parts warranty (excluding refrigerant) for one year from start-up.
- B. An labor warranty will be provided that covers the expense of labor to replace a part that is found to be defective in material or workmanship. The cost of reasonable technician travel and diagnostic time is included with standard hour allowances applying. Only a Trane commercial warranty agent may perform warranted repairs under the labor warranty. Replacement parts, loss of refrigerant, excess hours (overtime, nuisance calls, inefficiency or access problems) are not covered. Provide Whole Unit Labor Warranty for the duration of 1st year.
- C. A 2nd through 5th year motor/transmission/compressor parts warranty shall be provided based upon the RPM of the compressor as follows:

Compressor RPM	Warranty Term
0-5000	1 Year from start-up
5000-10,000	5 years from start-up
10,001 an above	5 years plus annual oil analysis

PART 2 PRODUCTS

2.1 SUMMARY

- A. Description: Factory-assembled and tested water chiller complete with compressor, evaporator, condenser, controls, starter or variable speed drive, interconnecting unit piping and wiring, indicating accessories, and mounting frame. Performance shall be per specification section 3 schedule.

- B. The contractor shall furnish and install centrifugal water chiller as shown and scheduled in the plans and specifications. The units shall produce the specified tonnage per the scheduled data in accordance with ARI 550/590-2003. The unit shall bear the ARI certification label as applicable.
- C. Approved Manufacturers:
 - 1. Trane
 - 2. Carrier
 - 3. York
 - 4. McQuay
- D. Unit shall be painted in accordance with the manufacturers standard procedures and practices.

2.2 COMPRESSOR AND MOTOR

- A. The compressor shall be centrifugal.
- B. Low pressure refrigerant machines shall be provided when available.
- C. Chiller should be able to unload to 20 percent of design tonnage with constant entering water temperature. The minimum unloading point shall be demonstrated at the time of the factory performance test. The machine shall be modified to include hot gas bypass if the minimum load cannot be met.
- D. Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the customer for approval.
- E. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable. If an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided.
 - 1. An oil reservoir shall collect any oil and refrigerant that leaks past the seal.
 - 2. A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
 - 3. Manufacturer shall warrant the shaft seal, reservoir, and float valve system against leakage of oil and refrigerant to the outside of the chiller for a period of 5 years from initial start-up, including parts and labor to replace a defective seal and any refrigerant required to trim the charge to original specifications. Inspections shall be performed a minimum of once a year.
 - 4. Motors shall have winding RTD's for temperature sensing on each phase. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
- F. Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion. Costs to be included in the bid.

- G. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

2.3 EVAPORATOR (CHILLER BARREL)

- A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration.
- B. Evaporator tubes shall be internally enhanced. The minimum tube wall thickness shall be 0.025 inch.
- C. The evaporator water piping connections shall be grooved.
- D. The evaporator water boxes shall be standard non-marine type with connections per schedule.
- E. Supply and return head water boxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.
- F. Insulation will be 3/4" insulation and cover all low temperature surfaces to include the evaporator, water boxes, and suction elbow. Economizer, if applicable, is insulated with 3/8" insulation.
- G. Units with multi-stage compressors shall incorporate an interstage flash vessel "economizer". All units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of subcooling.
- H. Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer at the end of each year for the first five years of operation to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion. Costs to be included with bid.

2.4 CONDENSER

- A. The condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration.
- B. Condenser tubes shall be internally enhanced. The minimum tube wall thickness shall be 0.028 inch.
- C. The condenser water piping connections shall be grooved.
- D. The condenser water boxes shall be standard non-marine type with connections per schedule.

- E. Supply and return head water boxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

2.5 PURGE SYSTEM

- A. The manufacturers of low pressure machines, must provide a purge system. Acceptable purges are the Trane EarthWise Purge and the York Skyguard Purge. The Turboguard Purge is not acceptable.
- B. The purge efficiency must meet ASHRAE Standard 147-2002 paragraph 4.7.
- C. The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Standard 147-2002, paragraph 4.7.2 (a).

2.6 CONTROLS

- A. The chiller shall be controlled by a unit mounted, stand-alone Direct Digital Control (DDC) system. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer.
- B. Enclosure shall be unit mounted NEMA 250 Type 1 using wire duct. Zip ties are not acceptable.
- C. A color, touch sensitive liquid crystal display (LCD) shall be unit mounted and a minimum of 12.1" diagonal. The display shall be fully adjustable in height and viewing angle. Animated graphical representations of chiller subsystem operation shall be used to enhance the user interface.
- D. Display shall consist of a menu driven interface with easy touch screen navigation to organized subsystem reports for compressor, evaporator, condenser, purge and motor information as well as associated diagnostics. The controller shall display all active diagnostics and a minimum of 20 historical diagnostics.
- E. The controller shall have the ability to display all primary sub-system operational parameters on dedicated trending graphs. The operator must be able to create up to 6 additional custom trend graphs, choosing up to 10 unique parameters for each graph to trend log data parameters simultaneously over an adjustable period and frequency polling.
- F. The chiller control panel shall provide control of chiller operation and monitoring of chiller modules, sensors, actuators, relays and switches. The chiller control panel shall include controls to safely and efficiently operate the chiller.
- G. Safeties - the chiller control panel shall provide the following safeties:
 - 1. Low chilled water temperature
 - 2. Low evaporator refrigerant temperature or pressure

3. High condenser refrigerant pressure
 4. Evaporator and condenser water flow status
 5. Low oil pressure
 6. Low oil temperature
 7. High oil temperature
 8. High motor winding temperatures
 9. High motor current
 10. Starter/AFD function faults
 11. Sensor faults
 12. Unit controls operation
 13. The chiller control panel or starter shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:
 - a. Current phase loss
 - b. Current phase unbalance
 - c. Current phase reversal
 - d. Under/Over voltage
 - e. Motor current overload
 - f. Distribution fault protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current
 - g. Starter contactor fault protection
 - h. Starter transition failure
- H. The chiller control panel shall be capable of displaying system data in I-P or SI units.
- I. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:
1. Run time
 2. Number of starts
 3. Current chiller operating mode
 4. Chilled water set point and set point source
 5. Electrical current limit set point and set point source
 6. Entering and leaving evaporator water temperatures
 7. Entering and leaving condenser water temperatures
 8. Saturated evaporator and condenser refrigerant temperatures
 9. Evaporator and condenser refrigerant pressure
 10. Oil tank temperature
 11. Oil tank pressure
 12. Oil pump discharge pressure
 13. Differential oil pressure
 14. Compressor motor current per phase
 15. Compressor motor percent RLA
 16. Compressor motor voltage per phase
 17. kW energy consumption and power factor
 18. Compressor motor winding temperatures per phase
 19. Purge operating mode
 20. Purge operating status
 21. Time until next purge run

22. Daily pumpout - 24 hours
 23. Avg daily pumpout - 7 Days
 24. Purge refrigerant compressor suction temp
 25. Purge liquid temp (chiller condenser saturated refrigerant temperature)
 26. Daily pumpout limit/alarm
- J. The chiller control panel shall provide password protection of all setpoints.
- K. Control authority must be capable of handling at least four conditions: Off, local manual at the chiller, local automatic at the chiller and automatic control through a remote source.
- L. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive mode. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.
- M. The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls.
- N. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.
- O. The chiller control panel shall be capable of providing short cycling protection.
- P. The chiller control panel shall provide a relay output that shall energize whenever the compressor is running.
- Q. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.
- R. The chiller control panel shall provide a relay output that shall energize whenever the chiller is operating at maximum capacity.
- S. The chiller control panel shall provide a head relief request relay output to indicate that the chiller is in condenser limit mode and thereby requesting condenser water temperature relief.
- T. The chiller control panel shall provide an analog output signal that shall indicate the condenser refrigerant pressure or condenser/evaporator differential refrigerant pressure.
- U. The chiller controller shall communicate directly to Siemens control system via Modbus or Bacnet.

2.7 STARTERS

A. VARIABLE SPEED DRIVE (VSD), UNIT MOUNTED

1. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.
3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
4. The VSD shall be solid state, microprocessor based pulse width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
6. The VSDs shall each be furnished in a NEMA 1 metal enclosure having:
 - a. Minimum short circuit with stand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
 - b. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
 - c. The entire chiller package shall be U.L./C.U.L. listed.
7. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
8. Compliance to recommendations stated in IEEE 519-1992.
 - a. The VSD design shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than 5-percent.
9. Input shall be nominal 480 volts, three phase, 60 Hertz AC power, +/- 10 percent of nominal voltage.
10. Line frequency 38-60 hertz.
11. The VSD shall include the following features:
 - a. All control circuit voltages are physically and electrically isolated from power circuit voltage.
 - b. One hundred fifty percent instantaneous torque available for improved surge control.
 - c. Minimum and maximum speed adjustments.
 - d. Soft start, adjustable linear acceleration, coast to stop.

- e. Adjustable current limiting and UL approved electronic motor overload protection.
 - f. Insensitivity to incoming power phase sequence.
 - g. VSD and motor protection from the following faults:
 - Output line-to-line short circuit protection.**
 - Line-to-ground short circuit protection
 - Phase loss at AFD input
 - Phase reversal / Imbalance
 - Over-voltage
 - Under-voltage
 - Over temperature
 - h. Carrier frequency shall be fixed at 2 Khz for maximum efficiency.
 - i. Automatic operation at minimum speed if the input reference is lost.
12. The following VSD status indicators shall be available to facilitate startup and maintenance:
- Output speed in hertz and rpm**
 - Input line voltage
 - Input line kW
 - Output/load amps
 - Average current in percent RLA
 - Load power factor
 - Fault
 - VSD transistor temperature
13. Service Conditions - at full output power; no external venting or heat exchangers shall be required.
- a. Operating ambient temperature 32-104 F (0-40 C).
 - b. Room ambient 0-95% relative humidity.
 - c. Elevation to 150 feet (400 meters).
14. Warranties
- a. The variable speed drive shall be warranted by the manufacturer for a period of twelve months from the date of project completion and startup. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.
15. Proof-of-Flow
- a. Manufacturer to provide differential pressure switches for the evaporator and condenser for field installation. Flow switches are not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. Include for connection of oil pump if required.
- C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- D. Furnish and install necessary auxiliary water piping for oil cooling units if required.
- E. Arrange piping for easy dismantling to permit tube cleaning.
- F. Provide piping from chiller relief device to outdoors. Size as recommended by manufacturer.
- G. Contractor to field install differential pressure switches across the evaporator and condenser. Coordinate location with chiller manufacturer.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the chiller(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the chillers(s). Chiller manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.
- B. A start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Conduit and wire for lights and receptacles in tunnels.
 - 2. Conduit and wire for motors and other loads.
 - 3. Breakers in switchboards, motor control center, and panelboards.
 - 4. Variable frequency drives for existing and new motor installations.
 - 5. Motor starters (controllers) in existing motor control center for new pump motors.
 - 6. Other miscellaneous electrical as noted on drawings

1.2 SYSTEM DESCRIPTION

- A. Power circuits for chilled water system pump motors
 - 1. Variable frequency drives
 - 2. Disconnect switches
- B. Power circuit for new 750T Chiller, including breaker in main distribution panel.
 - 1. Connect cable or wire at source and chiller power and control panel.
- C. Lighting and receptacles in tunnels.
- D. Identify location of electrical components.

1.3 SUBMITTALS

- A. Section 01300 – Submittals

PART 2 PRODUCTS

- A. Section 26 05 19 through 26 52 00, inclusive.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Provide temporary wiring and connections to maintain existing systems in service during construction as necessary. Coordinate with owner.

- B. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- C. Remove, relocate, and extend existing installations to accommodate new construction.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 INSTALLATION

- A. Section 26 05 19 through 26 52 00, inclusive.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Stranded conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 16 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 2.5 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
 - 2. Exposed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
 - 3. Above Accessible Ceilings: Use only Type THHN/THWN insulation, in raceway.
 - 4. Wet or Damp Interior Locations: Use only Type THHN/THWN insulation, in raceway.

5. Exterior Locations: Use only Type XHHW insulation, in raceway.
6. Underground Locations: Use only Type XHHW insulation, in raceway.

1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper.

1.5 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Product Data: Submit for wire and each cable assembly type.
- C. Test Reports: Indicate procedures and values obtained.

1.6 QUALITY ASSURANCE

- A. Section 01400 – Quality Requirements.
- B. Perform Work in accordance with Municipality of Portland, OR requirements.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.9 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 20 ft (6000 mm) of length shown.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 1. American Insulated Wire Corp.
 2. General Cable Co.
 3. Southwire

4. Superior Essex
 5. Okonite
 6. Or approved equal
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 75 degrees C.
- F. Insulation Material: Thermosetting.

2.2 WIRING CONNECTORS

- A. Solderless Pressure Connectors:
1. Wire sizes up to and including #10AWG: Compression or crimp terminals shall be similar to “Sta-Kon” (by Thomas & Betts).
 2. Wire sizes #8 AWG and larger: Connectors shall be compression-type. Use manufacturer’s recommended tooling.
 3. Pigtail splices for wire sizes up to AWG including #10 AWG may be made with hand twist wire-nuts similar to “Skotchlok” by 3M Company.
 4. Substitutions: Section 01630 – Product Requirements and Substitutions.
- B. Compression Connectors:
1. Up to #4/0 AWG short-barrel single-hole lugs - similar to “Color-Keyed” by Thomas & Betts.
 2. Short-barrel two-hole lugs, similar to “Color-Keyed” by Thomas & Betts.
 3. For 250 kcmil and larger – Long barrel single-holed or two-holed lugs - similar to “Color-Keyed” by Thomas & Betts.
 4. Two-way connectors (splices) – Similar to “Color-Keyed” by Thomas & Betts.
 5. Substitutions: Section 01630 – Product Requirements and Substitutions.

2.3 TERMINATIONS

- A. Terminal Lugs for Wires #6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires #4 AWG and Larger: Compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.

- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire #4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, #6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.

- 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, #10 AWG and smaller.
- G. Install stranded conductors for branch circuits #10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires #4 AWG and larger to copper bus bars.
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.
- K. Do not install wire terminals, such as ring or spade terminals, for wire termination in components utilizing compression terminal blocks, e.g. mother control center, variable frequency drives, etc.

3.5 WIRE COLOR

- A. General: See Section 26 05 53 – Electrical Identification.

3.6 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

- B. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

- D. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.5 SUBMITTALS

- A. Section 01300 - Submittals
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgements: For conditions not covered by UL listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

- A. Section 01400 – Quality Requirements

- B. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- C. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- D. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- E. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- F. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01630 – Product Requirements and Substitutions: Product Delivery, Storage, and Handling.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for Raceway Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.

- C. Sleeves for Raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

2.4 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. Fire Trak Corp. Model.
 - 3. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
- C. Color: As selected from manufacturer's full range of colors.

2.5 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Sheet metal.
 - 3. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

2.6 EQUIPMENT BASES

- A. Provide equipment bases for all floor mounted electrical equipment. Unless otherwise indicated, provide poured-in-place concrete bases, nominally 4 inches high, and 1 inch larger on all exposed edges than the equipment to be mounted.
- B. On all equipment bases in interior locations, unless otherwise noted, provide two or more parallel, cast-in-place, continuous-slot channel erector system concrete inserts for equipment mounting. Bolt equipment to channels. Provide additional surface mounted channels where required to match and line up with existing equipment.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Construction Coordination.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide expansion anchors.
 - 2. Steel Structural Elements: Provide beam clamps and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and self-drilling inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.

- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where conduit penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

G. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, floor, and ceiling, as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 01780 – Contract Closeout: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01780 – Contract Closeout: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 03 - Equipment Wiring Connections.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53 - Identification for Electrical Systems.
 - 4. Section 26 27 16 - Electrical Cabinets and Enclosures.
 - 5. Section 26 27 26 - Wiring Devices.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Raceway:
 - 1. Basis of Measurement: By linear foot.
 - 2. Basis of Payment: Includes materials, delivery, handling, and installing.
- B. Boxes:
 - 1. Basis of Measurement: By cubic foot.
 - 2. Basis of Payment: Includes materials, delivery, handling, and installing.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground More than 5 feet outside Foundation Wall: Provide rigid steel conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit, intermediate metal conduit, plastic coated conduit, thickwall nonmetallic conduit and thin-wall nonmetallic conduit. Provide cast metal or nonmetallic boxes.
- D. In or Under Slab on Grade: Provide rigid steel conduit. Provide cast or nonmetallic metal boxes.
- E. Outdoor Locations, Above Grade: Provide rigid steel conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit and, electrical metallic tubing. Provide cast boxes.
- G. Wet and Damp Locations: Provide rigid steel or aluminum conduit, intermediate metal conduit, electrical metallic tubing, and thickwall nonmetallic conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide rigid steel conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- I. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit and, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.5 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.6 SUBMITTALS

- A. Product Data: Submit for the following:
 - 1. Liquidtight flexible metal conduit.
 - 2. Raceway fittings.
 - 3. Conduit bodies.
 - 4. Pull and junction boxes.
 - 5. Handholes.
 - 6. Conduit, or raceway

- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual routing of conduits larger than 1 inch.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.9 COORDINATION

- A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 00.
- B. Coordinate mounting heights, orientation and locations of outlets.

PART 2 PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp.
 - 4. Appleton
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit. Furnish aluminum fittings with steel conduit. All steel fittings.

2.2 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices

3. Rob Roy
4. Or approved equal

- B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 1. Carlon Electrical Products
 2. Hubbell Wiring Devices
 3. Thomas & Betts Corp.
 4. Appleton
 5. Crouse-Hinds
- B. Product Description: Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. Appleton
 2. Allied
 3. Or approved equal
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression set screw indenter type.

2.5 NONMETALLIC CONDUIT

- A. Manufacturers:
 1. Carlon Electrical Products Model.
 2. Or approved equal
- B. Product Description: NEMA TC 2; Schedule 40 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 OUTLET BOXES

- A. Manufacturers:
 1. Carlon Electrical Products
 2. Hubbell Wiring Devices

3. Thomas & Betts Corp.
 4. Crouse-Hinds
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, aluminum cast fer alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.7 PULL AND JUNCTION BOXES

- A. Manufacturers:
1. Appleton
 2. Hubbell Wiring Devices Model.
 3. Triangle
 4. Allied
 5. Circle AW
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section 26 27 16.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4 4X 6; flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron.
 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- E. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
1. Material: Galvanized cast iron.
 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 3. Cover Legend: "ELECTRIC".
- F. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
 2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- B. Identify raceway and boxes in accordance with Section 26 05 53.
- C. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 1 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

- X. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- B. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

- B. Related Sections:
 - 1. Section 27 05 53 - Identification for Communications Systems.
 - 2. Section 28 05 53 - Identification for Electronic Safety and Security.

1.2 SUBMITTALS

- A. Section 01300 – Submittals.

- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

- C. Samples:
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.

- D. Manufacturer's Installation Instructions:
 - 1. Indicate installation instructions, special procedures, and installation.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Gravoply
 - 2. Lamicaid
 - 3. Or approved equal
- B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- C. Letter Size:
 - 1. See label detail at end of section.
- D. Minimum nameplate thickness: 1/16 inch.

2.2 LABELS

- A. Manufacturers:
 - 1. Panduit Model PVL.
 - 2. Tyton-Hellerman Model Tag PP1.
 - 3. Or approved equal

2.3 WIRE MARKERS

- A. Manufacturers:
 - 1. Panduit Model PSWMS
 - 2. Brady Model DAT
 - 3. Tyton-Hellerman Model TAG 63L
 - 4. Raychem Model Shrink Mark
 - 5. Raychem Model TMS
- B. Description: self-laminating, heat shrinkable, or sleeve type wire markers.

2.4 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
 - 1. Tyton-Hellerman Model TAG PPI
 - 2. Panduit
 - 3. Thomas & Betts
- B. Description: Labels fastened with adhesive.
- C. Color:
 - 1. Medium Voltage System: Black lettering on white background.
 - 2. 480 Volt System: Black lettering on white background.
 - 3. 208 Volt System: Black lettering on white background.

2.5 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Thomas & Betts
 - 2. Panduit
- B. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.

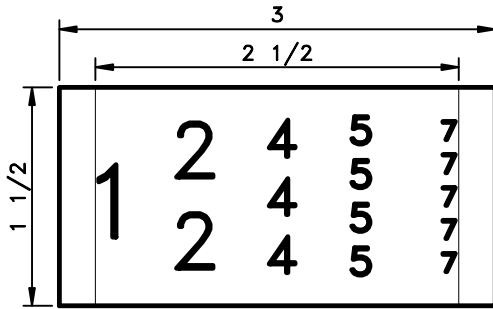
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards.
- C. Label Installation:
1. Install label parallel to equipment lines.
 2. Install label for identification of individual control device.
 3. Install labels for permanent adhesion.
- D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboards, pull boxes, outlet and junction boxes, and each load connection.
 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
 4. Legend:
 - a. Power and Lighting Circuits: Branch circuit or feeder number.
 - b. Control Circuits: Control wire number as indicated on schematic, interconnection diagrams, and drawings.
 - c. Use the following wire numbering convention for wires to process motors, process loads, and for instrumentation and controls: Source-Destination-Number.
 - 1) Example A: For a Power conductor from LCP-1 to Pump motor PU-18010 should read as follows: LCP1-PU18010-1.
 - 2) Example B: For a Instrumentation conductor from Control Panel LCP-1 to Pressure Switch PSH-04501B should read as follows: LCP1-PSH04051B-1.
 - 3) Multi-conductor cables (e.g., instrumentation and controls) shall be identified on the jacket by: Source-Destination. Example: LCP1-PSH04051B.
 - d. Use the wire numbering shown on the drawing for conductors in the interior of control panels.
- E. Raceway Marker Installation:
1. Install raceway marker for each raceway longer than feet.
 2. Raceway Marker Spacing: 20 feet on center.
 3. Legend:
 - a. Medium Voltage System: HIGH VOLTAGE.
 - b. 480 Volt System: 480 VOLTS.
 - c. 208 Volt System: 208 VOLTS.

- F. Stencil Installation:
 - 1. Apply stencil painting in accordance with Section 09 90 00.

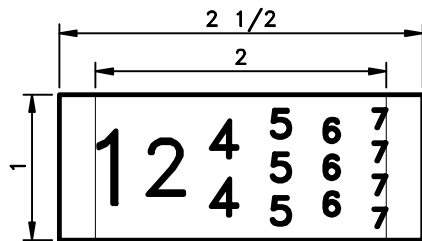
- G. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

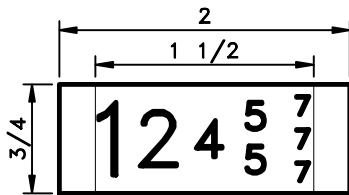
Appendix: Panel Label Detail



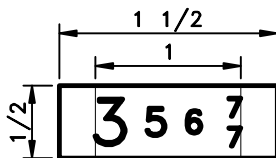
STYLE A



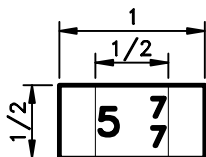
STYLE B



STYLE C



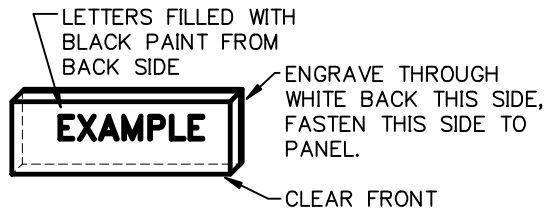
STYLE D



STYLE E

NOTES:

1. NAMEPLATE MATERIAL IS 2-PLY FLEXIBLE LAMICOID #7025 PLATE, CLEAR SURFACE AND WHITE BACK, OR "GRAVOPLY"
2. RECOMMENDED THICKNESS OF NAMEPLATE IS $\frac{1}{16}$ ".
3. FURNISH PLATES WITH ADHESIVE BACKING.
4. ENGRAVE LETTERS THROUGH THE WHITE BACK TO THE CLEAR CORE/FACE. USE A ROUNDED END CUTTER. V-SHAPED GROVES ARE NOT ACCEPTABLE.
5. FILL ENGRAVED LETTERS WITH BLACK PAINT.
6. ATTACH LABEL TO PANEL, CLEAR SIDE OUT.



LETTER SIZE		1	2	3	4	5	6	7
HT. OF LETTERS		$\frac{1}{2}$ "	$\frac{3}{8}$ "	$\frac{5}{16}$ "	$\frac{1}{4}$ "	$\frac{3}{16}$ "	$\frac{5}{32}$ "	$\frac{1}{8}$ "
NO. PER HORIZ. INCH		$2\frac{1}{4}$	3	$3\frac{3}{4}$	$4\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$9\frac{1}{2}$
MAX NO. CHARACT. PER LINE	STYLE A	5	7	9	11	16	18	22
	STYLE B	4	6	7	9	13	15	19
	STYLE C	3	4	5	6	9	11	14
	STYLE D	-	-	3	4	6	7	9
	STYLE E	-	-	2	2	3	3	4
MAX NO. OF LINES	STYLE A	2	3	3	4	4	5	5
	STYLE B	1	1	2	2	3	3	4
	STYLE C	1	1	1	2	2	3	3
	STYLE D	-	1	1	1	1	1	2
	STYLE E	-	1	1	1	1	1	2

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes main and distribution switchboards.
 - 1. Breaker in main switch board
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C12.1 - Code for Electricity Metering.
 - 2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.
- B. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 4. NEMA PB 2 - Deadfront Distribution Switchboards.
 - 5. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- B. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver individually wrapped for protection and mounted on shipping skids.
- B. Accept switchboards breaker on site. Inspect for damage.
- C. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 SEQUENCING

- A. Sequence Work to avoid interferences with building finishes and installation of other products.

PART 2 PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

- A. Manufacturers:
 - 1. General Electric – (existing switchboard)

2.2 INSULATED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. General Electric – match existing
- B. Product Description: NEMA AB 1, enclosed, insulated-case circuit breaker.
- C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
 - 1. Handle Lock: Provisions for padlocking.
 - 2. Grounding Lug: In each enclosure.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify switchgear is suitable for breaker installation.

3.2 EXISTING WORK

- A. Maintain access to existing switchboard and other installations remaining active.
- B. Clean and repair existing switchboards to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install in accordance with NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install engraved plastic nameplates in accordance with Section 26 05 53.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.5 ADJUSTING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections.
- C. Adjust circuit breaker trip and time delay settings to values to match new chiller load.
Field verify.

3.6 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA PB 1 - Panelboards.
 - 3. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 - Safety for Panelboards.
 - 2. UL 1283 - Electromagnetic Interference Filters.
 - 3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- B. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 MAINTENANCE MATERIALS

- A. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. GE Electric – (existing)
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard. Match existing.
- C. Molded Case Circuit Breakers: Match existing. NEMA AB 1, bolt-on plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- D. Enclosure: NEMA PB 1, Type 1

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.
- B. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install new breakers in existing panelboards.
- B. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard and load center. Revise directory to reflect circuiting changes to balance phase loads.
- C. Install engraved plastic nameplates in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

END OF SECTION

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes existing motor control centers.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
 - 5. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 6. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
 - 7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time and current curves of equipment and components.

- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate field test and inspection procedures and test results.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MOTOR CONTROL CENTER

- A. Manufacturers:
 - 1. Cutler-Hammer – (existing unit)
- B. Product Description: NEMA ICS 3, Class I, Type B motor control center.
- C. Service Conditions: NEMA ICS 2.
 - 1. Temperature: 75 degrees F.
 - 2. Altitude: 200 feet.
- D. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.
- E. Voltage Rating: 480 volts, three phase, three wire, 60 Hertz.
- F. Integrated Equipment Short Circuit Rating: 6500 amperes rms symmetrical at 480 volts.
- G. Configuration: Units front mounting only, accessible from front only.
- H. Enclosure: NEMA ICS 6, Type 1.
- I. Finish: Manufacturer's standard gray enamel.

2.2 FULL-VOLTAGE NON-REVERSING CONTROLLERS

- A. Manufacturers:
 - 1. Cutler-Hammer
- B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- C. Control Voltage: 120 volts, 60 Hertz.
- D. Overload Relay: NEMA ICS 2; bimetal.
- E. Product Options and Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each normally open contacts in addition to seal-in contact.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
 - 4. Pushbuttons: Unguarded type.
 - 5. Indicating Lights: Transformer, LED type.
 - 6. Selector Switches: Rotary type.
 - 7. Control Power Transformers: 120 volt secondary, 75 VA minimum, in each motor controller, as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.3 FEEDER TAP BREAKERS

- A. Molded-Case Thermal Magnetic Breakers: Single or dual-mounted as shown.
- B. Sized to Match Load: Field verify breaker size before installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify motor control center is suitable for unit installation.

3.2 EXISTING WORK

- A. Maintain access to existing motor control centers and other installations remaining active and requiring access.

3.3 INSTALLATION

- A. Install in accordance with NEMA ICS 2.3 and NEMA 7.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.

- C. Select and install heater elements in motor controllers to match installed motor characteristics.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Install dual circuit-breaker units in motor control center.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.16.

Inspect and test variable frequency controllers according to NEMA ICS 7.1.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. Arrow Hart Wiring Devices
 - 2. Eagle Electric
 - 3. Hubbell
 - 4. Leviton

- B. Single Pole Switch:
 - 1. Hubbell Model 1221
 - 2. Leviton Model 1221-2
 - 3. Arrow Hart Model 1991

- C. Double Pole Switch:
 - 1. Hubbell Model 1222
 - 2. Leviton Model 1222-2
 - 3. Arrow Hart Model 1992

- D. Three-way Switch:
 - 1. Hubbell Model 1223
 - 2. Leviton Model 1223-2
 - 3. Arrow Hart Model 1993

2.2 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Hubbell Model 5361
 - 2. Leviton Model 5361
 - 3. Arrow Hart Model 5361

- B. Duplex Convenience Receptacle:
 - 1. Hubbell Model 5362
 - 2. Leviton Model 5362
 - 3. Arrow Hart Model 5362

- C. GFCI Receptacle:
 - 1. Hubbell Model GF 5362
 - 2. Leviton Model 5899
 - 3. Arrow Hart Model GF 5342

2.3 WALL PLATES

- A. Manufacturers:
 - 1. Arrow Hart Wiring Devices
 - 2. Eagle Electric
 - 3. Leviton
 - 4. Hubbell

- B. Decorative Cover Plate: 302 stainless steel.

- C. Weatherproof Cover Plate: Stainless steel plate with hinged and gasketed device cover.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole on bottom.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- F. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor, as shown on drawings.
- C. Install convenience receptacle 24 inches above finished floor, or as shown on drawings.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fusible and nonfusible switches.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Product Data: Submit switch ratings and enclosure dimensions.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. GE Electrical
 - 2. Hubbell Inc.
 - 3. Westinghouse Electric Corp.
 - 4. Square D
- B. Product Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.

- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 12.
 - 2. Exterior Locations: Type 4.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. GE Electrical
 - 2. Hubbell Inc.
 - 3. Westinghouse Electric Corp.
 - 4. Square D
- B. Product Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches for motors and drivers as shown.
- B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

- C. Height: 5 feet to operating handle.
- D. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 26 28 23

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. General Electric
 - 2. Cutler-Hammer
 - 3. Square D
 - 4. Siemons
 - 5. Or approved equal
- B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- C. Service Conditions:
 - 1. Temperature: 75 degrees F.
 - 2. Altitude: 200 feet.

- D. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time, short time continuous current setting for automatic operation. Range of Adjustment: 100 percent.
- E. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.
- F. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Locate and install engraved plastic nameplates in accordance with Section 26 05 53.

3.2 ADJUSTING

- A. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION

SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Variable frequency motor speed controllers.
- B. Related Sections:
 - 1. Section 26 28 19 – Enclosed Switches.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 3. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.8 WARRANTY

- A. Furnish five year manufacturer warranty for variable frequency controller.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. ABB Model ACS550.
- B. Product Description: NEMA ICS 7, enclosed variable frequency controller suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 7.1.
- C. Ratings:
 - 1. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
 - 2. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
 - 3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 - 4. Operating Ambient: 0 degrees C to 40 degrees C.
 - 5. Minimum Efficiency at Full Load: 95 percent.
 - 6. Time to Stop: 5 seconds.
- D. Design Features:
 - 1. Employ microprocessor-based inverter logic isolated from power circuits.
 - 2. Employ pulse-width-modulated inverter system.
 - 3. Design for ability to operate controller with motor disconnected from output.
 - 4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

- E. Indicators and Manual Controls:
 - 1. Input Signal: 4 - 20 mA DC.
 - 2. Display: Furnish integral digital display to indicate output voltage, output frequency, and output current.
 - 3. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, over-temperature, and input power ON.
 - 4. Volts Per Hertz Adjustment: Plus or minus 10 percent.
 - 5. Current Limit Adjustment: 60 - 110 percent of rated.
 - 6. Acceleration Rate Adjustment: 0.5 - 30 seconds.
 - 7. Deceleration Rate Adjustment: 1 - 30 seconds.
 - 8. Control Power Source: Integral control transformer.

- F. Fabrication:
 - 1. Wiring Terminations: Match conductor materials and sizes as indicated on Drawings.
 - 2. Enclosure: NEMA 250, Type 1, suitable for equipment application in places regularly open to public restricted to persons employed on premises accessible only to qualified personnel.
 - 3. Finish: Manufacturer's standard enamel.

2.2 SOURCE QUALITY CONTROL

- A. Shop, inspect and perform standard productions tests for each controller.

- B. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner Architect/Engineer at least seven days before inspection is allowed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify building environment is maintained within service conditions required by manufacturer.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1.

- B. Tighten accessible connections and mechanical fasteners after placing controller.

- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.

- D. Install engraved plastic nameplates in accordance with Section 26 05 53.

- E. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and startup variable frequency controller.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 2. Section 26 52 00 - Emergency Lighting.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.3 SUBMITTALS

- A. Manufacturer's Catalog Literature
- B. Product Data: Submit dimensions, ratings, and performance data.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 MAINTENANCE MATERIALS

- A. Furnish two of each plastic lens type.
- B. Furnish one replacement lamps for each lamp installed.
- C. Furnish two of each ballast type.

PART 2 PRODUCTS

2.1 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Type F5A:
 - 1. Manufacturer: Hubbell
 - 2. 1' x 4' surfaces MTD wet label
 - 3. Type: Wet-labeled industrial strip
 - 4. Housing: Molded impact-resistant, ABS plastic housing, metal parts, die-formed, code-gauged steel; UL listed, suitable for wet locations.
 - 5. Lens: Acrylic diffuser
 - 6. Ballast: solid-state electronic, 120V
 - 7. Finish: Metal-parts
- C. Type XI: Exit Sign
 - 1. Manufacturer: Hubbell, Levitron
 - 2. Type: Wet-labeled, universal mounted, UL listed, suitable for wet locations.
 - 3. Housing: Molded impact-resistant, ABS plastic housing; metal parts, die formed. code gauge steel.
 - 4. Lens: Acrylic
 - 5. Lamp: LED
 - 6. Ballast: None
 - 7. Finish: Manufacturer's standard

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Cooper Industries Inc. Model.
 - 2. General Electric Co. Model.
 - 3. Hubbell Lighting Model.
- B. Product Description: Electronic ballast less than 10 percent THD certified by Certified Ballast Manufacturers, Inc. to comply with ANSI C82.1, suitable for lamps specified, with voltage to match luminaire voltage.

2.3 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. General Electric Co. Model.
 - 2. Philips Electronics Model.
 - 3. Siemens Corp. Model.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- B. Install wall-mounted luminaires at height as indicated on Drawings
- C. Install accessories furnished with each luminaire.
- D. Connect luminaires to branch circuit outlets provided under Section 26 05 33 as indicated on Drawings.
- E. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- F. Install specified lamps in each luminaire.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 CLEANING

- A. Remove dirt and debris from enclosures.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

3.4 PROTECTION OF FINISHED WORK

- A. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 52 00
EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes emergency lighting units and exit signs.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 2. Section 26 51 00 - Interior Lighting: Exit signs.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SYSTEM DESCRIPTION

- A. Emergency lighting to comply with requirements.

1.4 SUBMITTALS

- A. Manufacturer's Literature
 - 1. Exit Sign
 - 2. Emergency Light Fixture
- B. Product Data: Submit dimensions, ratings, and performance data.
 - 1. Exit Sign
 - 2. Emergency Lighting Fixtures

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Furnish one replacement lamps for each lamp installed.
- B. Furnish one replacement battery for each battery type and size.

PART 2 PRODUCTS

2.1 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Cooper Industries
 - 2. Or approved equal

- B. Product Description: Self-contained fluorescent emergency lighting unit.
 - 1. Battery: 6 12 volt, nickel-cadmium type, with 1.5 hour capacity.
 - 2. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
 - 3. Lamps: Compact fluorescent.
 - 4. Housing: Steel with gray hammer tone finish.
 - 5. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.
 - 6. TEST switch: Transfers unit from external power supply to integral battery supply.
 - 7. Electrical Connection: 6 foot cord with plug cap, NEMA WD 6, Type 5-15 configuration. Conduit connection.
 - 8. Input Voltage: 120 volts.

2.2 EXIT SIGNS

- A. Manufacturers:
 - 1. Cooper Industries
 - 2. Or approved equal

- B. Product Description: Exit sign fixture suitable for use as emergency lighting unit.
 - 1. Housing: Sheet steel.
 - 2. Face: Translucent plastic face with red letters on white background
 - 3. Battery: 6 volt, nickel-cadmium type, with 1.5 hour capacity.
 - 4. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
 - 5. Lamps: LED Compact fluorescent Manufacturers standard.
 - 6. Input Voltage: 120 volts.

2.3 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

- A. Manufacturers:
 - 1. Cooper Industries

- B. Product Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.
 - 1. Lamp Ratings: One F40CW lamp providing 1100 lumens, minimum.
 - 2. Battery: Sealed nickel-cadmium type, rated for 10 year life.
 - 3. Include TEST switch and AC ON indicator light, installed to be operable and visible from outside of assembled luminaire.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33 as indicated on Drawings.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.

3.2 FIELD QUALITY CONTROL

- A. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.3 PROTECTION OF FINISHED WORK

- A. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing designated paving, curbs, and planters.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
 - 5. Excavating topsoil.
- B. Related Sections:
 - 1. Section 01565: Tree and Plant Protection
 - 2. Section 01732: Waste Management.
 - 3. Section 32 90 00: Planting.

1.2 SUBMITTALS

- A. Section 01300 - Submittals: Requirements for submittals.

1.3 QUALITY ASSURANCE

- A. Conform to 01732 - Waste Management Code for environmental requirements and disposal of debris.
- B. Perform Work in accordance with City of Portland Public Work's standards.

PART 2 PRODUCTS

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify waste area for placing removed materials.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than three working days before performing work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping as specified in Section 01500 - Temporary Facilities and Controls and Section 01565 – Tree and Plant Protection.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.3 CLEARING

- A. Clear areas required for access to site and execution of Work to minimum depth of 3” inches.
- B. Clear undergrowth and deadwood, without disturbing subsoil.

3.4 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Partially remove paving, curbs, and planters as indicated on Drawings. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Do not burn or bury materials on site. Leave site in clean condition.

3.5 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, marked areas, entire site, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes site grading, removal of topsoil and subsoil, building excavating and trenching, backfilling, and compacting.

1.2 SUBMITTALS

- A. Samples: Submit 10 lb sample of each type of fill to testing laboratory, in air tight containers.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Portland standard.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Topsoil: Reusable excavated friable loam; free of subsoil, roots, grass, weeds, large stone, and foreign matter.
- B. Subsoil: Excavated material, graded free of lumps larger than 6 inches, rocks larger than 3 inches, organic material, and debris.

2.2 FILL MATERIALS

- A. Type A - Select Granular Material: Coarse stone gravel: Angular, natural stone; free of shale, clay, friable material, debris.
 - 1. Grading: AASHTO M147; Grade 57.
 - 2. Grading:
 - a. Minimum Particle Size: less than 5% passing through the No. 200 sieve.
 - b. Maximum Size: 3/4 inch.
- B. Type B - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
 - 1. Minimum Size: 1/4 inch.
 - 2. Maximum Size: 5/8 inch.
- C. Type C - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
- D. Type D - Subsoil: Reused, Imported, free of rock larger than 3 inch size, and debris.
- E. Type E - Blended Material.

- F. Type F - Soil Cement.

2.3 ACCESSORIES

- A. Geotextile Fabric.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- D. Maintain and protect existing utilities to remain.
- E. Verify foundation or basement walls are braced to support surcharge forces imposed by backfilling operations.

3.2 PROTECTION OF ADJACENT WORK

- A. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
- B. Grade excavation top perimeter to prevent surface water run-off into excavation or to adjacent properties.

3.3 TOPSOIL EXCAVATING

- A. Do not excavate wet topsoil.
- B. Excavate topsoil and remove excess topsoil not being reused from site.

3.4 SUBSOIL EXCAVATING

- A. Remove groundwater by pumping to keep excavations dry.
- B. Excavate subsoil from marked areas required for building foundations, piling, construction operations, and other Work.
- C. Slope banks to angle of repose or less, until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.

- E. Proof roll bearing surfaces. Fill soft spots with fill and compact uniformly to 95 percent of maximum density.
- F. Correct unauthorized excavation at no cost to Owner.
- G. Fill over-excavated areas under structure bearing surfaces in accordance with direction by Architect/Engineer.
- H. Stockpile subsoil in area designated on site Remove excess subsoil not being reused from site Remove subsoil from site.

3.5 TRENCHING

- A. Excavate for precast trench and other cast in place structures.
- B. Cut trenches sufficiently wide to enable installation of structures and allow inspection.
- C. Support precast trench and structures during placement and compaction of bedding fill.
- D. Backfill trenches to required contours and elevations.
- E. Place and compact fill materials as for Backfilling.

3.6 BACKFILLING

- A. Backfill areas to contours and elevations. Use unfrozen and unsaturated materials.
- B. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric over unstable subsoil.
- D. Place fill material in continuous layers and compact in accordance with schedule at end of this section.
- E. Place material in continuous layers as follows:
 - 1. Soil Materials: Maximum 8 inches compacted depth.
 - 2. Fill Materials: Maximum 6 inches compacted depth.
- F. Employ placement method so not to disturb or damage foundations, foundation perimeter drainage, foundation dampproofing, foundation waterproofing and protective cover, or utilities in trenches.
- G. Maintain optimum moisture content of backfill materials to attain required compaction density.
- H. Backfill against supported foundation walls. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- I. Slope grade away from building minimum 5 percent slope for minimum distance of 10 ft, unless noted otherwise.

3.7 PLACING TOPSOIL

- A. Place topsoil in areas where planting is scheduled.
- B. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.
- C. Remove large stone, roots, grass, weeds, debris, and foreign material while spreading.
- D. Roll placed topsoil.
- E. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.8 TESTS

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
- C. Frequency of tests per Section 31 23 17.

3.9 TOLERANCES

- A. Top Surface of Exposed Subgrade: Plus or minus one inch.
- B. Top of Topsoil: Plus or minus 1/2 inch.

3.10 SCHEDULE

- A. Interior Slab-On-Grade: Type A fill, 6 inches thick or as indicated on drawings, compact uniformly to 95 percent of maximum density; with cover of Type C fill, 2 inches thick, compact uniformly to 95 percent of maximum density.
- B. Exterior Side of Foundation Walls and Retaining Walls Over Granular Filter Material and Foundation Perimeter Drainage: Type D Type A fill, to subgrade elevation, compact uniformly to 90 percent.
- C. Fill Under Landscaped Areas: Type D fill, to 12 inches below finish grade, compact uniformly to percent of maximum density.
- D. Fill Under Asphalt Concrete Paving: Type A fill, to inches below finish paving elevation, compact uniformly to percent of maximum density.

END SECTION

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities from 5 feet outside building to utility service.
 - 2. Compacted fill from top of utility bedding to subgrade elevations.
 - 3. Backfilling and compaction.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete materials.
 - 2. Section 31 20 00 - Earth Moving: Topsoil and subsoil removal from site surface.
 - 3. Section 33 05 16 – Utility Structures.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

- A. Section 01300 – Submittals.

- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- D. Soil compaction test results.
- E. Certified Laboratory Test Reports: Test reports including grain size distribution, optimum moisture content and plasticizing index shall be submitted for the following:
 - 1. Trench foundation material.
 - 2. Trench backfill material.
 - 3. Drainage aggregate material.

1.5 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Oregon

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Section 01040 – Project Coordination: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type D as specified in Section 31 20 00.
- B. Structural Fill: Type A as specified in Section 31 20 00.
- C. Granular Fill: Type C as specified in Section 31 20 00.
- D. Concrete: Structural concrete as specified in Section 03 30 00 with compressive strength of 5000 psi.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, non-woven.
 - 1. TC Mirafi; Model 170N
 - 2. Substitutions: Section 01630 - Product Requirement and Substitutions.

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

- A. Excavate subsoil required for utilities to utility service.
- B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard, measured by volume.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
- D. Do not advance open trench more than 100 feet ahead of installed trench.
- E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- F. Excavate bottom of trenches maximum 2 feet wider than outside width of trench.

- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of trench. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Notify Engineer, and request instructions.
- K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type and compact to density equal to or greater than requirements for subsequent backfill material.
- L. Trim excavation. Remove loose matter.
- M. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
- N. Remove excess subsoil not intended for reuse, from site.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

- C. Place fill material in continuous layers and compact in accordance with schedule at end of this section.
- D. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 6 inches compacted depth.
 - 3. Granular Fill: Maximum 6 inches compacted depth.
- E. Employ placement method that does not disturb or damage foundation perimeter drainage, utilities in trench, and other underground structures.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Do not leave more than 50 feet of trench open at end of working day.
- H. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

- A. Section 01400 - Quality Requirements: Tolerances.
- B. Top Surface of General Backfilling: Plus or minus from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- D. Frequency of Tests:
 - 1. Bedding and backfill in trenches: One test per 100 feet in each lift.
 - 2. Appurtenance Structures: One test per 10 square yards or fraction thereof in each lift.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01780 – Contract Closeout: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.9 SCHEDULE

A. Trench

1. Cover duct and bedding with Fill Type: To subgrade elevation as shown on drawings with thickness as shown on drawings.
2. Compact uniformly to minimum 95 percent of maximum density.

END OF SECTION

SECTION 31 25 13
EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Erosion and sediment control measures taken during construction.
- B. Related Sections:
1. Section 03 10 00 - Concrete Forming and Accessories.
 2. Section 03 20 00 - Concrete Reinforcing.
 3. Section 03 30 00 - Cast-In-Place Concrete.
 4. Section 04 05 03 - Masonry Mortaring and Grouting.
 5. Section 05 12 00 - Structural Steel Framing.
 6. Section 07 90 00 - Joint Protection.
 7. Section 31 10 00 - Site Clearing.
 8. Section 31 20 00 – Earth Moving.
 9. Section 31 23 17 - Trenching.
 10. Section 32 80 00 – Planting Irrigation.
 11. Section 32 90 00 - Planting.
- C. REFERENCES
1. ASTM D 4354 – Standard Practice for Sampling of Geosynthetics for Testing
 2. ASTM D 4355 – Deterioration of Geotextiles from Exposure to UL Light and Water
 3. ASTM D 4491 – Standard Test Methods for Water Permeability of Geotextiles
 4. ASTM D 4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 5. ASTM D 4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
 6. ASTM D 4833 – Standard Test Method for Puncture Resistance of Geotextiles

1.2 SUBMITTALS

- A. Section 01300 – Submittals: Requirements for submittals.
- B. Contractor shall designate an onsite Erosion and Sediment Control Inspector and shall submit the name of the Owner’s Representative for submittal to DEQ as part of the DEQ 1200-C Permit requirements.

- C. Contractor Developed Erosion and Sediment Control (ESCP): Develop a complete ESCP that incorporates the design ESCP and all modifications into it.
 - 1. Erosion and sediment control features, other than those shown on the plans, may be required depending on the Contractor's methods of operation and schedule.
 - 2. Plan shall address treatment and/or prevention of erosion during construction. As a basis, the Contractor may begin with the ESCP presented the project drawings.
 - 3. For each phase of the scheduled work, indicate on the ESCP how the proposed erosion and sediment control devices will divert and store flows, limit runoff from exposed areas, filter sediment, and stabilize exposed soils during construction.

- D. Implementation Schedule: Submit a complete earthwork implementation schedule which includes the following information if applicable:
 - 1. Installing perimeter controls
 - 2. Construction phasing
 - 3. General site clearing and grubbing
 - 4. Utility trenching
 - 5. Earthwork for buildings
 - 6. Earthwork for roads and paving
 - 7. Temporary stabilization of exposed soil surfaces
 - 8. Work required in wetlands
 - 9. Maintaining and monitoring temporary controls
 - 10. Storage and disposal of waste soil materials
 - 11. Haul road and borrow pit controls
 - 12. Additional controls for wet season work
 - 13. Completion of seeding prior to fall/winter months

- E. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts of the following items:
 - 1. Sediment control fencing
 - 2. Erosion control blankets

- F. Submit proposed mix design of each class of concrete for review prior to commencement of Work.

- G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01780 - Contract Closeout: Requirements for submittals.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with requirements of Section 01400.

- B. Codes and Regulations: All work shall conform to the applicable and local state codes, laws and regulations including OSHA and Public Works Engineering Standards of local public authorities with jurisdiction.

- C. In particular, all erosion control and surface water design measures shall conform to DEQ and City of Portland requirements.
- D. Maintain one copy copies of each document on site.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01040 – Project Coordination: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.6 DEQ 1200-C EROSION AND SEDIMENT CONTROL

- A. An Erosion and Sediment Control Permit has been issued by Oregon Department of Environmental Quality. (1200-C).
- B. Contractor is responsible for administration and conformance of all erosion and sediment control requirements stipulated in this permit.
- C. In particular, Contractor provides the following:
 - 1. All maintenance of ESCP measures as outlined in the Maintenance Requirements.
 - 2. Adherence to Additional Water Quality Requirements.
 - 3. Adherence to Minimum Monitoring Requirements as outlined in Schedule B.
 - 4. Adherence to Compliance Schedule as outlined in Schedule C.
 - 5. Contractor's Erosion and Sediment Control Inspector shall be responsible for maintenance and monitoring of the ESCP.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01630 - Product Requirements: Environmental conditions affecting products on site.

PART 2 PRODUCTS

2.1 SEDIMENT CONTROL FENCING

- A. Woven or non-woven geotextiles shall be composed of long chain, synthetic polymeric filaments or yarns formed into a stable network that retains its relative structure during the handling and placement.
- B. At least 95% by weight of the long chain polymers shall be a polyolefin or polyester.
- C. Geotextiles shall have the selvege finished so the outer fibers are prevented from pulling away from the fabric.

- D. Fabrics shall meet or exceed the properties specified in the following table. If the fabric manufacturer's submittal lists typical or typical average values instead of minimum average values, the required values in the table below will be increased 25%.
- E. Supporting Wire Mesh: Two-millimeter gauge steel wire mesh with 2" x 2" openings. A perforated polymeric mesh of equivalent grab tensile strength in accordance with ASTM D 4632 may be substituted for the steel wire mesh.

Geotextile Property	Test Method	Sediment Fence
Fabric Type	---	Woven
Minimum Grab Tensile Strength	ASTM D 4632	90 lb
Apparent Opening Size	ASTM D 4751	No. 30
Minimum Permittivity (s -1)	ASTM D 4491	0.05
Minimum UV Retained Strength	ASTM D 4355	70%
Minimum Puncture Strength	ASTM D 4833	---
Minimum Grab Elongation	ASTM D 4632	---

2.2 BIOBAGS

- A. Bio-filter bags fill material shall be clean 100% recycled wood product waste. Size of bag shall be generally 18" x 6" x 30" plastic mesh bags with ½" openings and weigh approximately 45 pounds.

2.3 WATTLES

- A. Wattles shall be manufactured from rice or coconut straw and shall be between 8" and 12" in diameter. The straw shall be wrapped in tubular plastic netting having a minimum strand thickness of 0.08 mm, a knot thickness of 1.4 mm, and shall be made from 85% high-density polyethylene. Fiber rolls shall be biodegradable and comprised of weed free revegetated materials.

2.4 GRAVEL CONSTRUCTION ENTRANCE

- A. A gravel construction entrance shall be the first site erosion control measure installed after clearing. No removal of stripped material is allowed until the gravel entrance is installed.
- B. Gravel material shall be clean pit run. The gravel pad shall be at least 8" thick. Width shall be the full width of the vehicle ingress and egress area.
- C. Subgrade reinforcement geotextile.

2.5 WOODEN CURB RAMP

- A. A wooden curb ramp shall be built with three (3) or more planks of increasing wood size, offset to allow for drainage. Material shall be untreated wood of 2" x 4" to 4" x 12" dimensions and shall be attached using nails, screws, or other fastening system.

2.6 STORM DRAIN INLET PROTECTION

- A. All gravels shall be washed clean prior to installation on the site. Gravel size shall be no larger than 1-1/2" rock and shall be larger than any mesh openings.
- B. Wire mesh shall be no greater than 1/2" opening size.
- C. Wrapped grates shall have fabric ends secured under the grate in such a manner as to not allow the grate to lift and flows to pass by.

2.7 TEMPORARY GRASS COVER

- A. Temporary grass cover must be established by October 1 or other erosion controls measures such as additional mulch or erosion control blankets will be required until adequate grass coverage is achieved. Seeding and protective mulch cover shall occur by September 1.
- B. Temporary grass cover shall be a dwarf grass mix "Pro-Time Companion" or approved equal. General mix shall be as follows:
 - 1. Dwarf Perennial Ryegrass 80% by seed count
 - 2. Creeping Red Fescue 20% by seed count
 - 3. Application Rate 100 minimum per acre

2.8 MULCH

- A. Mulch shall be straw, or hay, air dried, and free from seeds and coarse material. Minimum application shall be 2 tons per acre and general depth shall be 3-4 inches.

2.9 EROSION BLANKETS

- A. Erosion control blankets shall be mats comprised of biodegradable netting or organic fibers. Netting shall be twisted biodegradable cellulose fiber with 1/2" square grid size. Minimum weight 2.4 oz/sy, "OR-NET" erosion netting or approved equal.

2.10 PLASTIC SHEET COVERING

- A. Polyethylene plastic, 6 mil minimum thicknesses.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Verification of existing conditions before starting work.

3.2 PERIMETER CONTROLS

- A. Flag all construction site clearing limits. Do not disturb areas outside the flagging limits. Maintain the flagging during the construction project.
- B. Perimeter controls include interceptor ditches, berms in fill areas, and sediment fences. Install all appropriate perimeter controls before beginning major site grubbing or grading operations.

3.3 WET SEASON WORK

- A. Wet season work is defined as work between October 1 and May 30. Before working during the wet season, meet with local inspector and Owner's representative to review and update the ESCP and to develop a schedule to ensure that appropriate controls are implemented and maintained during the wet season work.
- B. During wet season work, stabilize soil stockpiles at the end of each workday by diverting flows, placing covers, or installing sediment barriers around the stockpiles. Limit excavation and bare ground activities to only that which is required for immediate operations.
- C. If soil erosion and sediment resulting from construction activities is not effectively controlled, the amount of disturbed area shall be limited to that which can be effectively controlled.
- D. Incorporate erosion and sediment control measures at the earliest practicable time and according to the approved implementation schedule and these specifications.

3.4 STABILIZATION

- A. Temporary Stabilization: Stabilize exposed soil surfaces not at finish grade at all times and soil surfaces at finish grades when working outside the permanent seeding dates. Temporary stabilization includes temporary seeding, mulching, and erosion control matting. Schedule temporary stabilization on a 14-day basis or more frequently if needed.
- B. Permanent Stabilization: Permanently stabilize exposed soil surfaces at finished grade. Permanent stabilization methods include riprap protection, seeding, and mulching. Permanent stabilization includes stabilization of temporary features such as detours, stockpiles, and staged earthwork. Immediately perform permanent stabilization at each completed excavation and embankment area except for areas that are scheduled to be redisturbed.

- C. If seed of any kind is applied and has not achieved 70% density of the surrounding existing grass areas prior to the end of the permanent seeding dates, then apply additional stabilization measures other than seeding.

3.5 SLOPE PROTECTION AND EROSION CONTROL

- A. Site preparation should include the removal of all grasses, brush, and sod. Vehicle and foot traffic should be minimized on bearing surfaces or above prepared subgrade areas to reduce the amount of disturbed material that would need to be excavated prior to pouring foundation concrete or the placement of structural fill.
- B. Temporary cut slopes included at 1-1/2H:1V or steeper be covered with Visqueen sheeting and have maintained cutoff or diversion ditches shall be at the top of the slopes to prevent surface water flowing over the excavation face.
- C. Maximum vertical cut section shall be 4 feet for slopes in unweathered glacial till. For cuts greater than 4 feet high, that portion above the 4 foot vertical section shall be sloped back at not steeper than 1H:1V. Permanent cut slopes shall be provided with cut-off or diversion ditches at the top to prevent unrestricted flow of water over the cut bank.
- D. In the case of stabilization seeding and plantings for swales, slopes, and water quality facilities, it is the Contractor's responsibility to sequence the work such that the plantings are established prior to October 1.

3.6 BIOBAGS

- A. At no time shall more than a six inch depth of sediment be allowed to accumulate behind bio-filter bags or fiber rolls. Sediment should be removed or regarded onto the slope, or new lines of barriers installed uphill of sediment laden barriers.
- B. Once the upslope area is stabilized, bio-filter bags shall be removed or reused onsite. Fiber rolls may be left onsite as a semi-permanent, biodegradable landscape feature. Bio-filter bags fill material shall be incorporated as mulch after completion of site work and must be approved by Unified Sewerage Agency. Removal will necessitate a post construction site visit. The bags shall be disposed of at a local recycling or solid waste disposal facility.

3.7 EROSION BLANKETS

- A. Application
 1. As channel stabilization against concentrated runoff flows (with adequate approval and permits) for active waterways.
 2. On areas of steep slopes (greater than 50%) and areas of moderate slopes that are prone to erosion.
 3. As a cover on ground surfaces exposed during the wet season (October 1st through April 30th).
 4. As a supplemental aid to seed and/or mulch treatment on slopes or in ditches or swales.

5. No blanket product shall be installed outside of manufacturer's specifications.

B. Design Criteria/Specifications

1. Erosion blankets shall be used on level areas and on slopes up to 1:1. Where soil is highly erodible, netting shall only be used in conjunction with organic mulch such as straw or wood fiber. The blanket must be applied so that it is in complete contact with the soil; if it is not, erosion will occur beneath it. Erosion blankets shall be securely anchored to the slope in accordance with manufacturer's recommendations.
2. Install fiber rolls or other barriers at various locations on the slope to minimize full slope length flows.
3. Deformed plastic filament matting shall be used for stream velocity protection and other special applications when approved by the jurisdiction.
4. Provide additional seed over and under mat installations to enhance vegetative cover growth.

3.8 SEDIMENT TRAPS

- A. Sediment Traps/Overflow Spillway. The sediment trap may be formed completely by excavation or by construction of a compacted embankment. It shall have a sediment storage depth not to exceed 1.5 feet, topped by a maximum 2-foot deep settlement zone. Sediment trap side slopes shall be 3:1 or flatter. The outlet of the trap should be a weir/spillway, providing a minimum 1-foot overflow depth between the spillway and embankment. A turbidity curtain, fabric wrapped outlet or similar filter must be constructed to filter runoff from the trap prior to discharge from the construction site.

3.9 MONITORING

- A. Receiving Stream: Observe and record turbidity within 25 feet upstream and downstream of locations where surface waters from the construction site enter the stream. If turbidity is increased greater than 10% over existing background levels in the stream, further erosion and sediment control measures will be necessary.
- B. Sediment Removal: Remove sediment and upgrade or repair as needed within 2 days after the surrounding area has dried sufficiently to prevent further damage from equipment needed for repair operations. If rainfall continues over a 24-hour period or other circumstances preclude equipment operation in the area, hand carry and install additional sediment control measures as needed to catch sediment until trapped sediment can be removed.
- C. Catch Basins: Maintain catch basin inserts and other forms of inlet protection by removing trapped sediment when storage capacity has been reduced by 50%.
- D. Sediment Controls: Remove sediment from sediment fences, barriers, check dams, and sediment traps once it has reached one third of the exposed height of the device or storage depth. Replace aggregate and rock filter material with new aggregate material when sediment reduces the filtering capacity of the device by one-half.

- E. Biofilter Bags: Replace biofilter bags with clean washed bags when removing sediment from them. Wash bags in an approved sediment control area.
- F. Paved Areas: Keep all paved areas clean for the duration of the project. Use cleaning methods that do not transport sediment-laden water to receiving streams.
- G. Construction Engineers: Add and remove aggregate or other specified material as needed to maintain the proper function of the construction entrances.

3.10 FINISHING AND CLEAN-UP

- A. Within 30 days of notification of acceptance of permanent stabilization, remove temporary erosion and sediment control devices and materials from the area. Remove accumulated sediment control devices and materials from the area. Remove accumulated sediment before removing the devices and materials.
- B. Immediately shape and permanently stabilize areas affected by the removal process. All temporary erosion and sediment control features that are not incorporated into the permanent work remain the property of the Contractor.
- C. Do not remove temporary erosion and sediment control devices before permanent stabilization is accepted.

3.11 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

3.12 CLEANING

- A. Section 01780 - Contact Closeout: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.
- F. Within 30 days of notification of acceptance of permanent stabilization, remove temporary erosion and sediment control devices and materials from the area. Remove accumulated sediment control devices and materials from the area. Remove accumulated sediment before removing the devices and materials.

- G. Immediately shape and permanently stabilize areas affected by the removal process. All temporary erosion and sediment control features that are not incorporated into the permanent work remain the property of the Contractor.
- H. Do not remove temporary erosion and sediment control devices before permanent stabilization is accepted.

3.13 PROTECTION

- A. Section 01780 - Contract Closeout: Requirements for protecting finished Work.

END OF SECTION

SECTION 32 80 00
IRRIGATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

- A. The General Conditions, Supplementary Conditions and Division 1 bound herewith apply in addition to this Specification and accompanying Drawings.

1.2 SUMMARY

- A. Work of this Section includes, but is not limited to:

1. Field locating existing irrigation system components within and adjacent work area prior to beginning of construction.
2. Cutting and capping existing irrigation piping as indicated and as identified as necessary by field discovery.
3. Providing connections to existing irrigation system as needed.
4. Providing temporary irrigation coverage as needed.
5. Providing new materials as indicated.
6. Trenching and backfilling;
7. Inspections and demonstrations;
8. Record drawings;
9. Warranty;

1.3 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Manufacturing Qualifications: Provide only new materials and equipment of the approved type and, where indicated, from the specified manufacturers for all portions of the work.
- B. Sub-Contractor Requirements:
1. Sub-contract this work to an experienced irrigation system installer acceptable to the Owner.
 2. The irrigation and planting work shall be done by the same sub-contractor.

3. The sub-contractor shall have and maintain in good standing for the entire Contract period, a State of Oregon Landscape Contractor's license for all types of irrigation work required by this Contract.
 4. The sub-contractor shall provide the same site supervisor and landscape crew leader for the entire project. Crew leader shall be on site at all times when irrigation work is taking place.
- C. Drawings and Specification – Site Set: Maintain a complete set of current up-to-date drawings and specifications on site, and easily accessible to work crews at all times when work is underway.
- D. Drawing and Specification Familiarity: The on-site supervisor and lead crew members shall have reviewed and be familiar with all current drawings and specifications.
- E. Record Drawings:
1. It is the Contractor's responsibility to provide complete, clear, and accurate drawings which record the actual installed location of the irrigation system.
 2. Provide irrigation plan drawings recording the actual installed location for mainline, lateral pipe, valves, sleeves, control wire routes, and zone outlines
 3. Field Record Drawings: At all times when installation work is underway, a set of plans shall be kept on site to record installation locations. Measure installed locations and mark up plan daily before leaving job site. Identify locations by notations and dimension from at least two fixed locations
 4. Final Record Drawing: On a clean base plan, using field information, carefully draft on irrigation material and equipment locations with reference notes and dimensions. All drafting shall be clear and legible. Each type of material and equipment shall be represented by a clear and unique symbol.
 5. Provide the original,(2) copies of the Drawings, and (1) electronic copy to Owner. Revise if unacceptable as directed by Owner.
- F. Site Conditions: Prior to beginning irrigation installation work tour the project site and:
1. Locate and mark locations of existing irrigation system, utilities, and other underground improvements. Except where necessary and approved to remove, take action needed to protect. Where damage occurs, pay all costs associated with any disruption, and provide repairs satisfactory to the improvement owner.
 2. Note Conditions which might adversely affect the work and finished product. Call all problems to the Owner's attention. Corrective measure shall have been taken prior to beginning work. Beginning work means that the Contractor accepts the conditions of the site and all consequences there of.
 3. Perform work only when site and weather conditions are suitable. Provide protective covering, during rain, over all solvent welding work.

4. Take site dimensions of landscape areas prior to beginning work. Note any dimensional discrepancies between plan and site measurements to the Owner prior to proceeding.

1.5 SUBMITTALS

- A. At the time of the demonstration for Installation Acceptance (Section 32 9000) provide the following:
 1. Record / As Built Drawings: (also refer to Quality Control paragraphs of this Section)
 - a. Provide clean clear drawings showing and dimensioning the installed location for all valves, mainline, common and control wiring, lateral and manifold piping. Locations shall be shown by dimensions from fixed above ground improvements. Note where piping and wiring is in common trenches.
 - b. Drawings shall be done on bond paper, at the same or more detailed scale as the Construction Documents.
 - c. All drafting and text shall be neat and legible.
 - d. Drawings shall be marked as "Record Drawings" and be signed by the Sub-Contractors representative responsible for confirming and marking the information. The person's name shall be printed below the signature.
 - e. Provide the original and (3) full sized copies.
 - f. Drafting and information shall be as acceptable to the Owner. Make corrections and provide additional information as directed.
 2. Controller Enclosure Inserts: Provide one "Zone Map" as described above, and one timing schedule, with clear plastic laminated cover, neatly folded and set into the irrigation controller enclosure. Both shall be easily accessible. Mark the timing schedule with an erasable marker. Indicate the day(s), time(s), and duration of operation for each irrigation zone.

1.6 SEQUENCING

- A. Prior to beginning construction, review site conditions, review adjacent irrigation system, and determine static water pressure. Submit findings of these observations as specified.
- B. Prior to general project excavation, locate irrigation system components. Prior to general excavation expose common and control wire just outside work area. Cut and put exposed ends in a temporary valve box. Prior to or carefully during general excavation work, cut and cap existing piping at edge of work area and mark location.
- C. Before conducting Pressure Holding Test Inspection:
 1. Pre-test system to verify all is ready for Owner's review;
 2. Remove excavated soils which do not meet specified requirements for use as backfill material.
 3. Provide all sleeve marking nails, in-place;

4. Verify all piping and valves are uncovered.
- D. Do not install backfill soil covering pipe before successfully conducting the pressure holding test and receiving Owner's approval.
- E. All materials and installations shall be in place and fully operational and automatically controlled, reviewed and approved by Owner, before any planting and sodding can take place.
- F. Sequence and conduct trenching and excavation work so as to prevent contamination of topsoil and prepared planting area.

1.7 WARRANTY

- A. Comply with all requirements and conditions of the General Requirements and supplemental conditions as described herein.
- B. Warrant all work, workmanship, materials, equipment, and installations for a period of one year after Final Acceptance of Landscape Work (Section 32 80 00).
- C. Provide replacement and corrective work within 24 hours of notice during the irrigation season. During off-season periods corrective actions within 5 work days.
- D. Warranty requirements include providing replacement and repair of all landscape and other improvements and materials damaged and adversely effected by defects in the irrigation work and by work related to Warranty corrections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be new, of the indicated and approved manufacturer and type.

2.2 MATERIALS

- A. Lateral Lines: PVC 1120, NSF Class 220, plain or bell end with factory chamfered leading edge.
- B. Pipe Fittings:
 1. Schedule 40 PVC fittings for pipe to pipe connections.
 2. Swing Joint Assemblies: Pre-manufactured assemblies of Schedule 40 PVC for connection of rotors to lateral pipe.
 3. Poly Pipe and Fittings: Poly-pipe, barbed fittings, and rotating barbed elbows; 36" maximum pipe length.

- C. Pipe Glue: Primer and Solvent (separate solutions) specifically for the use to prepare and weld/glue PVC pipe. IPS No. 711 P-70 primers and IPS cement purple color or approved alternate.
- D. Sprinklers: Materials and assemblies as detailed and approved by Owner.
- E. Trench Backfill: Site and imported soil which is loose/friable and free of all rock, gravel, clay, clods, debris, organic debris, and extraneous material and clean masons sand are both acceptable materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Conditions: Installer must examine the areas and conditions under which landscape irrigation system is to be installed and notify the Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.3 PROTECTION

- A. Protect system components at all times. Keep rock, gravel, soils and other debris from entering pipe, sprinklers, valves and other materials. Provide temporary covers and caps as needed. Do not leave open pipe ends and sprinklers unprotected.
- B. Provide fencing as needed to secure the site and irrigation work area and open excavations and trenches.

3.4 PREPARATION

- A. Clean Planting area sub-grade and soils and make free of gravel, rock, debris, and extraneous materials prior to beginning trenching and as needed prior to installing materials and equipment.
- B. All planting areas shall be rough graded before irrigation work begins.
- C. Determine and mark locations of utilities and underground improvements before making any excavations. Maintain location markings and offsets and preserve as needed to keep clearly marked throughout the construction period. Protect said improvements. If damage occurs, provide repairs and replacements as required by and acceptable to the improvement's owner.
- D. Before beginning installation work, mark out planting bed edges and review with Owner for approval.

- E. Purging: During the course of work purge all debris from piping. Purge before installing control valves, before installing sprinklers and soaker hose, and as needed to eliminate all debris from all main and lateral, pipes. Purge soaker hose as needed.
- F. Erect and maintain protective fencing as needed.

3.5 INSTALLATION

A. Trenches

- 1. Pipe:
 - a. Excavate trenches as needed to provide at least 18" cover over pipes.
 - b. Where sub-soils contain rock and gravel, excavate trenches additionally as needed to provide a 3 inch deep setting bed.
 - c. Excavated soil which contains materials which make it unacceptable for backfilling shall be removed from site and replace with acceptable backfill materials.
- 2. Excavate trench bottoms with uniform bottoms. Slope evenly to low points.
- 3. Remove rock and other debris and foreign materials which projects into trench.
- 4. Adjacent parallel pipe shall be installed in common trenches at same elevation and with at least 2 inches of separation between pipes and pipes and edges of trench.
- 5. Trench Width: Make trenches wide enough to/for:
 - a. Allow for tamping and compacting of materials around and above pipe.
 - b. Allow for 'snaking' of pipe;
 - c. Placement of pipe with required 2 inch (minimum) separation between pipes in common trenches, and 2 inches between pipe and edge of trenches.
- 7. Dewater trenches prior to installing pipe and backfilling trenches.
- 8. Carefully record the location of trenches and pipe on Record Drawings before backfilling.

B. Pipe :

- 1. Slope pipe at 1% (minimum) to facilitate drainage through manual drain valves.
- 2. Do not stack parallel pipe in same trench. Install pipe parallel in same trench at the same level. Install pipe with at least 2 inches of clearance between pipe and between pipe and edge of trenches.. Place soil to maintain pipe separation during backfilling.
- 3. Provide and make all connections water tight.
- 4. Perform work only during suitable weather.
- 5. When making connections provide protective covering during rain. Debur, dry and clean pipe before making connections.

6. Use primer and solvent to weld socket connections. Use PVC cement to lightly and fully coat the full depth and diameter of joined surfaces.
7. Use Teflon tape to seal all threaded joints. Provide tape two to three wraps thick.
8. All nipples, except at control valves, shall be at least 6 inches long.

C. Sprinklers:

1. Install as indicated. Set plumb and square.
2. Make connections only at bottom ports of sprinklers
3. Install center of sprinklers 4 inches away from pavement edges and back of curbs. Install 12 inches from face of building and walls. Install further out if needed to avoid building edge drain gravel and footing drains.

e routed along all lateral lines and into valve box of the control valve for that zone.

D. Back Fill:

1. Backfill pipe trenches with soils free of all rock, gravel, debris, and other extraneous materials which would inhibit proper compaction and damage pipe.
2. Remove excavated soils containing unacceptable materials. Dispose of off site. Where gravel and gravel laden soils are encountered, remove these materials from trench line and dispose of off site. Unacceptable excavated materials shall be removed from site prior to the pressure holding inspection.
3. Provide imported or clean friable site soil, acceptable for backfilling, as needed.
4. Place and compact backfill material as needed to prevent future settlement. Place in 6-8 inch deep layers. Settle and compact each layer before placing subsequent layers. Perform compaction work in a manner which will not damage and displace pipe and wire.
5. First, place backfill between pipes and between pipes and edge of trenches as needed to maintain required separation between parallel pipes.
6. Prior to Pressure Holding Test:
 - a. Do not cover piping before pressure holding tests are complete;
 - b. Where rocky sub-grade occur place bedding soil;
 - c. Place soil between pipes in same trench, between pipe and edge in trench to provide required separation, and below pipe where rocky subsoils occur.

3.6 MANUAL WATERING

10909-07001

Irrigation
32 80 00-7

- A. Provide temporary manual watering as needed for plants and lawn

3.7 OBSERVATIONS, TESTS AND DEMONSTRATION

- A. Providing notification and making arrangements for inspections is the responsibility of the Contractor. Notify the Owner at least five work days prior to the date requested for any inspection. Inspections and tests will be conducted as fitting the Owner's schedule as close to the requested date and time as possible.
- B. Time required for initial testing and inspections will be part of the Contract amount. Re-testing and re-inspections due to the Contractor's failure to meet standards will result in the Contractor having to pay for the Owner's and Owner's consultant's time spent at the re-testing and writing up subsequent test results.
- C. Site Condition and Dimension Inspection: Prior to beginning irrigation construction work and after other site improvements are in place, tour the site and take note of site conditions and dimensions. Note any conditions which will interfere with the installation and operation of the irrigation system. Note any site dimensions which are different than those scaled from the bid/construction documents. Report all problems and differences to the Owner before proceeding with installation work. Proceeding with work indicates acceptance of site conditions.
- D. Pressure Holding Test and Installation Review:
 - 1. Prior to Owner's attendance at test complete all required task, including, but not limited to the following:
 - a. Pre-test the system to make sure it is ready and will hold pressure
 - b. Remove all unacceptable excavated materials. Note that the top 12" of material in all planting areas shall be imported blended amended topsoil. Excavated soils can not be used in that area;
 - c. Install sleeve marking nails;
 - d. Have pipe bedding and separation materials in place;
 - e. All new piping shall be in place and fully installed. Isolate new components from existing until after testing is complete. During the course of this test the Owner will review exposed components to gauge compliance with Contract requirements. Should any short comings be noted take corrective action as needed. Should the Owner indicate it necessary, make arrangements for re-testing after corrective action(s) have been satisfactorily completed.
 - 2. Testing Procedure and Requirements:
 - a. Prior to backfilling and covering any pipe s and prior to installing sprinklers test all new piping at a static pressure of 100 psi for 30 minutes. Any loss of pressure greater than 3 psi constitutes test failure. Take corrective actions necessary to make system water tight and arrange with Owner for re-testing.
 - b. In preparation for testing, slowly fill all piping and valves with water. Open all valves, including control valves, to get water into all piping (mainline, lateral, and manifold

pipe). Purge all air from the system. Bleed system and continue filling operations as needed. Slowly bring the piping and valves up to 100 psi. After ten minutes the system may be again pressurized and brought up to 100 psi. After that the pressurizing device shall be disconnected and an isolation valve at the upstream side of the backflow preventer shall be closed.

- c. Provide (2) pressure gauges at separate locations on the portions of the system being tested.

E. System Readiness Demonstration:

1. Prior to beginning any planting and sodding, and after all fine grading and soil preparation work is complete, review the installed irrigation system.
2. Operate all irrigation zones within and surrounding the work area. to demonstrate full coverage and completeness of work.
3. If short comings are detected take all corrective action needed before planting and seeding begins. Conduct another inspection as directed by Owner to determine if corrective actions are complete and satisfactory.
4. This inspection shall be done at the same time as the pre-installation plant layout inspection specified in Section 32 9000.

F. System Demonstration: At the time for the Installation Inspection (Section 32 9000), demonstrate the successful, full, and automatically controlled operation of each of the irrigation zones.

G. Review all installed equipment and materials with the Owner. Take corrective action as needed. Arrange for a re-inspection if required by the Owner.

H. Final Approval: At the time of the inspection for Final Acceptance (Section 32 9000), again demonstrate the successful, full, and automatic operation of all zones.

I. The Pressure Holding test shall be done for at least half of the system at any one time. The System Demonstration and Final Approval demonstration shall be done for the whole system.

J. Informal and interim reviews and inspections may be conducted by the Owner at their discretion.

K. Where short comings are noted, take corrective action. Notify the Owner when corrective actions have been completed.

END OF SECTION

SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of landscape development work is shown on drawings and in schedules.
- B. Work under this section generally includes, but is not limited to:
 - 1. Salvaging of existing plant material where indicated and delivering them to the Owner at an on-campus location indicated by Owner.
 - 2. Sub-grade cleaning and preparation.
 - 3. Providing topsoil and amendments.
 - 4. Fine grading landscape areas.
 - 5. Providing new sod and indicated plant material.
 - 6. Providing, fertilizer, soil amendments, and planting area mulch.
 - 7. Adjusting irrigation system as needed.
 - 8. Maintenance and warranty.
- C. Maintenance: Maintenance work begins at the start of the Contract and continues until Final Acceptance.
- D. Final Acceptance: Final Acceptance will be acknowledged, in writing, by the Owner when all landscape work of this section and Section 32 80 00 is complete and acceptable.

1.2 SCHEDULE AND SEQUENCE

- A. Salvage existing plants prior to beginning other construction activities.
- B. Do not place topsoil until after the Owner has inspected and approved the prepared landscape area sub-grade.
- C. Do not dig planting holes and install plant materials until after Owner has reviewed and approved planting locations. Mark location of plant materials, and have Owner review and approve locations, before digging planting holes. Owner, at their discretion, may require the Contractor to set plants out to 'mark' planting locations.

- D. Do not begin topsoil placement and planting work until after all other sub-contractors and trades can be excluded from landscape areas. Erect barriers to keep others out of planting areas after preparation work has begun.

1.3 QUALITY ASSURANCE

A. Landscape Sub-Contractor:

1. Sub-contract the landscape planting and irrigation work to a single experienced Landscape Contracting firm acceptable to the Owner.
2. Sub-contract the landscape planting and irrigation work to the same experienced Landscape Contractor. The Landscape Contractor must have a current Landscape Contractor's license from the State of Oregon.
3. The Landscape Contractor shall have an experienced work supervisor on side at all times when landscape works in underway.

B. Plans and Specifications:

1. The Landscape Contractor shall have a current set of clean legible Landscape Planting and Irrigation plans and specifications at the site at all times when landscape work is underway. These documents shall be conveniently located and accessible to landscape work crew.
2. The landscape supervisor and all members of the landscape work crew shall be familiar with the plans and specifications.

C. Plant Material Quality:

1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
2. Do not make substitutions. If specified landscape material is not obtainable, submit to Owner proof of non-availability and proposal for use of equivalent material. Timing of substitution requests shall be in compliance with requirements specified in this Section.
3. Provide trees, shrubs, and ground covers grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock free of disease, insects, eggs, larvae and defects, sun-scald, injuries, abrasions or disfigurement.
4. Provide trees and shrubs of sizes shown or specified. All plants shall be equal to or better than quality and size standards indicated in ANSI Z 60.1 – American Standard for Nursery Stock. Trees and shrubs of larger size may be used, at no additional cost, if acceptable to Owner, and if sizes of roots or balls are increased proportionately.
5. All plants shall be well formed and balanced. Foliage shall be full and well distributed throughout plants. Conifers shall have a single leader. Trees with weak crotches shall not

be provided. Where plants are placed in formal and linear arrangements provide plants which are uniform in size, form, and character. Conifers with multiple leaders are not acceptable.

6. Quantities: Provide quantity of plant material indicated on drawings. Where a difference occurs between the number of plant symbols shown and any numerical indication of plant quantities, provide the greater quantity.
7. Inspection: Owner reserves right to inspect trees, shrubs, and ground cover at any time for compliance with requirements for name, variety, size, and quality. Remove unacceptable plants and provide acceptable replacements within 7 days unless approved otherwise, in writing, by the Owner.

D. Environmental Conditions

1. Install materials when environmental conditions are not detrimental to performance of good quality work and good condition of materials being installed.
2. Planting shall not be permitted when:
 - a. Air temperatures are lower than 35 degrees (F);
 - b. Air temperatures are above 90 degrees (F);
 - c. Soils are saturated and soggy;
 - d. Soils are dry;
 - e. Wind velocity is 30 mph and greater.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Sod: Deliver sod to site only when all preparations are complete and ready for immediate sod installation. Sod shall be installed within 8 hours of delivery. Sod shall be delivered to the site directly from the growing grounds and shall be harvested no more than 24 hours before delivery
- C. Existing Plants to be Removed and Reused: Dig, containerize or wrap in burlap all existing plants within the work area. Follow standard horticultural practices. Store in off site location until ready for re-installation..
- D. Do not remove container grown stock from containers until planting time.
- E. Handle all plants with care. Lift and move by holding onto containers and root balls. Do not drop. Do not move by rolling on root balls and containers. Provide lifting and moving equipment suitable for load and capable of moving and setting plants without damage to plants and injury to workers. Meet all applicable OSHA rules and regulations.

1.5 SITE CONDITIONS

- A. Examine site conditions and notify Owner if found to be adverse to performing work and to health and vigor of plants. Proceeding with work indicates the Contractor has accepted all conditions, consequences, and will meet all Contract requirements.

- B. Utilities: Determine and mark location of underground utilities and improvements. Perform work in a manner which will avoid possible damage. Hand excavate, as required.
- C. Adverse Conditions: When conditions detrimental to plant installation and growth are encountered, such as rubble, contaminated soils, adverse drainage conditions, and obstructions, notify Owner before proceeding with further work.

1.6 SPECIAL PROJECT WARRANTY

- A. Warranty lawns, for all causes, through specified maintenance period and until Final Acceptance.
- B. Warranty ground cover, perennials, ornamental grasses, trees, and shrubs, from installation and additionally for a period of one year after date of Final Acceptance. Prior to Final Acceptance warranty shall be for all causes. After Final Acceptance warranty shall be for all causes except for defects resulting from neglect by Owner, abuse and damage by others.
- B. Remove and replace trees, shrubs, ground cover, other plants found to be poorly formed, thin, stressed, dead, unhealthy, and not showing vigorous and healthy growth. During warranty period, make replacements within five days of notice unless otherwise approved by Owner. Additionally, replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Owner, it is advisable to extend warranty period for a full growing season.
- C. All replacement materials shall be fully warranted for a period of one year following replacement.
- D. Another inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection.
- E. Warranty work additionally includes replacement and repair of all site improvements adversely impacted by work failure, plant material warranty work; repair and regrading of areas where settlement occurs; and site cleaning and debris disposal related to warranty work.
- F. Prior to Final Acceptance replacement plant materials shall be provided at the size indicated on the Drawings. After Final Acceptance replacement plants shall be provided at the average size of surrounding like plants.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Topsoil for landscape work is not available at site and must be provided from an approved off site source.
- B. Provide new imported topsoil which is loose, friable, natural sandy-silt loam. Soil must be free of all weeds (seed and all other viable parts), rock, gravel, clay, clods, un-decomposed organic matter; debris, and all other extraneous material. Component of soil passing the # 200 screen

shall be no greater than 5% (by volume).

- C. Provide topsoil approved by Owner, meeting Owner's acceptance and all the requirements of the specifications.
- D. Topsoil which is contaminated when it arrives at the site or which becomes contaminated with unacceptable material at any time is unacceptable. Unacceptable topsoil shall be removed, disposed of off-site and replaced with acceptable materials. Requirements of replacement work includes removal and replacement of all other work and materials adversely effected by topsoil replacement work.

2.2 SOIL AMENDMENTS

- A. Organic Amendment: Medium to fine ground, chemically stable, thoroughly composted, commercially produced yard debris (compost) and mushroom compost..
- B. Lime: Dolomite lime, horticultural type; 90% passing a 10 mesh screen and not less than 50% passing through a 100 mesh screen.
- C. Gypsum: Granular calcium sulphate, horticultural type (Webfoot Fertilizer Co. or approved alternate).
- D. Commercial Fertilizer: Complete fertilizer of neutral character, with at least 50% of the nitrogen in slow release form. Apply at manufacturer's recommended rates at 30 day intervals:
 - 1. Shrub and Ground Cover Areas: 10-10-10 blend.
 - 2. Lawn Areas: 20-10-10 blend
 - 3. Plant Pit Back Fill: 10-10-10 Osmocote thoroughly blended into backfill soil.

2.3 MULCH

- A. Bed Mulch: Covering over all shrub/ground cover beds and around trees in lawn. Medium/fine ground hemlock bark
- B. Lawn Mulch: Covering over seeded lawn areas. Wood cellulose, died green, specifically made for covering of newly seeded landscape areas.

2.04 PLANTS AND LAWN MATERIALS

- A. Provide plants which meet or exceed all relevant requirements of ANSI Z60.1 "Standard for Nursery Stock". Plants shall be in excellent condition; well and symmetrically formed; free of all weeds, disease, infestations, broken branches, and other defects. Plants which do not meet these requirements shall be removed and replaced with acceptable materials which meet all requirements.
- B. Provide plants of the size and type indicated. After the Contractor has submitted the "Plant Material Acquisition Verification", if plant materials of the indicated size have not been acquired as presented, the Owner may, at no additional cost to the Contract, require the Contractor to

provide larger sized plants.

- C. Trees and Shrubs may be provided with containerized or balled and burlaped rootballs.
- D. Lawn: Sod; "Oregon Turf" sod or approved alternate

2.05 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Anti-Desiccant: Emulsion type, film forming blend, designed to permit transpiration and retard excessive loss of moisture from plants. "Wilt-Prof" or approved alternate.
- B. Tree Supports:
 - 1. Stakes: 2x2x8 foot long, untreated Douglas Fir; free of all knots, checks, cracks, and other defects.
 - 2. Wire: Form stake to tree tie, #16 gauge galvanized steel wire. With galvanized staple nail to secure wire to stake.
 - 3. Tree Tie: 8"-10" long x 2" wide section of rubber tire or tube. Secure ends of ties to wire.
- C. Weed, Insect, and Disease Control Material: Utilize only materials which meet specified requirements and which are acceptable to and have been approved by the School District. Submit a list of proposed materials to the District for review and comment. Utilize alternative materials or utilize alternative methods as directed by and acceptable to the District.

2.06 MIXES

- A. Lawn Areas: Provide the following prior installation of sod and seed.
 - 1. Topsoil: 12" (minimum) deep (after full settlement).
 - 2. Lime: 50 lbs per 1,000 square feet.
 - 3. Gypsum: 40 lbs per 1,000 square feet.
 - 4. Fertilizer: Specified blend at manufacture's recommended rate for new seed and sod beds.
 - 5. Organic Amendment: 4 inch (minimum settled depth) deep layer
- B. Shrub and Ground Cover Planting Beds: Provide the following prior to installation of shrubs, trees, and ground cover in planting beds:
 - 1. Topsoil: 18" (minimum) deep (after settlement).
 - 2. Fertilizer: Specified blend at manufacture's recommended rate for new planting beds.
 - 3. Organic Amendment: 6 inch (minimum settled depth) layer

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine sub grade, verify elevations, observe conditions under which work is to be performed and notify contractor of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 PREPARATION

A. Weed Control

1. Keep all planting areas free of weed growth at all times from beginning of construction through to Final Acceptance. Should weeds be allowed to become established or go to seed, the Owner, at their discretion, may require the Contractor to remove soils to a stipulated depth and replace it with imported topsoil. This would be done with no additional cost to the Owner.
2. Spray kill and remove all weeds prior to beginning sub-grade preparation work.
3. Existing areas which have been disturbed by work of the contract shall have existing ground level vegetation (grasses and other weeds) eradicated by use of contact herbicides.
4. Do not use any herbicide which will have any residual impact on existing and newly seeded and planted materials. Utilize only contact type herbicides. Only chemical materials acceptable to the School District may be used on site.

B. Salvage and Delivery of Existing Plants:

1. Carefully excavate a suitable sized root ball for each plant. Handle rootball to prevent damage and breaking.
2. Wrap rootball with jute burlap and secure with twine or place in suitably sized container.
3. Keep rootballs in-tact and moist until delivery to Owner.
4. Deliver plants to site(s) on campus indicated by Owner and carefully off-load at site(s)

C. Sub-Grade Preparation:

1. Sub-grade preparation must be completed before topsoil and other soil amendments may be installed.
2. Excavate as needed to provide a sub-grade level which allows mulch, topsoil, and amendments to be placed at specified depths and to indicated finish grades. Remove excavated materials from site.

3. Loosen sub-grade to a depth of at least 6 inches.
4. Remove debris, and contaminated soils from sub-grade and dispose of off site. Provide additional topsoil as needed to fill voids created by removal.
5. Along the edges of pavements excavate and remove gravel base extending beyond edge of paving. Do not undermine the pavement.
6. Provide imported topsoil fill as needed to bring sub-grade up to required elevations.
7. In planting beds and lawn areas, rip and till sub-grade to provide a loose material at least 8 inches deep.
8. Conduct work in a manner which will protect roots of existing trees. Use hand tools where required. Reduce excavation depths, if approved by Owner, where needed to protect tree roots.
9. This work shall be done just prior to the scheduled time for further landscape work. From the time when this work begins other trades shall be kept off of the improved landscape areas.

B. Planting Area Soil Placement:

1. After sub-grade preparation work is complete, inspected and approved by Owner, provide topsoil in specified depths. Place an even 4 inch depth of topsoil over prepared sub-grade and till to form a uniformly blended layer of topsoil and sub-soils at least 8 inches deep. Place remainder of topsoil in 6 inch (maximum) deep layers and tamp and roll to prevent future settlement.
2. Grade to provide approximate finish grade prior to installing plant materials. Final finish grading shall be done after planting is complete and before mulching and sodding occurs.
3. Do not allow topsoil to become contaminated with gravel, construction debris, or any other material. Remove contaminated soil and replace with clean topsoil.

C. Soil Amendment:

1. Organic Amendment:
 - a. Place and spread at required depth evenly over the entire area.
 - b. Till into top 6-8 inches of soil to form and uniformly blended topsoil/organic amendment mix.
2. Lime and Gypsum: Just prior to seeding or sodding lawn and installing plants, spread evenly over planting areas. Till to blend into soils to specified depths.
3. Fertilizer:

- a. Prior to r sodding lawn and installation of plants spread specified fertilizer over planting areas at indicated rates. Till to work into the soil to a depth of 6 inches-8 inches.
 - b. After planting has been completed top-dress specified fertilizers evenly over planting areas.
4. Do not allow amendment work to bring gravel and other debris up into the top 6 inches of soil in lawn areas. Alter amendment process as approved by the Owner to prevent soil contamination. Where topsoil becomes contaminated, remove and replace with clean material.

3.3 PLANT INSTALLATION

- A. Layout – Before Digging Plant Holes: Set out or mark locations of trees and shrubs in locations indicated on drawing. Contact Owner and have them review and approve locations before digging planting holes. Adjust locations as directed.
- B. Planting Hole Excavation:
1. Dig holes twice the diameter and 2” (for shrubs) and 6” for trees shallower than the plant’s root ball. Scarify the edges and bottom of the plant hole.
 2. If sub-soils are dry fill planting hole with water and allow to drain out before setting plant.
- C. Handling:
1. Handle plants carefully and in a manner which will not damage branches, foliage and break or fracture root balls.
 2. Do not drop and drag plants.
 3. Do not move by holding onto branches or rolling by root balls.
 4. Do not lift or move plants using equipment which will damage or disfigure plants. Plants where trunk and bark damage has occurred during movement shall be removed from site and be replaced with plants meeting all requirements.
 5. Provide equipment to move and place trees as needed. Do not exceed workers, OSHA lifting limits.
- D. Placing Trees and Shrubs:
1. Remove entire container and wire baskets. Cut off and remove burlap and twine from top and sides of root balls. Dispose of these materials off site. Do not roll burlap and twine down into planting hole.
 2. Place plants plumb and in the center of the planting hole. By hand loosen the soil all around the face of root balls of containerized plants

3. Place blended backfill mix all around and half way up the root ball. Tamp and work to eliminate voids, make firm, and prevent future settling. Water to help settle, but do not make mix soggy. Place remainder of backfill mix and make firm up to finish grade. Place up to the top of the root ball and angle down to finish grade.

E. Anti Desiccant:

1. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage.
2. If deciduous tree or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again 2 weeks after planting.

F. Pruning:

1. Prune as needed to remove dead or damaged branches. After pruning plants must still meet size requirements, be well form, have central leaders (where appropriate), and have not gaps of asymmetrical aspects.
2. Remove excessively pruned or malformed stock resulting from improper pruning. Replace with good quality plants meeting all requirements

G. Tree Staking:

1. Stake trees with (3) stakes each, wire and protective ties, as indicated, immediately after planting.
2. Affix wire to stake with galvanized staple type nail.
3. Wire shall not be taut, but shall be slack enough to allow tree trunk at least 2" of free movement in all directions without putting any strain on wire.

3.4 SODDING NEW LAWNS

A. General

1. It is the Contractor's responsibility to determine the time when lawn will be installed and seed or sod the lawn in accordance with the seasonal requirements specified. The additional costs of sodding must be included in the original Contract amount if lawns will be installed during that time.
2. Bring lawn areas to a firm finely graded condition before sodding.
3. Grade lawn evenly to blend with surrounding lawn and finish surfaces. Finish grades shall be approximately match pre-construction grades.
4. Rake, roll, and water to make firm and prevent future settlement. Do not overly compact. Leave top of soil raked and loose to encourage easy penetration by roots.

5. Water lawn areas to allow for detection of high and low areas. Do not make soggy. Take corrective action as needed to eliminate ruts, high spots uneven areas, and all puddles. When eliminating puddles, re-grade areas within puddle, uphill, and down hill as needed to provide continuous even sheet drainage across entire lawn panel.
6. Keep all foot and vehicular traffic off of prepared lawn areas.
7. After sodding is complete erect string and wood stake 'fence' all around to discourage trespass.
8. Water sodded areas using a fine spray to moisten the ground. Hand water if necessary and adjust timing of sprinkler system daily if required by changes in weather conditions. Maintain optimum soil moisture at all times until seed has sprouted and seed or sod has become well rooted. Do not make ground soggy or water to the extent that water puddles on and runs across ground surface.
9. Sod shall be installed within 24 hours of harvesting. Keep moist at all times. Sod shall be well rooted strongly bound material capable of holding together when held by any edge.
- 10 Do not place sod pieces which are shorter than 24 inches or narrower than 18 inches. Cleanly cut sod with sharp tool. All cut faces shall be smooth.
- 11 Provide and place only sod in good condition. Remove sod which is or becomes damaged or in less than optimum condition.
- 12 Just prior to placing sod, spread a ½" thick layer of dry fine ground commercially composted yard debris over otherwise prepared area to be sodded. Lightly rake the compost into the top of the soil.
- 13 Place sod rolls and panels on lightly moistened and fully prepared soil. Place sod tightly butted to adjacent sod pieces. 'Humping' and gaps at edges are not acceptable.
- 14 Stagger the end joints of adjacent sod strips.
- 15 Do not work or travel directly on sod and prepared soils below. Provide and work on plywood paths and platforms set on soil.
- 16 When sod is in place pull or push light lawn roller over it to attain full and direct soil to soil contact

3.5 MULCHING

- A. Fine grading work shall be complete and acceptable before mulch is placed.
- B. Provide two inch deep covering of bark mulch in all shrub/ground cover planting areas, except where gravel is indicated as the mulch/surface cover.
- C. Provide a five foot diameter, three inch deep bark mulch ring around all trees in lawn.

- D. Keep mulch off all plants, walls and paved areas.
- E. Pull mulch away from base/root crown of all shrubs.
- F. Keep all mulched areas free of weeds and grasses.
- G. Place soil separation fabric and secure in place prior to placing gravel and river stone. Place gravel stone over indicated areas, at required depth without displacing fabric.

3.6 MAINTENANCE

- A. Maintenance requirements begin at the start of the Contract. Keep all landscape areas weed free and keep site clean of debris and materials from landscape areas. Keep existing trees and lawn areas to remain protected, watered, fertilized, and mown as needed to keep in good condition.
- B. Maintain trees, shrubs, lawns, and all other landscape planted areas until Final Acceptance but in no case less than 30 days after Installation Acceptance.
- C. Perform maintenance tasks on a weekly basis unless otherwise noted. Task not performed shall be considered as Contract value not provided and shall result in a reduction in the Contract amount due to the Contractor. Provide maintenance schedule indicating the day of the week when work will be performed. Notify Owner prior to changing schedule.
- D. Maintain and care for trees, shrubs and all other landscape planed areas by fertilizing, pruning, cultivating and weekly weeding. Tighten and repair stake supports and reset trees and shrubs to proper grades or vertical position as required. Spray as required to keep trees and shrubs free of insects and disease. Fertilize and treat as specified and additionally as needed to provide planting areas free of weeds, disease, and infestation and in good condition with vigorous growth and good health.
- E. Maintain and care for lawns until Final Acceptance. An acceptable lawn shall be fully established, have a uniform rich green color, dense stand of grass, free of thin, bare or eroded, depressions, disease, infestations, and weeds. Mow grass at 2 inch height when it attains a height of 2 1/2 inches.
- F. Mow weekly and edge at every other mowing thereafter. Remove grass clippings and dispose. Fertilize and otherwise treat as necessary to provide an acceptable uniform rich green color dense stand of lawn of free of all disease, infestations, and disease. Final Acceptance of landscape areas will not be acknowledged until lawns are accepted.
- G. Maintain lawns by watering, fertilizing at least every 25 days, weeding, mowing and trimming weekly and other operations such as rolling, re-grading and replanting as required to establish a smooth, rich green, weed free, full, and otherwise acceptable lawn.
- H. Adjust irrigation as needed to conserve water while providing optimum soil moisture levels. Adjust as needed, daily if necessary, to conform to weather conditions and plant establishment needs.

- I. Review the operation of the irrigation system at least once a week to verify proper working and identify any problems. Take remedial actions immediately.

3.7 CLEANUP AND PROTECTION

- A. Keep pavements buildings, and landscape areas clean of landscape materials and keep work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.8 INSPECTION AND ACCEPTANCE

- A. Providing notification and making arrangements for inspections is the responsibility of the Contractor. Notify the Owner at least five work days prior to the date requested for any inspection. Inspections and tests will be conducted as fitting the Owner's schedule as close to the requested date and time as possible.
- B. Time required for initial testing and inspections will be part of the Contract amount. Re-testing and re-inspections due to the Contractors' failure to meet standards will result in the Contractor having to pay for the Owner's and Owner's consultant's time spent at the re-inspection and writing up subsequent inspection reports.
- C. Milestone Inspections:
 1. Make arrangements for and provide assistance for landscape work to be inspected, reviewed, and accepted at the following 'milestones':
 - a. Sub-Grade Approval Inspection: When sub-grade preparation work is complete and prior to placement of topsoil.
 - b. Topsoil Placement and Plant Layout Approval Inspection: When topsoil and amendments are in place, 'rough' finish grading is complete, and location for plants are marked. This shall be done prior to digging planting holes and installing plants.
 - c. Installation Completion Acceptance Inspection: When all landscape installation work is completed, including maintenance, Architect will, upon request, make an inspection to determine Installation Acceptance.
 - d. Final Acceptance Inspection: 30 days (minimum) following Installation Acceptance the Owner will, upon request, make an inspection to determine Final Acceptance. All landscape and irrigation work shall be complete and in good condition, seeded areas fully establish, all areas clean and weed free, all short comings corrected, and all work in compliance with Contract Requirements.
 2. See Section 02810 for combined irrigation and planting inspections.

3. Subsequent work shall not be undertaken until the Owner has approved the milestone work.
 4. Sub-grade, topsoil placement, and planting location inspections shall be conducted for at least 50% of the landscape work at one time. Costs of additional inspections shall be borne by the Contractor.
 5. Inspections for Installation Completion and Final Acceptance may only be done for all landscape work at the same time. Partial acceptances at these steps will not be considered.
- D. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Owner and found to be acceptable. Materials and work not meeting the Owner's approval shall promptly be removed. Replacements shall be provided and corrective action taken within five days unless approved, in writing, otherwise by Owner.
- E. The Owner, at their discretion, will conduct interim inspections at times of their choosing. Provide assistance as needed.

END OF SECTION

SECTION 33 05 16

UTILITY STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes precast concrete utility structures:
 - 1. Trench systems
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 20 00 - Concrete Reinforcing.
 - 3. Section 31 20 00 – Earth Moving
 - 4. Section 31 23 17 - Trenching

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 318 - Building Code Requirements for Structural Concrete.
 - 2. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 - 3. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
- B. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 - 3. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 6. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - 7. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 8. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 9. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 10. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 11. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

12. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
13. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
14. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
15. ASTM C33 - Standard Specification for Concrete Aggregates.
16. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
17. ASTM C138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. ASTM C192/C192M - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
22. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
26. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
27. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
28. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
29. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
30. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
31. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
32. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
33. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
34. ASTM C1504 - Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts, Storm Drains, and Sewers.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

- D. National Precast Concrete Association:
 - 1. NPCA Quality Control Manual for Precast Plants.
 - 2. NPCA Plant Certification Program.

1.3 DESIGN REQUIREMENTS

- A. Design structures for minimum loads in accordance with ASTM C857.
 - 1. Roof Live Load: Comply with the following loading conditions, including impact load.
 - a. Heavy Traffic: ASTM C857; A-16, maximum 16,000 lb each wheel.
 - b. Medium Traffic: ASTM C857; A-12, maximum 12,000 lb each wheel.
 - c. Light Traffic: ASTM C857; A-8, maximum 8,000 lb each wheel.
 - d. Walkway Traffic: ASTM C857; A-0.3, maximum 300 psf.

1.4 SUBMITTALS

- A. Section 01300 – Submittals.
- B. Shop Drawings:
 - 1. Indicate structure locations, elevations, sections, equipment supports, sizes and elevations of penetrations.
 - 2. Indicate design, construction and installation details, typical reinforcement and additional reinforcement at openings and for each type, size and configuration.
- C. Product Data:
 - 1. Submit data for covers, steps, component construction, features, configuration, and dimensions.
- D. Design Data:
 - 1. Submit concrete mix design for each different mix.
 - 2. Submit design calculations signed and sealed by professional engineer.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Obtain precast concrete utility structures from single source.
- B. Perform structural design in accordance with ACI 318.
- C. Perform Work in accordance with NPCA Quality Control Manual for Precast Plants.
- D. Conform to the following for material and fabrication requirements:
 - 1. Single Cell Box Culverts: ASTM C1433.
 - 2. Three Sided Structures: ASTM C1504.
 - 3. Other Structures: ASTM C913.

- E. Perform welding in accordance with the following:
 - 1. Structural Steel: AWS D1.1.
 - 2. Reinforcing Steel: AWS D1.4.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum years documented experience.
- C. Welders: AWS qualified within previous 12 months.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01630 - Product Requirements and Substitutions: Requirements for transporting, handling, storing, and protecting products.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast structures. Lift structures from designated lifting points.
- C. Do not deliver products until concrete has cured 5 days or attained minimum 75 percent of specified 28 day compressive strength.
- D. Store precast concrete structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- E. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE UTILITY STRUCTURES

- A. Fabricators:
 - 1. Utility Vault - Wilsonville
 - 2. Hanson Pipe & Products
 - 3. Contech Construction Co.
 - 4. Advantage Precast
- B. Precast Concrete Utility Structures: Reinforced precast concrete.

2.2 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Type II - Moderate Portland type.

- B. Fine and Coarse Aggregates: ASTM C33, except gradation requirements do not apply.
- C. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES

- A. Air Entrainment: ASTM C260, certified by manufacturer to be compatible with other admixtures.
- B. Chemical Admixtures: ASTM C494/C494M. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
- C. Fly Ash Calcined Pozzolan: ASTM C618 Class.

2.4 CONCRETE REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade; deformed billet steel bar .
- B. Reinforcing Wire:
 - 1. Plain Wire: ASTM A82; unfinished.
 - 2. Deformed Wire: ASTM A496 unfinished.
- C. Welded Steel Wire Fabric:
 - 1. Plain Wire: ASTM A185; unfinished.
 - 2. Deformed Wire: ASTM A497; unfinished.

2.5 ACCESSORIES

- A. Membrane Curing Compound: ASTM C1315 Type 1, Class C.
- B. Inserted and Embedded Items:
 - 1. Structural Steel Sections: ASTM A36/A36M.
- C. Joint Sealants and Joint Gaskets:
 - 1. External Sealing Bands: ASTM C877; Type I rubber and mastic bands.
 - 2. Preformed Joint Sealants for Concrete Pipe and Box Sections: ASTM C990.
 - 3. Elastomeric Joint Sealants: ASTM C920; silicone polyurethane; Grade NS, Class 25.
- D. Pipe Entry Connectors: ASTM C923.
- E. Grout:
 - 1. Cement Grout: Portland cement, sand and water mixture with stiff consistency to suit intended purpose.
 - 2. Non-Shrink Grout: ASTM C1107, Grade A ; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 28 days.

2.6 CONCRETE MIX

- A. Select proportions for normal weight concrete in accordance with ACI 318. and ACI 211.1.
- B. Provide concrete to the following criteria:
 - 1. Compressive Strength: 4,000 psi at 28 days.
 - 2. Water Cement Ratio:
 - a. Concrete Exposed to Freezing and Thawing: Maximum 0.45 percent by mass.
 - b. Watertight Concrete Not Exposed to Freezing and Thawing: Maximum 0.45 percent by mass.
 - c. Concrete Exposed to Corrosive Conditions: 0.40 percent by mass.

3. Air Content:

	Severe Exposure	Moderate Exposure
3/8 inches	6.0 to 9.0	4.5 to 7.5
1/2 inches	5.5 to 8.5	4.7 to 7.0
3/4 inches	4.5 to 7.5	3.5 to 6.5
1 inches	4.5 to 7.5	3.0 to 6.0
1-1/2 inches	4.5 to 7.0	3.0 to 6.0

- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs approved through submittal process.
 - 1. Do not use calcium chloride.

2.7 FABRICATION

- A. Fabricate precast concrete utility structures in accordance with ACI 318. and NPCA Quality Control Manual for Precast Plants.
- B. Fabricate precast concrete utility structures to size, configuration, and openings as indicated on Drawings.
- C. Construct forms to provide uniform precast concrete units with consistent dimensions.
- D. Clean forms after each use.
- E. Install reinforcing by tying or welding to form rigid assemblies. Position reinforcing to maintain minimum 1/2 inch cover. Secure reinforcement to prevent displacement when placing concrete.
- F. Position and secure embedded items to prevent displacement when placing concrete.

- G. Deposit concrete in forms. Consolidate concrete without segregating aggregate.
- H. Provide initial curing by retaining moisture using one of the following methods:
 - 1. Cover with polyethylene sheets.
 - 2. Cover with burlap or other absorptive material and keep continually moist.
 - 3. Apply curing compound in accordance with manufacturer's instructions.
- I. Provide final curing in accordance with manufacturer's standard.
- J. Remove forms without damaging concrete.

2.8 CONCRETE FINISHES

- A. Formed Surfaces Not Exposed to View: As formed.
- B. Unformed Surfaces: Finish with vibrating screed or hand float.
 - 1. Permitted: Color variations, minor indentations, chips, and spalls.
 - 2. Not Permitted: Major imperfections, honeycomb, or other defects.

2.9 SOURCE QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Perform the following tests for each 150 cy of concrete placed, with minimum one set of tests each week.
 - 1. Slump: ASTM C143/C143M.
 - 2. Compressive Strength: ASTM C31/C31M ASTM C192/C192M and ASTM C39/C39M.
 - 3. Air Content: ASTM C231 or ASTM C173.
 - 4. Unit Weight: ASTM C138.
- C. Visually inspect completed precast structures for defects.
 - 1. Repair defects affecting exposed to view surfaces to achieve uniform appearance.
 - 2. Repair honeycomb by removing loose material and applying grout to produce smooth surface flush with adjacent surface.
 - 3. Repair major defects only when permitted by Architect/Engineer Owner.
- D. Make test results available to Engineer upon request.
- E. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Engineer at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01040 – Project Coordination: Verification of existing conditions before starting work.
- B. Verify items provided by other sections of Work are properly sized and located.
- C. Verify correct size and elevation of excavation.
- D. Verify subgrade and bedding is properly prepared, compacted and ready to receive Work of this section.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

- A. Install underground precast utility structures in accordance with ASTM C891.
- B. Lift precast concrete structures at lifting points designated by manufacturer.
- C. When lowering structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- D. Install precast concrete base to elevation and alignment indicated on Drawings.
 - 1. Connect drain from trench system to sump drainage system in existing vault, as indicated on drawings.
- E. Assemble multi-section structures by lowering each section into excavation.
 - 1. Clean joint surfaces.
 - 2. Install watertight joint seals in accordance with manufacturer's instructions using elastomeric joint sealants, grout, or butyl resin sealants.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements.
- B. Section 01780 - Contract Closeout: Field inspecting, testing, adjusting, and balancing.
- C. Perform the following tests and inspections for structures indicated to be watertight:

1. Hydrostatic Exfiltration Test: In accordance with manufacturer's instructions.

3.5 SCHEDULES

A. Precast Trench:

1. Base Section: 75 inches x 24 inches clear inside dimensions.
2. Cover Section: As required for tight continuous seal to base section.

END OF SECTION

SECTION 33 21 13

INJECTION WELL SUPPLEMENTAL CONDITIONS

PART 1 GENERAL

1.1 GENERAL CONDITIONS

See Contract Conditions

1.2 FIGURES

- A. Included herein as part of the contract documents are the following drawings:
1. HG-1 Injection Well Plan and Section
 2. M 40 Cramer East Plant Chiller Water P & ID

1.3 CONTRACT TIME

- A. There are two time schedules for this project:
1. Substantial Completion:
 - a. All Work under this Contract shall be substantially complete within 90 calendar days after the date established in the Notice to Proceed. Time is of the essence for this injection well. For the purposes of this project, Substantial Completion shall be defined as completion of drilling, well completion, and development.
 2. Final Completion:
 - a. Final Completion of all Work under this Contract, including injection (including submittal of test data), securing the well site, demobilization, cleanup, and video logging the borehole and issuance of Final Submittals shall be within 120 days after the Notice to Proceed.

1.4 NOTICE TO PROCEED

- A. The Owner intends to provide written Notice to Proceed within 15 days after the Contract has been executed and the performance bond and all required insurances have been filed with, and approved by the Owner. However, the Owner retains the right to delay the Notice to Proceed. The Owner will provide the Contractor with notification that the Notice to Proceed will be delayed and an estimate of when Notice to Proceed will be issued as soon as a delay is anticipated. The Contractor shall not commence work under the Contract until such written notice has been given. **The Owner intends, however, to issue the notice to proceed by: July 15, 2008.**
- B. The Contractor shall notify Owner seven (7) days prior to starting the work. However, if agreed to by the Owner, the Contractor may start work sooner than seven (7) days after receiving the Notice to Proceed.

- C. The Contractor shall commence work and drilling within ten (10) days after the date of the Notice to Proceed, which includes mobilizing to the site and starting drilling, or such other date as agreed to by the Owner as may be fixed by the Notice to Proceed, which date shall establish the date for commencement of the time permitted to complete the work. Work (drilling, completing and testing the new Cramer Hall injection well) shall proceed continuously after the Notice to Proceed has been given.

1.5 LIQUIDATED DAMAGES

- A. The amount of Liquidated Damages specified under the terms of this Contract shall be:
 - 1. Per Division 1

1.6 EXTRA WORK AND CHANGE ORDERS

- A. The Owner may approve Change Orders and extensions of Contract time. All Change Orders must be approved in writing; an adjustment of the surety bond will be negotiated with the Contractor at the time of the change.
- B. The Owner shall have the right to require, and the Contractor agrees to do extra work over and above that which is indicated by the Contract Documents and covered by the unit prices of the Contract, or negotiated price or prices. Extra work will be a logical part of the Contract, arising from reasonably unforeseeable conditions, changed requirements or new information based on subsurface conditions. Such additional work shall be undertaken only upon written instructions from the Owner's Representative or Engineer.
- C. Extra work shall be done at prices agreed upon between the Contractor and Owner, but in no event exceeding unit prices established in the Contract. When such order pertains to work of a class or classes for which no unit prices are established, then the agreed adjustment shall be based either on:
 - 1. Unit prices decided on fair and equitable grounds, or
 - 2. Lump sum decided on fair and equitable grounds, or
 - 3. By force account.

1.7 AUTHORITY OF OWNERS REPRESENTATIVE

- A. The Owner has delegated to the Owners Representative and/or the Engineer the authority to decide all questions, excepting time extensions, which may arise as to the quantity, quality and acceptability of materials furnished; the rate of progress of the work; interpretation of the Plans and Specifications; the measurement of all quantities; and the acceptable fulfillment of the Contract on the part of the Contractor.

1.8 WATER AND POWER

- A. New Cramer Hall Injection Well
 - 1. The Contractor shall make all arrangements necessary to obtain sufficient power for the construction and injection testing of the well. The drill site is located in a vault along SW Montgomery Street, near the intersection with SW Broadway, and is next to Cramer Hall. Power will be provided to the job site from Cramer

Hall. Noise reduction will be important and the Contractor is encouraged to engineer the site to reduce noise.

2. The Contractor shall be responsible for hiring a licensed electrician to complete the required wiring for connecting to the chosen power source by safe and legal means. **The Owner is not responsible for providing the power to service to the Contractor's equipment.**
3. The Contractor shall be responsible for supplying water as needed during the drilling operation and testing. **Water is available at a hydrant within 100 ft.** It will be necessary to pipe the water to the drill site and it will be necessary for the Contractor to secure the water line as needed to protect pedestrians and to ensure vehicle and pedestrian access as necessary along S.W. Montgomery Street. In order to use water from the hydrant through a direct connection, an acceptable method for conveyance of the water from the hydrant to the site would have to be developed by the Contractor and approved by the Owner. The Contractor shall obtain a permit from the City of Portland to use water from the hydrant and the Contractor will be responsible for all hookups and cost of the water including costs associated with acceptable back flow prevention device as required by the City. The Contractor shall furnish all valves, hoses, connections, and miscellaneous fittings necessary to obtain sufficient water for drilling the new well.

1.9 SAFETY

- A. Contractor shall develop, publish and implement the overall Drilling Safety Program for the Project. This program shall conform to all applicable codes and laws. Contractor shall submit the written Safety program to the Owner's Representative within seven (7) days after receipt of the written Notice to Proceed. The program shall subsequently be distributed to and implemented by the Contractor's personnel as well as its Subcontractors and Suppliers. Contractor shall fully implement and comply with their Drilling Safety Program, and shall submit to the Owner's Representative a letter signed by the Contractor's owner/president affirming such implementation and compliance within fifteen (15) days after on-site work has commenced.

1.10 PAYMENT AND INTEREST TO SUBCONTRACTORS

- A. Contractor shall include in each subcontract for property or services entered into by the Contractor and subcontractor, including material suppliers, a payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract within 10 days that such amounts are paid to the Contractor for that work. Contractor shall also include an interest penalty clause obligating the Contractor to pay the subcontractor an interest penalty on amounts due in the case of each payment not made in accordance with the payment clause, for the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is paid. The interest rate will be as specified in ORS 279.435.
- B. Contractor shall include in each of its subcontracts a provision requiring the subcontractor to include a payment and interest clause conforming to that of the above paragraph for each of its subcontracts and requiring each of its subcontracts to include such clause in their subcontracts with each lower-tier subcontractor or supplier.

1.11 SCHEDULES AND SEQUENCE OF WORK

- A. New Cramer Hall Injection Well
 - 1. Test Well
 - a. Substantial Completion – Drilling and Well Installation 90 Days
 - b. Final Completion – Testing and Logging 100 Days
 - 2. Project Closeout and Completion 120 Days

1.12 WORK LIMITS AND HOURS

- A. Contractor shall confine work to the Owner’s property upon which the well is going to be installed. Contractor shall coordinate use of the site with other contractors or activities that may be occurring on the site. Contractor shall limit work to the following daily schedule:

Monday through Friday: 7:00 a.m. to 9:00 p.m. or darkness (whichever comes first)
Saturday: 8:00 a.m. to 9:00 p.m. or darkness (whichever comes first)
Sunday (excluding holidays): 9:00 a.m. to 9:00 p.m. or darkness (whichever comes first)

1.13 STANDBY/DELAY TIME, INCIDENTAL, AUTHORIZED HOURLY WORK

- A. Time lost to the project schedule can be expected during the course of project execution due to unavoidable and unforeseen events. Time lost to the project due to such circumstances may be originated by the Owner, Owner’s Representative or the Contractor. Time lost from the stoppage of work at the request of Owner or Owner’s Representative shall be defined as “standby time.” Time lost due to the inability of the Contractor to proceed shall be defined as “delay time.” These terms are further defined as follows:
 - 1. **Authorized hourly work** shall include furnishing all equipment, labor, tools, and miscellaneous materials necessary to conduct activities not covered under other bid items as approved by the Owner’s Representative in writing. The Owner’s Representative and the Contractor will maintain records for this work. The Owner’s Representative’s record will be binding. No hourly payment will be made to the Contractor for work being performed to condition or ream the borehole or to repair, clean, or replace equipment that is not in working condition.
 - 2. **Standby time** is the duration of idle time greater than 1 hour accrued at the request of the Owner’s Representative. The Contractor’s workers and equipment shall remain onsite while standby time is in effect. In the event of standby time, the owner shall pay the Contractor for equipment and crew per hour, not to exceed 8 hours per working day, and only hours between 8:00 a.m. and 5:00 p.m. No standby time will be paid during the required grout-curing period or for the recovery period following the constant rate injection test.
 - 3. **Delay time** is defined as avoidable delays greater than 1 hour caused by neglect in planning, improper scheduling or sequencing of work by the Contractor. These items shall include, but are not limited to, the Contractor’s tardiness and inability to provide the trained staff and adequate equipment in a reasonable manner. Delay time shall not include time lost to the project as a result of conditions beyond the Contractor’s control. These unavoidable delays shall

include, but are not limited to, inclement weather and unexpected or unusual conditions. In the event of delay time, the Contractor shall credit the owner for the Owners Representative's time onsite for the period where delay time is in effect, not to exceed 8 hours per working day. The Contractor may give a 12-hour notice to Owner's Representative that there will be a delay without being assessed damages in the event of equipment breakdown and parts not easily attainable and must be ordered. Shorter notice may suffice at the Owner's Representative's discretion if it does not result in an expenditure of the Owners Representative's time on the project. A working day shall be defined for this purpose as 8:00 a.m. to 5:00 p.m., including a 1-hour lunch break, Monday through Friday, excluding holidays. Any additional hours worked each day will be negotiated between Owner's Representative and Contractor.

PART 2 MATERIALS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 33 21 14
INJECTION WELL MOBILIZATION/DEMobilIZATION,
EROSION CONTROL & WATER MANAGEMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes mobilization, site preparation, erosion control and water management, and site cleanup for construction of new Cramer Hall injection well.

1.2 CLEARING, SITE ACCESS, AND SECURITY

- A. New Cramer Hall Injection Well
 1. The new Cramer Hall well site is located vault next to Cramer Hall near the intersection of SW Montgomery Street and SW Broadway, next to Cramer Hall, Portland Oregon. The drill site is to be secured with fencing each night prior to leaving the site.
 2. The new well site is relatively level and although in an urban setting is suitable for a drill rig. We anticipate that some site work and improvements will be needed prior to starting drilling. It is the Contractor's responsibility to visit the site and to assess the amount of effort required to prepare the site for this particular project. The Contractor shall be responsible for communicating access improvement and schedule requirements to the Owner. The Contractor shall employ methods to prevent mud and sediment from being tracked onto public streets.

1.3 EROSION CONTROL

- A. The Contractor shall obtain an Erosion Control Permit from the City of Portland. Erosion Control shall consist of installation, maintenance and removal of temporary erosion and sedimentation control measures. See Section 31 25 13 – Erosion Control.

1.4 EROSION CONTROL PLAN

- A. The Contractor shall submit an erosion control (EC) plan for work associated with the new Cramer Hall injection well project (drilling, and pump testing) for review and approval by the Owner's Representative. The erosion control plans shall comply with all applicable requirements set forth in the City's EC Manual. The Contractor shall design the plans to meet the standards using measures that will best fit the Contractor's construction sequencing and approved schedule. The erosion control plans shall be approved and the erosion control measures installed and inspected by the Owner or Owner's Representative prior to mobilization to the sites. Installation of Erosion Control to meet an approved plan shall not relieve the Contractor of any responsibility for enforcement actions resulting from violation of the standards set forth in the City's

Erosion Control (EC) Manual. The Contractor will maintain one copy of the most current approved erosion control plan at each job site.

1.5 WATER MANAGEMENT PLAN

A. New Cramer Hall Injection Well

1. Water produced from drilling, well development and well testing at the new injection well site can be discharged to a storm sewer located on site as long as it does not exceed the turbidity standards set by the regulating agency. The Contractor shall be responsible for obtaining all necessary discharge permits from the City of Portland and other regulating agencies, for controlling water discharge so that erosion does not occur, and so ensuring that the discharged water meets the turbidity standard as set by the agency(ies) regulating the storm sewer. The contractor shall submit a water management plan for this project prior to starting drilling that provides the necessary compliance with project specific permits. The Owner's Representative prior to starting drilling shall approve the water management plan. The Contractor will not be paid standby time in the event the project is shut down due to nonconformance with permit criteria.

PART 2 MATERIALS

2.1 GENERAL

- A. The Contractor is responsible for determining whether the Cramer Hall injection well site condition requires specific materials and measures to ensure adequate erosion and sedimentation control as required by the City's EC Manual. The City's EC Manual provides recommendations for best management practices and materials that can be implemented to meet erosion control requirements.

2.2 DRILLING WATER

A. New Cramer Hall Injection Well

1. The hydrant for drilling water is located within 100 ft. The Contractor is responsible for obtaining the necessary permit from the City to use the water and to provide all necessary equipment and materials to transmit the water from the hydrant at this location to the drill site. Since a road is next to the drill site (Montgomery Street), the Contractor shall install necessary equipment to allow the water line to cross the road while at the same time allow car access, as needed. Furthermore, the Contractor shall furnish all valves, hoses, connections, and miscellaneous fittings necessary to obtain sufficient water for drilling the new well.

PART 3 EXECUTION

3.1 SITE PREPARATION

- A. Arrange with the Owner for preparation of the well site such that ground surface remains stable during drilling, including but not limited to placement of materials sufficient to support the drilling machine and support vehicles, and to prevent damage to the sidewalks.

3.2 SITE CLEANUP

- A. Contractor shall remove rubbish and debris from sites at conclusion of Work. The Contractor shall remove excess drill cuttings from the site.

3.3 EROSION CONTROL INSTALLATION

- A. Contractor shall construct and install the erosion control measures as outlined in the approved Erosion Control Plan and according to the City's EC Manual, and manufacturer's installation instructions.

3.4 EROSION CONTROL MAINTENANCE

- A. Erosion control measures shall be inspected and maintained as set forth in the City's EC Manual. Erosion control measures shall be maintained on the site until the potential for erosion to occur, as a result of project activities, has been abated. In no case will erosion prevention and sedimentation control measures be removed prior to City inspection and approval.
- B. The contractor shall ensure that all erosion prevention measures shown on the approved plan are installed and function in a manner that meets the standards set in the Contractor's Erosion Control Plan. If the installed erosion prevention control system does not adequately contain the sediment on the project site, the measures shall be field adjusted as necessary by the Contractor. Any deletions, additions, substitutions or any other modification of the measures shown on the approved Erosion Control Plan shall be reviewed and approved by the Owner's Representative prior to installation.
- C. During active construction, the contractor shall inspect the erosion control facilities daily. The contractor shall maintain, adjust, repair or replace erosion control measures to ensure that they are functioning properly. Immediately remove eroded sediment carried or tracked onto the pavement surfaces, off-site areas, or into storm drainage systems such as storm drain inlets, ditches or culverts. Do not flush sediment directly into storm drainage system. Collect and dispose of sediment off site or as directed by Owner's Representative. Water containing sediment shall not be flushed or allowed to flow into storm drainage systems or waterways without first passing through an approved sediment filtering facility or device adequate to meet the standards for discharge set forth in the City's discharge permit.

- D. On inactive construction sites, the Contractor shall inspect the erosion control measures, in a timely manner, to prevent violation of the standards set forth by the City of Portland. Make adjustments and repairs to ensure proper functioning of the measures.

3.5 EROSION CONTROL REMOVAL

- A. When the project is completed and materials associated with the drilling operation that can erode from the site have been removed or managed so that continued erosion potential is minimized, all temporary erosion control measures shall be removed from the construction site, unless otherwise directed by the Owner's Representative. A final inspection is required prior to removal of erosion measures.

3.6 WATER MANAGEMENT CONSTRUCTION AND MAINTENANCE

- A. Construct and install the water management systems in accordance with the approved water management plans for the drilling project outlined in these Technical Specifications. The systems shall be inspected daily by the Contractor to ensure that it is operating as planned. In no case will the water management measures be removed prior to City inspection and approval.

PART 4 MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Measurement and payment for mobilization, demobilization, site preparation, erosion control and water management and for the Cramer Hall injection well project is a lump sum items.

4.2 MOBILIZATION AND DEMOBILIZATION, AND SITE PREPARATION

- A. Measurement and payment for mobilization and demobilization and general site preparation for the Cramer Hall injection well project shall be on a lump sum basis and shall be full compensation for all labor and materials required to prepare each site for the Work, remove Contractor equipment, and to complete site cleanup after the Work has been performed. The Work is defined as site preparation and cleanup, completion and testing of a new Cramer Hall Injection well. Lump sum payment for these activities will be made in two parts. Fifty percent of the mob/demob will be paid in the first invoice for the project and 50 percent will be paid in the final invoice after completing final site cleanup for the injection well drilling and testing project. Compensation for mobilization, demobilization, and general site preparation, shall include all single items of incidental equipment not specified separately (e.g., excavation equipment) required to install the new injection well as specified in these Technical Specifications.

4.3 EROSION CONTROL

- A. The lump sum bid price for Erosion Control for the Cramer Hall injection well project, shall include the cost of all labor, materials and equipment used to provide, maintain and remove erosion control devices and measures at each drill site. The lump sum bid prices

shall include all costs associated with the preparation of the plans, modifications to the plans required to achieve compliance with the Contract and the City Code and maintenance of the measures in accordance with the City's erosion control manual. The lump sum bids for each Schedule price will also include removal or replacement of degraded measures with new materials when directed by the Owner's Representative.

- B. Amounts to be allowed for "Erosion Control" as partial payment made under the Contract for the Cramer Hall injection well project will be as follows:
1. When the plan has been approved and all erosion control materials and measures are in place and have been inspected and approved by the Owners Representative, 50% of the bid amount for this item will be paid.
 2. When 50% of the total original injection well drilling contract is earned from the remaining bid items, an additional 25% of the bid amount for this item will be paid.
 3. Upon completion of all work on the injection well drilling project, final inspection and approval from the Owners Representative, the remaining 25% of the amount bid for this item will be paid.

4.4 WATER MANAGEMENT

- A. The lump sum bid prices for the Cramer Hall injection well project for "Water Management Control", shall include the cost of all labor, materials and equipment used to provide, and maintain the approved systems at the drill site. The lump sum bid prices shall include all costs associated with the preparation of the plans, modifications to the plans required to achieve compliance with the Contract, the turbidity standard set by the regulating agency and the City Code and maintenance of the measures in accordance with the regulatory standards for turbidity reduction. The lump sum bid price will also include removal or replacement of degraded measures with new materials when directed by the Owners Representative. One hundred percent (100%) of the turbidity reduction and water management control for the project shall be paid at the completion of the Contract.

END OF SECTION

SECTION 33 21 15

INJECTION WELL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 NEW CRAMER HALL INJECTION WELL

- A. The completed Work will provide the Owner with one new Cramer Hall Injection Well on property owned by the Portland State University near the intersection of SW Montgomery and SW Broadway, next to Cramer Hall, Portland, Oregon. The Owner's Representative will stake the precise location of the new well prior to the pre-construction meeting. The well is anticipated to be completed at a **depth of 650 feet** below ground surface; however, the well may be completed shallower or at a greater depth if necessary and as approved by the Owner and Owner's Representative. Overall, the drill rig shall have the capability to drill to 1,000 feet below ground surface for this project. The project includes drilling, well installation, well completion (surface seal and seal installation through the upper Troutdale Formation), well development, installation of a screen and liner assembly, if needed, and aquifer testing. The objective is to drill and complete a well capable of recharging the basalt aquifer at a rate of up to 1,500 gallons per minute with spent water from the Cramer Hall chiller condenser cooling water system.

1.2 WORK COVERED BY THE CONTRACT DOCUMENTS

- A. The work for this Contract also includes installation of downhole injection piping, an injection control valve and completion of the wellhead assembly, including controls, piping and valves, so that the well can inject up to 1,500 gallons per minute into the lower basalt formation. Detailed specifications for the downhole control valve and wellhead completion are covered under Section 31 21 18 Cramer Hall Injection Control Value.

1.3 ORGANIZATION AND INTERPRETATION OF CONTRACT DOCUMENTS

- A. Specifications and Drawings included in these Contract Documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance.
- B. A part of the Work that is necessary or required to make each installation satisfactory and operable for its intended purpose, even though it is not specifically called out in the Specifications or on the Drawings, shall be performed as incidental work as if it were described in the Specifications and shown on the Drawings.

1.4 CONSTRUCTION TIME

- A. The time for final completion of the new Cramer Hall injection well is 120 days from the date of the Notice to Proceed.

1.5 HYDROGEOLOGIC INFORMATION

- A. Well logs for wells drilled near the site are available on-line from the Oregon Water Resources Department. Figure 1 presents a diagram of the proposed Cramer Hall injection well. The water well logs and the proposed Cramer Hall injection well diagram are for the Contractor's information only, and Owner will not be responsible for the Contractor's application or interpretation of the information, or for spatial variations of subsurface conditions between the well locations.

1.6 EXAMINATION OF SITE AND CONDITIONS

- A. Contractor must determine for themselves and to their own satisfaction, all the conditions and circumstances affecting the project or the cost of the proposed work by personal examination of the sites and the Plans and Specifications and by such other means as they may choose. It is understood and agreed that information as to underground or other conditions or obstructions indicated in the Plans and Specifications has been obtained by the Owner from data at hand. There is no express or implied agreement that such conditions are fully or correctly shown and the Contractor must take into consideration the possibility that conditions affecting the cost or quantity of Work may differ from those indicated.

1.7 PRE-CONSTRUCTION CONFERENCE AND SUBMITTALS

- A. A pre-construction conference shall be held within five (5) days after the Notice to Proceed. At this meeting the Contractor shall submit:
 - 1. Documentation of certifications testing for each welder on the project.
 - 2. Documentation of licensing and bonding of State of Oregon well drillers to be used on the project.
 - 3. A detailed construction schedule, which will be followed by the Contractor throughout the duration of the project, and updated a minimum of once per month as needed.
 - 4. The names, addresses, and telephone numbers of two or more persons employed by the Contractor who can be reached during evening and weekend hours to handle emergency matters.
 - 5. Material Safety Data Sheets for any and all hazardous chemical products to be used by the Contractor on this project.
 - 6. A listing of all materials proposed to be furnished for this project showing the supplier's name and address, manufacturer's name and product identification number, and catalog cut sheets to clearly identify materials.
 - 7. Erosion Control Plan for the well site.
 - 8. Water Management Plan for the well site.
 - 9. Project Safety Plan.
- B. Work shall not commence until all of these items have been received and approved by the Owner's Representative and erosion control measures are installed at the well sites where work is to begin.

1.8 LIST OF SUBMITTALS

- A. The submittals outlined below apply to the new Cramer Hall injection well project. All submittals shall conform to requirements in Section 1300 – Submittals and the following:

1.9 SUBMITTALS REQUIREING OWNERS REPRESENTATIVE APPROVAL – GENERAL

- A. The Contractor shall submit the items listed on the following Table to the Owner’s Representative for review and approval. The Owner’s Representative reserves the right to request additional submittals that are not included in this Table. Approval of the Owner’s Representative shall not relieve the Contractor from responsibility for any error or omission in the submittal. Obtain the Owners Representative’s approval prior to beginning any work. No deviations from the approved drawings shall be allowed without the prior approval of the Owners Representative. No work may begin until all submittals have been reviewed and approved. Approval of the submittals will be given in writing.

Item	Submittal
Welder certification	Copy, certificate(s)
Bonded well driller license certifications	Copy license(s)
Erosion Control	Plan
Water Management	Plan
Well screen assembly – if used (After drilling the borehole)	Plan, Installation drawings, Equipment List and Manufacturer’s Specifications

1.10 SUBMITTALS REQUIRING OWNER’S REPRESENTATIVE APPROVAL DURING DRILLING AND WELL INSTALLATION AND TESTING

- A. Proposed changes in well design, materials used, or cement grouting methods.
- B. Submit three copies of the drawings for the well site showing the proposed equipment layout, water discharge channels or pipelines, settling ponds if needed, and drill cutting disposal areas and obtain approval from the Owner’s Representative prior to the start of work at the drill site.
- C. Proposed method of sealing casing.
- D. Screen submittal – if used. The Contractor shall provide a submittal prepared by the screen manufacturer, which includes a schematic of the screen assembly. The schematic shall include collapse and tensile strength, estimated screen weight, screen outside diameter and clear inside diameter, slot size and the square inches of open area per lineal foot of screen.
- E. Development tools and methods proposed for development of the new production well.

- F. Injection Test Submittal 1. Submit two copies outlining the injection test plan, including injection test procedures, injection pipe dimensions and setting, metering and flow control equipment, data measurement equipment, and data measurement methods.
- G. Injection Test Submittal 2. Submit within two days of test completion, two copies of injection test data (step rate injection test, constant rate injection test, and recovery test) in hard copy form and one electronic file, in Microsoft EXCEL spreadsheet format.

1.11 SUBMITTALS AT COMPLETION OF WELL CONSTRUCTION

- A. Contractor shall submit “as constructed” drawings of the new Cramer Hall injection well. The drawings shall provide information to clearly show calculations, dimensions, and assumptions.

1.12 QUALITY CONTROL SUBMITTALS

- A. Contractor’s daily drilling logs that include a description of materials encountered, work completed, and water level measurements at the start of drilling and periodically taken each day.
- B. Drilling fluid additive certification that additives are suitable for potable water well applications.
- C. Manufacturer’s Mill Certificate on steel casing.
- D. Grout seal additives certification that additives are suitable for potable water well applications.
- E. Weight measurements of cement grout seal material at 25, 50, 75, and 100 percent of seal placement.
- F. Manufacturer’s descriptive data indicating materials of construction including configuration of screen (see also Screen submittal).
- G. Results of plumbness and alignment testing.

1.13 CONTRACT CLOSE OUT SUBMITTALS

- A. Final well log, well construction diagram, injection test data (hard copy and electronic file), start card information, special standards requests and approvals (if obtained), and copies of the well report submitted to the Oregon Water Resources Department (OWRD) that document the drilling and construction of the new Cramer Hall injection well.

1.14 SUBMITTAL PROCEDURES

- A. Unless otherwise specified herein, furnish two (2) copies of all submittals to the Owner’s Representative and/or the Engineer.

- B. Coordinate submittals for related operations to avoid delay because of the need to review submittals concurrently for coordination. The Owner's Representative or Engineer reserves the right to return submittals requiring coordination without action or marked "SUBMIT SPECIFIED ITEM". Resubmit all related operations submittals simultaneously.

1.15 SUBMITTAL REVIEWS

- A. The Owner's Representative and/or the Engineer will review and mark each submittal.
- B. The Owner's Representative and/or the Engineer's review of the submittals are applied to the general characteristics and to a general design only. The Owner's Representative and/or the Engineer's review does not include a review of dimensions and quantities except that the Owner's Representative and/or the Engineer will review dimensions only to the extent to coordinate overall control dimensions with other work. Review by the Owner's Representative and/or Engineer does not in any way release the Contractor from the responsibility to comply with the requirements of the Contract Documents and for the proper fit, construction sequences, dimensions and quantities. The Owner's Representative and/or Engineer's review does not constitute acceptance of departures from the Contract Documents, from supplementary drawings or instructions, and from applicable Codes, laws, or ordinances or from boards, commissions, and departments having jurisdiction. The Contractor shall make special note by separate letter and clearly mark on the submittal any deviations from the Contract Documents.
- C. The review by the Owner's Representative and/or Engineer of any shop drawings, product data, samples, construction methods, and equipment or any other submittals is only for conformance with the general design concept of the project and does not extend to consideration of structural integrity, safety, construction feasibility, or practicality, detailed compliance with contract requirements or any other obligation of the Contractor. Any action shown is subject to the requirements of the Plans and Specifications. The Contractor is responsible for the means, methods, and materials used in completing the project, confirming and correlating all dimensions, fabricating and construction techniques, coordinating the work with that of all other trades, and the satisfactory performance of the entire work in strict accordance with the contract documents. It is the responsibility of the Contractor to confirm that all specifications, dimensions, and materials will result in the successful completion of the project as described herein and as may result from changed conditions encountered during drilling.

PART 2 MATERIALS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 33 21 16

NEW CRAMER HALL INJECTION WELL – ABI 1A/ABI 1B

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor shall supply all materials, labor, appurtenances, equipment, incidentals and testing necessary for the construction of one new injection well for the Portland State University Cramer Hall chiller condenser cooling water system. Perform all operations required to finish the project, complete in place, and ready for its intended use. The project consists of the construction and injection testing the new Cramer Hall injection well, whose depth is estimated to be approximately **650 feet below ground level**. Figure 1 is a diagram illustrating the proposed new injection well design; final design most likely will be modified based on subsurface conditions encountered during drilling. The objective is to drill and complete a well capable of recharging the basalt aquifer at a rate of up to 1,500 gallons per minute with spent water from the Cramer Hall chiller condenser cooling water system.
- B. The sequence of work for drilling the new injection well shall include the following:
1. Drill 20-inch borehole from 0 to 250 feet below ground surface.
 2. Install 16-inch casing and seal to 250 feet below ground surface.
 3. Drill 16-inch borehole from 250 to 650 feet below ground surface.
 4. Provide falling-head testing support during borehole advancement below 250 feet below ground surface for up to 16 hours. Falling-head tests will be completed during borehole advancement starting around 300 feet below ground surface to total depth drilled as directed by the Owner's Representative.
 5. Develop the well and clean-out drilling cuttings as needed.
 6. Video log the unlined borehole.
 7. Additive Alternate No. 1B: Install the liner and screen assembly (from 240 to 650 feet below ground surface)
 8. Complete a step rate injection test and a constant rate injection tests (Section 33 21 17 New Cramer Hall Injection Well Tests.)

1.2 PERMITS AND STANDARDS

- A. The Contractor engaged to drill the new Cramer Hall injection well shall be licensed and bonded in the State of Oregon, and must comply with all Oregon Administrative Rules for Well Construction and Maintenance, OAR 690-200-005 through 690-235-020. The Contractor shall obtain at its expense the start cards and furnish the well log and well report for the new well to the licensing state agency. The Contractor shall obtain at its expense approval for any Special Standards required to complete the well as described in this specification requirements for well construction as defined under OAR 690-200-0021.

1.3 REFERENCES

- A. The following is a list of standards, which may be referenced in the contract.
- B. American Petroleum Institute (API):
 - 1. Spec 5L-90, Specification for Line Pipe, 38th edition.
 - 2. API 10-A, Specification for Materials and Testing for Well Cements.
- C. American Society for Testing and Materials (ASTM)
 - 1. A53-90b, Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded, and Stainless.
 - 2. A409 Stainless Steel Casing.
 - 3. A139-90, Standard Specification for Electric-Fusion (ARC) Welded Steel Pipe (NPS 4 and Over)
 - 4. C33-90, Fine Aggregate
 - 5. C150-89, Standard Specification for Portland Cement
 - 6. A606 Type 4, HSLA steel casing
- D. American Water Works Association (AWWA)
 - 1. A100-06, Standard for Water Wells
 - 2. C200-91, Standard for Steel Water Pipe, 6 Inches or Larger
 - 3. C206-91, Standard for Field Welding of Steel Water Pipe
 - 4. C654-87, Standard for Disinfection of Wells
- E. State of Oregon
 - 1. Oregon Administrative Rule (OAR) 690-200-005 through 690-235-020
 - 2. OAR 333-061-0005 through 333-061-0098

1.4 LOCATION OF PRODUCTION WELL

- A. The new Cramer Hall injection well site will be located next to Cramer Hall in a vault along SW Montgomery Street, near the intersection of SW Broadway, Portland Oregon (Figure 1 and Figure 2). The Owner's Representative will stake/mark the location of the Well at the site prior to the pre-construction meeting.

1.5 CONSTRUCTION SITE AND EASEMENTS

- A. The Contractor shall be responsible for improving the site as needed to allow access to where the well will be drilled. The Owner will provide any temporary easements necessary to provide access to the construction site.

1.6 DRILLER'S DAILY LOG (Refer also to Submittals Requirements in Section 01300).

- A. Daily drilling and formation logs shall be prepared by the well drill operator and presented at the end of each drilling day to the Owner and Owner's Representative. The log shall contain the following information on forms provided by the Contractor and approved by the Owner's Representative.
 - 1. Name and location of the well.

2. Depth, thickness, type, general characteristics and drilling characteristics of each material encountered. Evidence of water bearing zones. Note chattering or other drilling action that is evidence of the type of materials being penetrated.
3. The size of hole drilled, the average time required to drill a foot of depth for each formation, and locations where drilling is hard or easy.
4. Static water level or artesian pressure at the wellhead at the start of each day's work.
5. A record of materials used during well construction each day, including but not limited to casing, fittings, and grout.
6. A record of hourly Work performed, including but not limited to well development and injection testing.

1.7 STATE OF OREGON WELL LOG AND REPORT

- A. The Contractor shall prepare and submit a well log to OWRD for the new Cramer Hall injection well as is required by the State of Oregon. The Contractor shall furnish the Owner a copy of the well log and well report filed to comply with the State of Oregon's requirements for the new water well. The Owner will furnish the Contractor with the necessary tax lot information to be included in the State water well report.

PART 2 MATERIALS

2.1 TEMPORARY CASING

- A. The Contractor shall, if necessary, provide temporary well casing of such strength to reach the maximum designated depth undamaged, and shall be of such strength so that the temporary casing(s) can be completely removed from the well.

2.2 PERMANENT WELL CASING

- A. Well casing shall be new, low-carbon steel pipe with a minimum wall thickness of 0.375 inches for 16-inch nominal pipe to depths of 250 feet. Wall thickness for 12-inch I.D. casing installed as part of the screen and liner assembly if used to depths of 650 feet shall be a minimum of 0.375 inches for low carbon steel casing. All well casing and steel pipe shall conform to the latest edition of one of the following specifications: ASTM A53 for "Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless", Type E or S, Grade B, Black wall; or ASTM A135 for "Electric-Resistance- Welded Steel Pipe", Grade B; or API 5L for "Welded and Seamless Steel Line Pipe, Type E or S, Grade B, Black Wall" ASTM A 606 Type 4 High-Strength Low-Alloy Steel and for Stainless Steel casing ASTM Designated A-409.
- B. Well casing shall have the brand name, wall thickness, and ASTM designation clearly stamped on each pipe. Manufacturer rejected pipe shall not be used. Well casing shall be clean and free of drilling mud or other foreign material prior to the final disinfecting of each well.

2.3 CASING TOP FLANGE

- A. Top of well surface casing shall be provided with a flange that conforms to ASME/ANSI B16.1 Class 250. Contractor shall provide a temporary well cap that can be secured to the top of this flange, after drilling and down hole tools are removed from the hole. The well cap shall have a minimum $\frac{3}{4}$ -inch diameter threaded access port with cap.

2.4 CASING JOINTS

- A. All welding shall be done by a certified welder, as certified by an independent testing laboratory as per AWS D1.1. Casing joints when welded shall be a complete penetration, vee-groove weld with a 60-degree angle bevel, 1/16" root opening, and the feather-edge shall be ground to provide a land. The weld shall not use a backing ring. Provide a 1/32" surface build/finish. Prior to welding, the contractor shall inspect the bevel edge and if it is serrated or otherwise not smooth it shall be ground smooth.

2.5 PIPE FITTINGS AND SPECIALS

- A. The Contractor shall provide all fittings, drive shoes, welding rings, grout shoes and centering guides as necessary to complete the well.

2.6 ADDITIVE ALTERNATE NO. 1B. WELL SCREEN AND LINER ASSEMBLY AND FITTINGS

- A. If elected by the Owner, the Contractor shall install a well screen and liner assembly as defined as that portion of the completed well which includes the well screens, blank pipe or 0-slot screen below, between, and above the screens; and any bottom and top fittings (weld rings) necessary to make the assembly sand tight. The well screen material shall be Type 304 stainless steel conforming to ANSI requirements. The well screen and liner assembly is expected to be a string of screen and blank pipe that shall extend from 240 feet to 650 feet below ground surface. In addition the assembly shall include a 12-inch Addco Setting Sub or equal, as approved by the Owner's Representative. The Setting Sub shall be fitted with a setting shoe on the bottom to be welded to the liner assembly, and a reverse rope thread to allow the release of the liner and screen assembly at 240 feet below ground surface. The outside diameter of the Setting Sub shall be approximately 15 inches to allow for centering of the liner and screen assembly in the 16-inch surface production casing and shall include chamfered or beveled inside top edges. The blank sections of pipe shall be low carbon steel casing, with a minimum wall thickness of 0.375 inches. The total length of the screen for the screen-liner assembly is assumed to be 60 feet. Well screens shall be of continuous slot, wire-wrap design, manufactured by Johnson Screens or approved equal. The screen design shall provide a manufacturer's transmitting capacity of at least 1,500 gallons per minute with entrance velocities of less than 0.1 feet/second. It is anticipated that the slot size will be 0.250-inches.
- B. Diameter
 - 1. The diameter of the screens and the liner casing shall be 12-inches OD (Outside diameter). The outer winding that forms the screen surface and the internal longitudinal bars shall be joined at each intersection by welding. Both members of the screen shall be Type 304 stainless steel conforming to ANSI requirements.

2. Because the actual casing and screen lengths, depth setting, and screen slot size are subject to change depending upon conditions encountered during drilling, it is the Contractor's responsibility to obtain confirmation from the screen manufacturer that the screen assembly being installed has adequate collapse and tensile strength for the conditions encountered in the borehole.
3. The Contractor shall provide a certified copy of the manufacturer's screen specification used to formulate the bid for the well screen.

C. Slot Openings

1. The selection of the screen slot opening will be based on maintaining the entrance velocity at or less than 0.1 feet/second, while at the same time maximizing the transmitting capacity of the well, which should be at a minimum of 1,500 gallons per minute. The screen and liner assembly will **not** be gravel packed unless unusual subsurface conditions dictate otherwise. It is anticipated that the slot size will be 250-slot, which is equal to 0.25-inch. For screen slot opening sizes greater than 0.050-inch, the tolerance is +/- 0.005-inch as measured in the field by the Owner's Representative. Deviation from these standards may be cause for rejection of well screen materials.

D. Welding

1. All welding material used to couple screen components shall be stainless. Top and bottom fittings required for the screen assembly shall be manufactured out of the same material as the screens. Joints between screen sections shall be welded and shall have tensile and collapse strength equal to or greater than that of the well screen. Stainless steel 309 welding rod or equivalent shall be used to weld stainless steel screen sections to the low carbon steel blank pipe section. The Contractor may recommend alternative welding materials; approval of alternates shall be at the Owners Representative's discretion.

E. Centering

1. The Contractor shall provide centering guides, for the screen assembly as necessary.

F. Tail Pipe

1. Below the bottom-most section of screen the assembly shall have a maximum five-foot section of blank pipe to serve as tail pipe.

2.7 FILTER PACK

Not Used.

2.8 FORMATION SAMPLE CONTAINERS

- A. Contractor shall collect formation samples. Containers for formation samples shall have a minimum nominal capacity of one quart, be constructed of transparent PVC plastic, and have a screw-on lid at least 3 inches in diameter. Larger sample volumes (minimum one-half gallon) shall be collected for the lower, screened interval to facilitate splitting samples for potential sieve analysis and archiving in the quart jars. A sample of the container proposed for use shall be submitted to the Owner's Representative for approval

prior to the start of work. Formation samples shall be given to the Owner's Representative after the drilling and screen assembly and liner design has been completed. The name of the well and the depth/interval the sample was collected from shall be marked with waterproof ink in the sample container.

2.9 CEMENT GROUT

- A. The requirements for grout materials shall conform to OAR 690-210-0310. A maximum of five percent (by weight) of bentonite clay may be added to the grout mixture to improve its flow properties. To accelerate curing, grout placed beneath the static water level may be made with quickset cement using an accelerating admixture of 2 pounds CaCl per sack of cement, or with ASTM Type III High Early Strength cement.

2.10 VIDEO LOGGING

- A. Provide necessary equipment to color video log the entire length of the completed well with depth below ground surface encoded on the video. **The Video Logging shall be completed prior to lining the borehole with the screen assembly.** The camera shall be equipped with side viewing capability without the use of mirrors. The camera must not have been used to video boreholes containing contaminated groundwater. Contractor shall provide three copies of the video to the Owner's Representative.

PART 3 EXECUTION

3.1 DRILLING METHODS

- A. Upper Borehole for Production Casing: The Contractor may use a combination of methods including air rotary, mud rotary, cable tool and reverse circulation, to drill the 16-inch borehole from the ground surface to 250 feet +/- feet below ground surface.
- B. Lower Borehole: Reverse circulation drilling or conventional air rotary techniques shall be used to drill the lower borehole from 250 feet to +/- 650 feet below ground surface. The Contractor shall not use mud rotary or cable tool drilling methods in the lower borehole from 250 to 650 feet below ground surface, when drilling and/or reaming the borehole to the target diameter of 12-inches. The contractor shall exercise care in preventing borehole over-excavation. Only clean potable water can be added to the well in the lower borehole during drilling.

3.2 DRILLING EQUIPMENT CAPABILITIES

- A. The Contractor's equipment shall be sufficient to produce a completed well as shown in Figure 3, and it shall also be capable of drilling to a maximum of 1,000 feet as indicated in these specifications. Increases in borehole and well casing diameters to accommodate the Contractor's existing equipment may be approved by the Owner's Representative at the Contractor's expense when requested by the Contractor.

3.3 WELL DEPTH, LOCATION AND TARGET YIELDS

- A. The depth below the ground surface to which casing, or drilling operation shall be terminated will be specified by the Owners Representative as the well is being drilled. The table below provides the approximate depths and diameters, and the target well yield. The target well yield is based upon experience with similar production/injection wells and well logs for existing wells in the area. The estimated yields may vary due to site-specific subsurface conditions.

B. Table 3.1: Injection Well Summary

Production Casing Nominal Diameter (Inches)	Approximate Depth to Bottom of Production Casing ¹	Expected or Target Well Injection Yield (GPM)	Alternative No. 1B Screen Assembly Diameter (Inches)	Alternative No. 1B Approximate Length of Combined Screen Sections	Alternate No. 1B Approximate Depth to the Top/Bottom of Screen/Liner Assembly ¹	Alternate No. 1B Approximate Length of Screen/liner Assembly
16	250 feet	1,500	12	60 feet	240 feet/ 650 feet	410 feet

¹ Depth in feet below ground surface.

3.4 TEMPORARY WELL CASING

- A. If necessary, all pipe used as temporary casing to maintain the bore hole walls, or to obtain samples required during the drilling, shall remain the property of the Contractor and be removed from the well site.

3.5 TEMPORARY WELL CAP

- A. The Contractor shall provide a temporary watertight and secure cover for the well while the Contractor's personnel are not at the well site, and for any period of time between the completion of drilling and testing, and after testing is complete.

3.6 CEMENT GROUT SEAL

- A. Cement grout shall be used to seal the production well casing to oversized drill hole walls as shown on the Plans and to the depths specified by the Owner's Representative. All grouting methods shall conform to OAR-690-210. The Contractor shall ensure that grout will not intrude into the lower open borehole below the seal. The Contractor shall employ all available measures to prevent grout intrusion into the aquifer production zone (interflow zones).

3.7 FORMATION SAMPLES

- A. Samples shall be taken from the formation being drilled at no greater than 10-foot intervals and at every change in formation. All formation samples shall be representative of the material penetration. Each sample shall be marked with depth below the ground surface from which the sample was taken.

3.8 ADDITIVE ALTERNATE NO. 1B. WELL SCREEN AND LINER ASSEMBLY DESIGN

- A. If requested by the Owner, the Contractor shall provide a recommendation for the well screen and liner assembly for review by the Owner's Representative. Screen slot size will be determined based on target yield of the newly drilled well and based on maintaining the entrance velocity at less than 0.1 feet/second. It is anticipated that the screen slot size will be 0.250-inch. The total length of screen, the depth below ground surface where screen openings are to be placed, and the length and location of blank steel pipe sections within the screen assembly will be recommended by the Contractor and approved by the Owners Representative. A minimum of 5-feet of blank pipe shall extend below the bottom-most screen section.

3.9 ADDITIVE ALTERNATE NO. 1B. WELL SCREEN AND LINER ASSEMBLY

- A. If requested by the Owner, the Contractor shall install the screen and liner assembly and fittings in conformance with the manufacturer's recommendations, and use a method of field welding that is appropriate to the materials used and field conditions encountered. The overall length of screen/liner assembly is 410 feet. The Owner reserves the right to increase or decrease the total overall assembly length, including the surface seal, and the relative lengths of well screen and blank pipe.

3.10 MEASUREMENTS REQUIRED DURING DRILLING

- A. The Contractor with a weighted steel tape shall make accurate measurements of the depth of the hole below ground surface or other device approved by the Owner's Representative and recorded in the driller's log. The following measurements shall be recorded: (1) depth to water prior to commencing drilling each day, (2) depth of the permanent casing, (3) depth to the bottom of the liner casing, (4) depth to the bottom of the borehole, and (5) diameter of the casing in each segment of the borehole.

3.11 DRILL CUTTINGS AND WATER CONTROL

- A. Drill cuttings shall be contained within the construction site and **disposed of off site.**
- B. Drilling methods that minimize water production during drilling are preferred. Any turbid water produced during drilling and development shall be managed and controlled by the Contractor. Turbid or sediment laden water shall not cause erosion or directly enter any surface water bodies, collection mains, outfalls or storm drain inlets without filtering or other procedures required in the Erosion Control Plan and the Water Management Plan. Large quantities of clean water, for example, produced during the development (air lifting) shall be pumped-to-waste to suitable discharge points approved by the Owner's Representative. Turbid water will not be permitted to enter the storm water collection mains. Contractor shall ensure that water placed into the Owner's collection mains or outfalls meets the disposal requirements of the regulating agency's permit prior to placement in these locations.

3.12 WELL DEVELOPMENT

- A. The Contractor shall develop the well to remove drilling fluid, drill cuttings and fine material from the stratum penetrated by the borehole so that the well will yield water with a low settleable solids content. The Contractor shall notify the Owner's Representative not less than 2 calendar days in advance of the date and time when well development will be started.
- B. Development shall consist of airlifting, which will induce flow from the formation into the well. The actual method and tools used will be subject to review by the Owner's Representative. After completion of the well's development, the bottom of the well shall be cleaned of all sand and drill cuttings by a sand pump bailer. During development measurements made by the Contractor shall include but not be limited to sand content (measured in mg/L with a Rossum sand tester) and short-term specific capacity (gallons per minute per foot of drawdown). The total volume of material removed shall be recorded. Development will continue until there are no measurable reductions in sediment content and no measured increases short-term specific capacity. The Owner's Representative will determine when well development can be terminated.
- C. Sand content shall average not more than 5.0 mg/L for an air lifting cycle of 2 hours duration. The Contractor shall measure sand content with a centrifugal (Rossum type) sand tester. If the well discharge exceeds the 5.0 mg/L criterion, as measured every 2 hours during the last hour of the air lifting the well shall be redeveloped by the Contractor.
- D. The Contractor shall measure well water turbidity every 2 hours in the final stages of the development procedure. It is specified that a maximum of 1 Nephelometric Turbidity Unit (NTU) will be allowed as criteria of complete development. If the well discharge water is in excess of 1 NTU, the well shall be redeveloped by the Contractor.
- E. The Contractor shall manage development water in accordance with the Water Management Plan
- F. Development is assumed to take 16 hours.

3.13 WATER SAMPLES

- A. The Owners Representative may take water samples periodically during development and injection testing. The Contractor shall provide a means to collect water samples (i.e., sample petcock valve) during development.

3.14 PLUMBNESS AND ALIGNMENT

- A. The well shall be constructed such that the required injection equipment, including a downhole control valve, can be easily moved through the well and utilized. The Contractor shall conduct a plumbness and alignment test after installing the well screen assembly.

- B. The plummet for the plumbness testing shall be a rigid spindle with an outer diameter 0.5 inches smaller than the inside diameter of the well screen assembly and with a length 1.5 times the inside diameter of the well screen assembly. The pulley supporting the line holding the plummet shall be located so that the line is exactly vertical above the center axis of the casing. The height of the pulley shall be recorded and kept constant throughout the test. As the plummet is lowered into the well casing, measurements shall be taken to determine the distance between the top of the plummet and the top of the casing and also the horizontal deflection of the line at the top of the casing. Two readings of horizontal deflection, at right angles to each other, shall be made with orientation relative to true north recorded. Readings of horizontal deflection shall be made to the nearest 0.05-inch at minimum intervals of 10 feet of plummet depth. The test shall be conducted by the Contractor and observed by the Owner's Representative, and a copy of the test data shall be delivered to the Owner. The cased part of the well will be deemed adequately plumb if the horizontal displacement from the vertical is less than $\frac{2}{3}$ the diameter of the inner casing per 100 feet.
- C. The Contractor shall conduct an alignment test of the well screen assembly. The well will be deemed adequately straight if a section of a pipe or a dummy, not less than 40 feet long and an outside diameter not more than 1.0 inch smaller than the inside diameter of the casing being tested can be lowered freely the full depth of the well screen assembly. Results of the alignment test shall be verified by the Contractor and submitted to the Owner.
- D. If the Owner elects to install a well screen assembly (Additive Alternate No. 1B), and if the well screen assembly cannot meet these criteria for plumbness and alignment, the well shall be corrected at the Contractor's expense or abandoned due to the fault of the Contractor and a new well will be constructed at no additional expense to the Owner.**
- E. The Contractor shall take care not to contact or damage the screen assembly with a plummet or dummy. The Contractor shall be responsible for correcting any damage to the screen assembly or replacing the well at the Contractor's expense if the screen assembly is damaged during plumbness and alignment testing.

3.15 DISINFECTION

- A. Clean well of foreign substances after completion of well and testing.
- B. The well shall be disinfected in conformance with OAR 690-210-380
- C. Place sodium hypochlorite solution at a strength and volume to produce an available, well-mixed chlorine concentration of at least 50 mg/L throughout the entire water column in the well.
- D. The chlorine solution shall remain in the well for a minimum of 24 hours.
- E. Contractor is responsible for not discharging chlorinated water to surface water bodies, per the Water Management Plan.

3.16 VIDEO LOGGING

- A. Contractor shall video log the entire length of the completed well from 0 to 650 feet below ground surface **prior to installing the screen/liner assembly**. Video logging will not be conducted for at least 3 days after well development is completed. If the borehole is too cloudy, the Contractor shall flush the borehole with potable water and allow sufficient time for the borehole to become clear so that, in the opinion of the Owner's Representative, the video log will show sufficient detail of the borehole. If the quality of the video does not meet the Owner's Representatives approval, the Contractor shall re-video the borehole at no extra expense to the City. The Contractor shall notify the Owner's Representative at least two days in advance of performing the video.

3.17 SITE CLEANUP

- A. Refer to Section 31 10 00. The Contractor shall complete final site cleanup including but not limited to removal of all drilling equipment, tools and unused well materials at the conclusion of all work performed under this contract. **The Contractor shall remove drill cuttings**. Site cleanup shall meet with the approval of the Owner's Representative.

3.18 EROSION CONTROL AND WATER MANAGEMENT

- A. Refer to Section 21 25 13. The Contractor shall be responsible for installing and maintaining erosion and sediment control measures at the well site.

PART 4 MEASUREMENT AND PAYMENT

- 4.1 For all unit price bid items, payment will be based on the actual quantities of each item used.

4.2 DRILLING

- A. Measurement and payment for drilling shall be on a per linear foot basis according to the unit prices for the various diameter boreholes required to install casing as described in the Plans and Specifications, and shall be full compensation for all labor and materials required to advance the borehole (cased or uncased) to the required depth, and for sample collection. If additional drilling footage is required **and approved by the Owner's Representative** beyond what is indicated in the Specifications and as presented in the plan, then the Contractor shall be reimbursed for the additional footage of drilling at the unit price specified in the bid schedule submitted by the Contractor for this project

4.3 CASING

- A. Measurement and payment for installation of casing shall be on a per linear foot basis, according to the unit prices for the various diameter casings required in the Plans and Specifications, and shall be full compensation for all labor and materials required to install the casing, exclusive of grout seals except where specified. If additional casing is required **and approved by the Owner's Representative** beyond what is indicated in the Specifications and as presented in the plan, then the Contractor shall be reimbursed for the additional casing on a per foot basis at the unit price specified in the bid schedule

submitted by the Contractor for this project. Casing required as stickup shall be considered incidental to the project.

4.4 TEMPORARY CASING

- A. No specific payment will be made for installing and removing temporary casings. Measurement and payment for footage drilled shall be full compensation for borehole intervals utilizing temporary casing to maintain the borehole during drilling.

4.5 ADDITIVE ALTERNATE NO. 1B: WELL SCREEN AND LINER ASSEMBLY

- A. If elected by the Owner, the measurement and payment for furnishing and installing the screen and liner assemblies shall be on a per linear foot basis for the screen length and for the blank casing length and shall include necessary fittings and weld rings, and shall be full compensation for all labor and materials required to design and install the screens and liner to the required depth. No separate payment will be made for the time during the period when the production well screen/liner assembly is designed, ordered and delivered. If additional well screen/liner assembly is required and ***approved by the Owner's Representative*** beyond what is indicated in the Specifications and as presented in the plan, then the Contractor shall be reimbursed for the additional well screen/liner assembly on a per foot basis at the unit price specified in the bid schedule submitted by the Contractor for this project. The Owner reserves the right to choose Additive Alternate No. B at price per lineal foot specified.

4.6 GROUT

- A. Measurement and payment for installation of grout seals shall be on a unit (per vertical foot grouted) basis for the surface seal and shall include all equipment necessary to place the seal (grout shoe, tremie pipes, grout pumps). If additional grout is required and ***approved by the Owner's Representative*** beyond what is indicated in the Specifications and as presented in the plan, then the Contractor shall be reimbursed for the additional grout on a per foot basis at the unit price specified in the bid schedule submitted by the Contractor for this project.

4.7 WELL DEVELOPMENT

- A. Measurement and payment for completing well development shall be based on the bid hourly cost. If additional time are required and approved by the Owner's Representative beyond what is indicated in the Specifications and as presented in the plan, then the Contractor shall be reimbursed for the additional development time on a per hour basis at the per hour price specified in the bid schedule submitted by the Contractor for this project.

4.8 RIG HOURLY WORK

- A. Measurement and payment for drill rig hourly work includes work authorized by the Owner's Representative and well alignment testing and shall be at the bid hourly price.

No separate measurement and payment under this bid item will be made for drill rig work that is covered by other bid items for drilling operations, grouting, casing installation, and well development.

4.9 VIDEO LOGGING

- A. Payment shall be made on a lump sum basis assuming 650 feet of borehole. Payment will not be made if the video is of poor quality or the video does not cover the specified depth interval. The Contractor will not be paid for standby time while the borehole is being flushed and/or while the Contractor is waiting for the borehole to clear.

END OF SECTION

SECTION 33 21 17

NEW CRAMER HALL INJECTION WELL INJECTION TESTS – ABI 1A

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall injection test the new Cramer Hall well upon completion of the development, in accordance with these specifications. Prior to conducting the injection test, the Contractor shall provide one week's notice to the Owner's Representative. The injection test procedure shall consist of the furnishing, installation, operation, and removal of necessary equipment, including installation of an injection pipe in the well below the static water level, to complete the injection test as specified. Testing shall be conducted by the Contractor in phases:
1. Falling head tests and air lift testing during borehole advancement.
 2. Step rate injection test.
 3. Constant rate injection test.
 4. Recovery test.

1.2 DISCHARGE OF TEST WATER

- A. Discharge of test water, which may occur during air lifting testing only, from the new injection well, shall be to the storm water drain located onsite. The Contractor shall provide a temporary pipeline to the point of discharge that is secure and does not pose a hazard to City employees, visitors or nearby residents. The Contractor will conduct any monitoring of the discharge to meet any permit requirements and will comply with requirements of the Erosion Control and Water Management Plan.

PART 2 MATERIALS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

- A. Contractor shall provide all equipment (piping, meters, valves, and etc.) to successfully complete the injection tests under the conditions described herein. Failure of the Contractor's equipment during the tests shall void the tests and the tests shall be repeated at the Contractor's expense.

3.2 FALLING HEAD TESTS AND AIR LIFT TESTING

- A. During drilling of the production well, the Owner's Representative will conduct falling head tests, which will consist of adding a slug of potable water to the borehole and measuring the resulting water level response. These tests will be completed in the morning prior to the starting of drilling to limit time not spent drilling the injection well; however, the bid form for this project does account for the time the driller spends helping setup and run the tests. The Contractor shall provide a flow meter and necessary piping so that the Owner's Representative can inject a known quantity of potable water into the borehole for the tests. The flow rate cannot fluctuate greater than 5 percent during the test and instrumentation shall be sufficiently accurate to measure a 1 percent change in the flow rate. The Owner's Representative will collect necessary water level data with the help of the Contractor. The Owner's Representative will do data reduction and analysis. For bidding purposes up to 12 hours have been assumed for the falling head tests (6 tests each about 2 hours per test).
- B. After drilling the borehole the contractor shall complete up to 4 hours worth of air lift testing, as directed by the Owner's Representative. The Contractor will be required to provide an estimate of the amount of water generated during the air lift test. The airlift testing will, at a maximum, consist of setting the rods at approximately 650 feet below ground surface with about 600 feet or more of submergence, and lift the water from the assumed static water level of 100 feet to the ground surface.

3.3 STEP INJECTION TEST

- A. The step rate injection test shall consist of injecting water through an injection pipe into the well below the static water level at four different rates, as directed by the Owner's Representative, with up to 30 minutes of injection at each rate, followed by an increase in the injection rate step. For planning purposes, the rates are 50, 100, 200 and 300 gallons per minute (or more if greater volumes of water are available from the on-site source). If the facilities assembled by the Contractor fail to perform to the minimum standards of these Specifications, the step rate injection test shall be repeated at no cost to the Owner.

3.4 CONSTANT RATE INJECTION TEST

- A. Upon satisfactory completion of the step rate injection test and recovery of the water level in the well to within 0.5 foot of the previously recorded static water level in the pumped well or within 95% of its pre-static water level, which ever is least, the constant rate injection test shall begin at the injection rate and time of day specified by the Owner's Representative. The injection rate for the constant rate injection test will be based on step rate injection test data, but could be as high as 500 gallons per minute if water at this rate is available from the on-site source. The constant rate injection test shall continue without interruption for the period of time specified by the Owner's Representative and the injection rate shall not fluctuate more than 5 percent. The constant rate injection test shall be conducted for a period of up to 48 hours (2 days). A total of 48 hours (2 days) also is required for the recovery portion of the injection test or until the water level is within 95% of the pre-test static water level, which ever is less. Therefore the downhole equipment used to perform the injection test could be used for as long as 4 days since the equipment cannot be removed until the test is complete to ensure accurate

test data have been obtained. Failure of the Contractor's equipment during the test and/or fluctuation in the injection rate greater than 5 percent shall void the test and the Contractor shall receive no payment for a failed test. After a failed test, the Contractor shall restart the test and continue the test for the specified period.

- B. All injection test equipment furnished by the Contractor shall remain his property and be removed from the well sites upon completion of the testing. The Contractor cannot remove the equipment from the borehole until the test is 100% completed (i.e., after the recovery period).
- C. After removal of the test equipment from the well, the Contractor shall disinfect and seal the well.

3.5 INJECTION TEST INJECTION PIPE

- A. The Contractor shall furnish an injection pipe of sufficient diameter that it will remain at full pipe flow during the injection tests. The final size of the injection pipe for the constant rate injection test shall be determined after the step rate injection test. The injection pipe shall also be installed to at least 20 feet below the static water level, which is assumed to be around 100 feet below ground surface.

3.6 WATER SAMPLING, SLOW CONTROL, AND WATER LEVELING MONITORING

- A. The Contractor shall furnish and operate the equipment necessary to measure and record the injection flow rates, and measure water levels. The Contractor shall provide a calibrated orifice and manometer or a totalizing in-line flow meter or both, which reads in gallons per minute. Ideally, the flow meter will be electronic and able to record data in a data logger. The equipment and set-up will meet with the approval of the Owner's Representative. During each portion of the injection test, the injection rate shall be maintained by the Contractor within +/- 5% of the target flow rate. If the flow rate is not maintained within this range, the Owner's Representative may terminate the test, request that the Contractor correct the problem, and rerun the test at the Contractor's expense.
- B. The Contractor shall install a minimum of two 1-inch diameter PVC drop pipes in the well that extend to below the injection pipe to allow access for manual water level measurements and for installing a dedicated pressure transducer and data logger in the well. The Contractor shall supply the dedicated pressure transducer and data logger for the injection well and the Contractor will also collect manual water level measurements during the tests.

3.7 TEMPORARY PIPELINE

- A. The Contractor shall furnish, assemble, and disassemble a temporary above ground pipeline of sufficient capacity to permit the injection test to develop the required flows during testing of the well. The pipeline shall remain the property of the Contractor and be removed from the well site. The pipeline route shall be selected by the Owner's Representative. The Contractor shall secure the pipeline so that it is safe.

- B. The temporary pipeline shall be sufficiently watertight to prevent damage to the drill site and easements. The ends and joints in the pipeline shall be restrained if necessary to prevent movement or separation of the pipeline during the injection tests.

3.8 REQUIRED MEASUREMENTS

- A. During the step rate and constant rate injection tests, the Contractor shall read and record the flow rate, total cubic feet or gallons pumped, and water level in the well being tested by use of an electronic water level meter. The intervals for the water level readings are as follows:

0 to 10 minutes	– every 10 seconds
10 to 100 minutes	– every 1 minute
100 to 1,000 minutes	– every 10 minutes
1,000 minutes to cessation of injection	– every 100 minutes

- B. After the first 10 minutes, flow measurements will be made on the same schedule. Following shut-down of the injection test, recovery readings shall be made by the Contractor in the well at intervals matching those required for the injection phase of the test. The Contractor may remove the test equipment from the well after the well has recovered to within 95 percent of the pre-test water level or with approval from the Owner's Representative.

PART 4 MEASUREMENT AND PAYMENT

4.1 FURNISH, INSTALL INJECTION TEST EQUIPMENT AND APPURTENANCES

- A. Measurement and payment for furnishing, installing and removing the injection test equipment and appurtenances shall be on a lump sum basis. No hourly payment will be made for the recovery period following the step rate injection tests (anticipated to be a maximum of 4 hours) or for the recovery period following the constant rate injection test (anticipated to be a maximum of 48 hours).

4.2 INJECTION TESTING

- A. Measurement and payment for operating the injection test equipment and appurtenances during the tests shall be at the unit contract rate. In the event that the step rate injection test and/or the constant rate injection test are run longer than the times allocated in this Specification package, and ***as approved by the Owner's Representative***, then the Contractor shall be paid for the additional time (including equipment rental) at the hourly unit price as presented in the bid submitted for this project.

END OF SECTION

SECTION 33 21 18
CRAMER HALL INJECTION CONTROL VALVE, INJECTION PIPES,
AND WATER LEVEL PROBED TRANSDUCER PIPES – ABI 1C

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall furnish and install one (1) injection control valve complete, as shown on the drawings and/or specified herein, including the injection control valve, aboveground control components, the hydraulic control lines connecting the aboveground control components to the injection control valve components installed down the well, and other appurtenances, and accessories as necessary for a complete system; (2) connect the 8-inch injection control valve to the 10-inch diameter injection pipe; (3) install a 10-inch injection pipe with the injection control valve in the well from the ground surface to approximately 120 feet below ground surface, inclusive of strapping the injection control valve hydraulic lines to the 10-inch injection pipe; and (4) install two 1-inch diameter water level probe pipes in the well to 115 feet below ground surface and strap them to the 10-inch injection pipe. CONTRACTOR must confirm final valve size will allow design flow rate of 1,500 gpm with 10 psig at the surface. Valve designation is FCV 046.

1.2 SUBMITTALS

- A. As required by Section 01300 and in accordance with Section 01300.

1.3 WARRANTY

- A. Valve Manufacture and Design.
1. The injection control valve installed downhole, the control components located aboveground, and the hydraulic control lines connecting the aboveground control components to the injection control valve components that are installed downhole shall be warranted not to fail for a minimum period of five (5) years commencing at the date of final acceptance.
 2. Any repairs necessary to remedy any problems arising during the warranty period as a result of valve manufacture or design shall be performed by the injection valve manufacturer at no cost to the OWNER.
 3. All costs associated with the repair, including but not limited to, the cost for pulling and reinstalling the injection pipe and the injection control valve, and all costs incurred by the injection control valve manufacturer in traveling to the site and performing the repairs shall be borne by the valve manufacturer.
 4. All work necessary to repair the valve and return the Cramer Hall injection well system to a fully functional state shall be conducted within 14 calendar days for the date that the OWNER gives notice of a valve failure.
 5. The injection control valve manufacturer shall provide a bond in the amount of \$20,000 and for a duration of five (5) years to cover the costs described herein should there be a need to remedy any problems arising during that period as a result of valve manufacture or design.

- B. Injection Control Valve Installation
 - 1. The injection control valve, and all the injection control valve components within the well, shall be installed by the CONTRACTOR that is certified by the State of Oregon to work on water wells. Installation of the valve shall be warranted not to cause failure for a minimum period of five (5) years commencing at the date of final acceptance.
 - 2. Any repair costs incurred to remedy any problems arising during that period as a result of valve installation shall be borne by the CONTRACTOR at no cost to the OWNER. These shall include all costs associated with the repair, including but not limited to the cost for pulling and reinstalling the injection pipe and the injection control valve, and all costs incurred by the injection control valve manufacturer in traveling to the site and performing repairs. All work necessary to repair the valve and return the injection well system to a fully functional state shall be conducted within 14 calendar days of the date that the OWNER gives notice of failure.

- C. In the event of a failure of the injection control valve for which the cause is contested, an independent third party shall determine whether the failure resulted from the design and/or manufacture of the injection control valve or from installation. The cost for the third party analysis shall be borne in full by the party determined to have caused the defect either through design and manufacture of the injection control valve or installation of the valve.

PART 2 PRODUCTS

2.1 INJECTION CONTROL VALVES

- A. Materials. All metal parts for the injection control valve shall be stainless steel. All other injection components shall be made of corrosion resistant materials.
- B. Performance. The injection control valve shall provide a cavitation free control of the recharge rate under the operating conditions described herein and shown on the plans.
- C. Valve Operating Conditions.
 - 1. Maximum well re-injection flow rate: 1,500 gpm.
 - 2. Minimum residual pressure at the ground surface at the wellhead during recharge: 10 psi.
 - 3. Static water level: Approximately 100 feet below ground surface (BGS) – to be verified after drilling the test well.
 - 4. Maximum allowable water level during recharge: 20 feet below finish floor at Cramer Basement.

2.2 INJECTION VALVE CONTROLS

- A. The aboveground components for control of the injection control valve that is installed downhole shall be supplied and warranted by the manufacturer of the injection control valve. Aboveground control components shall interface with the programmable logic controller (PLC) main control panel specified elsewhere in these Contract Documents.

The main controller shall direct the injection control valve to open or close by starting a hydraulic pump and energizing the appropriate solenoid valve. For the hydraulic control, a means shall be provided for bypassing or overriding the PLC main controller to allow for local, manual control.

- B. The hydraulic injection control valve position indicators and limit switches shall be supplied for indicating when the valve is in the closed position and for generating an alarm if the valve has lost hydraulic pressure. The position indicators/alarms shall interface with the PLC main control panel.
- C. Two (2) hydraulic control lines shall extend from the valve control components located above ground to the injection control valve installed down the hole. The control lines shall be supplied and warranted by the manufacturer of the injection valve. Hydraulic fluid shall be food grade mineral oil, NSF certified for potable water.
- D. All electrical components for control of the injection control valve, including solenoid valves and pump motors, shall comply with the requirements of Division 26 - Electrical.
- E. Above ground components shall be protected against corrosion. Coatings shall comply with Section 09 90 00 - Protective Coatings.

2.3 INJECTION CONTROL VALVE ACCEPTABLE MANUFACTURERS

- A. 3R Valve of Echo, Oregon – or equivalent.

2.4 INJECTION PIPE COLUMN

- A. The 10-inch diameter injection pipe shall not be less than Schedule 40 steel pipe joined with butt-threaded straight couplings. Pipe sections shall not exceed 10-feet in length. The 10-inch to 8-inch reducer pipe shall be not less than Schedule 40 steel.

2.5 WATER LEVEL PROBE TRANSDUCER PIPES

- A. Two 1-inch diameter Schedule 80 flush-joint threaded PVC pipes for the dedicated pressure transducer and for access for a manual water level meter shall be supplied.

PART 3 EXECUTION

3.1 INJECTION CONTROL VALVE INSTALLATION

- A. Aboveground and injection components of the injection control valve shall be installed in accordance with the manufacturer's written instructions and as shown and specified in the Contract Documents. The 8-inch control valve shall be connected securely to a 10-inch diameter by 8-inch diameter reducer that allows the injection control valve to be connected to the 10-inch diameter injection pipe.
- B. The injection control valve and the control conduits within the well casing shall be installed by the CONTRACTOR that is certified by the State of Oregon to work on water

wells. The conduits for control of the injection control valve shall be strapped to the 10-inch injection column between the transducer pipes. The conduits for the control of the injection control valve shall be installed in a manner that prevents kinks in, and damage to, the conduits. Installation and securing of the conduits shall be neat and tidy to ensure that the conduits and piping for the level probes will all pass easily and freely through the entire pipe length.

- C. The hydraulic lines for the injection control valve will require a 3-inch diameter conduit to run the hydraulic lines out of the well vault to the control location as specified elsewhere in these Technical Specifications.

3.2 INJECTION CONTROL VALVE TESTING

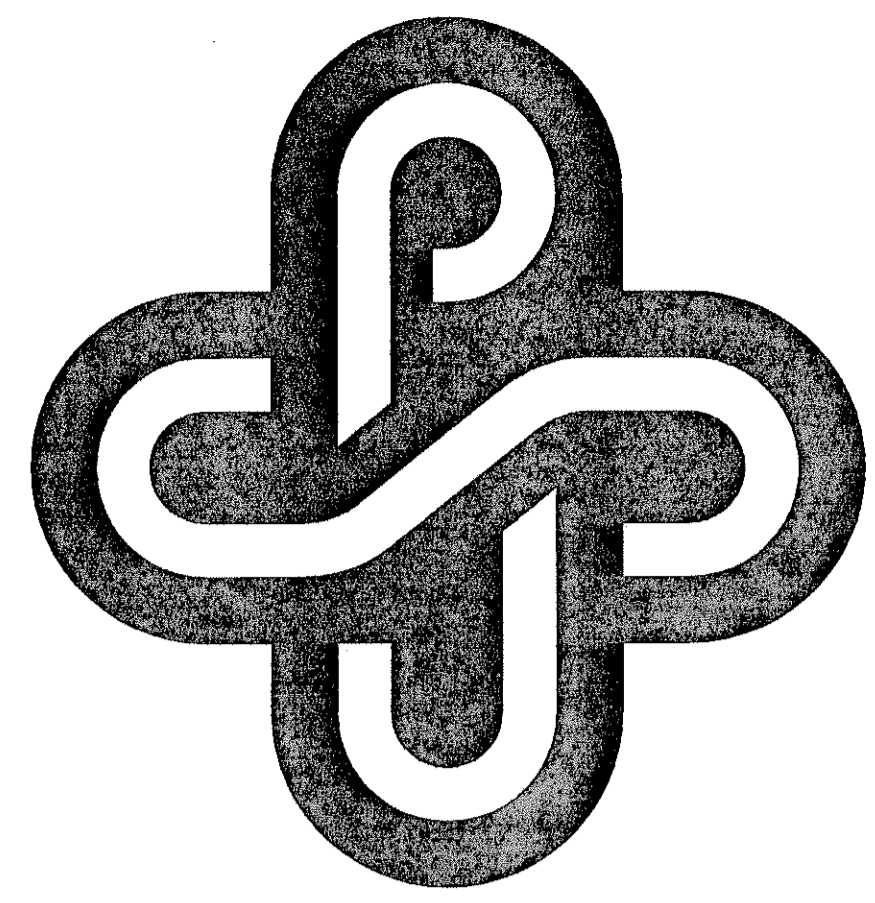
- A. The hydraulic control conduits shall be tested for leakage after installation. A written procedure for the leakage test shall be prepared by the injection control valve manufacturer and presented to the ENGINEER for approval at least one (1) week prior to the testing.
- B. The injection control valve shall be functionally tested after installation. A written procedure for the functional testing shall be prepared by the CONTRACTOR in conjunction with the injection and control valve manufacturer. The proposed testing procedure shall be presented to the ENGINEER for approval at least one (1) week prior to the testing.

3.3 SERVICES PROVIDED BY THE INJECTION CONTROL MANUFACTURER'S REPRESENTATIVES

- A. The CONTRACTOR shall provide the services of the injection control valve manufacturer's representative to observe and verify the proper installation of the injection control valve and control lines by the contractor that is certified by the State of Oregon to work on water wells.
- B. The injection control valve manufacturer's representative, having observed the installation of the injection control valve, shall submit a written report indicating whether the installation was done in accordance with the manufacturer's written instructions and detailing any reservations or shortcomings that the manufacturer's representative may have regarding the installation of the injection control valve and control conduits. The Certificate of Substantial Completion shall not be issued prior to receipt of the report from the injection control valve manufacturer's representative.
- C. Inspection, Startup and Field Adjustment – the injection control valve manufacturer's representative shall be present at the site for not less than three (3) working days, in addition to those days provided in the previous paragraphs, to furnish the following services.
 1. Inspect, check, adjust if necessary and approve the installation of all the injection control valve components.
 2. Start-up and field-test the injection control valve for proper operation.
 3. Perform necessary field adjustments during the test period until the injection control valve installation and operation are satisfactory to the ENGINEER.

4. Instruct the OWNER'S personnel in the operation and maintenance of the injection control valve. Instructions shall include step-by-step trouble shooting procedures with all necessary test equipment. Provide the OWNER with an operations and maintenance manual.
- D. The costs of all inspection, start-up, testing, adjustment and instruction work performed by the injection control valve manufacturer's representatives shall be borne by the CONTRACTOR.
- E. For the purposes of this paragraph, a work day is defined as an 8-hour period at the site, excluding travel time.
- F. The ENGINEER may require that the inspection, start-up, and field adjustment services above be furnished in three (3) separate trips.

END OF SECTION



Portland State

UNIVERSITY

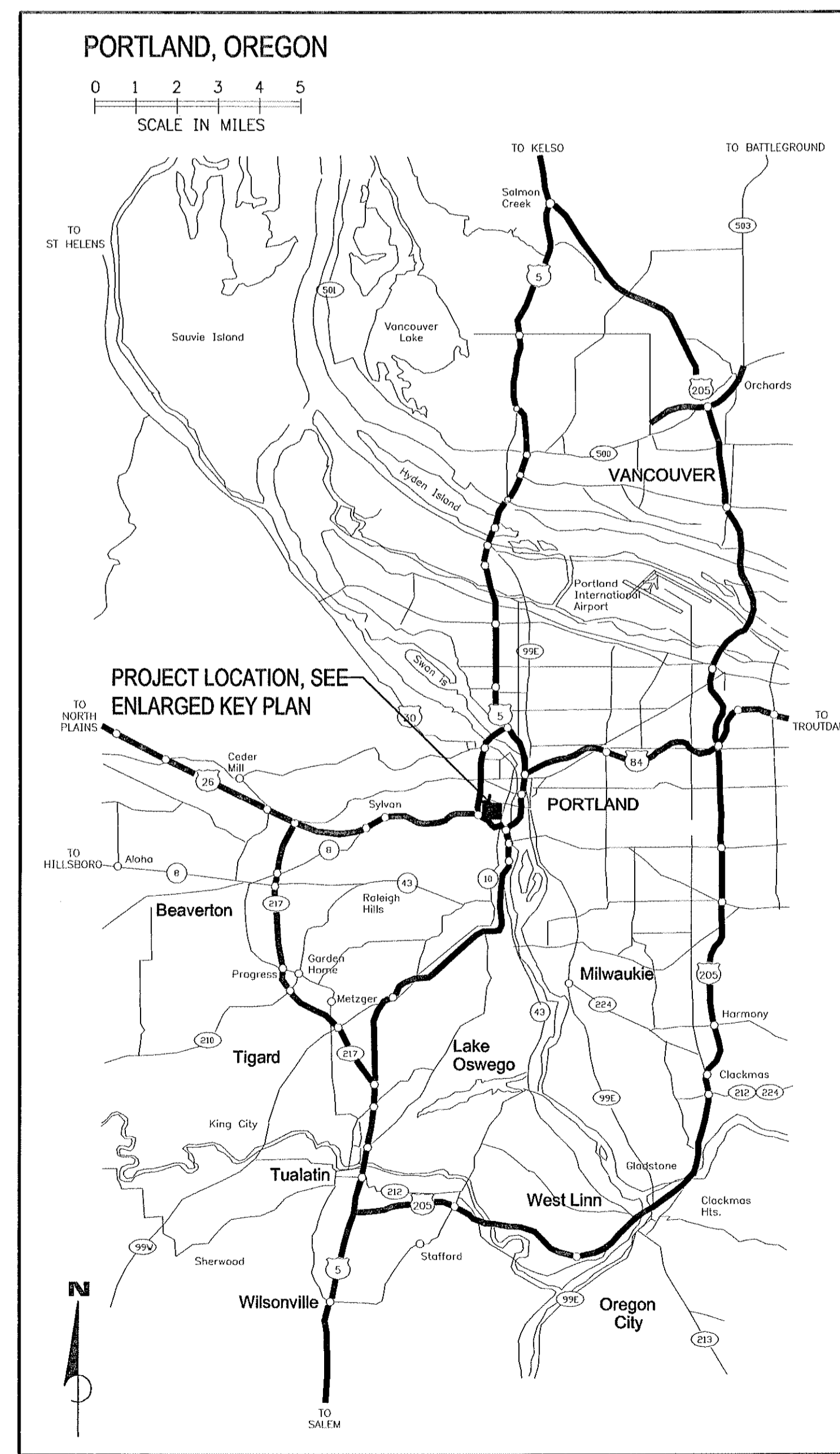
CAMPUS WIDE LOOP PHASE 1 BP2 STEAM & CHILLED WATER IMPROVEMENTS "ISSUED FOR CONSTRUCTION"

PSU Facilities & Planning
617 SW Montgomery Street, Suite 202
Mail Code: FAP . PO Box 751
Portland, Oregon 97207-0751
Office 503-725-3738 . Fax 503-725-4329

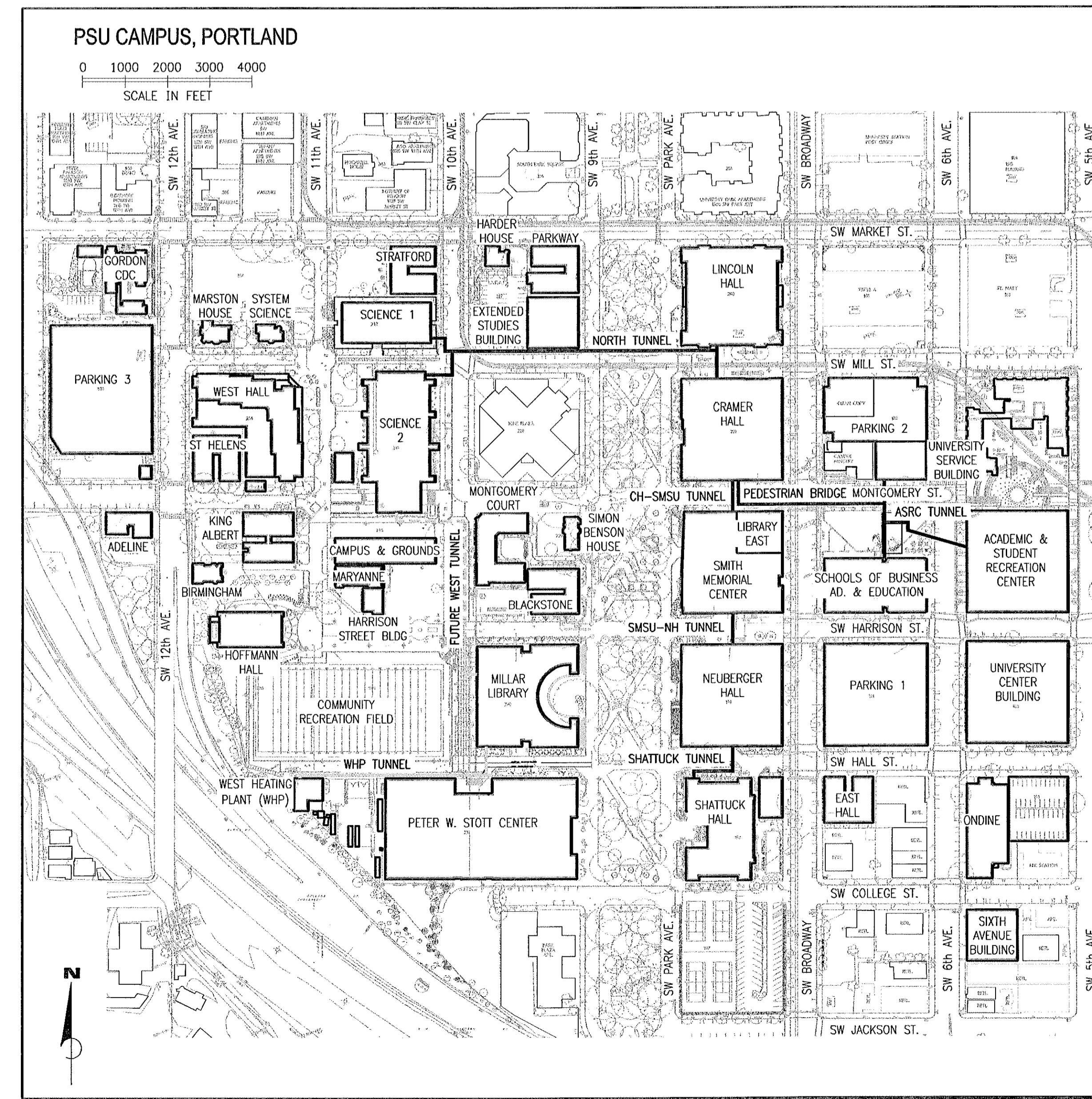
PSU CAMPUS WIDE LOOP PROJECT TEAM

PROJECT MANAGEMENT:	SJO CONSULTING ENGINEERS, DIVISION OF WINZLER AND KELLY
COST ESTIMATING:	J.J. HENRI CO.
CIVIL ENGINEERING CONSULTANT:	SJO CONSULTING ENGINEERS, DIVISION OF WINZLER AND KELLY
STRUCTURAL CONSULTANT:	PROGRESSIVE ENGINEERING
ARCHITECTURAL CONSULTANT:	DULL OLSON WEEKES ARCHITECTS INC.
LANDSCAPING CONSULTANT:	MURASE ASSOCIATES
MECHANICAL ENGINEERING CONSULTANT:	SJO CONSULTING ENGINEERS, DIVISION OF WINZLER AND KELLY WINZLER AND KELLY
INSTRUMENTATION CONSULTANT:	SJO CONSULTING ENGINEERS, DIVISION OF WINZLER AND KELLY
ELECTRICAL ENGINEERING CONSULTANT:	SJO CONSULTING ENGINEERS, DIVISION OF WINZLER AND KELLY
INJECTION WELL CONSULTANT:	CSI WATER SOLUTIONS, INC.

DRAWING #	DESCRIPTION	05/23/2008 ISSUED FOR BID & PERMIT	07/15/2008 BIG CLARIFICATION FOR PERMIT SET	08/29/2008 ISSUED FOR CONSTRUCTION
T1	TITLE SHEET BP2	0	-	1
CIVIL DRAWINGS				
C1.3	ASCR TRENCH PLAN & DETAILS	0	-	1
C1.4	ASCR TRENCH EROSION PLAN AND DETAILS	0	-	1
H02.0	CRAMER HALL INJECTION WELL PLAN AND SECTIONS	0	-	1
STRUCTURAL DRAWINGS				
S1.0	STRUCTURAL NOTES	0	-	1
S1.1	PIPING ENCLOSURE STRUCTURAL	0	1	2
S1.2	PIPING ENCLOSURE STRUCTURAL	0	1	2
S1.3	PIPING STRUCTURAL DETAILS	0	1	2
S1.4	PIPE RISER SUPPORT COLUMN	0	1	2
ARCHITECTURAL DRAWINGS				
A1.1	ASCR WALKWAY CHASE AND COLUMN DETAILS	0	-	1
A1.2	ASCR CRAMER PIPE CHASE DETAILS	0	-	1
LANDSCAPING DRAWINGS				
L5.0	LANDSCAPE DEMOLITION PLAN	0	-	1
L6.0	LANDSCAPE CONSTRUCTION PLAN AND DETAILS	0	-	1
L7.0	LANDSCAPE PLANTING PLAN AND IRRIGATION NOTES	0	-	1
L7.1	LANDSCAPE PLANTING AND IRRIGATION DETAILS	0	-	1
MECHANICAL DEMOLITION DRAWINGS				
M0.1	MONTGOMERY STREET BRIDGE PIPING DEMO PLAN	0	-	1
M0.30	CRAMER EAST PLANT STEAM P&ID DEMO	0	-	1
M0.40	CRAMER EAST PLANT CHILLED WATER P&ID DEMO	0	-	1
M0.42	CENTRAL CAMPUS CHILLED WATER P&ID DEMO	0	-	1
M0.10	MONTGOMERY STREET BRIDGE PIPING DEMO PLAN	0	-	1
M0.2.0	CRAMER PIPING DEMO PLAN - BELOW PLATFORM	0	-	1
M0.2.1	CRAMER PIPING DEMO PLAN - ABOVE PLATFORM	0	-	1
M0.3.0	SMSU SUB BASEMENT PIPING DEMO PLAN	0	-	1
M0.4.0	NEUBERGER & SHATTUCK TUNNEL PIPING DEMO PLAN	0	-	1
M0.6.0	NORTH TUNNEL PIPING DEMO PLAN	0	-	1
MECHANICAL SCHEMATIC DRAWINGS				
M0.1	LEGEND AND SYMBOLS	0	-	1
M0.2	PIPE & VALVE SCHEDULES	0	-	1
M0.3	EQUIPMENT SCHEDULES	0	-	1
M3.0	CRAMER EAST PLANT STEAM P&ID	0	-	1
M3.1	WEST HEATING PLANT STEAM P&ID	0	-	1
M4.0	CRAMER EAST PLANT CHILLED WATER P&ID	0	-	1
M4.1	NORTH TUNNEL, SB1 & SB2 CHILLED WATER P&ID	0	-	1
M4.2	CENTRAL CAMPUS CHILLER WATER P&ID	0	-	1
MECHANICAL PIPING DRAWINGS				
MP1.1	ASCR PIPING PLANS AND ELEVATION	0	1	2
MP1.2	ASCR PIPING DETAILS AND ELEVATIONS	0	-	1
MP1.3	ASCR PIPING DETAILS AND ELEVATIONS	0	1	2
MP2.0	CRAMER PIPING PLAN	0	-	1
MP3.0	SMITH MEMORIAL STUDENT UNION PIPING PLAN AND ELEVATION	0	-	1
MP4.0	NEUBERGER HALL PIPING PLAN AND ELEVATION	0	-	1
MP5.0	SHATTUCK HALL PIPING PLAN AND ELEVATION	0	-	1
MP6.0	NORTH TUNNEL (EAST) PIPING PLAN AND ELEVATION	0	-	1
MP6.1	NORTH TUNNEL (WEST) PIPING PLAN AND ELEVATION	0	-	1
MP8.1	SEISMIC VALVE PLAN & DETAILS	0	-	1
MP8.2	CRAMER HALL SUB-BASEMENT ECONOMIZER & DETAILS	0	-	1
MP8.3	MECHANICAL PIPING DETAILS	0	-	1
MP8.4	MECHANICAL PIPING DETAILS	0	-	1
MP9.0	PIPING DETAILS	0	-	1
ELECTRICAL DRAWINGS				
E0.1	ELECTRICAL POWER LEGEND, ABBREVIATIONS & GENERAL NOTES	0	-	1
E0.2	ELECTRICAL EQUIPMENT MATRIX	0	-	1
E0.4	ELECTRICAL POWER	0	-	1
E1.1	ASCR POWER POWER AND LIGHTING PLAN	0	-	1
E2.0	CRAMER ELECTRICAL DEMO PLAN	0	-	1
E2.1	CRAMER HALL BASEMENT ELECTRICAL PLAN	0	-	1
INSTRUMENTATION DRAWINGS				
I0.1	INSTRUMENTATION LEGEND, ABBREVIATIONS & GENERAL NOTES	0	-	1
I0.2	INSTRUMENTATION MATRIX	0	-	1
I1.0	PSU CAMPUS INSTRUMENTATION & CONTROLS PLAN	0	-	1
I2.0	CRAMER HALL INSTRUMENTATION & CONTROLS	0	-	1



2
T1 PROJECT LOCATION PLAN
PSU CAMPUS LOOP PHASE 1 BP2
SCALE: AS NOTED



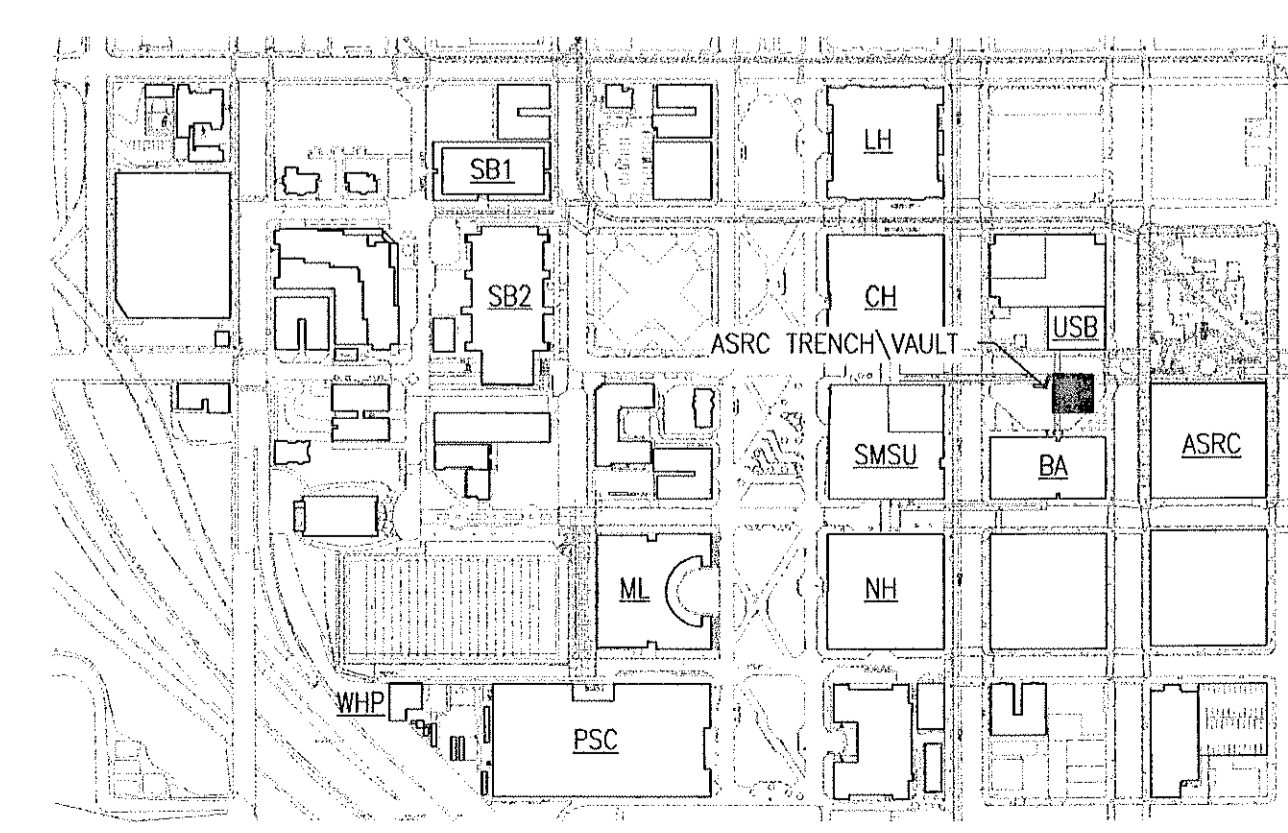
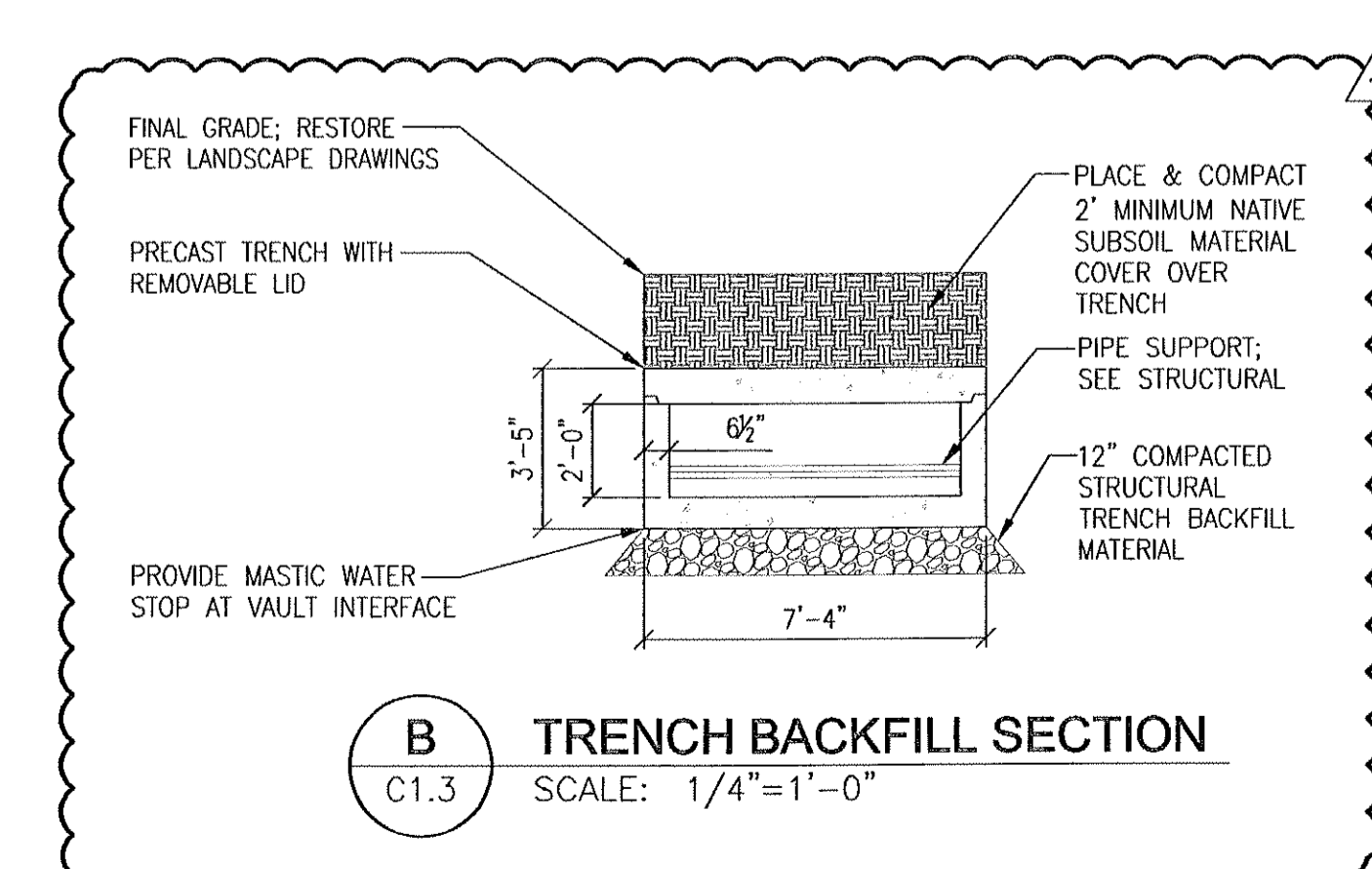
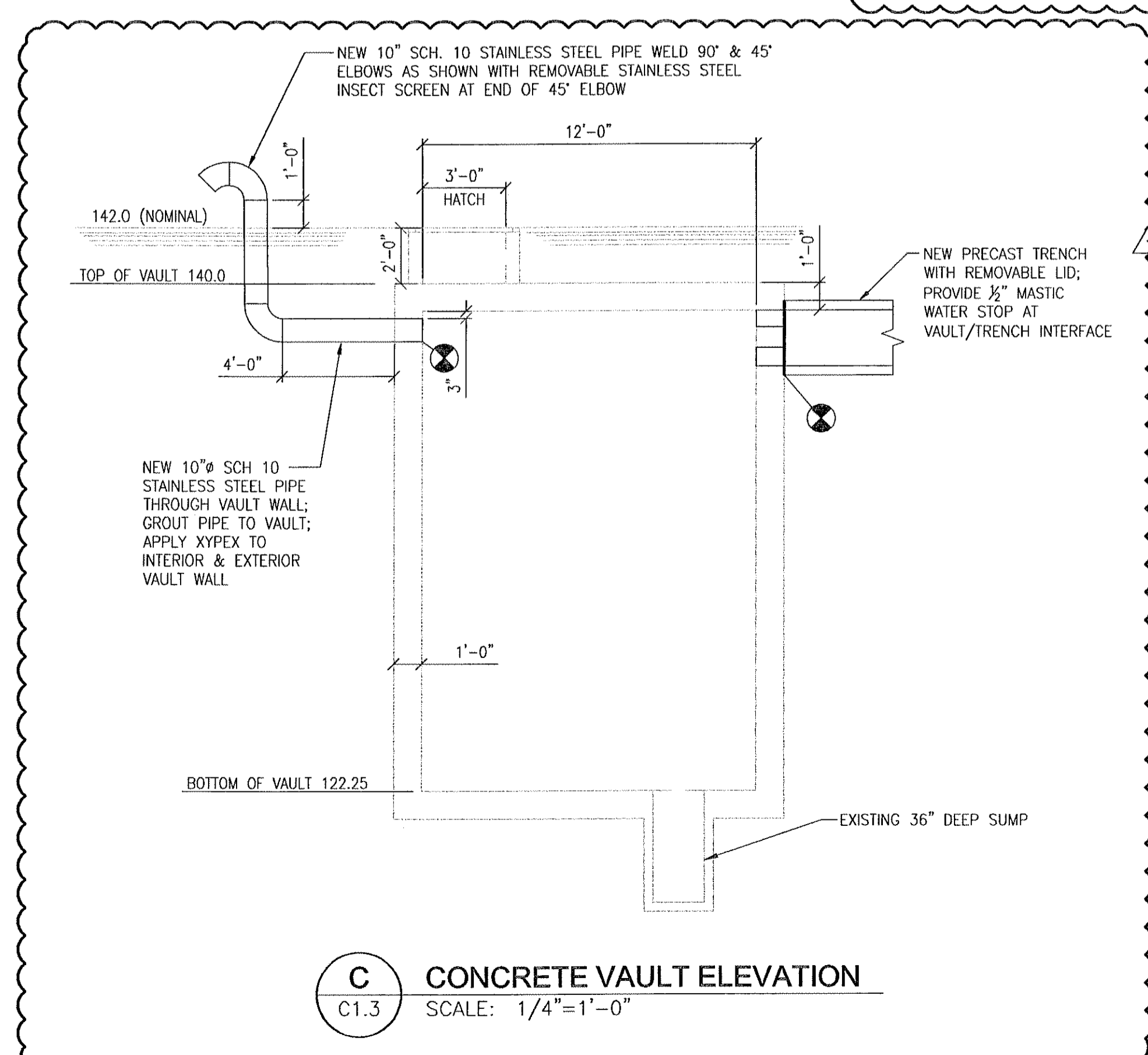
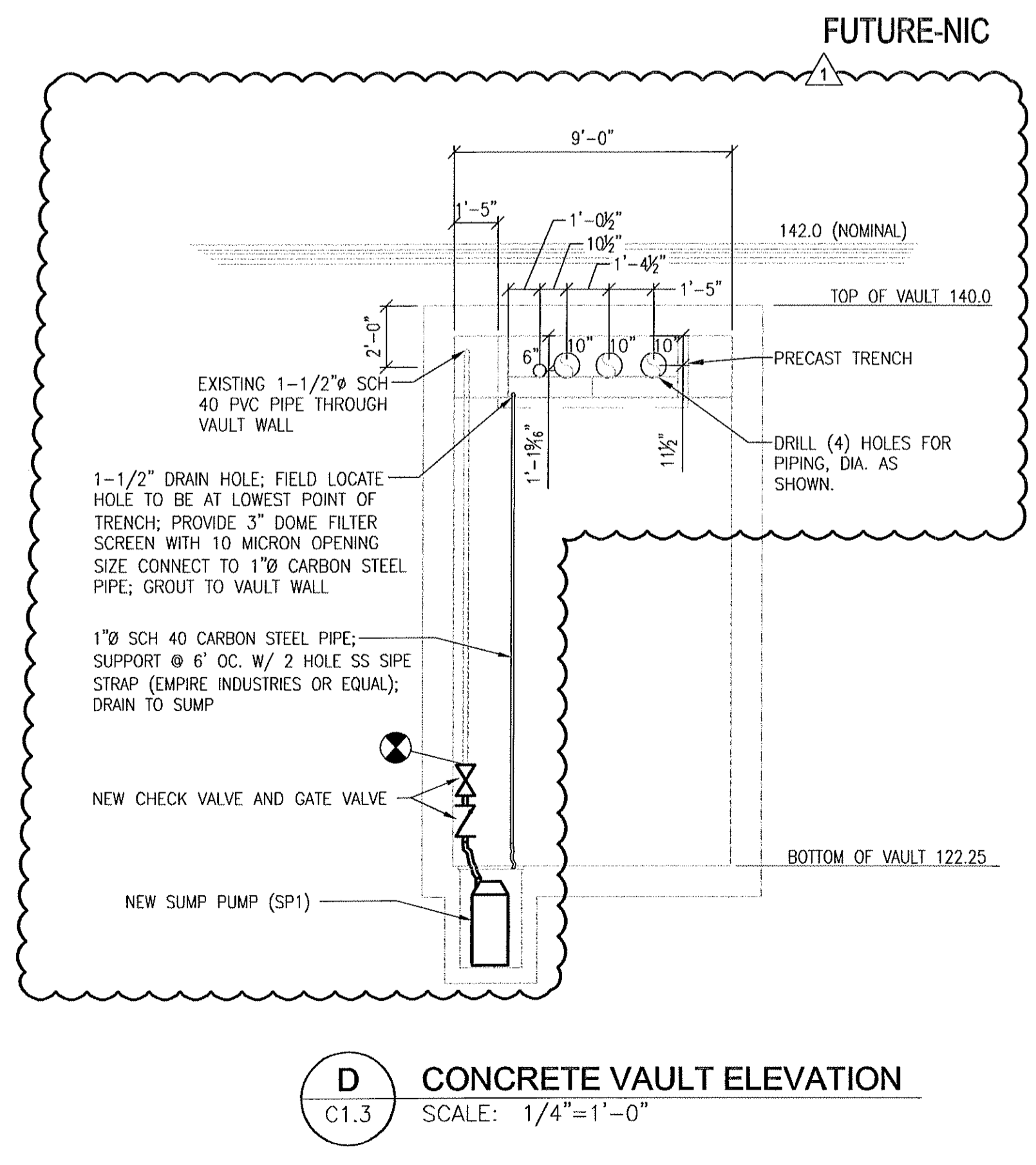
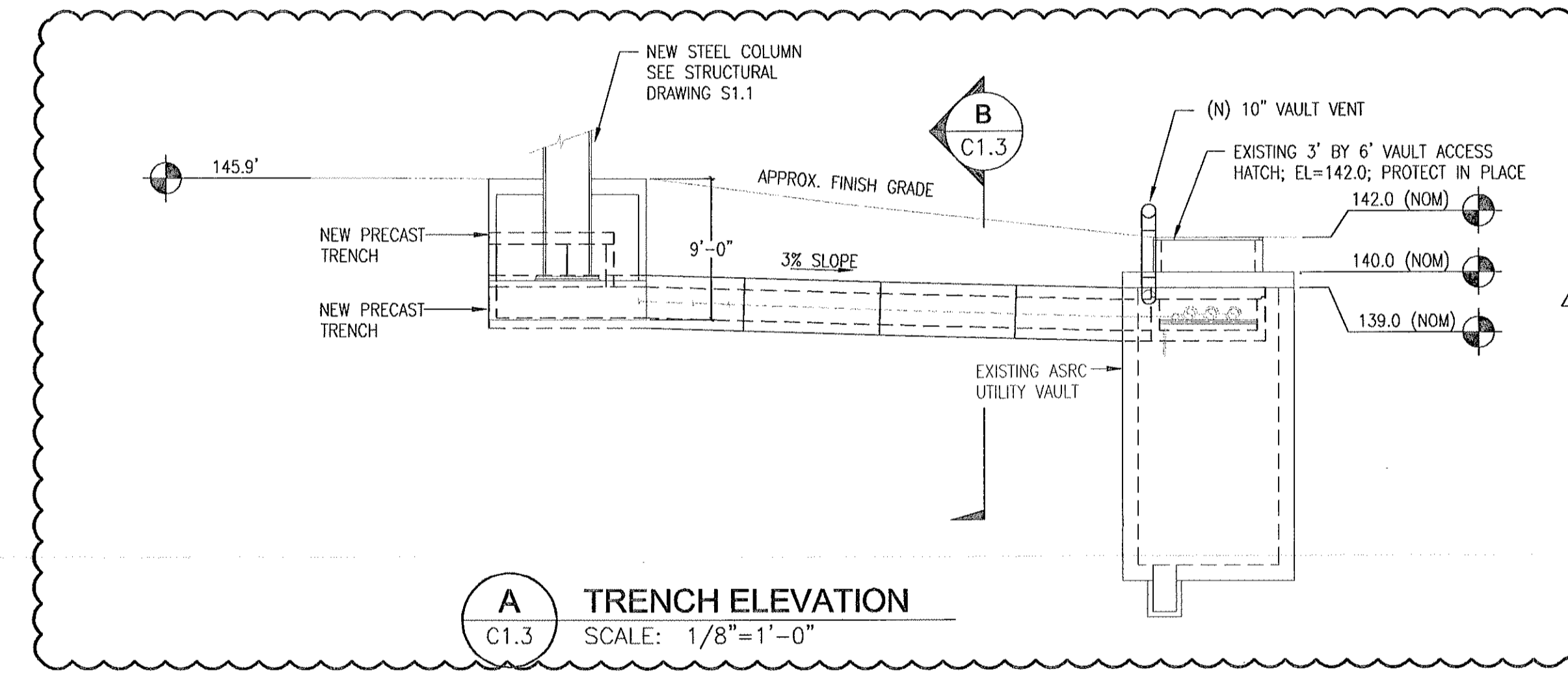
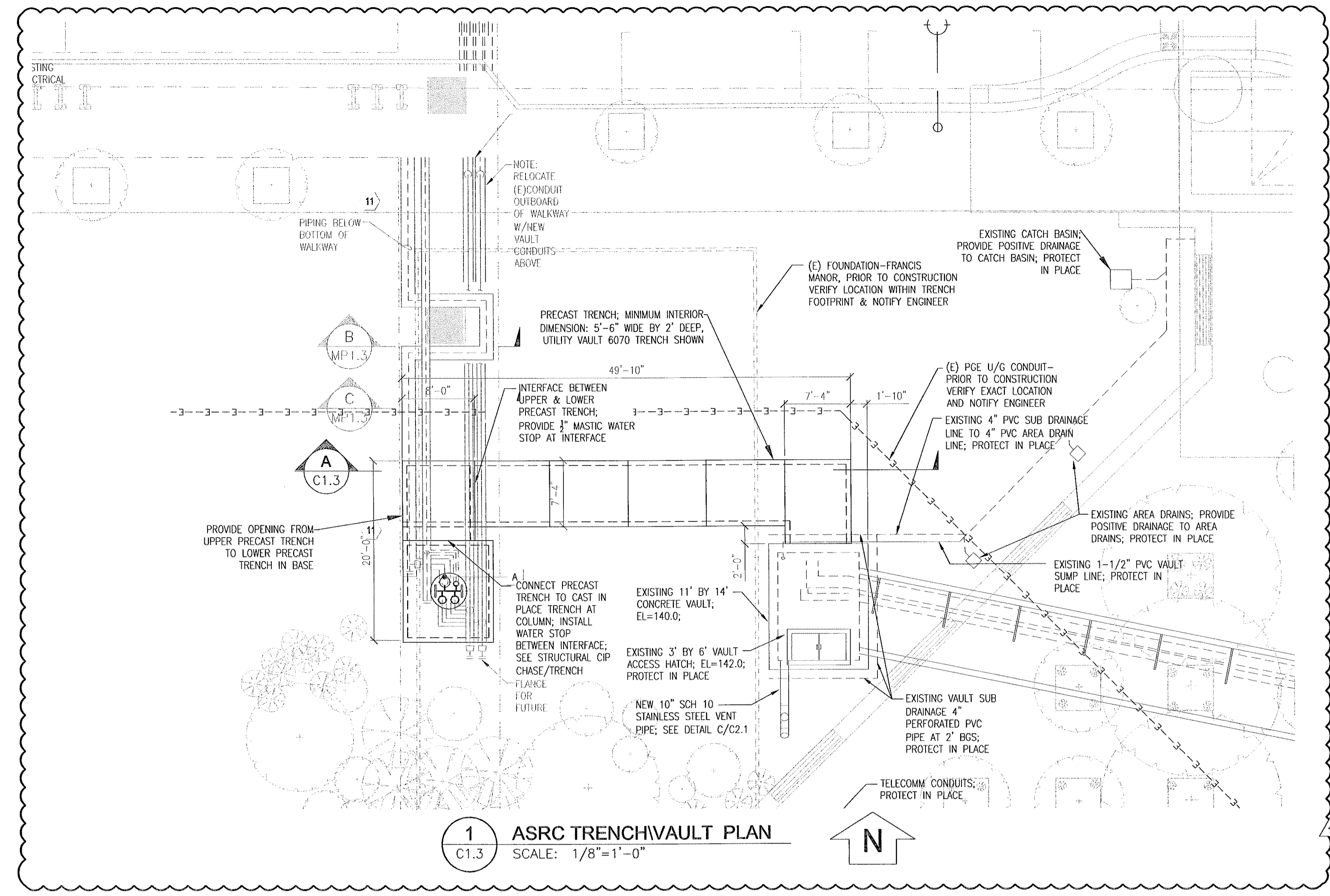
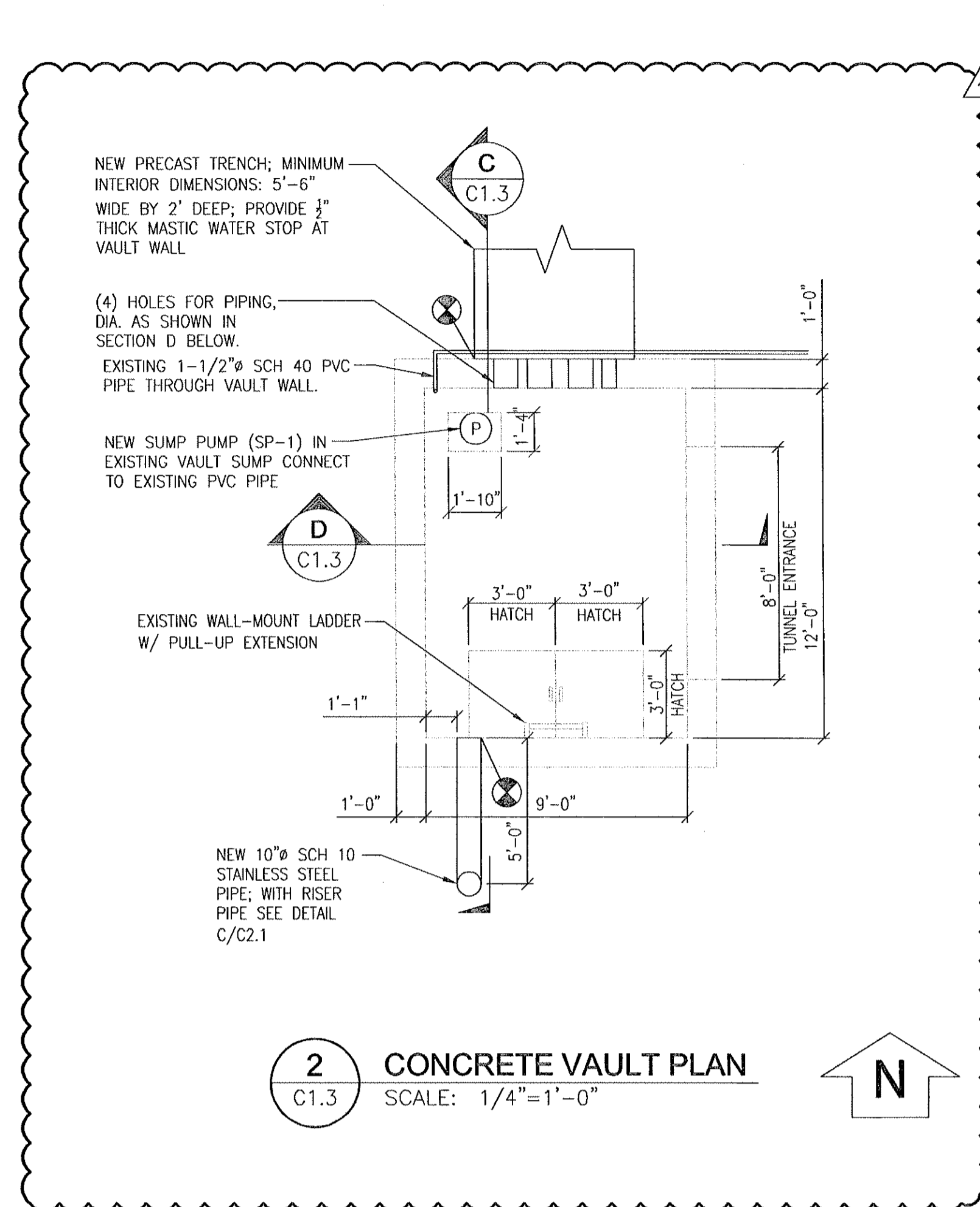
1
T1 PROJECT KEY PLAN
PSU CAMPUS LOOP PHASE 1 BP2
SCALE: AS NOTED

3
T1 PROJECT DRAWING SCHEDULE
PSU CAMPUS LOOP PHASE 1 BP2
SCALE: AS NOTED

no.	date	by	revisions
PSU CAMPUS WIDE LOOP PHASE 1 BP2 STEAM & CHILLED WATER IMPROVEMENTS			
TITLE SHEET			
designed	date	drawn	date
MTC	10/08/07	approved	date
project no.	10009-07001	drawing no.	T-1
EXPIRES: 12/31/09			

KEYED NOTES

- 1 EXISTING UTILITIES LOCATED FROM SURVEY AND RECORD DRAWINGS. CONTRACTOR TO FIELD LOCATE ALL EXISTING UTILITIES AND REPORT ANY DISCREPANCIES TO OWNER.



1	08/29/08	ISSUED FOR CONSTRUCTION
0	05/23/08	JAT ISSUED FOR BID & PERMIT
no.	date	by
		revisions

SJO CONSULTING ENGINEERS
15275 SW BEAULACIA PKWY, SUITE 140
PORTLAND, OR 97244
PH: 503-228-3871 FAX: 503-228-3878

**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

project
ASRC TRENCH PLAN & DETAILS
dwg. title

designed	date
drawn	date
approved	date

project no. 1099-07001
drawing no. **C1.3**
EXP. 05/30/2010

NARRATIVE DESCRIPTIONS:

EXISTING SITE CONDITIONS

- EXISTING UNIVERSITY PROPERTY WITH CONSTRUCTION AREA COVERED IN COMPOST, NEARBY GRASSY & VEGETATED AREA, PAVED ROADS, BUILDINGS. SEE LANDSCAPE PLANS FOR CURRENT AREAS OF COMPOST COVER AND EXISTING VEGETATION.

DEVELOPED CONDITIONS

- MAJORITY OF GRASSY AREA TO REMAIN IN PLACE, A TOWER WILL BE ADDED UNDER ELEVATED WALK WAY AS A STEAM AND CHILLED WATER PIPE CHASE. AREAS WITH COMPOST COVER WILL HAVE GRASS OR PLANT REPLACED, SEE LANDSCAPING DRAWINGS.

NATURE OF CONSTRUCTION ACTIVITY AND ESTIMATED TIME TABLE

- EXCAVATION: (AUGUST 2008)
- PIPE COLUMN: (SEPTEMBER 2008)

TOTAL DISTURBED AREA = 1120 SF

SITE SOIL CLASSIFICATION

STIFF SANDY SILT 0 TO 20 PERCENT SLOPES OVER MEDIUM DENSE, SILTY FINE-GRAINED SAND, EROSION POTENTIAL HIGH.

RECEIVING WATER BODIES

WILLAMETTE RIVER

INSPECTION FREQUENCY:

SITE CONDITION	MINIMUM FREQUENCY
1. ACTIVE PERIOD	DAILY WHEN STORMWATER RUNOFF, INCLUDING RUNOFF FROM SNOWMELT, IS OCCURRING.
2. PRIOR TO THE SITE BECOMING INACTIVE OR IN ANTICIPATION OF SITE INACCESSIBILITY.	ONCE TO ENSURE THAT EROSION AND SEDIMENT CONTROL MEASURES ARE IN WORKING ORDER. ANY NECESSARY MAINTENANCE AND REPAIR MUST BE MADE PRIOR TO LEAVING THE SITE.
3. INACTIVE PERIODS GREATER THAN SEVEN (7) CONSECUTIVE CALENDAR DAYS.	ONCE EVERY TWO (2) WEEKS.
4. PERIODS DURING WHICH THE SITE IS INACCESSIBLE DUE TO INCLEMENT WEATHER.	IF PRACTICAL, INSPECTIONS MUST OCCUR DAILY AT A RELEVANT AND ACCESSIBLE DISCHARGE POINT OR DOWNSTREAM LOCATION.

- HOLD A PRE-CONSTRUCTION MEETING OF PROJECT CONSTRUCTION PERSONNEL THAT INCLUDES THE EROSION CONTROL INSPECTOR.
- ALL INSPECTIONS MUST BE MADE IN ACCORDANCE WITH DEQ 1200 C PERMIT REQUIREMENTS.
- INSPECTION LOSS MUST BE KEPT IN ACCORDANCE WITH DEQ'S 1200 C PERMIT REQUIREMENTS.
- CHANGES TO THE APPROVED SEC PLAN MUST BE SUBMITTED TO DEQ IN THE FORM OF AN ACTION PLAN.

BMP MATRIX FOR CONSTRUCTION PHASES:

REFER TO DEQ GUIDANCE MANUAL FOR A COMPREHENSIVE LIST OF AVAILABLE BMP'S.

BMPs	SITE CLEARING	RAW EXCAVATION	PIPE COLUMN CONSTRUCTION	WET WEATHER	FINAL STABILIZATION
ROCK SITE ENTRANCE					
SILT FENCING	**X	X	X	X	
INLET PROTECTION	**X	X	X	X	
MULCH					
ROCK PADS					
SLOPE BLANKETS					
COMPOST BLANKET/BERMS	*X	X	X	X	
GRASS STABILIZATION					X

- * SIGNIFIES BMP INSTALLED DURING PREVIOUS PHASE OF WORK.
- ** SIGNIFIES BMP THAT WILL BE INSTALLED PRIOR TO ANY GROUND DISTURBING ACTIVITY.

PROJECT LOCATION:

PORTLAND STATE UNIVERSITY
SW MONTGOMERY ST & SW 6TH AVENUE
PORTLAND, OR 97207
MULTNOMAH COUNTY, OR
LATITUDE = 45.5117, LONGITUDE = 122.6830

PERMITTEE'S SITE INSPECTOR:

NAME: JUSTIN THOMPSON
COMPANY/AGENCY: WINZLER & KELLY
(UNTIL PROJECT IS BID AND CONTRACTOR INSPECTOR IS DETERMINED)

PHONE: (503) 226-3921

FAX: (503) 226-3926

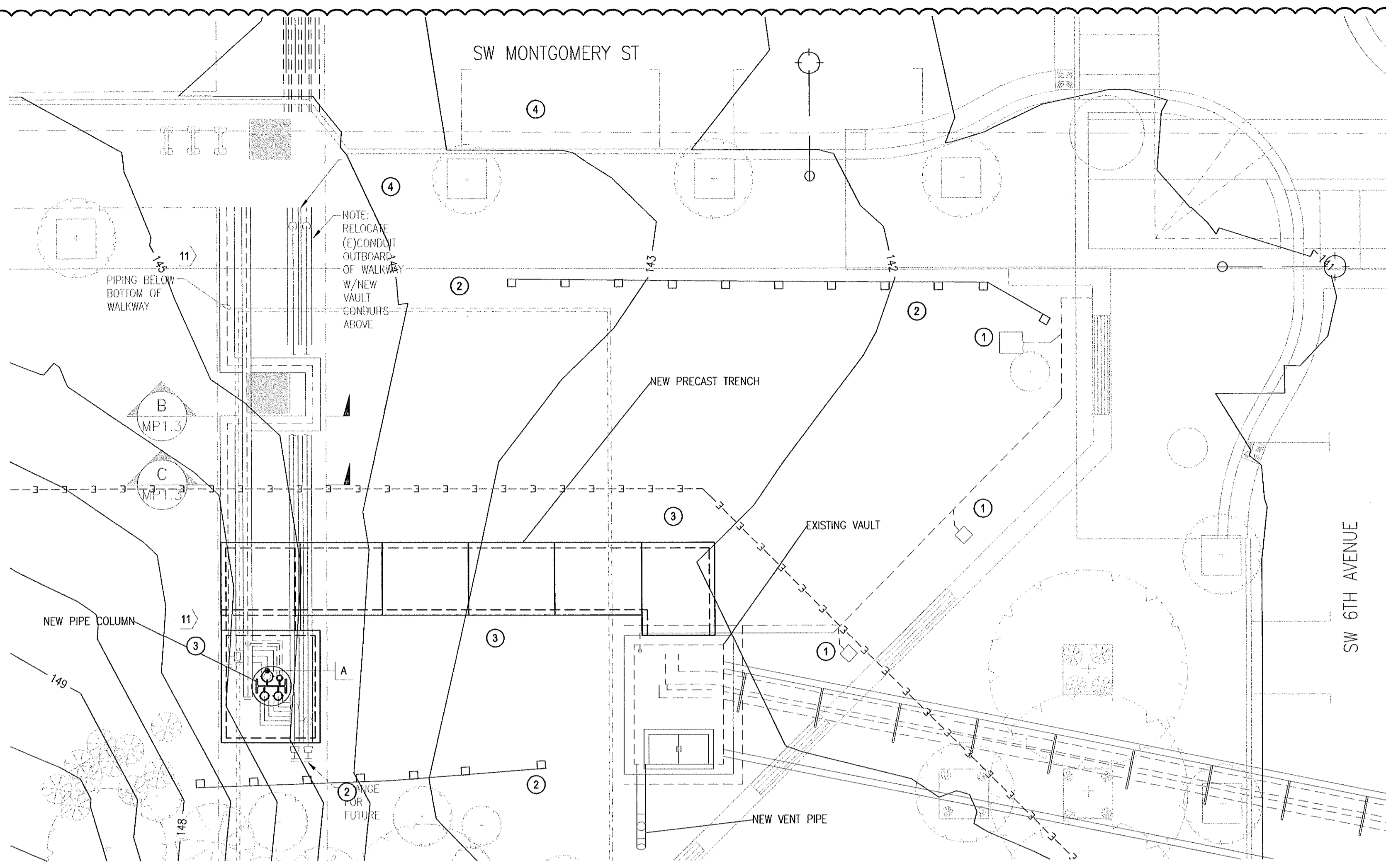
E-MAIL: jstthompson@w-and-k.com

DESCRIPTION OF EXPERIENCE:

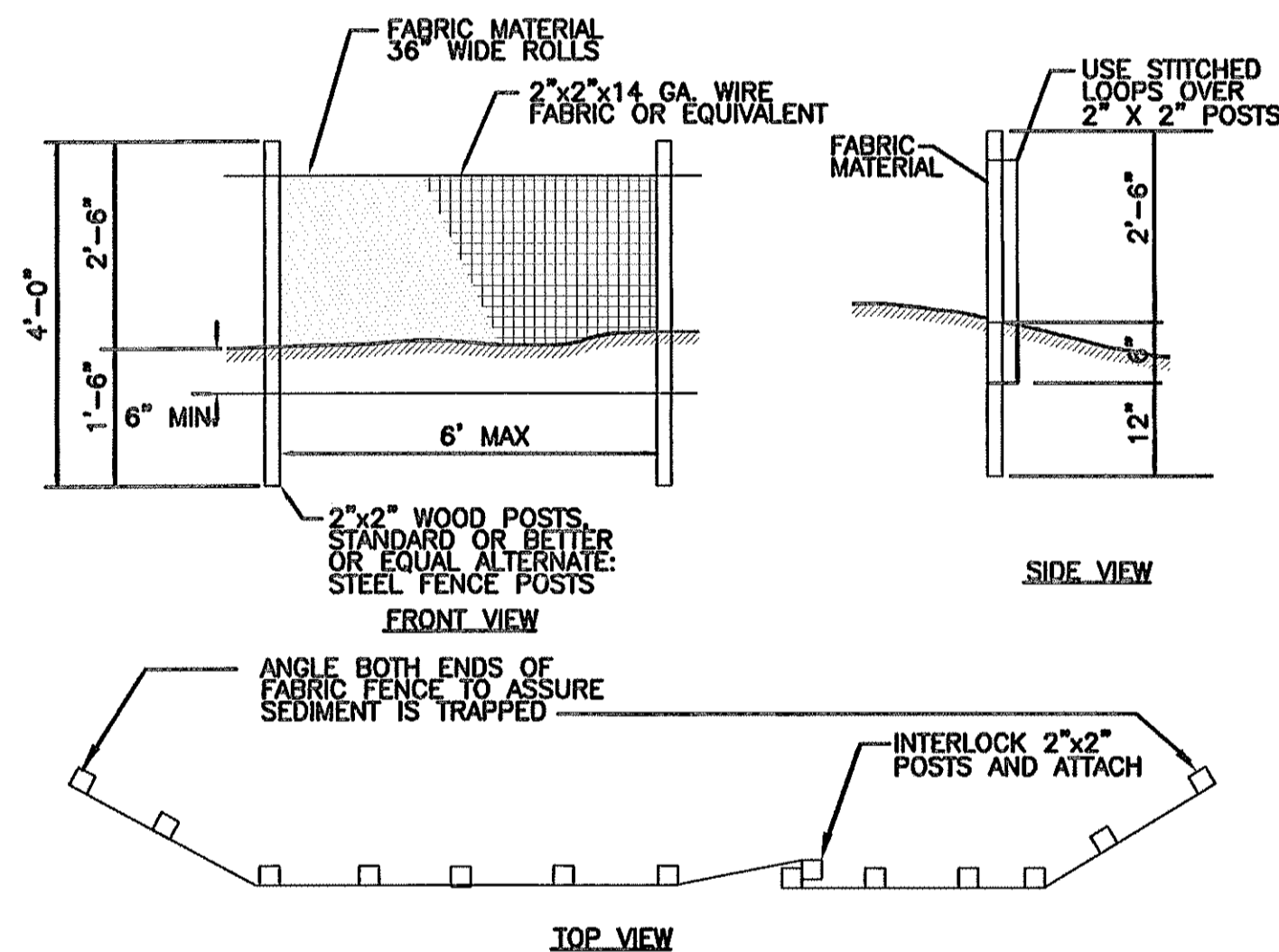
PROFESSIONAL CIVIL ENGINEER WITH 5 YEARS EXPERIENCE WITH GRADING AND EROSION CONTROL.

STANDARD EROSION AND SEDIMENT CONTROL PLAN DRAWING NOTES:

- HOLD A PRE-CONSTRUCTION MEETING OF PROJECT CONSTRUCTION PERSONNEL THAT INCLUDES THE INSPECTOR TO DISCUSS EROSION AND SEDIMENT CONTROL MEASURES AND CONSTRUCTION LIMITS. (SCHEDULE A.5.B.I.(3))
- THE ESCP MUST BE KEPT ON-SITE AND ALL EROSION AND SEDIMENT CONTROL MEASURES SHOWN ON THE PLAN MUST BE INSTALLED IN SUCH A MANNER TO ENSURE THAT SEDIMENT OR SEDIMENT LADEN WATER THAT ENTERS OR IS LIKELY TO ENTER SURFACE WATERS OR CONFORMANCE SYSTEMS LEADING TO SURFACE WATER, ROADWAY, OR OTHER PROPERTIES DOES NOT OCCUR. (SCHEDULE A.5.A.) AND (SCHEDULE B.3.B.)
- EROSION AND SEDIMENT CONTROL MEASURES INCLUDING PERIMETER SEDIMENT CONTROL MUST BE IN PLACE BEFORE VEGETATION IS DISTURBED AND MUST REMAIN IN PLACE AND BE MAINTAINED, REPAIRED AND PROMPTLY IMPLEMENTED FOLLOWING PROCEDURES ESTABLISHED FOR THE DURATION OF CONSTRUCTION, INCLUDING PROTECTION FOR ACTIVE STORM DRAIN INLETS AND CATCH BASINS AND APPROPRIATE NON-STORMWATER POLLUTION CONTROLS. (SCHEDULE A.5.B.I.(2)), (SCHEDULE A.5.B.I.(7)), (SCHEDULE A.7.D.I.(2)) & (SCHEDULE A.7.F.)
- BEGIN LAND CLEARING, EXCAVATION, TRENCHING, CUTTING OR GRADING AND EARTHWORK SURFACE ROUGHING AFTER INSTALLING APPLICABLE SEDIMENT PREVENTION AND RUNOFF CONTROL MEASURES NOT IN THE DIRECT PATH OF WORK. (SCHEDULE A.5.B.I.(4)), (SCHEDULE A.7.C.I.(1)) AND (SCHEDULE A.7.E.I.(1))
- APPLY TEMPORARY AND/OR PERMANENT SOIL STABILIZATION MEASURES IMMEDIATELY ON ALL DISTURBED AREAS AS GRADING PROGRESSES AND FOR ALL ROADWAYS INCLUDING GRAVEL ROADWAYS. (SCHEDULE A.5.B.I.(5)), (SCHEDULE A.5.B.I.(5)(C) & SCHEDULE A.5.B.I.(6))
- WET WEATHER BMP'S: CONSTRUCTION ACTIVITIES MUST AVOID OR MINIMIZE EXCAVATION AND CREATION OF BARE GROUND ON SLOPES GREATER THAN FIVE (5) PERCENT FROM OCTOBER 1 THROUGH MAY 31 EACH YEAR. (SCHEDULE A.7.A.I.)
- WET WEATHER BMP'S: TEMPORARY STABILIZATION OF THE SITE MUST BE INSTALLED AT THE END OF THE SHIFT BEFORE A HOLIDAY OR WEEKEND OR AT THE END OF EACH WORKDAY IF RAINFALL IS FORECAST IN THE NEXT 24 HOURS AND EACH WEEKEND AND HOLIDAY. (SCHEDULE A.7.A.I.I.)
- IDENTIFY, MARK, AND PROTECT (BY FENCING OFF OR OTHER MEANS) CRITICAL RIPARIAN AREAS AND VEGETATION INCLUDING IMPORTANT TREES AND ASSOCIATED ROOTING ZONES AND VEGETATION AREAS TO BE PRESERVED. IDENTIFY VEGETATIVE BUFFER ZONES BETWEEN THE SITE AND SENSITIVE AREAS (E.G., WETLANDS), AND OTHER AREAS TO BE PRESERVED, ESPECIALLY IN PERIMETER AREAS. PRESERVE EXISTING VEGETATION AND RE-VEGETATE OPEN AREAS WHEN PRACTICABLE BEFORE AND AFTER GRADING OR CONSTRUCTION. (SCHEDULE A.5.B.I.(1) & (2)) AND (SCHEDULE A.7.C.I.I.(1))
- PROVIDE PERMANENT EROSION PREVENTION MEASURES ON ALL EXPOSED AREAS TO PREVENT FROM BECOMING A SOURCE OF EROSION AND REMOVE ALL TEMPORARY CONTROL MEASURES, UNLESS LOCAL ORDINANCES REQUIRE OTHERWISE, AS AREAS ARE STABILIZED. (SCHEDULE A.5.B.I.(6)) AND (SCHEDULE A.7.C.I.I.(2))
- ALL TEMPORARY SEDIMENT CONTROLS MUST REMAIN IN PLACE UNTIL PERMANENT VEGETATION OR OTHER PERMANENT COVERING OF EXPOSED SOIL IS ESTABLISHED. IDENTIFY THE TYPE OF VEGETATIVE SEED MIX USED. (SCHEDULE A.7.C.I.I.(3)) & (SCHEDULE A.7.C.I.I.(4))
- SEDIMENT CONTROLS MUST BE INSTALLED AND MAINTAINED ALONG THE SITE PERIMETER ON ALL DOWN GRADIENT SIDES OF THE CONSTRUCTION SITE AND AT ALL ACTIVE AND OPERATIONAL INTERNAL STORM DRAIN INLETS AT ALL TIMES DURING CONSTRUCTION. (SCHEDULE A.7.D.I.(1) - (2))
- PRIOR TO ANY LAND DISTURBING ACTIVITIES EACH SITE MUST HAVE GRAVELED, PAVED, OR CONSTRUCTED ENTRANCES, EXITS AND PARKING AREAS WITH EXIT TIRE WASH TO REDUCE THE TRACKING OF SEDIMENT ONTO PUBLIC OR PRIVATE ROADS. (SCHEDULE A.7.D.B.I.(1))
- WHEN TRUCKING SATURATED SOILS FROM THE SITE, EITHER WATERTIGHT TRUCKS MUST BE USED OR LOADS MUST BE DRAINED ON-SITE UNTIL DRIPPING HAS BEEN REDUCED TO MINIMIZE SPILLAGE ON ROADS. (SCHEDULE A.7.D.B.I.(3))
- TEMPORARY STABILIZATION OR COVERING OF SOIL STOCKPILES AND PROTECTION OF STOCKPILE LOCATED AWAY FROM CONSTRUCTION ACTIVITY MUST OCCUR AT THE END OF EACH WORKDAY OR OTHER BMP'S, SUCH AS DIVERSION OF UNCONTAMINATED FLOWS AND INSTALLATION OF SEDIMENT FENCES AROUND STOCKPILES, MUST BE IMPLEMENTED TO PREVENT TURBID DISCHARGES TO SURFACE WATERS. (SCHEDULE A.7.E.I.(1)) & (SCHEDULE A.7.E.I.(1) - (3))
- BMP'S THAT WILL BE USED TO PREVENT OR MINIMIZE STORMWATER FROM BEING EXPOSED TO POLLUTANTS FROM SPILLS, NO DISCHARGE OF CONCRETE TRUCK WASH WATER, VEHICLE AND EQUIPMENT CLEANING, VEHICLE AND EQUIPMENT FUELING, MAINTENANCE, AND STORAGE, OTHER CLEANING AND MAINTENANCE ACTIVITIES, AND WASTE HANDLING ACTIVITIES. THESE POLLUTANTS INCLUDE FUEL, HYDRAULIC FLUID, AND OTHER OILS FROM VEHICLES AND MACHINERY, AS WELL AS DEBRIS, LEFTOVER PAINTS, SOLVENTS, AND GLUES FROM CONSTRUCTION OPERATIONS. (SCHEDULE A.7.E.I.(2))
- ANY USE OF TOXIC OR OTHER HAZARDOUS MATERIALS MUST INCLUDE PROPER STORAGE, APPLICATION, AND DISPOSAL. (SCHEDULE A.7.E.I.I.(2))
- SOLID WASTE AND HAZARDOUS MATERIALS MANAGEMENT - FOLLOW PROJECT WRITTEN SPILL PREVENTION AND RESPONSE PROCEDURES, EMPLOYEE TRAINING ON SPILL PREVENTION AND PROPER DISPOSAL PROCEDURES, REGULAR MAINTENANCE SCHEDULE FOR VEHICLES AND MACHINERY, AND MATERIAL DELIVERY AND STORAGE CONTROLS, TRAINING AND STORAGE, MATERIAL USE, COVERED STORAGE AREAS FOR WASTE AND SUPPLIES. (SCHEDULE A.7.E.I.I.(3))
- THE PERMITTEE MUST PROPERLY MANAGE HAZARDOUS WASTES, USED OILS, CONTAMINATED SOILS, CONCRETE WASTE, SANITARY WASTE, LIQUID WASTE, OR OTHER TOXIC SUBSTANCES DISCOVERED OR GENERATED DURING CONSTRUCTION AND MEET ALL STATE AND FEDERAL REGULATIONS AND APPROVALS. (SCHEDULE A.7.E.I.I.(4))
- THE ESCP MEASURES SHOWN ON THIS PLAN ARE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE MEASURES MUST BE UPGRADED AS NEEDED TO COMPLY WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL EROSION AND SEDIMENT CONTROL REGULATIONS. CHANGES TO THE ESCP MUST ALSO BE SUBMITTED IN THE FORM OF AN ACTION PLAN TO DEQ OR ITS AGENT FOR APPROVAL. (SCHEDULE A.7.F.)
- SIGNIFICANT AMOUNTS OF SEDIMENT, WHICH LEAVES THE SITE, MUST BE CLEANED UP WITHIN 24 HOURS AND PLACED BACK ON THE SITE AND STABILIZED OR PROPERLY DISPOSED. THE CAUSE OF THE SEDIMENT RELEASE MUST BE FOUND AND PREVENTED FROM CAUSING A RECURRENCE OF THE DISCHARGE WITHIN THE SAME 24 HOURS. ANY IN-STREAM CLEAN UP OF SEDIMENT SHALL BE PERFORMED ACCORDING TO THE GREEN DIVISION OF STATE LANDS REQUIRED TIME FRAME. (SCHEDULE A.7.F.I.(1))
- VACUUMING OR DRY SWEEPING MUST BE USED TO CLEAN-UP RELEASED SEDIMENT AND MUST NOT BE INTENTIONALLY WASHED INTO STORM SEWERS, DRAINAGE WAYS, OR WATER BODIES. (SCHEDULE A.7.F.I.(2))
- THE APPLICATION RATE OF FERTILIZERS USED TO REESTABLISH VEGETATION MUST FOLLOW MANUFACTURER'S RECOMMENDATIONS TO MINIMIZE NUTRIENT RELEASES TO SURFACE WATERS. TIME-RELEASE FERTILIZERS SHOULD BE USED WITH CARE WITHIN ANY WATERWAY RIPARIAN ZONE. (SCHEDULE A.7.F.I.(3))
- SEDIMENT MUST BE REMOVED FROM BEHIND A SEDIMENT FENCE WHEN IT HAS REACHED A HEIGHT OF 1/3 THE HEIGHT OF THE FENCE ABOVEGROUND AND BEFORE FENCE REMOVAL. (SCHEDULE A.7.F.I.I.(1))
- SEDIMENT MUST BE REMOVED FROM BEHIND BIO BAGS AND OTHER BARRIERS IF HAS REACHED A HEIGHT OF TWO (2) INCHES AND BEFORE BMP REMOVAL. (SCHEDULE A.7.F.I.I.(2))
- REMOVAL OF TRAPPED SEDIMENT IN A SEDIMENT BASIN OR SEDIMENT TRAP OR CATCH BASINS MUST OCCUR WHEN THE SEDIMENT RETENTION CAPACITY HAS BEEN REDUCED BY FIFTY (50)% AND AT COMPLETION OF PROJECT. (SCHEDULE A.7.F.I.I.(3) & (4))
- DEQ MUST APPROVE OF ANY TREATMENT SYSTEM AND OPERATIONAL PLAN THAT MAY BE NECESSARY TO TREAT CONTAMINATED CONSTRUCTION DEWATERING OR SEDIMENT AND TURBIDITY IN STORMWATER RUNOFF. (SCHEDULE A.7.F.I.I.)
- SHOULD ALL CONSTRUCTION ACTIVITIES CEASE FOR THIRTY DAYS OR MORE, THE ENTIRE SITE MUST BE TEMPORARILY STABILIZED USING VEGETATION OR A HEAVY MULCH LAYER, TEMPORARY SEEDING, OR OTHER METHOD. (SCHEDULE A.8.A.)
- SHOULD CONSTRUCTION ACTIVITIES CEASE FOR FIFTEEN (15) DAYS OR MORE ON ANY SIGNIFICANT PORTION OF A CONSTRUCTION SITE TEMPORARY STABILIZATION IS REQUIRED FOR THAT PORTION OF THE SITE WITH STRAW, COMPOST, OR OTHER TACKIFIED COVERING THAT PREVENT SOIL OR WIND EROSION UNTIL WORK RESUMES ON THAT PORTION OF THE SITE. (SCHEDULE A.8.B.)
- DAILY INSPECTIONS WHEN RAINFALL AND RUNOFF OCCURS OF THE BMP'S AND DISCHARGE OUTFALLS MUST BE THE PROJECT ESCP INSPECTOR. THESE INSPECTIONS AND OBSERVATIONS MUST BE RECORDED IN A LOG THAT IS AVAILABLE ON SITE. (SCHEDULE A.6.B.I.) & (SCHEDULE B.1.B.I.(1))
- BMP'S MUST BE INSPECTED BEFORE, DURING, AND AFTER SIGNIFICANT STORM EVENTS. (SCHEDULE A.7.F.I.)
- ALL ESCP CONTROLS AND PRACTICES MUST BE INSPECTED VISUALLY ONCE TO ENSURE THAT BMP'S ARE IN WORKING ORDER PRIOR TO THE SITE BECOMING INACTIVE, OR IN ANTICIPATION OF SITE INACCESSIBILITY AND MUST BE INSPECTED VISUALLY ONCE EVERY TWO (2) WEEKS DURING INACTIVE PERIODS GREATER THAN SEVEN (7) CONSECUTIVE CALENDAR DAYS. (SCHEDULE B.1.B.I.(2)-(3))
- IF PRACTICAL, INSPECTIONS MUST OCCUR DAILY AT A RELEVANT AND ACCESSIBLE DISCHARGE POINT OR DOWNSTREAM LOCATION DURING PERIODS WHICH THE SITE IS INACCESSIBLE DUE TO INCLEMENT WEATHER. (SCHEDULE B.1.B.I.(4))

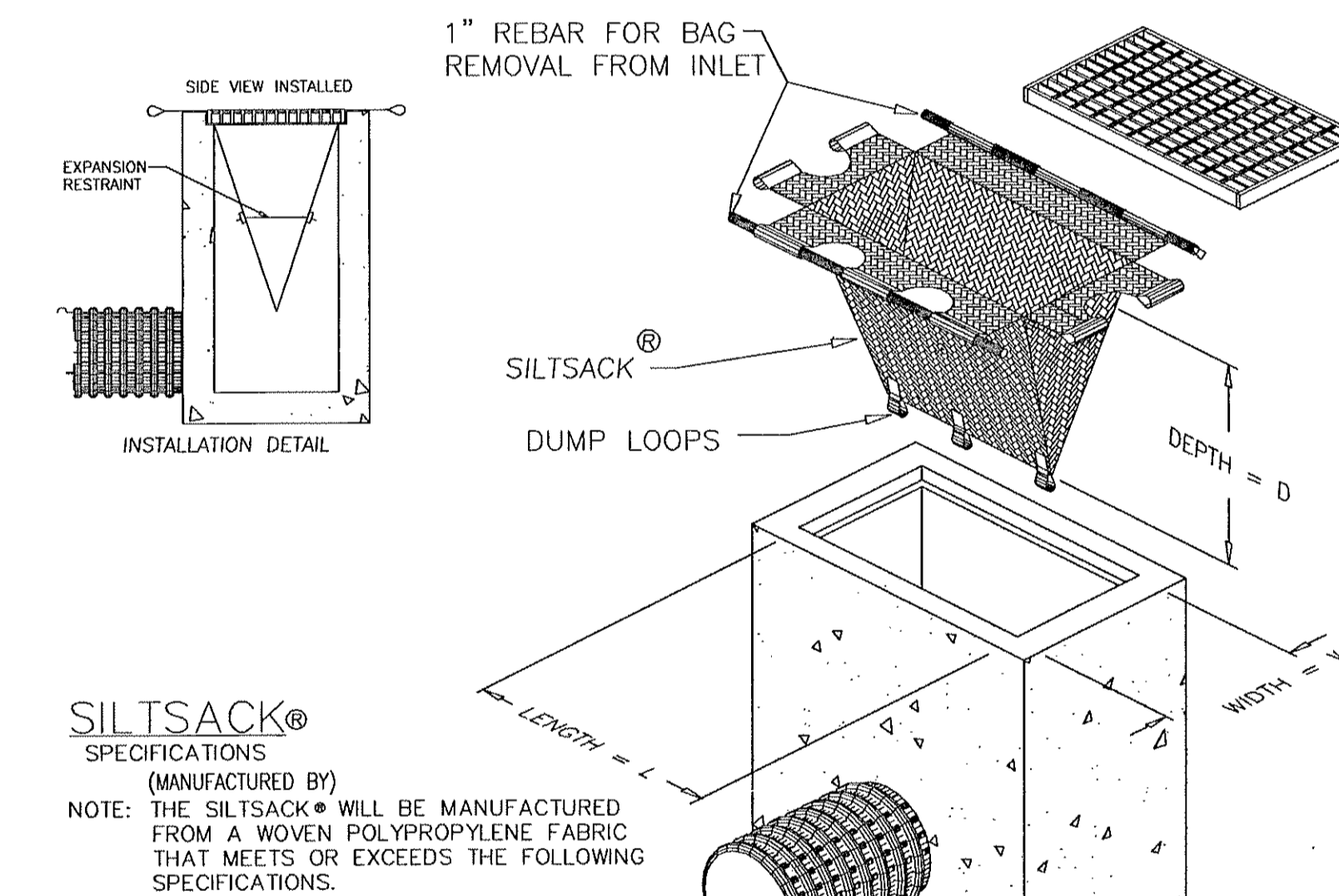


1 ASRC TRENCHVAULT PLAN
SCALE: 1/8"=1'-0"



- 2 SEDIMENT FENCE DETAIL**
SCALE: NONE
- NOTES:**
- BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE.
 - 2" x 2" FIR, PINE, OR STEEL FENCE POSTS.
 - STITCHED LOOPS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.
 - COMPACT ALL AREAS OF FABRIC TRENCH.

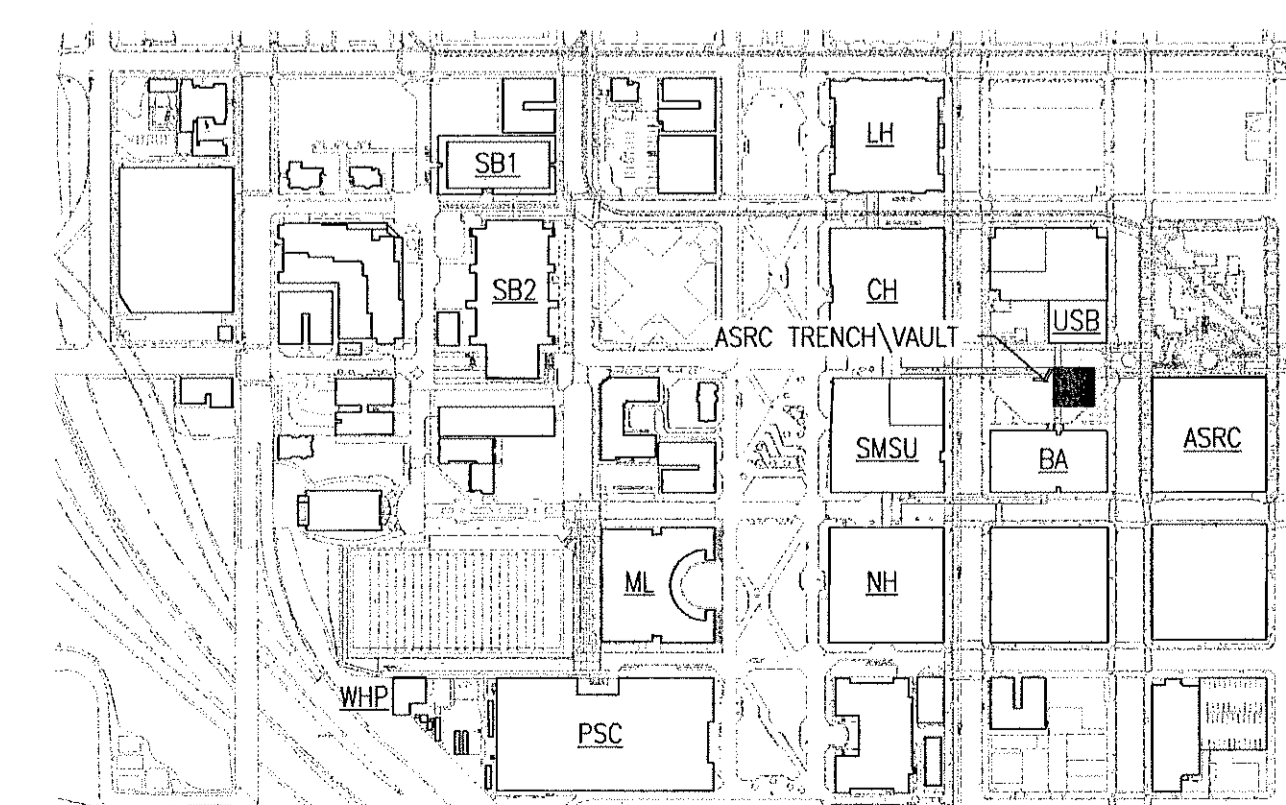
2 SEDIMENT FENCE DETAIL
SCALE: NONE



REGULAR FLOW SILTSACK®
(FOR AREAS OF LOW TO MODERATE PRECIPITATION AND RUN-OFF)

PROPERTIES	TEST METHOD	UNITS
GRAB TENSILE STRENGTH	ASTM D-4632	300 LBS
GRAB TENSILE ELONGATION	ASTM D-4632	20 %
PUNCTURE	ASTM D-4833	120 LBS
MULLEN BURST	ASTM D-3786	800 PSI
TRAPEZOID TEAR	ASTM D-4533	120 LBS
UV RESISTANCE	ASTM D-4355	80 %
APPARENT OPENING SIZE	ASTM D-4751	40 US SIEVE
FLOW RATE	ASTM D-4491	40 GAL/MIN/50 SQ FT
PERMITTIVITY	ASTM D-4491	0.55 SEC -1

3 INLET PROTECTION
SCALE: NONE



PSU CAMPUS - KEY PLAN

KEYED NOTES

- EXISTING UTILITIES LOCATED FROM SURVEY AND RECORD DRAWINGS. CONTRACTOR TO FIELD LOCATE ALL EXISTING UTILITIES AND REPORT ANY DISCREPANCIES TO OWNER.

EROSION CONTROL NOTES

- INSTALL INLET PROTECTION (TYPICAL OVER ALL OPEN GRATES AND INCLUDING CATCH BASINS AND YARD DRAINS).
- INSTALL SEDIMENT FENCE. (TYPICAL)
- RAKE AWAY EXISTING MULCH TO CONSTRUCT SMALL 6" HIGH BERM AROUND EXCAVATION ACTIVITIES. MAINTAIN MULCH COVER AS PART OF EROSION CONTROL MONITORING PLAN.
- SWEEP UP SEDIMENT TRACKED ONTO SIDEWALKS & PUBLIC ROADS AT A FREQUENCY TO PREVENT SEDIMENT ENTERING NEARBY STORM DRAINS OR THAT WOULD BE FURTHER TRACKED BY OTHER USERS & PRIOR TO END OF CONSTRUCTION WORK DAY.

FUTURE-NIC

1	08/29/08	ISSUED FOR CONSTRUCTION
0	05/23/08	JAT ISSUED FOR BID & PERMIT
no	date	by
		revisions

SJO CONSULTING ENGINEERS
15015 SW SEQUOIA PARKWAY, SUITE 140
PORTLAND, OR 97224
PHONE: 503.226.3921 FAX: 503.226.3928

WINZLER & KELLY
Project
PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

Dwg. Title
ASRC TRENCH EROSION CONTROL PLAN & DETAILS

designed	date
drawn	date
at	08/17/08
approved	date
project no.	
drawn no.	
drawing no.	

C1.4

EXP: 08/28/2010

DESIGN STANDARD: 2006 INTERNATIONAL BUILDING CODE WITH THE 2007 OREGON STRUCTURAL SPECIALTY CODE (OSSC)

DESIGN CRITERIA

- DESIGN LATERAL LOADS FOR NEW CONSTRUCTION, UNLESS NOTED OTHERWISE:
 - A. WIND: 2006 OSSC 1609.1.1 EXCEPTION 5
100 MPH EXPOSURE B W = 1.0
 - B. SEISMIC: INTERNATIONAL BUILDING CODE SEISMIC DESIGN CATEGORY D
SITE CLASSIFICATION C....
OCCUPANCY TYPE II
R = 3.25 IE = 1.0
SI = 0.33 SS = 0.93

GENERAL

- THESE STRUCTURAL NOTES ARE A SUPPLEMENT TO THE SPECIFICATIONS.
- SPECIFICATIONS AND CODES REFERENCED ARE THE VERSIONS MOST RECENTLY ADOPTED BY THE PERMITTING AUTHORITY.
- VERIFY THE DIMENSIONS AND CONDITIONS WITH THE ARCHITECTURAL DRAWINGS. FIELD VERIFY DIMENSIONS AND ELEVATIONS RELATIVE TO THE EXISTING STRUCTURE PRIOR TO FABRICATION OF MATERIALS.
- FOR FEATURES OF CONSTRUCTION NOT FULLY SHOWN, PROVIDE THE SAME TYPE AND CHARACTER AS SHOWN FOR SIMILAR CONDITIONS, SUBJECT TO REVIEW BY THE ARCHITECT AND STRUCTURAL ENGINEER OF RECORD.
- APPLY, PLACE, ERECT OR INSTALL ALL PRODUCTS AND MATERIALS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
- ADEQUATELY BRACE STRUCTURE AND ALL STRUCTURAL COMPONENTS AGAINST WIND, LATERAL EARTH AND SEISMIC FORCES UNTIL THE PERMANENT LATERAL-FORCE RESISTING SYSTEMS HAVE BEEN INSTALLED.
- SUBMITTALS:
 - A. SUBMIT SHOP DRAWINGS FOR:
 - REINFORCING STEEL
 - STRUCTURAL STEEL
 - METAL DECK
 - SUBMIT SHOP DRAWINGS, STAMPED BY A REGISTERED STRUCTURAL ENGINEER LICENSED IN THE STATE OF OREGON, FOR:
 - STEEL JOISTS AND GIRDERS
 - C. SUBMIT SHOP DRAWINGS PRIOR TO FABRICATION OF MATERIAL.

SITE PREPARATION

- REMOVE VEGETATION, RUBBISH AND EXISTING FILL WITHIN PROJECT FOOTPRINT AND 5'-0" (MINIMUM) BEYOND THE FOOTPRINT. STRIP TOP SOIL 6", MINIMUM.
- REMOVE AREAS OF SOIL THAT EXHIBIT EXCESSIVE WEAVING OR DEFLECTION UNDER THE WEIGHT OF THE ROLLER OR DUMP TRUCK
- BACK-FILL EXCAVATED AREAS WITH STRUCTURAL FILL AS DESCRIBED BELOW.
- CONSULT THE FOUNDATION INVESTIGATION REPORT, AVAILABLE AT ENGINEERS OFFICE, FOR ADDITIONAL INFORMATION.

STRUCTURAL FILL OR BACK-FILL

- STRUCTURAL FILL MATERIAL: SEE GEOTECHNICAL REPORT FOR ACCEPTABLE MATERIALS.
- PLACE STRUCTURAL FILL IN LOOSE LIFTS, MAXIMUM OF 8" IN THICKNESS.
- COMPACT STRUCTURAL FILL TO A MINIMUM DENSITY OF 95% OF MAXIMUM DRY DENSITY, AS DETERMINED BY ASTM D 1557.
- VERIFY ADEQUACY OF STRUCTURAL FILL COMPACTION WITH RANDOM FIELD DENSITY TESTS.
- COMPACT STRUCTURAL FILL WITHIN 5'-0" OF RETAINING OR BASEMENT WALLS WITH LIGHT-WEIGHT, HAND-HELD EQUIPMENT, EXERCISE CARE TO AVOID DAMAGE TO WALLS.
- CONSULT THE FOUNDATION INVESTIGATION REPORT, AVAILABLE AT THE ARCHITECT'S OFFICE, FOR ADDITIONAL INFORMATION.

FOUNDATIONS

- FOUNDATION SIZES BASED ON AN ALLOWABLE SOIL BEARING PRESSURE OF 1500 PSF DEAD AND LIVE LOADS WITH AN ALLOWABLE ONE-THIRD INCREASE FOR WIND AND SEISMIC.
- FOUNDATION ELEVATIONS SHOWN ARE TO TOP OF FOOTINGS.
- PLACE FORMS ON FIRM UNDISTURBED ORIGINAL SOIL, OR ON STRUCTURAL FILL. SEE STRUCTURAL FILL OR BACK-FILL NOTES FOR STRUCTURAL FILL INFORMATION.
- LOCATE BOTTOM OF FOOTINGS AT A MINIMUM OF 1'-6" BELOW FINAL GRADE
- PRIOR TO PLACEMENT OF CONCRETE REMOVE ALL DISTURBED SOIL FROM FOOTING EXCAVATION TO NEAT LINES.
- STEP BOTTOM OF FOOTINGS FROM ELEVATION TO ELEVATION AT A RATIO OF 1 VERTICAL TO 2 HORIZONTAL, WITH A MAXIMUM VERTICAL STEP OF 2'-0".

CONCRETE REINFORCING STEEL

- REINFORCING STEEL SHALL BE ASTM A 615, GRADE 60.
- WELDED REINFORCEMENT: ASTM A 706, GRADE 60.
- WELDED WIRE FABRIC: ASTM A 185, FLAT SHEETS.
- WELDED METAL INSERTS, CONNECTIONS: AWS D1.4.
- DETAIL, FABRICATE AND PLACE REINFORCING ACCORDING TO ACI 315. DETAILS AND DETAILING OF CONCRETE REINFORCEMENT.
- TYPICAL REINFORCING (MINIMUM, UNLESS NOTED OTHERWISE ON DRAWINGS):
 - A. CORNERS AND INTERSECTIONS OF WALLS AND FOUNDATIONS: CORNER BARS EQUAL IN SIZE AND NUMBER TO HORIZONTAL REINFORCING. LEF LENGTH: 48 BAR DIAMETER (2'-0" MINIMUM).
 - DO NOT FIELD BEND, DISPLACE, WELD, HEAT OR CUT REINFORCING UNLESS INDICATED ON THE DRAWINGS, OR APPROVED BY STRUCTURAL ENGINEER OF RECORD.
 - PLACE ELECTRICAL CONDUIT NEAR CENTER OF ELEVATED SLAB.
 - SPLAY REINFORCING AROUND SLAB OPENINGS WITH 1" IN 10" SPLAY, UNLESS NOTED OTHERWISE.
 - MINIMUM COVER FROM CONCRETE SURFACES TO REINFORCING:
 - 3" ± 1/2" TO BOTTOM OF FOOTING
 - 2" ± 1/2" TO EARTH FACE OF WALL
 - 1" ± 1/2" TO INSIDE FACE OF WALL
 - CENTER OF SLABS-ON-GRADE
 - REINFORCING LAP SPLICES (INCHES): CONFORM WITH ACI 318 "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", AS SHOWN BELOW, UNLESS NOTED OTHERWISE ON DRAWINGS:

BAR SIZE	3000PSI	
	TOP BARS	OTHER BARS
#3	28	22
#4	37	29
#5	47	36
#6	56	46

LAP SPLICE NOTES:

- TOP BARS ARE DEFINED AS HORIZONTAL BARS PLACES SUCH THAT MORE THAN 12" OF CONCRETE IS BELOW THE BARS.
- SPLICE LENGTH BASIS: CLASS B, CASE 1 SPLICE, WITH CENTER-TO-CENTER BAR SPACING OF GREATER THAN 3 BAR DIAMETERS.
- WHEN CENTER-TO-CENTER BAR SPACING IS LESS THAN 3 BAR DIAMETERS, INCREASE SPLICE TO 150% OF TABLE ABOVE.

CAST-IN-PLACE CONCRETE

- ALL CONCRETE MATERIALS, FORM WORK, MIXING, PLACING AND CURING SHALL BE IN ACCORDANCE WITH:
 - A. ACI 301 STANDARD SPECIFICATION FOR STRUCTURAL CONCRETE.
 - B. ACI 305 RECOMMENDED PRACTICE FOR HOT WEATHER CONCRETING AND
 - C. ACI 306 RECOMMENDED PRACTICE FOR COLD WEATHER CONCRETING.
- CONCRETE MIX DESIGN: UNLESS NOTED OTHERWISE, ALL CONCRETE STRENGTH SHALL BE:
 - 3,000 PSI FOR FOOTINGS
 - 3,000 PSI FOR: INTERIOR SLABS-ON-GRADE (MAXIMUM WATER: CEMENT RATIO = 0.42; LARGE AGGREGATE = 1"; WELL GRADED).

NOTES:

- UNLESS NOTED OTHERWISE, CONCRETE STRENGTH SHALL BE OBTAINED AT A MINIMUM OF TWENTY-EIGHT (28) DAYS AFTER PLACING AS DETERMINED BY LABORATORY-CURED CONCRETE CYLINDER TESTS.
- NO WATER SHALL BE ADDED TO THE CONCRETE OTHER THAN THAT REQUIRED BY THE MIX DESIGN APPROVED BY THE ENGINEER OF RECORD. WATER ADDED AFTER INITIAL CONCRETE BATCHING SHALL BE SPECIAL INSPECTED.
- PREPARE MIX DESIGNS FOR EACH TYPE OF CONCRETE BY EITHER LABORATORY TRIAL BATCH OR FIELD EXPERIENCE METHODS AS SPECIFIED IN ACI 301.
- USE PORTLAND CEMENT TYPE I OR II; CONFORM WITH ASTM C 150; SUPPLY FROM ONE (1) SOURCE.
- AGGREGATES SJA.; CPMPFR, WOTJ ASTE, C 33 AMD BE THOROUGHLY CLEANED AND WASHED PRIOR TO USE.
- CONCRETE EXPOSED TO WEATHER SHALL HAVE A 5% + 1% ENTRAINED AIR, BY VOLUME, AND SHALL CONFORM WITH ASTM C 260.
- FOR CONCRETE SLAB-ON-GRADE, USE MAXIMUM WATER/CEMENT RATIO OF 0.40 AND MINIMUM COARSE AGGREGATE SIZE OF 1".
- SLABS-ON GRADE SHALL UTILIZE SUPER PLASTICIZERS.
- USE SHRINKAGE REDUCING ADMIXTURE: ("TETRAQUARD" BY MASTERBUILDERS OR "ECLIPSE" BY W.R. GRACE) AT ONE (1) FALLOON PER CUBIC YARD OF CONCRETE. LIMIT SHRINKAGE TO 0.035% STRAIN AT 28 DAYS. TEST ACCORDING TO ASTM C157. NO AIR ENTRAINMENT.
- CONCRETE MIX PROPORTIONS:
 - A. PROPORTION ACCORDING TO ACI 318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE".
 - B. SUBMIT MIX DESIGNS, WITH COMPLETE STATISTICAL BACKUP, FOR REVIEW.
 - C. SAMPLING AND TESTING OF CONCRETE:
 - A. CONCRETE COMPRESSIVE STRENGTH OF LABORATORY CURED CYLINDERS SHALL BE TESTED AFTER THE SPECIFIED PERIOD AT 28 DAYS OR 56 DAYS AS NOTED.
 - B. SAMPLE, CURE AND TEST CONCRETE BYNDLERS ACCORDING TO APPLICABLE ASTM SPECIFICATIONS.
 - C. ACCEPTANCE OF COMPRESSIVE STRENGTH TEST RESULTS SHALL BE GOVERNED BY ACI 318, CHAPTER 5.
 - D. TEST A MINIMUM OF 3 CONCRETE TEST CYLINDERS FOR EACH 100 CU. YARDS, OR EACH DAY OF POUR, FOR EACH CONCRETE STRENGTH. TEST 1 CYLINDER AT 7 DAYS, 2 CYLINDERS AT 28 DAYS AND 1 CYLINDER AT 56-DAY PERIOD.
 - E. JOINTS:
 - A. CONSTRUCTION JOINTS BETWEEN FOOTINGS AND WALLS, AND WALL CONSTRUCTION JOINTS: ROUGHEN CONTACT AREA TO AN APPROXIMATE 1/4" AMPLITUDE, LEAVING THE CONTACT SURFACE CLEAN AND FREE OF LAITANCE.
 - B. SUBMIT LOCATIONS AND DETAILS OF PROPOSED CONSTRUCTION JOINTS NOT DETAILED ON THE DRAWINGS FOR REVIEW.
 - C. CHAMFER EXPOSED CORNERS 3/4", UNLESS NOTED OTHERWISE.
 - D. MASS CONCRETE CONSTRUCTION (SECTIONS THICKER THAN 3'-0"):
 - A. MIX DESIGN:
 - MAY OBTAIN DESIGN STRENGTH IN 56-DAYS.
 - COARSE AGGREGATE: ANGULAR SHAPED; SMOOTH AND INTERNATIONAL GRADING, WITHOUT GAPS.
 - TEMPERATURE CONTROL AND MONITORING:
 - COOL COARSE AGGREGATE WITH COOL WATER, ICE OR NITROGEN PIPING. ADJUST WATER ADDED AT BATCH PLANT IF ICE IS USED.
 - CONCRETE TEMPERATURE AT TIME OF PLACEMENT: BETWEEN 55 AND 80 DEGREES FAHRENHEIT.
 - INSULATE FORMS WITH WHITE VISQUEEN AND CONCRETE BLANKETS. PROVIDE A TOTAL INSULATION VALUE OF APPROXIMATELY R-2.

ANCHORS IN CONCRETE AND MASONRY

- INSTALL ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
- INSTALL WITH IBC SPECIAL INSPECTION ACCORDING TO SPECIAL INSPECTION PROGRAM.
- EXPANSION ANCHORS (CONCRETE):
 - A. ICC/ICBO-APPROVED; CONFORM WITH FF-S-325, GROUP II, TYPE 4, CLASS 1.
 - B. MATERIAL: ZINC PLATED ACCORDING TO ASTM B 633, HOT-DIPPED GALVANIZED ACCORDING TO ASTM A 153.
 - C. ACCEPTABLE ANCHORS:
 - a. TRUBOLT, BY ITW RAMSET/RED HEAD
 - b. POWER-STUD, BY POWER FASTENING INC.
 - c. "KWIK-BOLT III", BY HILTI FASTENING SYSTEMS, INC
 - d. WEDGE-ALL BY SIMPSON STRONG-TIE COMPANY, INC
 - D. DROP-IN ANCHORS (CONCRETE)
 - A. ICC/ICBO-APPROVED; CONFORM WITH FF-S-325, GROUP VIII, TYPE 1.
 - B. MATERIAL: ZINC PLATED ACCORDING TO ASTM B 633.
 - C. ACCEPTABLE ANCHORS:
 - a. HDI, BY HILTI FASTENING SYSTEMS, INC
 - b. STEEL DROP-IN BY POWERS FASTENING, INC
 - c. MULTI-SET II, BY RAMSET/RED HEAD, INC
 - d. TITEN HD BY SIMPSON STRONG TIE COMPANY, INC
 - D. ADHESIVE ANCHORS (CONCRETE OR GROUTED MASONRY):
 - A. ICC/ICBO-APPROVED
 - B. ANCHOR COMPONENTS: ALL-THREAD ROD, NUT, WASHER AND ADHESIVE INJECTION GEL SYSTEM.
 - C. ANCHOR RODS:
 - a. RODS WITH ROLLED THREADS.
 - b. ANCHOR ROD NUTS: CONFORM WITH ASTM A 194
 - c. ROD MATERIAL:
 - ASTM A 36 MATERIAL, ZINC PLATED ACCORDING TO ASTM B 633, TO ASTM A 153.
 - HOT-DIPPED GALVANIZED ACCORDING TO ASTM A 153.
 - ASTM A 193 GRADE B7 MATERIAL, ZINC PLATED ACCORDING TO ASTM B 633, HOT-DIPPED GALVANIZED ACCORDING TO ASTM A 153.
 - D. ACCEPTABLE ADHESIVE INJECTION GEL SYSTEMS:
 - a. HIT HY-150, BY HILTI FASTENING SYSTEMS, INC.
 - b. SET, BY SIMPSON STRONG-TIE COMPANY, INC.

NON-SHRINK GROUT

- CONFORM WITH ASTM C 1107 AND C.R.D.-621, CORPS OF ENGINEERS "SPECIFICATIONS FOR NON-SHRINK GROUT"
- SPECIFIED 28-DAY COMPRESSIVE STRENGTH: 5,000 PSI.
- DO NOT PRE-GROUT BASE PLATES.

STRUCTURAL STEEL

- FABRICATE, ERECT, IDENTIFY AND PAINT STRUCTURAL STEEL ACCORDING TO AISC SPECIFICATIONS.
- MATERIAL:
 - A. W AND WT SHAPES: ASTM A-36; F_y = 50 KSI
 - B. M, MT, S, ST, HP, C, MC AND L SHAPES: ASTM A 36; F_y = 36 KSI.
 - C. STEEL PIPE: ASTM A 53, GRADE B; F_y = 35 KSI
 - D. STEEL HSS SECTIONS (ROUND, SQUARE, RECTANGULAR):
 - COLD ROLLED: ASTM A 500, GRADE B; F_y = 46 KSI.
 - HOT ROLLED: ASTM A-501
 - GALVANIZED BOLTS (WHERE SHOWN ON DRAWINGS): HOT-DIPPED GALVANIZED ACCORDING TO ASTM A 153, CLASS C.
 - ANCHOR BOLTS:
 - a. ASTM A 307, GRADE A.
 - b. PROVIDE WITH STANDARD WASHERS AND NUTS.
 - c. GALVANIZE BOLTS (WHERE NOTED ON DRAWINGS) ACCORDING TO ASTM A 153, CLASS C. OVER-TAP NUTS TO CLASS 2A FIT BEFORE GALVANIZING, ACCORDING TO ASTM A 563.
 - PROVIDE BEVELED WASHERS AT BOLT HEADS OR NUTS BEARING ON SLOPING SURFACES.
 - WELDING:
 - a. CONFORM WITH AWS SPECIFICATIONS.
 - b. WELDERS TO BE QUALIFIED UNDER AWS SPECIFICATIONS.
 - c. WELDS MATERIAL: 70 SSI FILLER METAL, UNLESS NOTED OTHERWISE. PROVIDE LOW-HYDROGEN FILLER METALS AT MOMENT FRAME WELDS.
 - d. WELDS TO METAL DECK, METAL STUDS OR OTHER COLD-FORMED METALS; CONFORM TO AWS D1.3.
 - e. WELDING OF REINFORCING STEEL: AS NOTED IN "CONCRETE REINFORCING STEEL" PORTION OF STRUCTURAL NOTES.
 - f. WELDS TO GALVANIZED STEEL AND AREAS DAMAGED BY WELDING, FLAME CUTTING OR HANDLING: CLEAN, DRY AND REMOVE OIL, GREASE, SALT AND CORROSIVE PRODUCTS. APPLY ORGANIC COLD GALVANIZING COMPOUND WITH A MINIMUM OF 94% ZINC DUST IN THE DRY FILM. APPLY IN MULTIPLE COATS TO ACHIEVE AN 8 MIL THICKNESS.
 - CONTRACTOR TO DESIGN AND PROVIDE ERECTION AIDS (BOLTS, CLIPS, SHIMS, SEATS, ETC) REQUIRED TO FACILITATE CONSTRUCTION.
 - INSTALL AND INSPECT HEADED STUDS AND SHEAR CONNECTORS ACCORDING TO CHAPTER 7 OF AWS D1.1 "STRUCTURAL WELDING CODE-STEEL".
 - EMBEDDED STEEL ASSEMBLIES: HOT-DIP GALVANIZE ACCORDING TO ASTM A 123, WHERE NOTED ON DRAWINGS.
 - SEISMIC BRACING FOR PIPES CONTRACTOR TO PROVIDE SEISMIC BRACING FOR PIPERUNS THROUGHOUT THE PROJECT, WITH PLANS AND CALCS BY STATE OF OREGON LICENCED STRUCTURAL ENGINEER.

COLD-FORMED STEEL CONNECTIONS

- ALL PLATES AND LEDGERS SHALL BE ANCHORED WITH A MINIMUM OF THREE (3) ANCHORS PER PIECE.
- ALL SCREWS TO BE #10 SELF-DRILLING SHEET METAL (SDSM) SCREWS.

SPECIAL INSPECTION PROGRAM

TYPES OF WORK	CONTINUOUS	PERIODIC	COMMENTS
GRADING, EXCAVATION & FILL			REF. PROJECT SPECS
CONCRETE			
PLACEMENT OF REINFORCING STEEL			
BOLTS CAST IN CONCRETE			
PLACING OF REINFORCED CONCRETE			
MAKING OF TEST SPECIMENS			
STRUCTURAL WELDING			
SINGLE PASS FILLET WELDS NOT EXCEEDING 3/8"			
FILLET WELDS EXCEEDING 3/8"			
GROOVE WELDS (FULL OR PARTIAL PEN.)			
WELDED STUDS			
WELDED COLD FORMED FRAMING			
COLD FORMED STEEL FRAMING			
VERIFY MEMBER SIZES, CONNECTIONS & DEFLECTION HEADS			PER ICC/IBCO EVAL REPORT
ADHESIVE ANCHOR INSTALLATION			PER ICC/IBCO EVAL REPORT
EXPANSION BOLT INSTALLATION			

SPECIAL INSPECTION PROGRAM FOOTNOTES:

- PROVIDE SPECIAL INSPECTION, SPECIAL TESTING, REPORTING AND COMPLIANCE PROCEDURES ACCORDING TO CHAPTER 17 OF THE INTERNATIONAL BUILDING CODE WITH THE 2007 OREGON STRUCTURAL SPECIALTY CODE.
- SPECIAL INSPECTOR QUALIFICATIONS: DEMONSTRATE COMPETENCE, TO THE SATISFACTION OF THE BUILDING OFFICIAL, FOR INSPECTION OF THE PARTICULAR TYPE OF CONSTRUCTION OR OPERATION IN QUESTION.
- PRIOR TO THE BEGINNING OF CONSTRUCTION, REVIEW THE SPECIAL INSPECTION REQUIREMENTS WITH THE ARCHITECT, ENGINEER, BUILDING OFFICIAL, GENERAL CONTRACTOR AND SPECIAL INSPECTORS.
- DUTIES OF THE SPECIAL INSPECTOR INCLUDE, BUT ARE NOT LIMITED TO:
 - A. OBSERVE THE WORK FOR CONFORMANCE WITH THE APPROVED PERMIT DRAWINGS AND SPECIFICATIONS. BRING DISCREPANCIES TO THE IMMEDIATE ATTENTION OF THE GENERAL CONTRACTOR FOR CORRECTION, THEN, IF UNCORRECTED, TO THE ENGINEER AND TO THE BUILDING OFFICIAL.
 - B. FURNISH INSPECTION REPORTS FOR EACH INSPECTION TO THE BUILDING OFFICIAL, ARCHITECT, ENGINEER, GENERAL CONTRACTOR AND OWNER IN A TIMELY MANNER.
 - C. SUBMIT A FINAL REPORT STATING WHETHER THE WORK REQUIRING SPECIAL INSPECTION WAS INSPECTED, AND WHETHER THE WORK IS IN CONFORMANCE WITH THE APPROVED PERMIT DRAWINGS AND SPECIFICATIONS.
 - D. DUTIES OF THE GENERAL CONTRACTOR INCLUDE, BUT ARE NOT LIMITED TO:
 - A. NOTIFY SPECIAL INSPECTOR THAT WORK IS READY FOR INSPECTION AT LEAST 24 HOURS BEFORE INSPECTION IS REQUIRED.
 - B. MAINTAIN ACCESS TO WORK REQUIRING SPECIAL INSPECTION UNTIL IT HAS BEEN OBSERVED AND INDICATED TO BE IN CONFORMANCE BY THE SPECIAL INSPECTOR AND APPROVED BY THE BUILDING OFFICIAL.
 - C. PROVIDE THE SPECIAL INSPECTOR WITH ACCESS TO APPROVED PERMIT DRAWINGS AND SPECIFICATIONS AT THE JOB SITE.
 - D. MAINTAIN JOB-SITE COPIES OF ALL REPORTS SUBMITTED BY THE SPECIAL INSPECTOR.
- DEFINITIONS:
 - A. CONTINUOUS INSPECTION: THE INSPECTOR IS OBSERVING THE WORK REQUIRING SPECIAL INSPECTION AT ALL TIMES.
 - B. PERIODIC INSPECTION: THE SPECIAL INSPECTOR IS ON SITE AS REQUIRED TO CONFIRM THAT THE WORK REQUIRING SPECIAL INSPECTION IS IN CONFORMANCE.

SPECIAL TESTING REQUIREMENTS

- STRUCTURAL FILL OR BACK-FILL: VERIFY COMPACTION WITH RANDOM FIELD DENSITY TESTS.
- STRUCTURAL CONCRETE: SAMPLE AND TEST ACCORDING TO STRUCTURAL NOTES.
- STRUCTURAL STEEL:
 - A. NON-DSTRUCTIVE METHOD TESTING: CONFORM WITH AWS D1.1 SECTION 4, AND AWS D1.1, ANNEX K.
 - B. BASE METAL THICKER THAN 1.5" SUBJECTED TO THROUGH-THICKNESS WELD SHRINKAGE STRAINS: AFTER COMPLETION OF WELDS, ULTRASONICALLY TEST FOR DISCONTINUITIES HEHIND AND ADJACENT TO WELDS. ACCEPTANCE OR REJECTION OF MATERIAL DISCONTINUITIES WILL BE BASED ON THE DEFECT RATING ACCORDING TO THE (LARGER REFLECTOR) CRITERIA OF APPROVED NATIONAL STANDARDS, WITH CONCURRENCE OF THE STRUCTURAL ENGINEER OF RECORD.

STRUCTURAL OBSERVATION

STRUCTURAL OBSERVATION, IN ACCORDANCE WITH SECTION 1709 OF THE INTERNATIONAL BUILDING CODE, SHALL BE PERFORMED BY THE ENGINEER OF RECORD, IN THE FOLLOWING SEQUENCE. THE GENERAL CONTRACTOR SHALL CONTACT THE STRUCTURAL ENGINEER OF RECORD, FIVE (5) WORKING DAYS PRIOR TO COMPLETION OF THE STAGE INDICATED BELOW TO COORDINATE THE DATE OF OBSERVATION:

- FOUNDATIONS: PRIOR TO FIRST CONCRETE POUR
- STEEL FRAMING: AFTER THE ROOF FRAMING HAS BEEN ERECTED

FIBER REINFORCED POLYMER STRENGTHENING SYSTEM

MEET THE FOLLOWING CRITERIA

- ICC AC125 (2003)
- ICC AC178 (2001)
- AMERICAN CONCRETE INSTITUTE (ACI) ACI 440.2R-02

PERFORMANCE

- DESIGN THE COMPOSITE SYSTEM, ICC ES AC 125 DESIGN CRITERIA, TO ACHIEVE THE STRUCTURAL PERFORMANCE SHOWN ON THE STRUCTURAL DRAWINGS. DESIGN CALCULATIONS FOR THE COMPOSITE SYSTEM SHALL BE SUBMITTED FOR APPROVAL BY THE ENGINEER OF RECORD, AND SHALL BE STAMPED BY A REGISTERED CIVIL ENGINEER.

PRODUCTS

- MANUFACTURERS:**
- FYFE CO. LLC
NANCY RIDGE TECHNOLOGY CENTER, 6310 NANCY RIDGE DRIVE, SUITE 103, SAN DIEGO, CA, 92121. TEL: 858-642-0694, FAX: 858-642-0947, EMAIL: INFO@FYFECO.COM

COMPOSITE STRENGTHENING SYSTEM:

- COMPOSITE FABRIC: SCH FIBER - PRIMARY CARBON FIBER UNIDIRECTIONAL SCH FIBER - PRIMARY GLASS FIBER UNIDIRECTIONAL
- EPOXY SATURANT: TYFO S EPOXY TO BE COMBINED WITH THE FIBER TO FORM THE TYFO FIBER WRAP COMPOSITE.
- PRIMER/FILLER: TYFO WS THICKENED EPOXY FOR PROTECTIVE SEAL COAT, FILLING VOIDS AND PRIMER WHERE NEEDED.
- ANCHORAGE: SYSTEM COMPATIBLE ANCHORS SHALL BE PROVIDED AS DETAILED ON SUBMITTED CONSTRUCTION DRAWINGS.
- FINISH: TYFO A, TYFO U, TYFO HS, OR TYFO G PAINT TO BE COLOR MATCHED BY ARCHITECT. ALTERNATE FINISHES MUST BE APPROVED BY THE SYSTEM MANUFACTURER.

WALLS/DIAPHRAGMS/SLABS/BEAMS

- SURFACES SHALL BE PREPARED FOR BONDING BY MEANS OF ABRASIVE BLASTING OR GRINDING TO ACHIEVE A 1/8" MINIMUM AMPLITUDE. ALL CONTACT SURFACES SHALL BE CLEANED BY HAND OR COMPRESSED AIR. ONE PRIME COAT OF THE MANUFACTURER'S EPOXY SHALL BE APPLIED AND ALLOWED TO CURE FOR A MINIMUM OF ONE HOUR. PRIOR TO THE APPLICATION OF THE SATURATED COMPOSITE FABRIC, FILL ANY UNEVEN SURFACES WITH THE MANUFACTURER'S THICKENED EPOXY. PROVIDE ANCHORAGE AS DETAILED ON CONSTRUCTION DRAWINGS.
- ROUND OFF SHARP AND CHAMFERED CORNERS TO A RADIUS OF 1 INCH (±0.25")
- BOND CRITICAL SURFACE PREPARATION TECHNIQUES CAN BE VERIFIED BY MEANS OF ADHESION TESTING AS PER ASTM D4541.

APPROVED APPLICATOR:

CONTECH SERVICES, INC.
ATTN: DON ELLSWORTH
6917 NE 39TH COURT
VANCOUVER, WA 98661
503-223-9817

AMBIENT AND CONCRETE TEMPERATURES TO BE WITHIN 40°F AND 100°F

INSTALLATION PROCEDURES:

- FOLLOW MANUFACTURER'S INSTALLATION PROCEDURES

INSPECTION:

- THE COMPOSITE CASING SHALL BE COMPLETELY INSPECTED BY THE SPECIAL INSPECTOR DURING AND IMMEDIATELY FOLLOWING APPLICATION FO THE COMPOSITE

LABORATORY TESTING:

- SAMPLES SHALL BE TESTED PER ASTM D3039

DRAWING LIST

- S1.0 STRUCTURAL SPECIFICATIONS
- S1.1 PEDESTRIAN BRIDGE PIPE ENCLOSURES
- S1.2 PEDESTRIAN BRIDGE PIPE ENCLOSURES
- S1.3 EQUIPMENT SUPPORTS AND FOUNDATIONS

1	06/29/06	ISSUED FOR CONSTRUCTION
0	05/29/06	ISSUED FOR BID & PERMIT
no	date	by
		revisions

SJO
CONSULTING ENGINEERS
15575 SW SEQUOIA PKWY, SUITE 140
PORTLAND, OR 97224
PH: 503-254-8400 FAX: 503-254-9100

PROJECT: PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

dwg. title

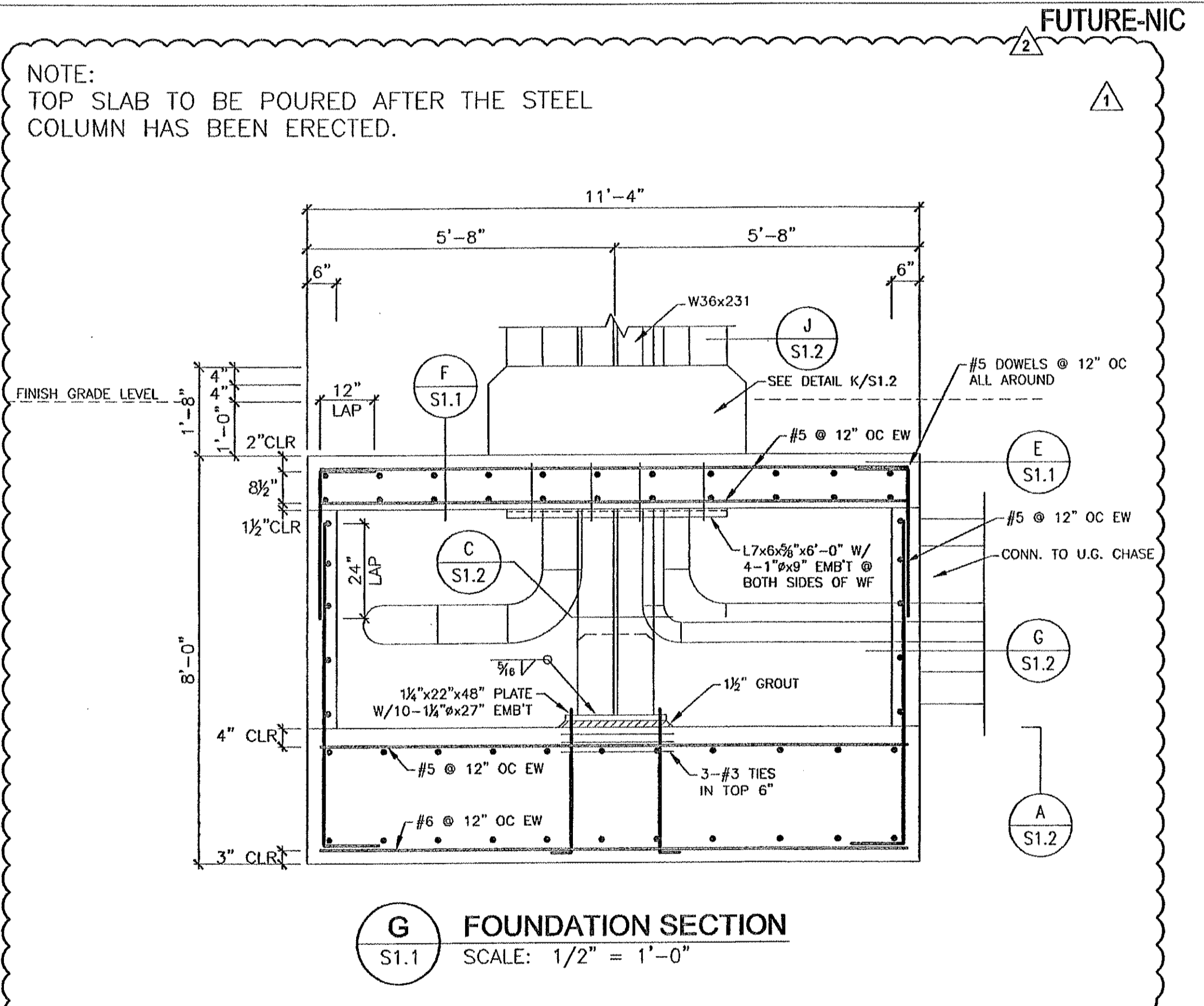
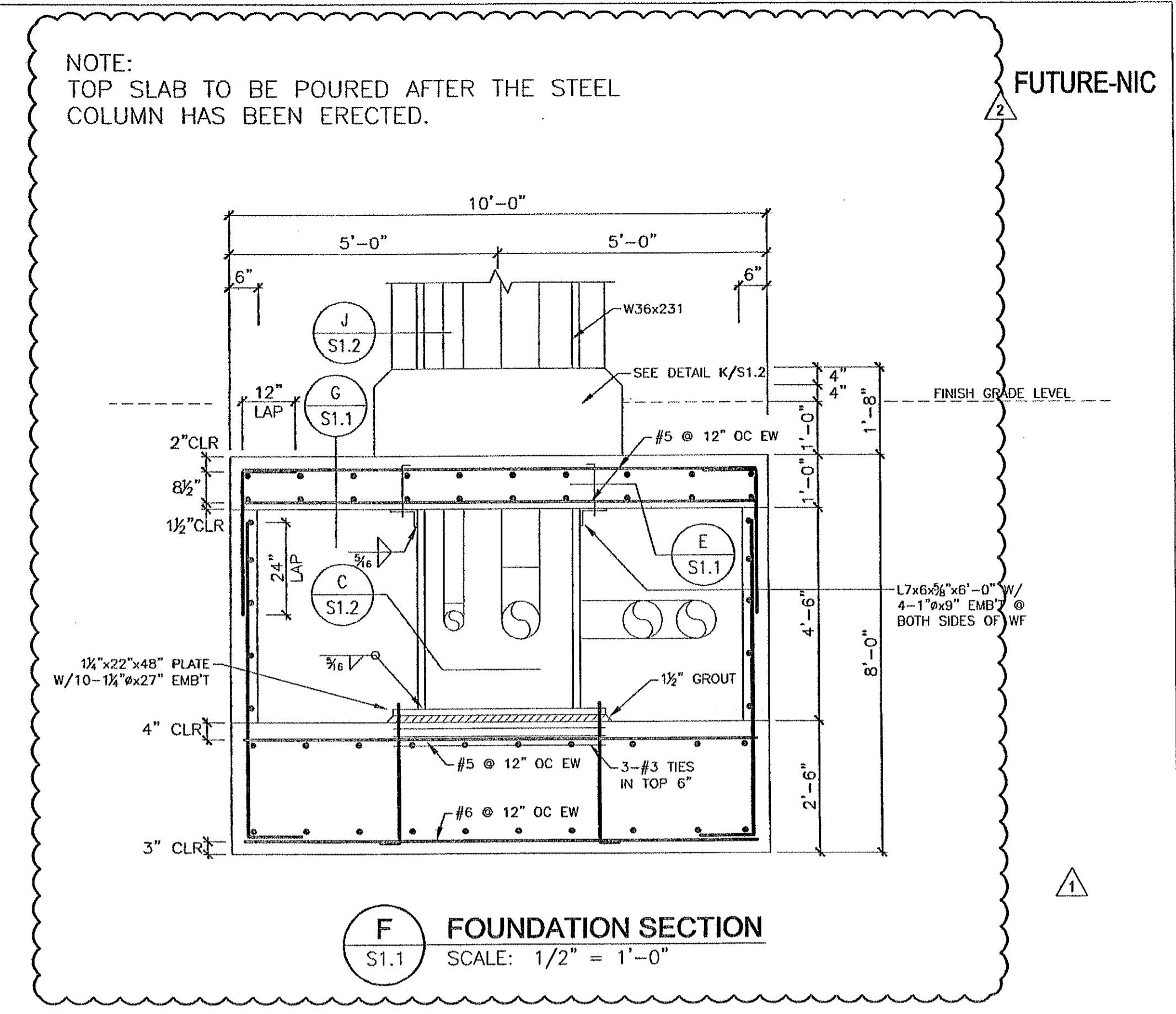
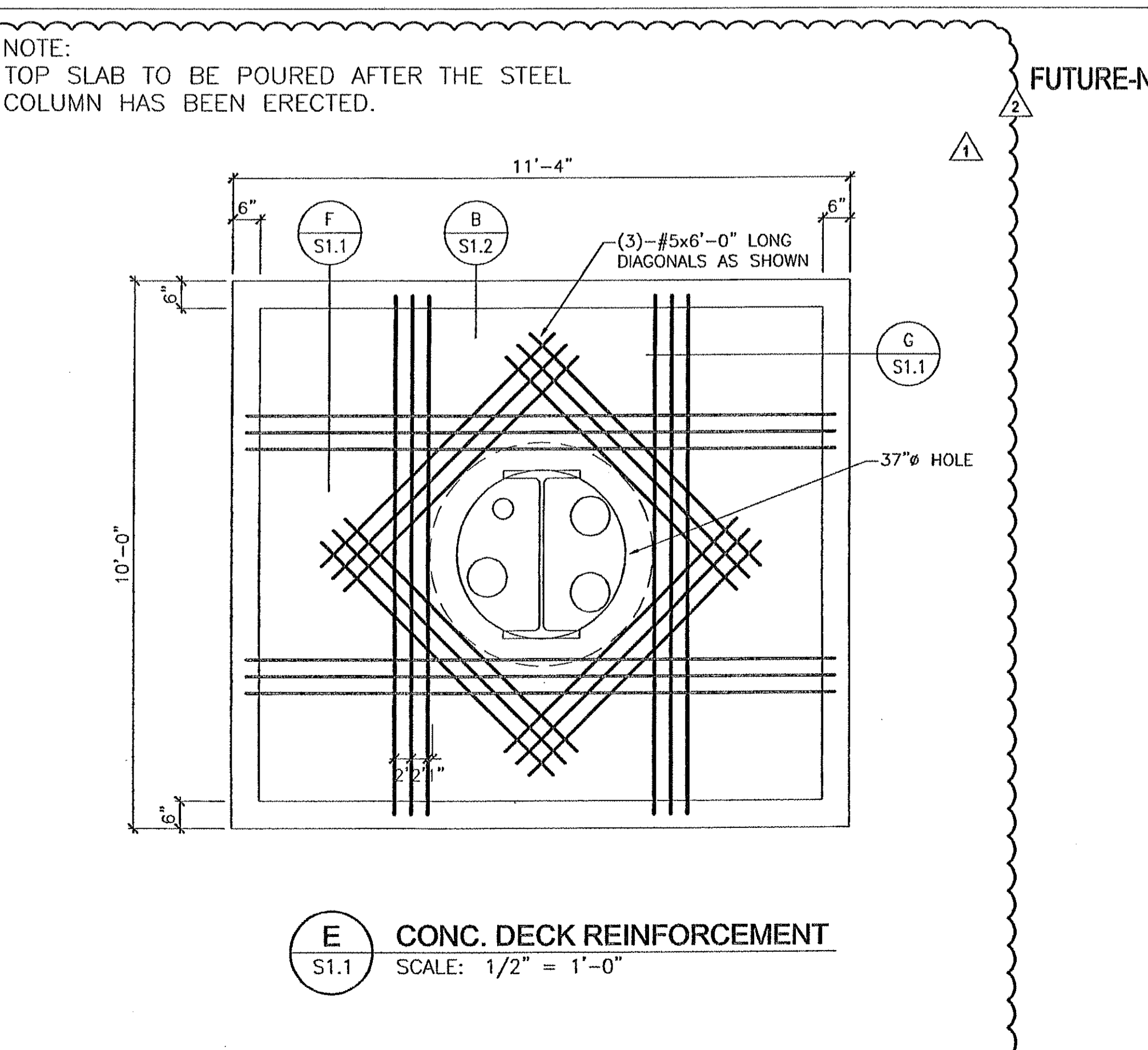
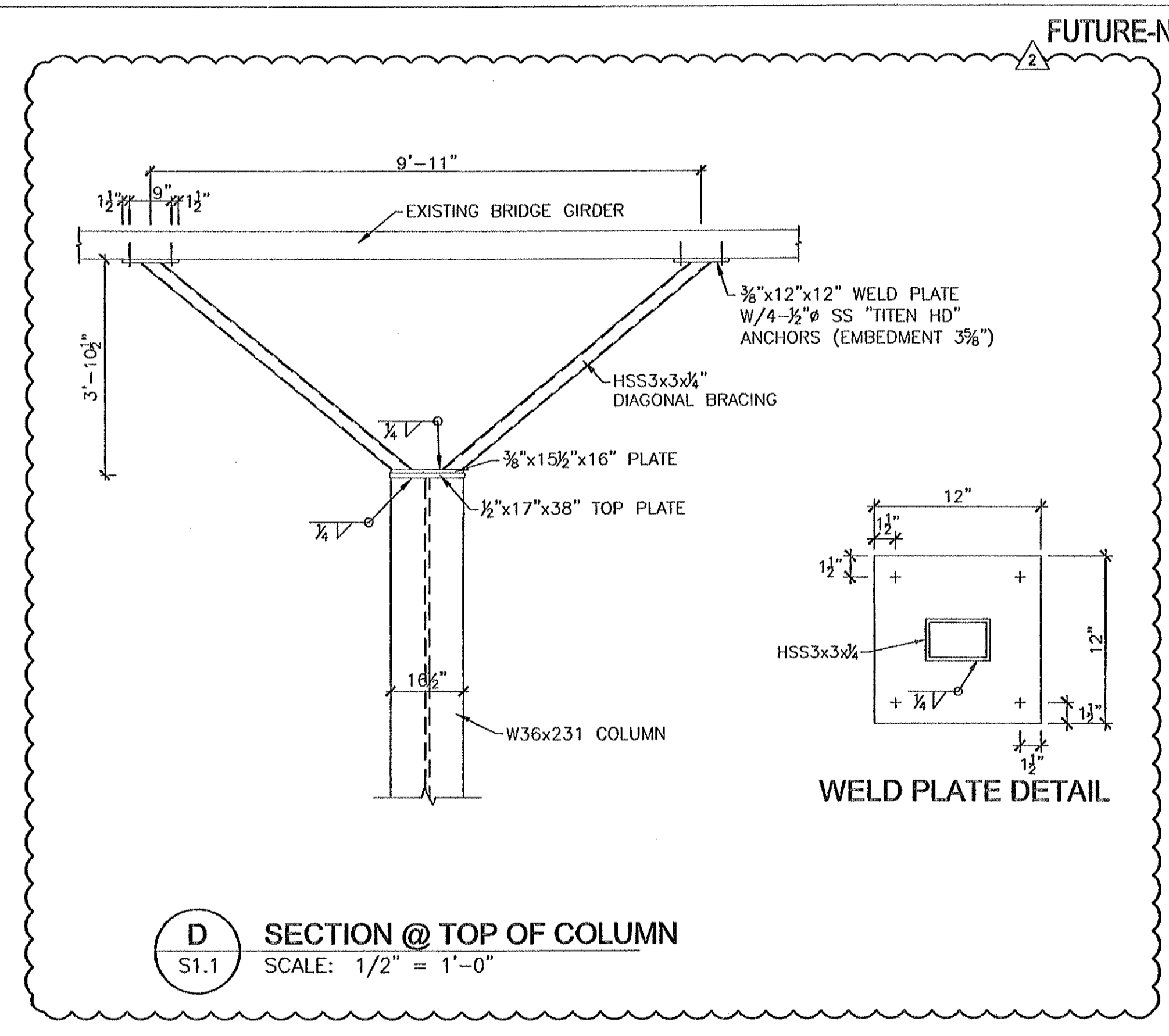
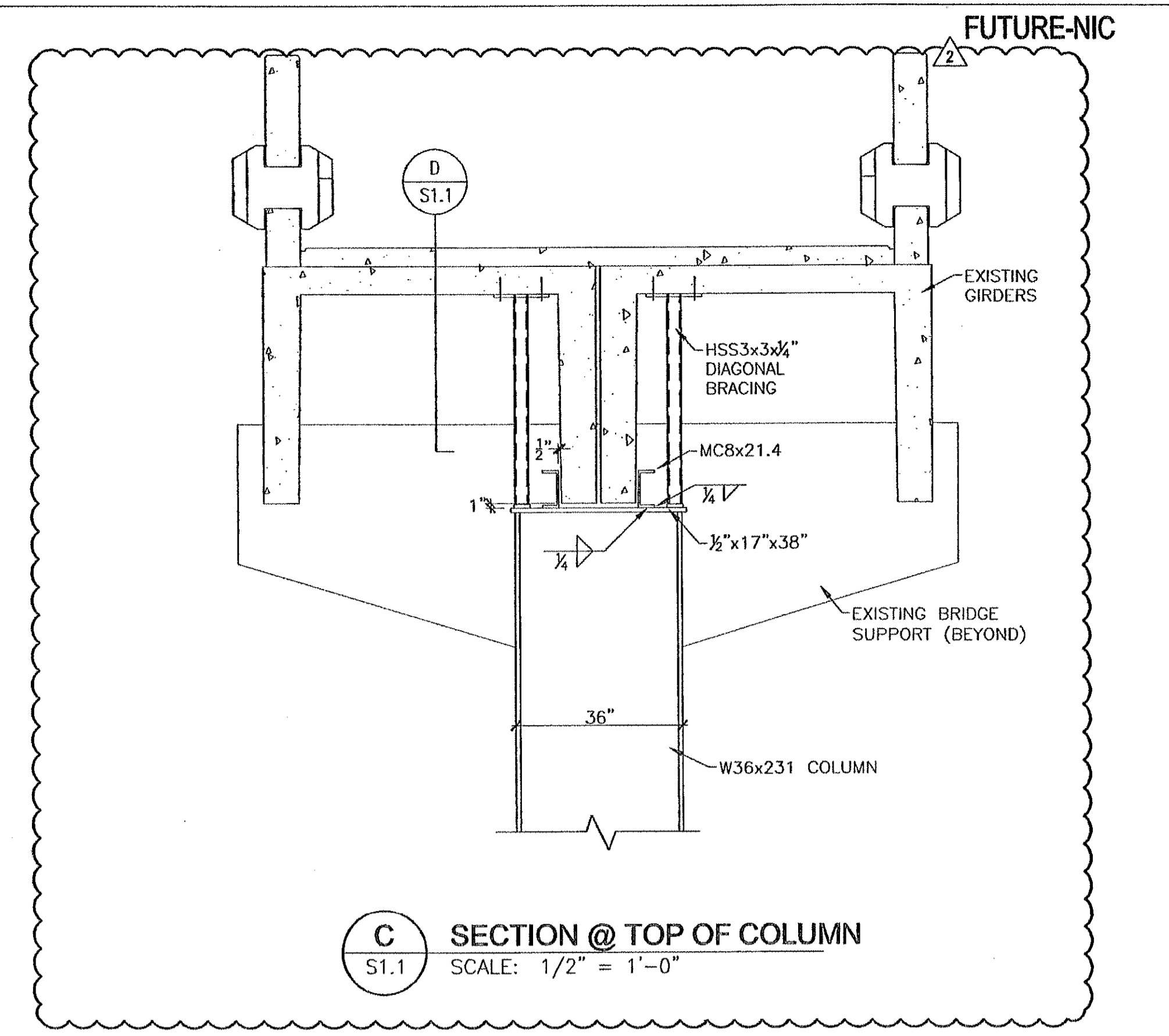
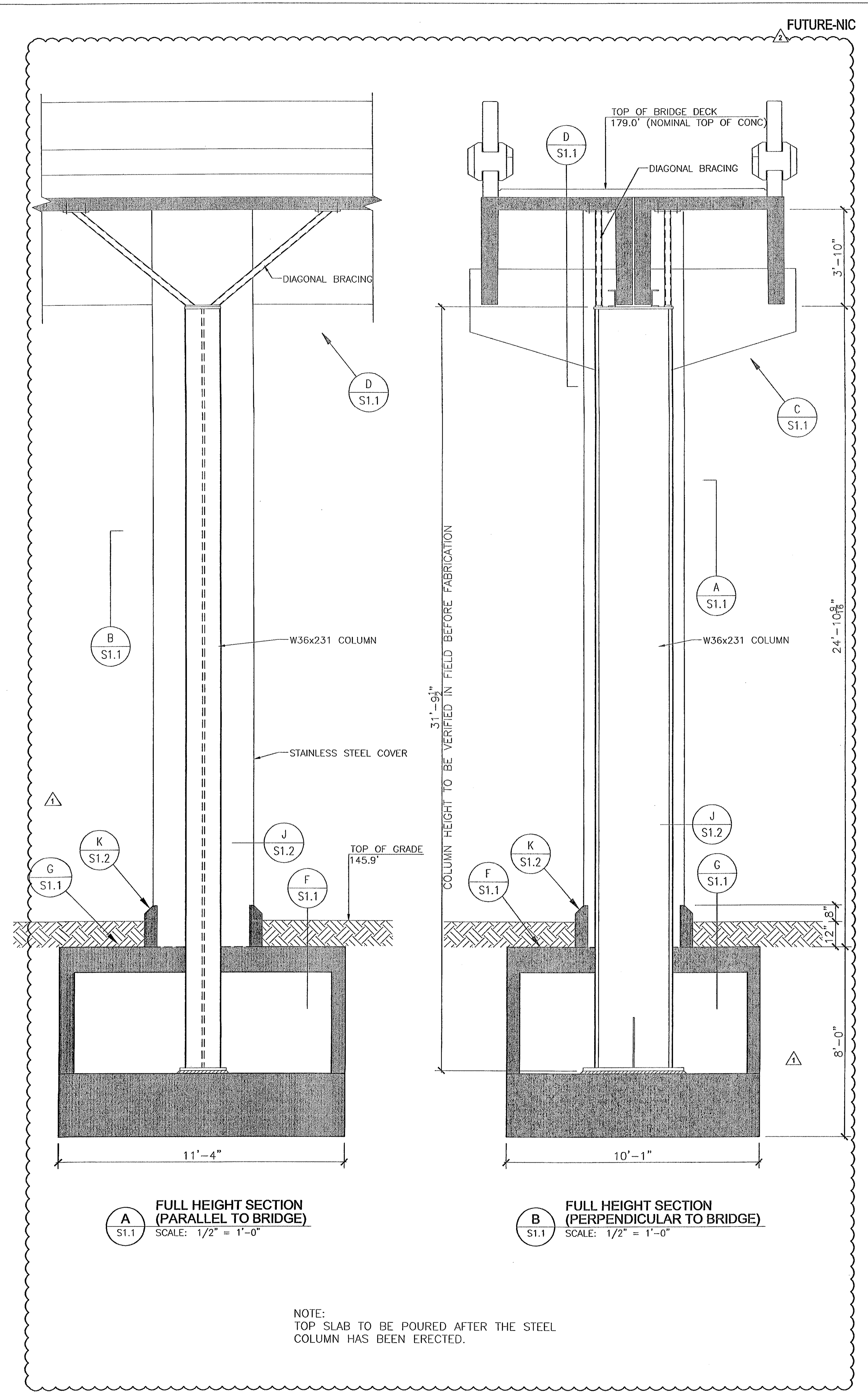
STRUCTURAL NOTES
E. RB. 08.

designed	date
drawn	05-13-08
approved	date
08	05-13-08
project no.	10009-02001
drawing no.	

PROGRESSIVE CONSULTANTS, INC.
8100 NE PARKWAY DRIVE, SUITE #40
VANCOUVER, WA 98662
(360) 254-8400 FAX (360) 254-3334

EXPIRES: 6-06-2009

S1.0



2	06/29/08	ISSUED FOR CONSTRUCTION
1	07/10/08	BID CLARIFICATION FOR PERMIT SET
0	05/23/08	ISSUED FOR BID & PERMIT
no	date	by
		revisions

SJO
CONSULTING ENGINEERS
15575 SW HECOMIA HWY., SUITE 140
PORTLAND, OR 97224
PHONE: 503-228-9121 FAX: 503-228-9128

PROJECT: PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

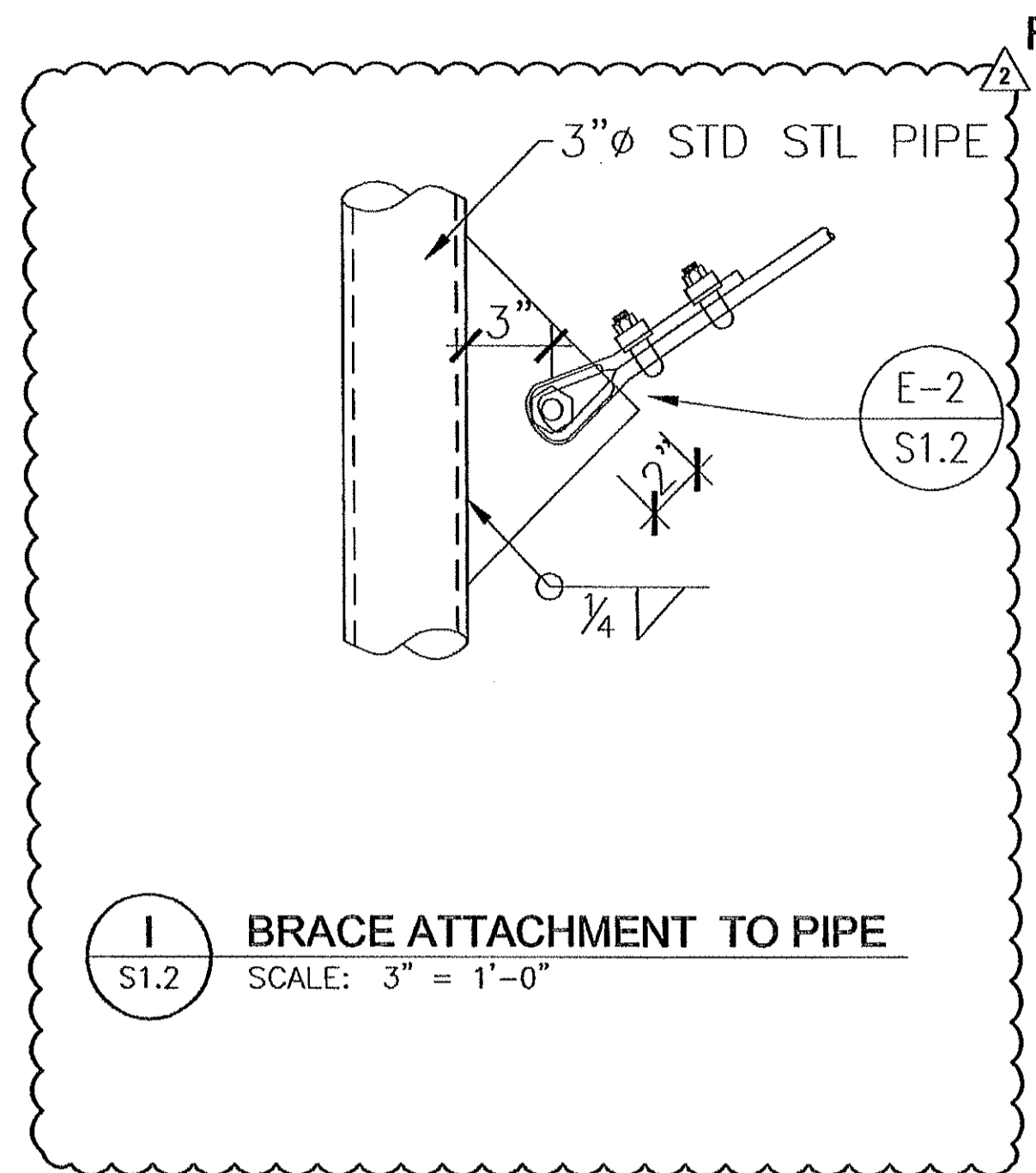
dwg. title: PIPE RISER SUPPORT COLUMN

designed	date
drawn	date
approved	date
project no.	date
drawing no.	

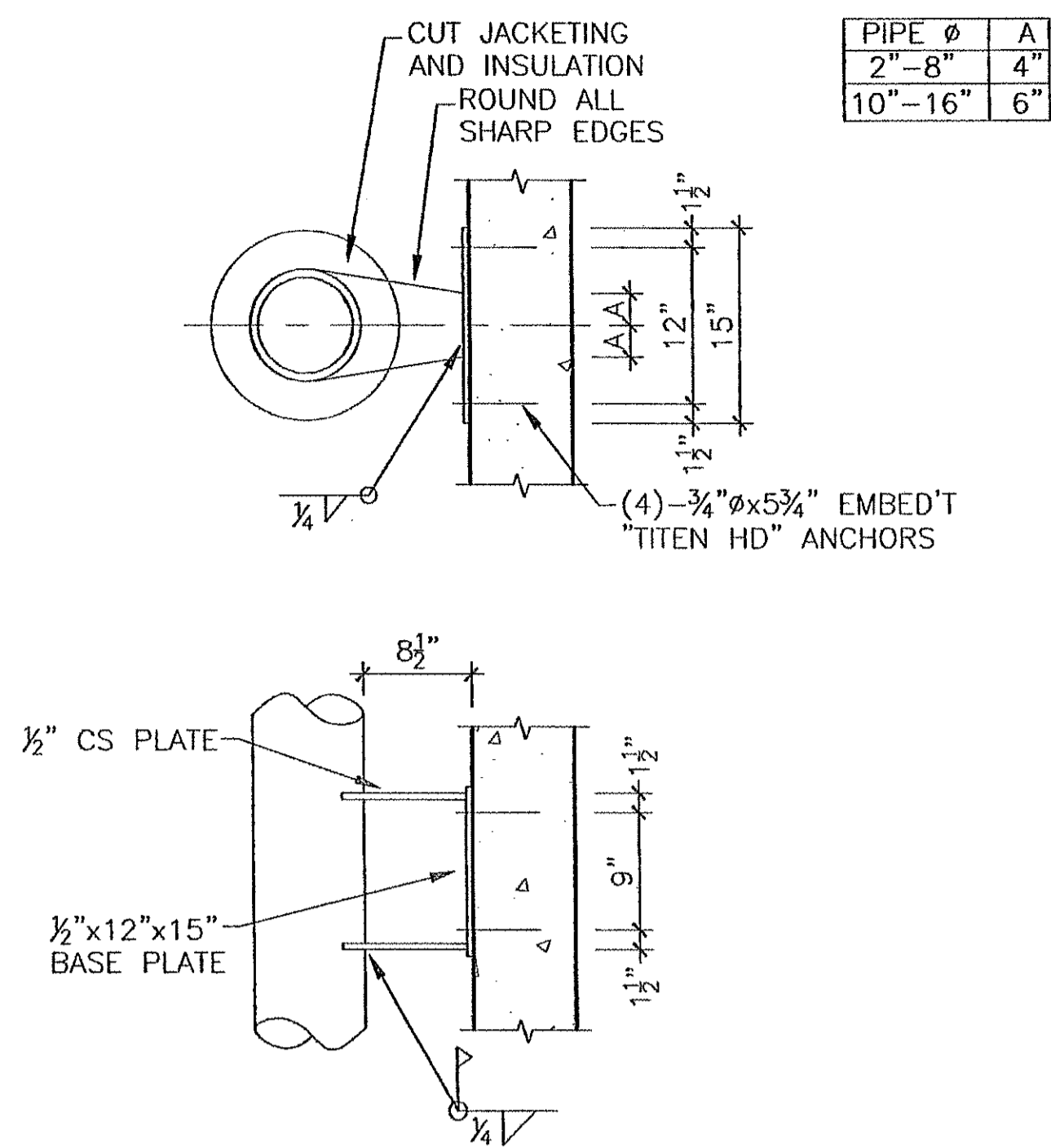
PROGRESSIVE CONSULTANTS, INC.
8100 NE PARWAY DRIVE, SUITE #40
VANCOUVER, WA 98662
(360) 254-8400 FAX (360) 254-3334

EXP: 08-09-09

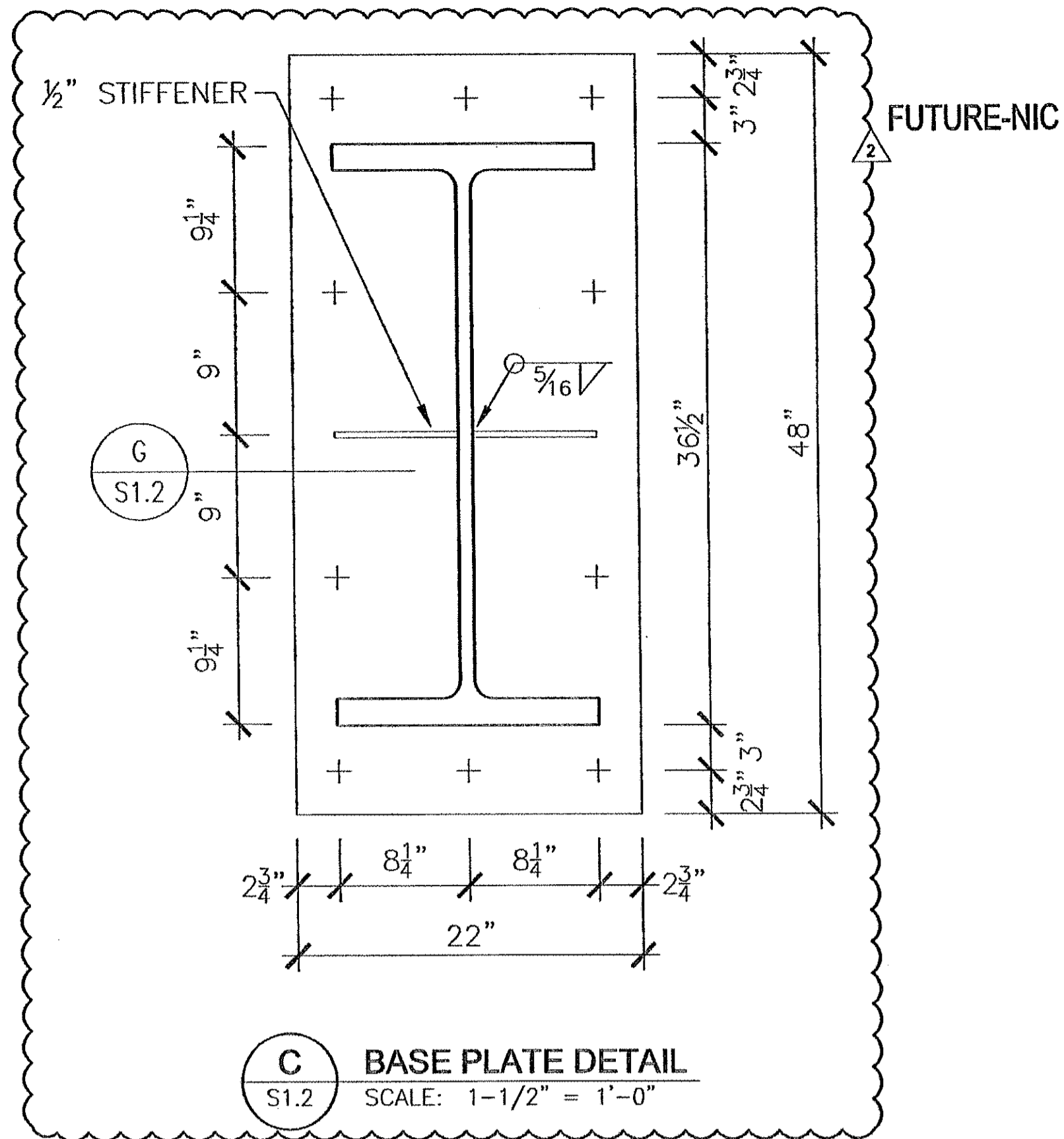
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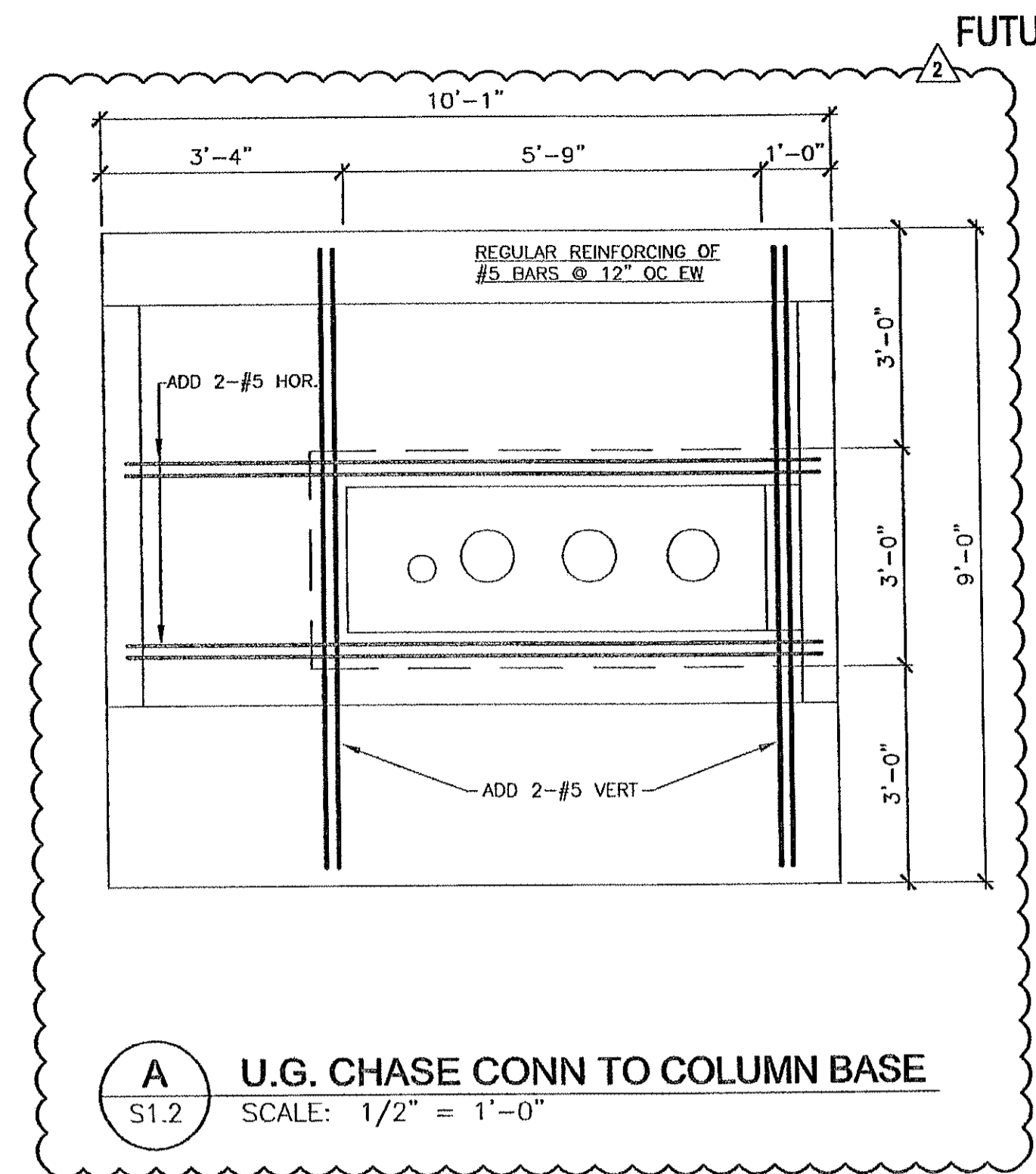
I BRACE ATTACHMENT TO PIPE
S1.2 SCALE: 3" = 1'-0"



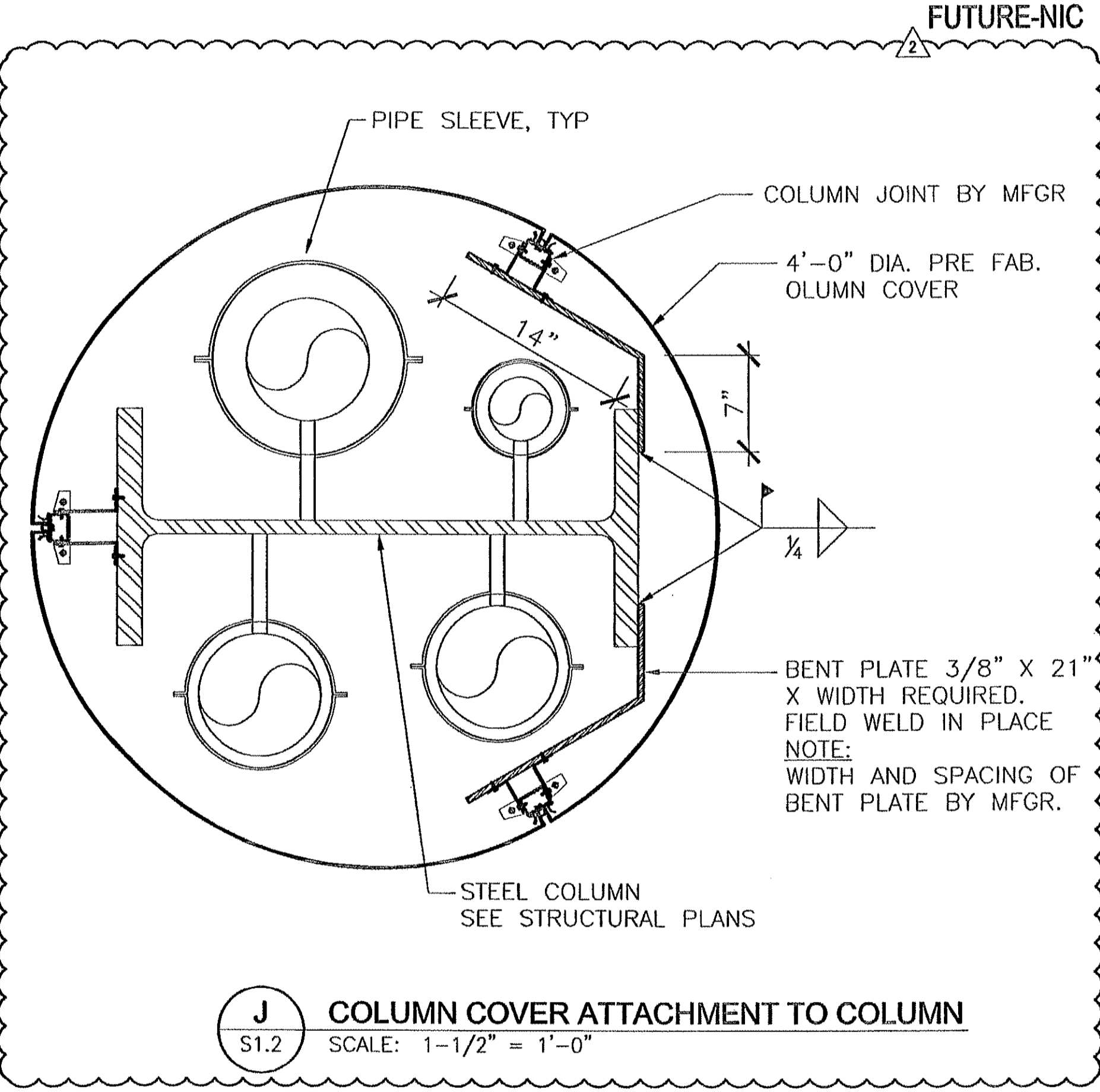
F PIPE SUPPORT DETAIL
S1.2 SCALE: 1" = 1'-0"



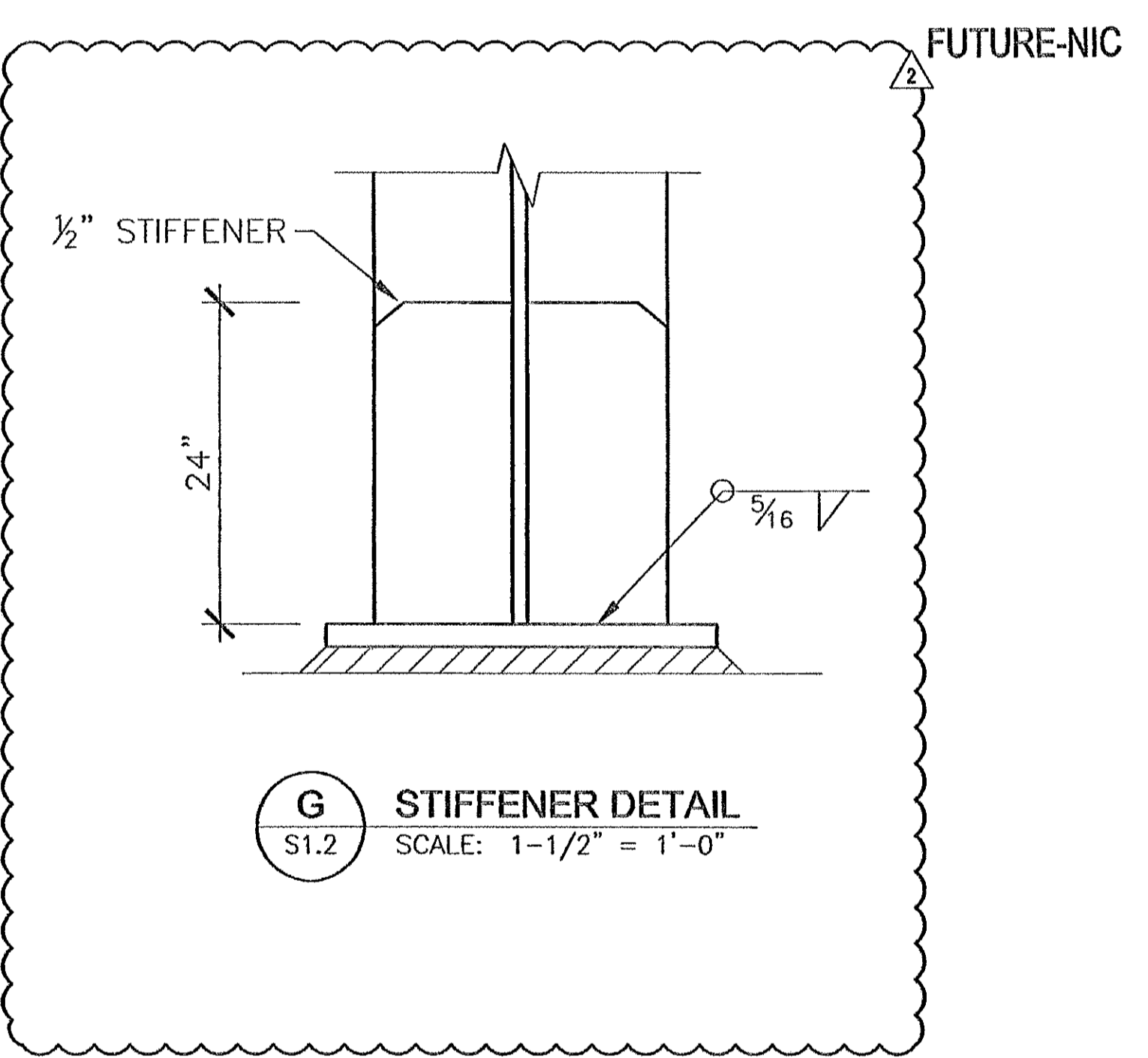
C BASE PLATE DETAIL
S1.2 SCALE: 1-1/2" = 1'-0"



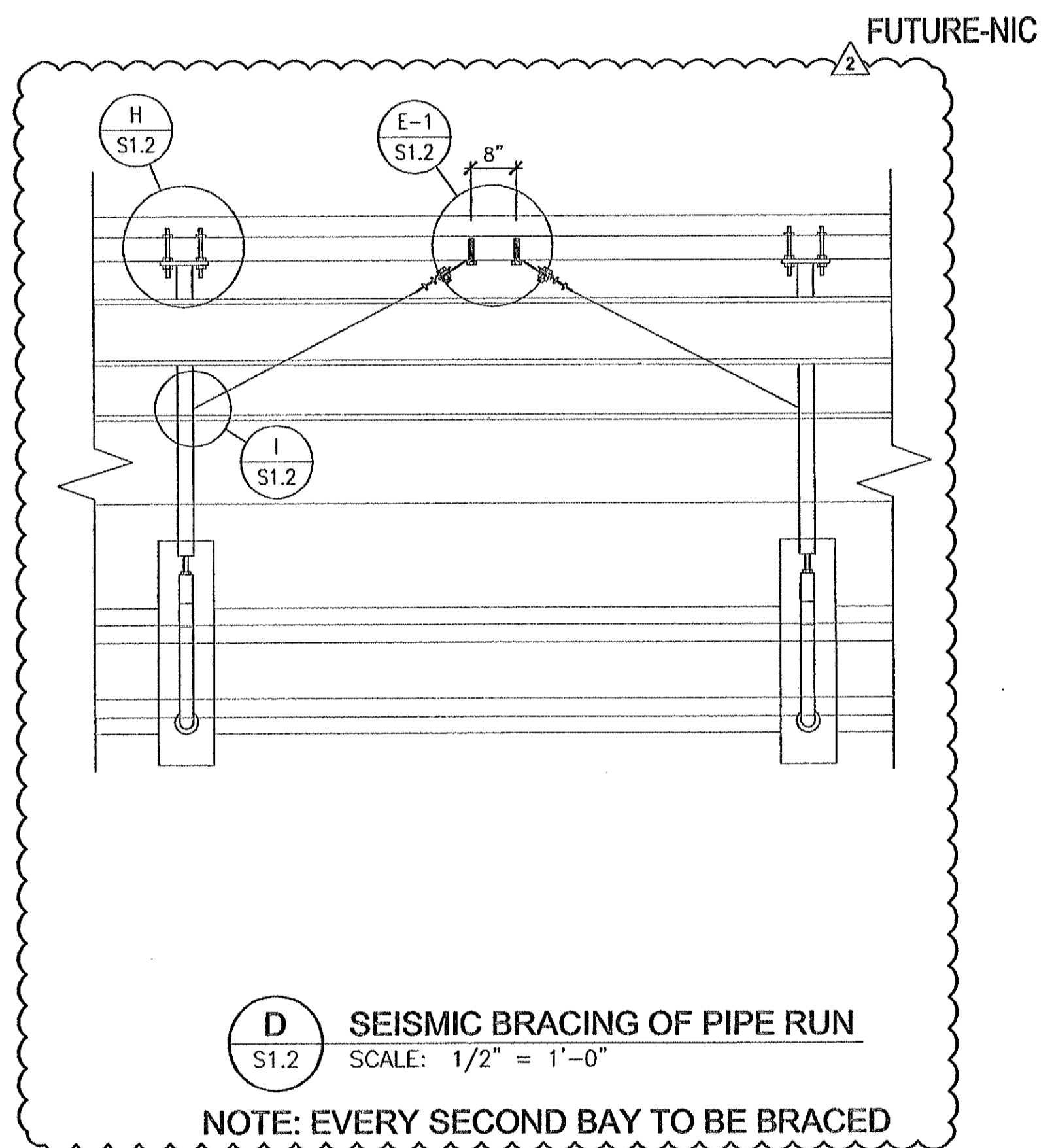
A U.G. CHASE CONN TO COLUMN BASE
S1.2 SCALE: 1/2" = 1'-0"



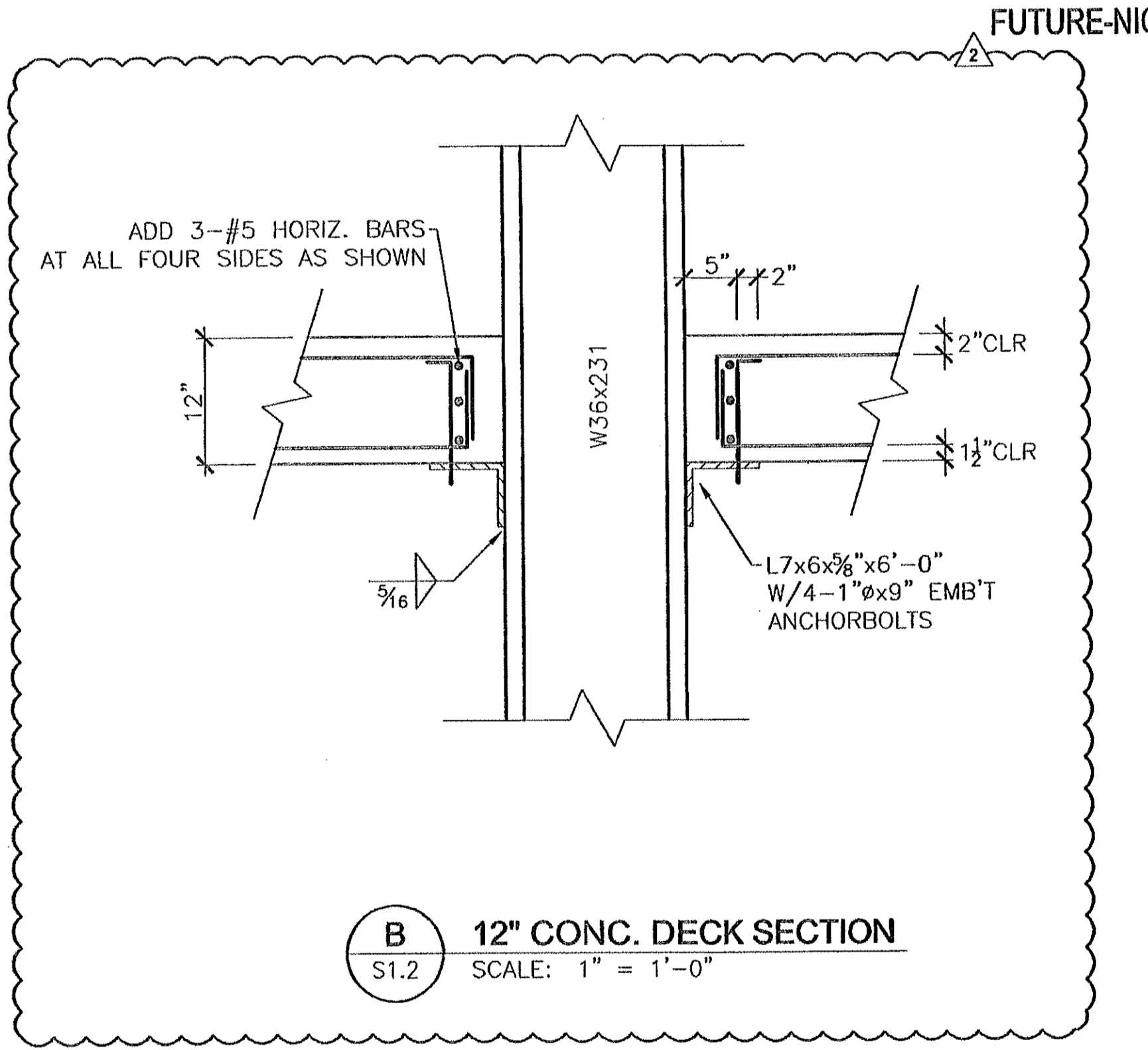
J COLUMN COVER ATTACHMENT TO COLUMN
S1.2 SCALE: 1-1/2" = 1'-0"



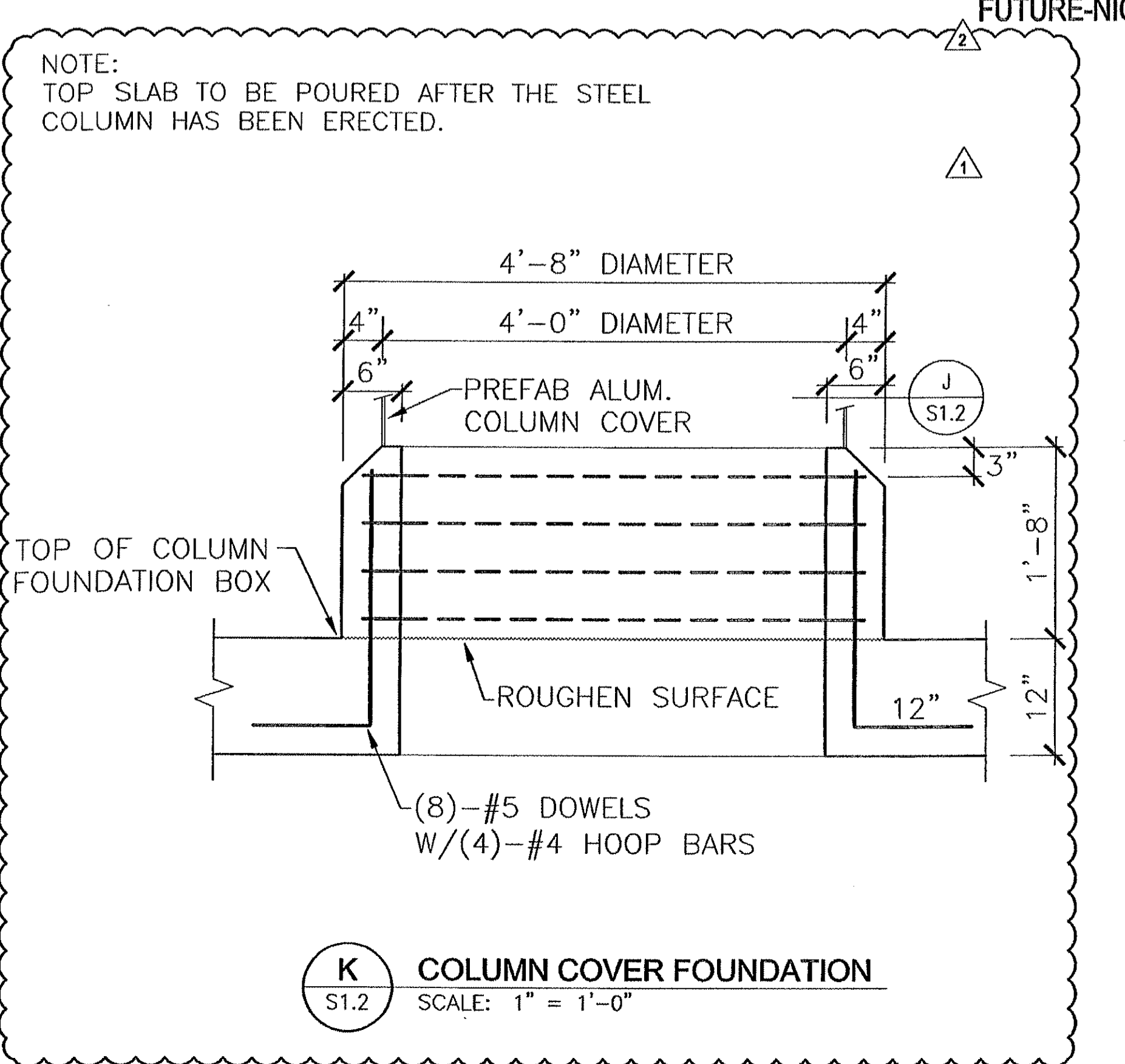
G STIFFENER DETAIL
S1.2 SCALE: 1-1/2" = 1'-0"



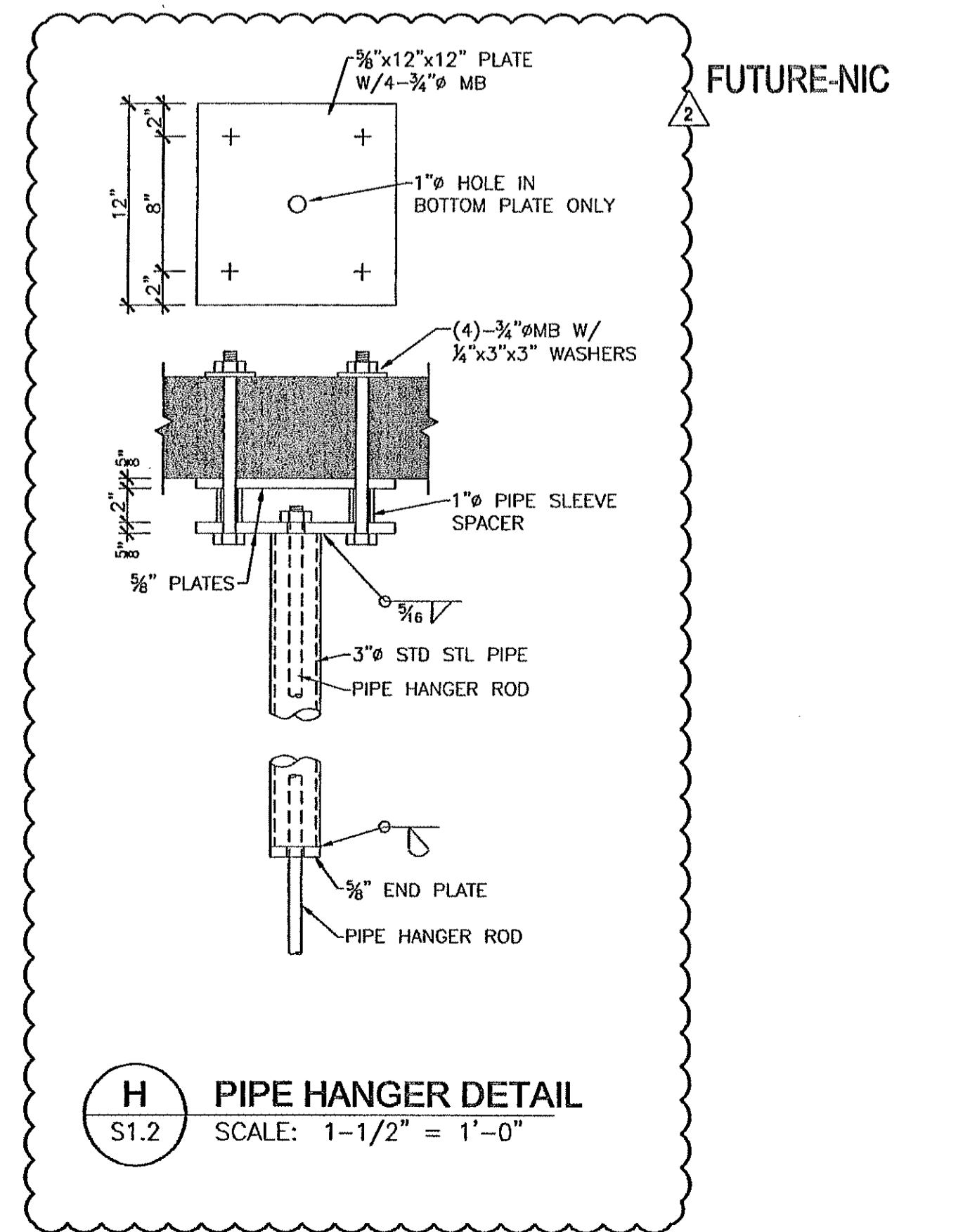
D SEISMIC BRACING OF PIPE RUN
S1.2 SCALE: 1/2" = 1'-0"
NOTE: EVERY SECOND BAY TO BE BRACED



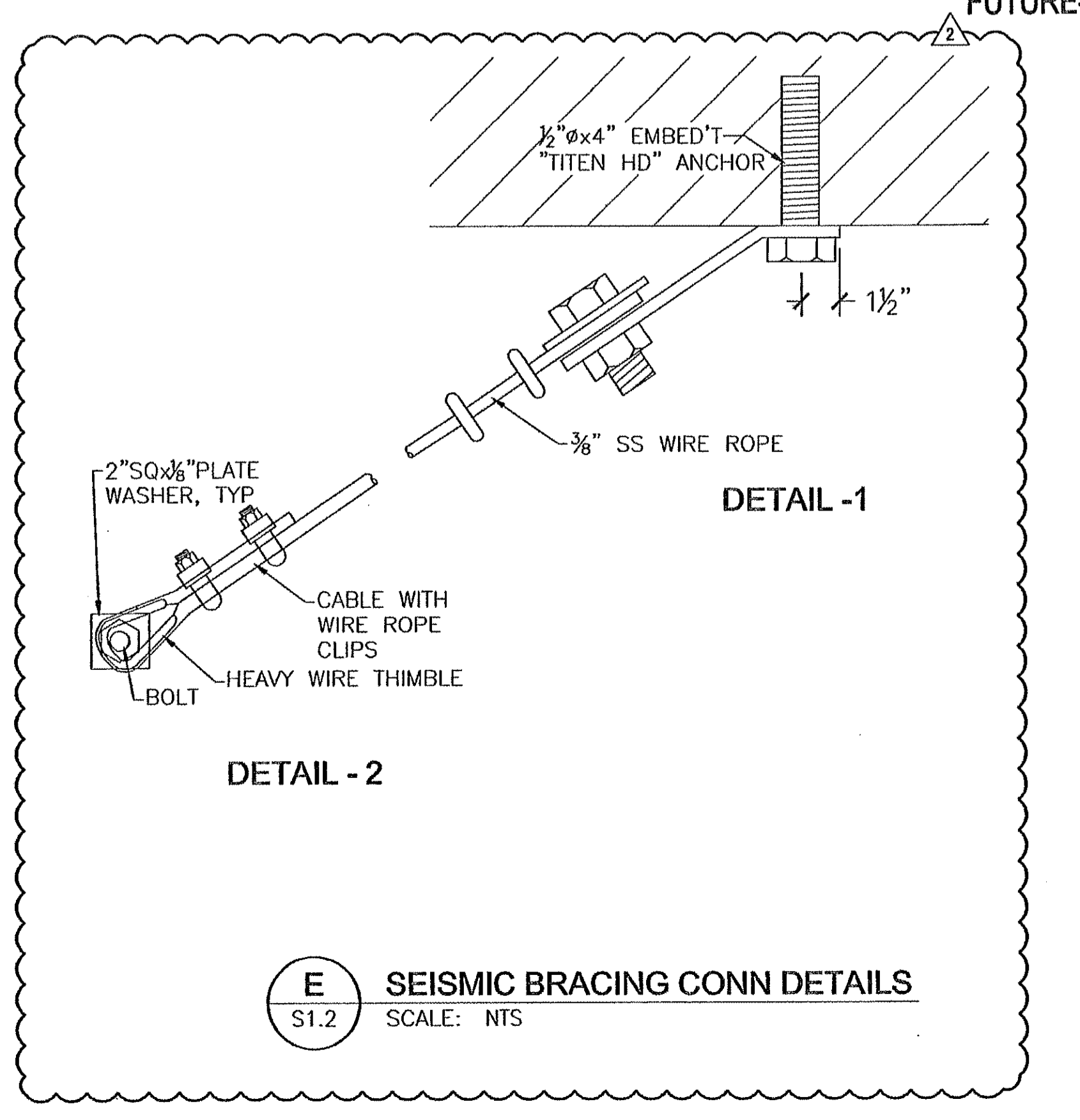
B 12" CONG. DECK SECTION
S1.2 SCALE: 1" = 1'-0"



K COLUMN COVER FOUNDATION
S1.2 SCALE: 1" = 1'-0"



H PIPE HANGER DETAIL
S1.2 SCALE: 1-1/2" = 1'-0"



E SEISMIC BRACING CONN DETAILS
S1.2 SCALE: NTS

2	08/29/08	ISSUED FOR CONSTRUCTION
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0	05/23/08	ISSUED FOR BID & PERMIT
no.	date	by
		revisions

SJO
CONSULTING ENGINEERS
A DIVISION OF
WENZLER & KELLY

15575 SW REGULICA PKWY, SUITE 140
PORTLAND, OR 97224
PH: 503-254-8400 FAX: 503-254-8928

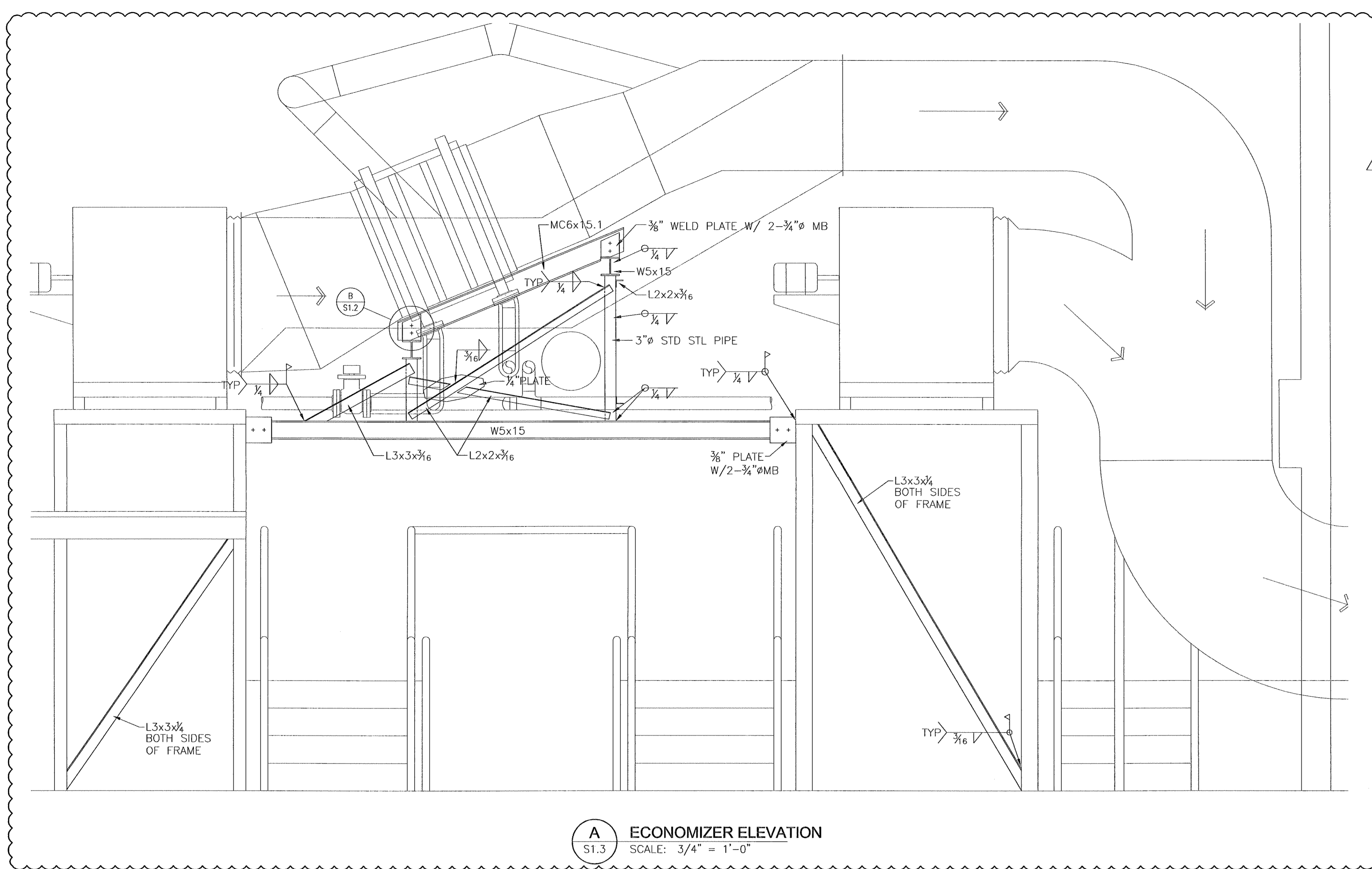
PROJECT: PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

dwg. title: PIPE RISER SUPPORT COLUMN

designed: B.T.B. date: 05-13-08
drawn: SL date: 05-13-08
approved: JSH date: 06-13-08
project no.: 10009-07001
drawing no.: S1.2

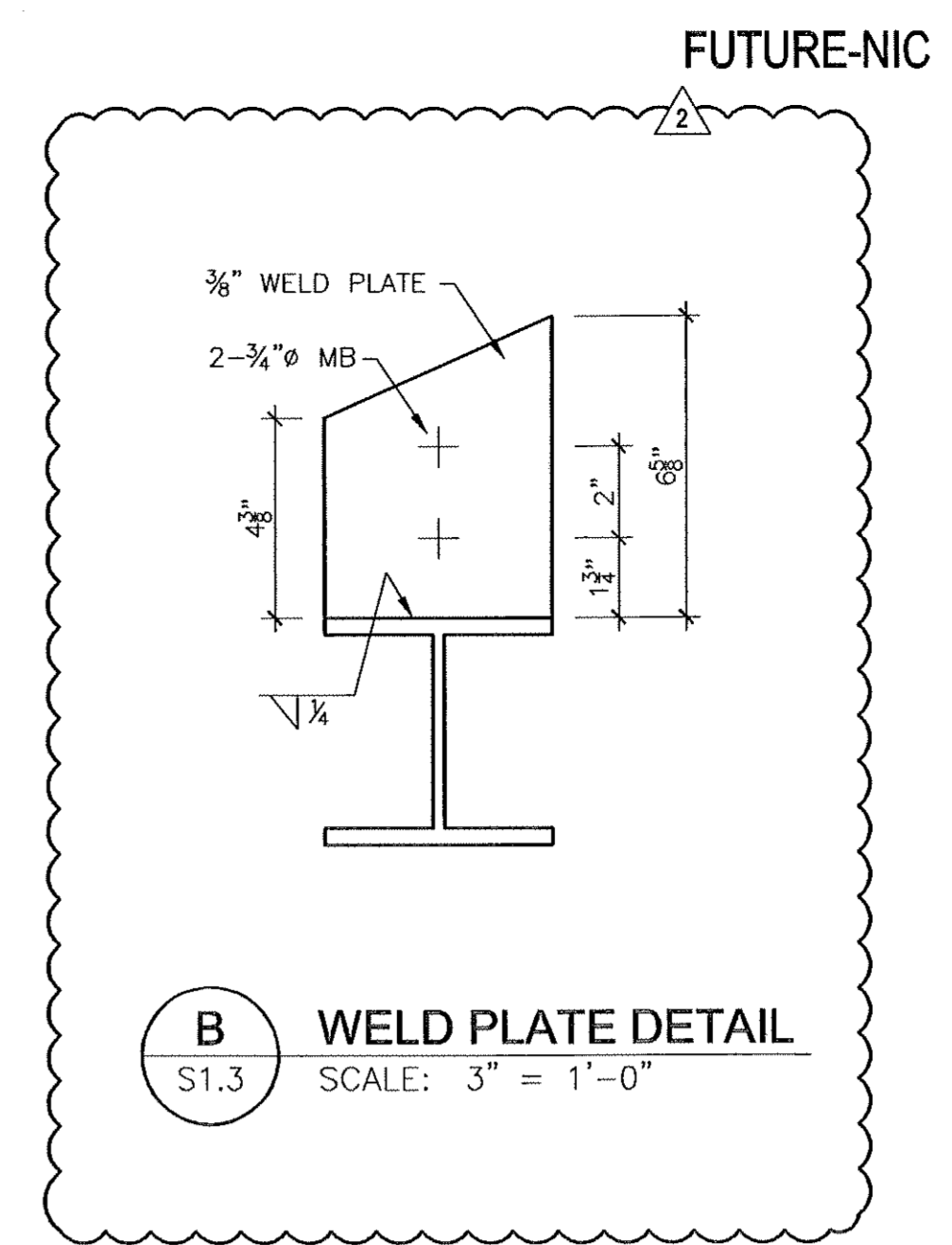
PROGRESSIVE CONSULTANTS, INC.
8100 NE PARKWAY DRIVE, SUITE #40
VINCENNES, IN 46062
(360) 254-8400 FAX (360) 254-3334

EXPIRES: 6-30-2009

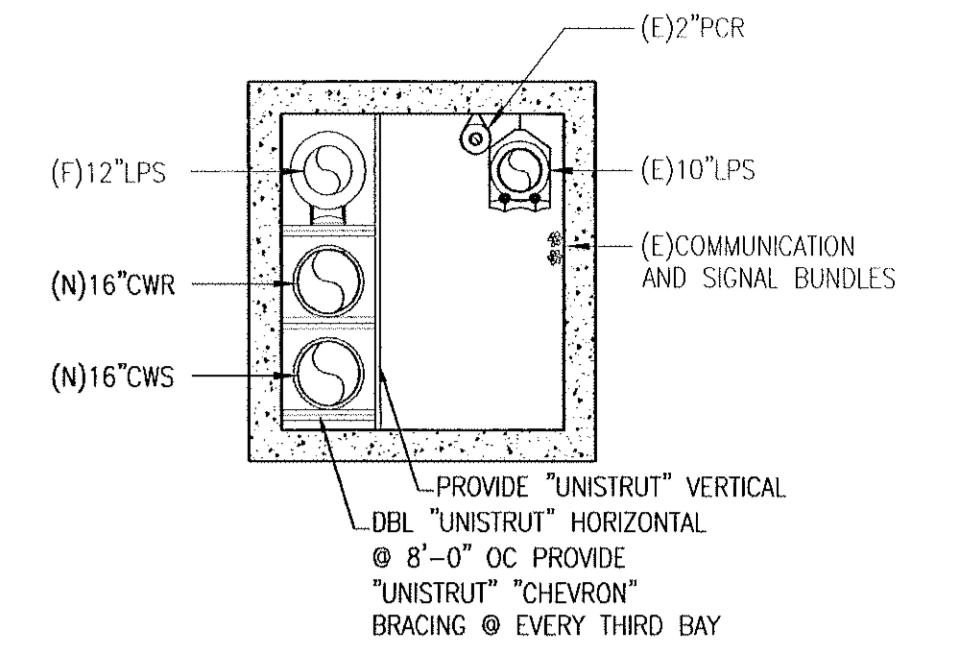


A ECONOMIZER ELEVATION
S1.3 SCALE: 3/4" = 1'-0"

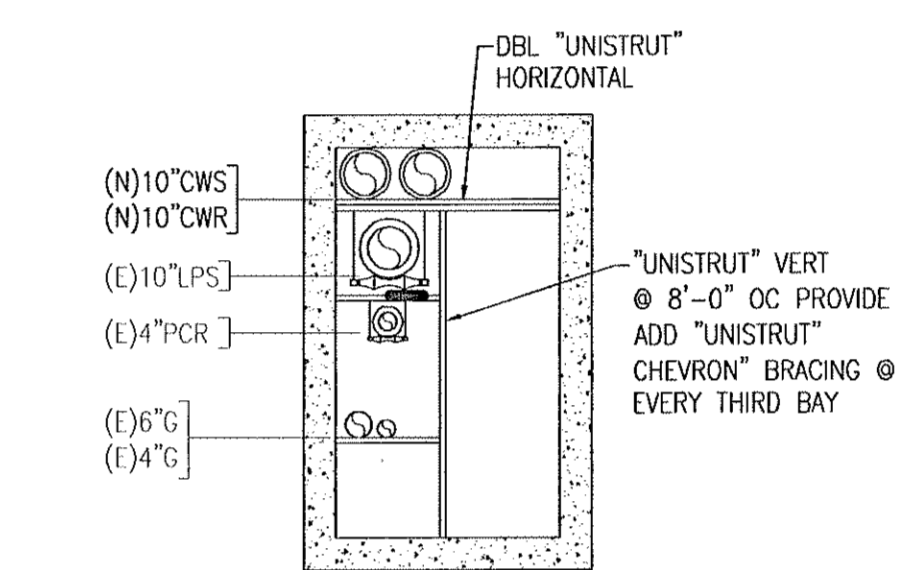
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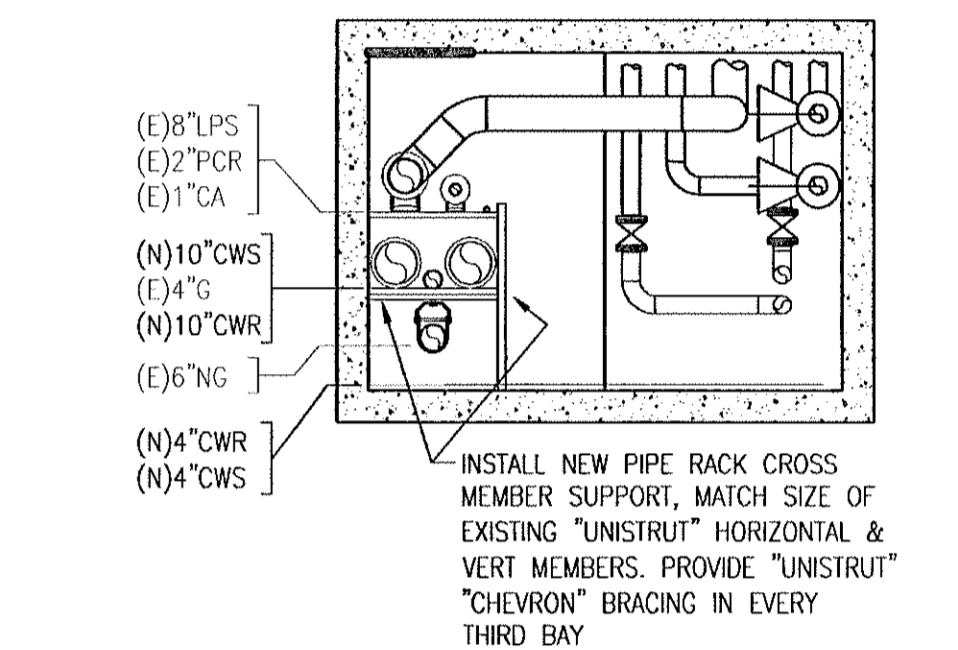
B WELD PLATE DETAIL
S1.3 SCALE: 3" = 1'-0"



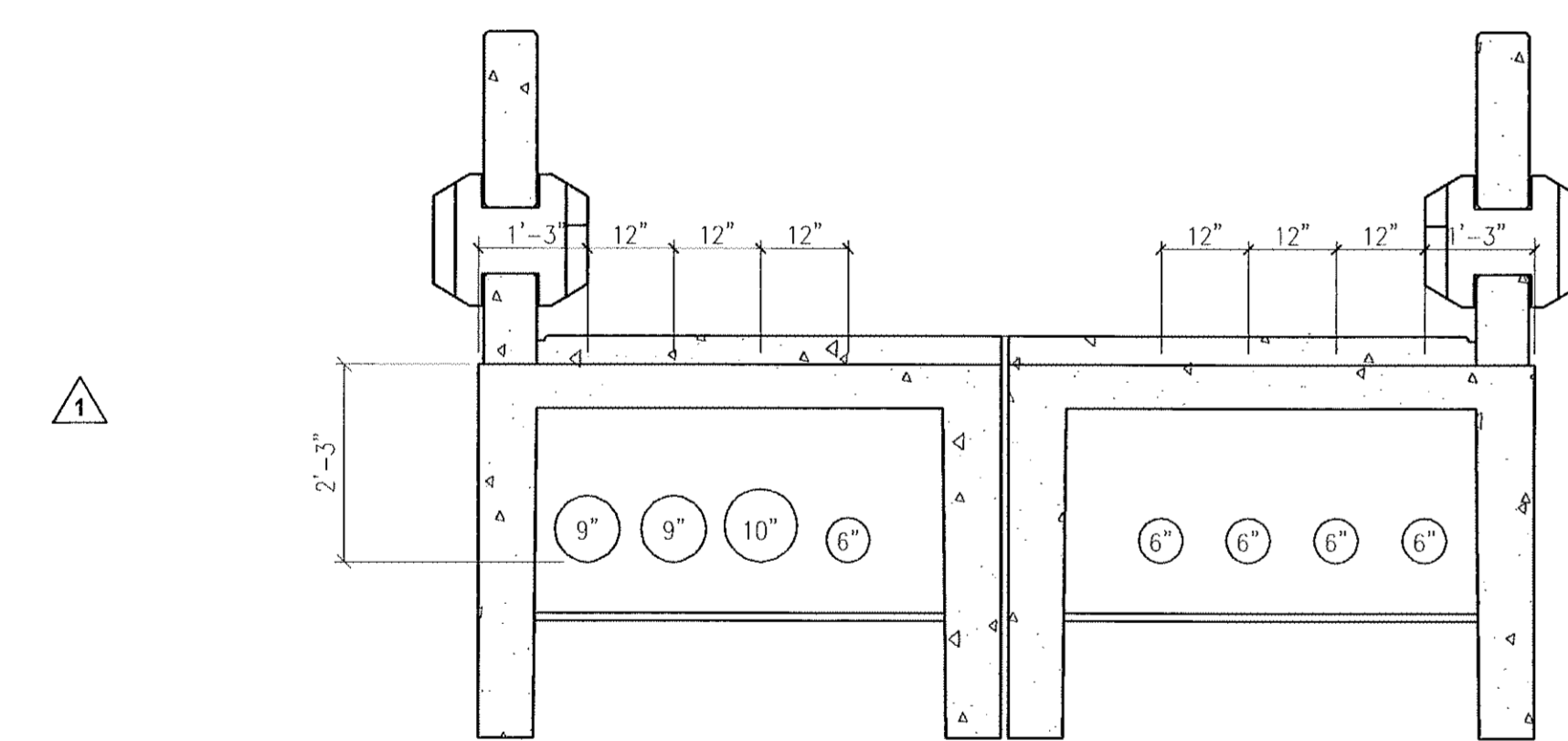
C PIPING SECTION SHATTUCK TUNNEL
S1.3 SCALE: 1/4" = 1'-0"



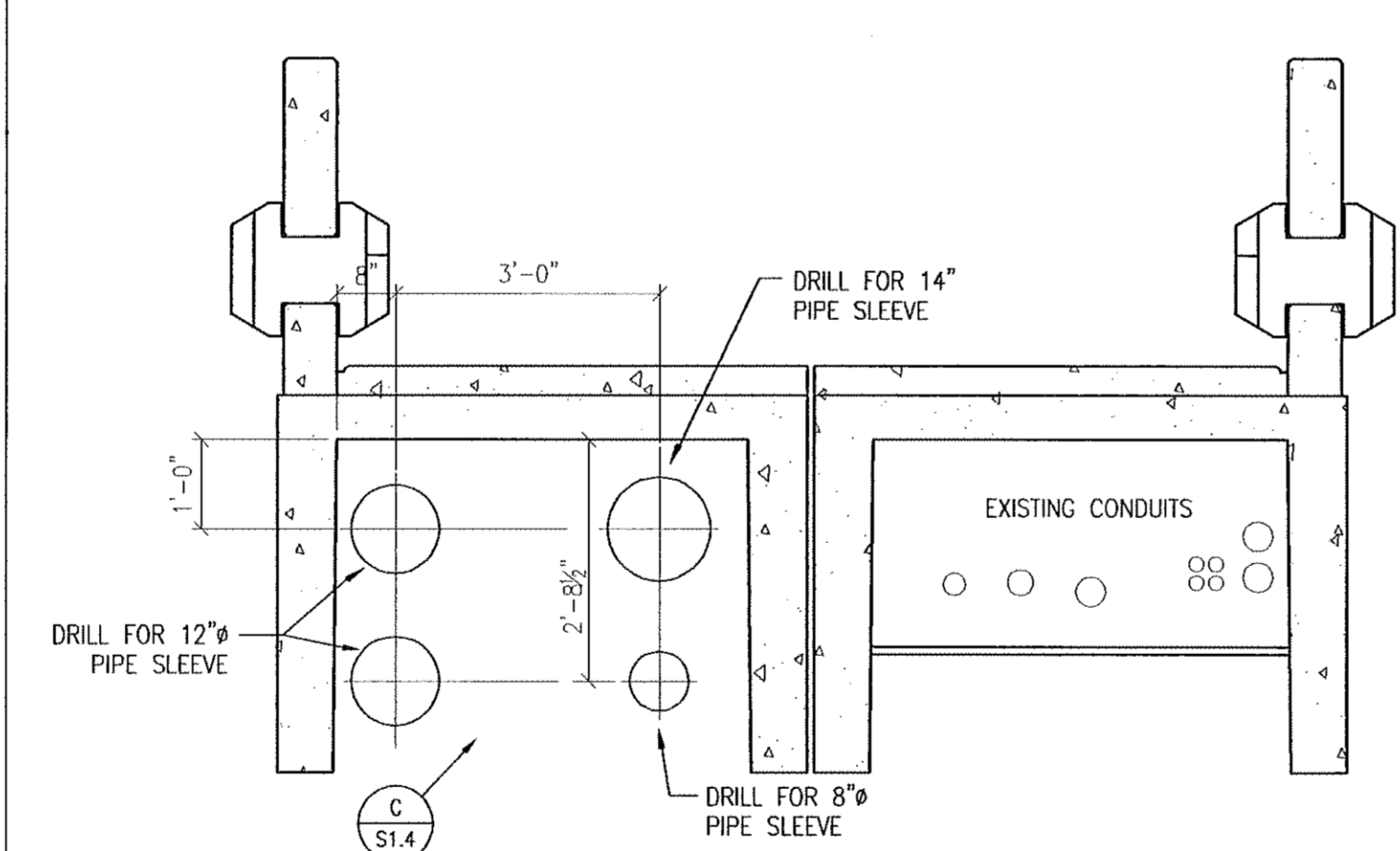
D PIPING SECTION NH SUB BASEMENT
S1.3 SCALE: 1/4" = 1'-0"



E PIPING SECTION NH SUB BASEMENT
S1.3 SCALE: 1/4" = 1'-0"

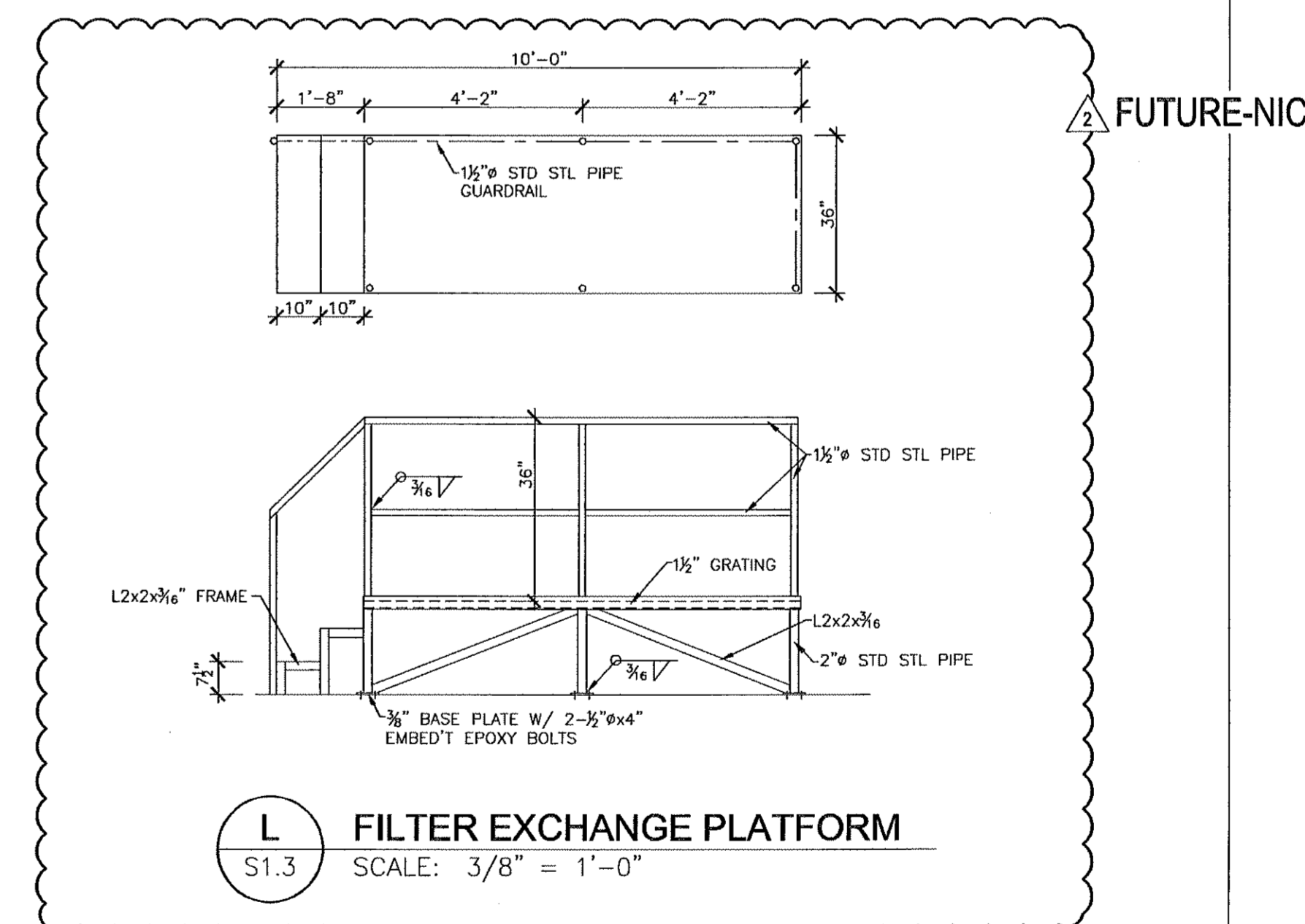


F EXISTING SIZE & LOCATION OF PIPE PENETRATIONS THRU EXISTING PRECAST BRIDGE GIRDER (SECTION LOOKING WEST)
S1.3 SCALE: 1/2" = 1'-0"

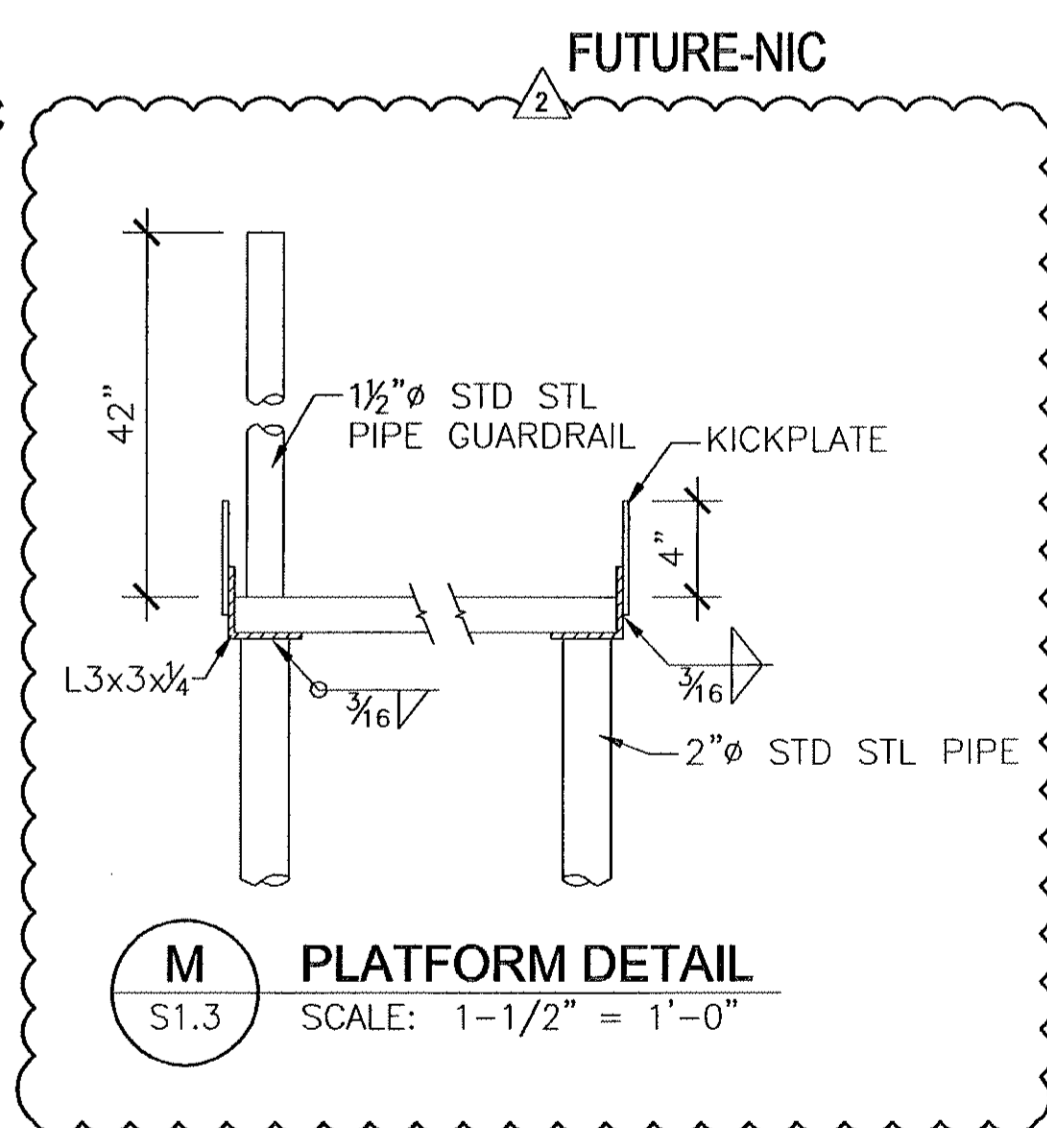


G NEW SIZE AND LOCATION OF PIPE PENETRATION OF PRECAST BRIDGE GIRDER (SECTION LOOKING WEST)
S1.3 SCALE: 1/2" = 1'-0"

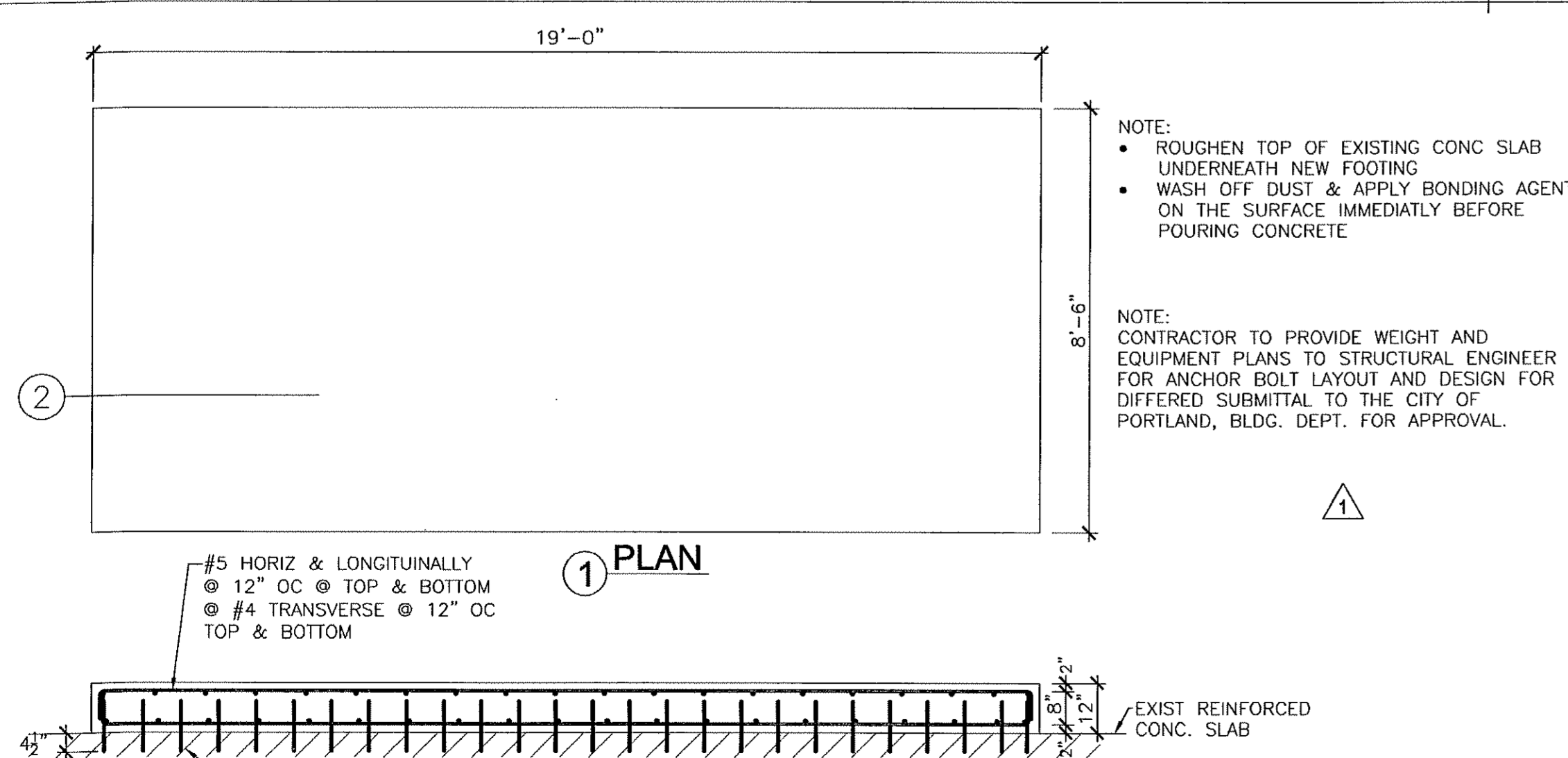
- NOTES:**
- REMOVE PIPES AND EXISTING SLEEVES.
 - REFILL HOLES W/ CONCRETE (5,000 PSI) & EPOXY BONDING AGENT MIX.
 - HAVE CONCRETE REACH FULL STRENGTH.
 - APPLY CARBONFIBER WRAPPING & RESIN TO REINFORCE GIRDER - LENGTH OF WRAPPED AREA PER CONTRACTOR'S STR'L ENGINEER'S SPECIFICATIONS.
 - DRILL GIRDER FOR NEW SLEEVES
 - INSTALL SLEEVES INTO EPOXY GROUT BEDDING.
 - AFTER GROUT HAS CURED, INSTALL PIPES
 - RECOMMENDED CONTRACTOR FOR BRIDGE GIRDER REINFORCEMENT: CONTECH SERVICES, INC. (DON ELLSWORTH) 503-223-9817
 - COORDINATE FINAL SLEEVE LOCATION WITH PIPING CONTRACTOR. SUBMIT COORDINATED SHOP DRAWINGS FOR REVIEW



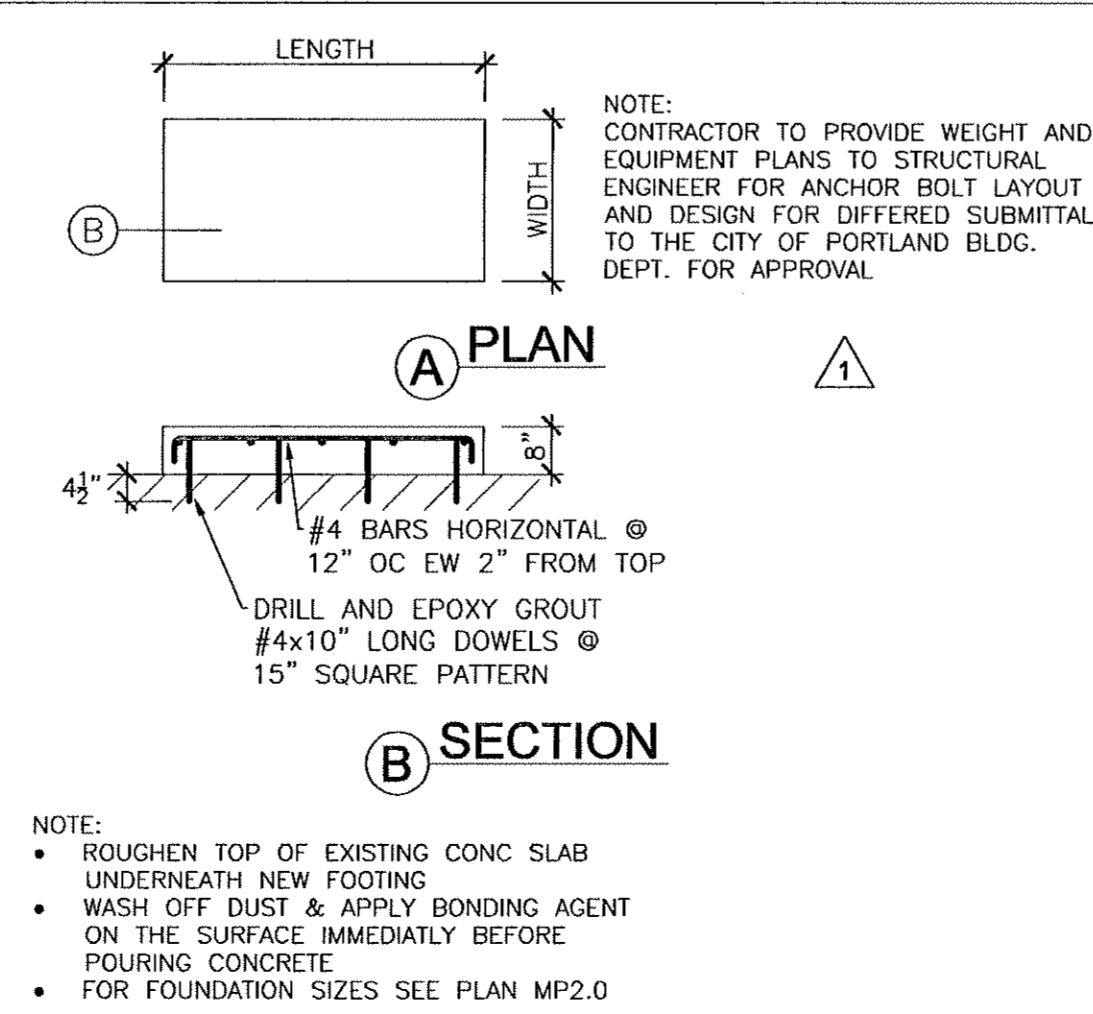
L FILTER EXCHANGE PLATFORM
S1.3 SCALE: 3/8" = 1'-0"



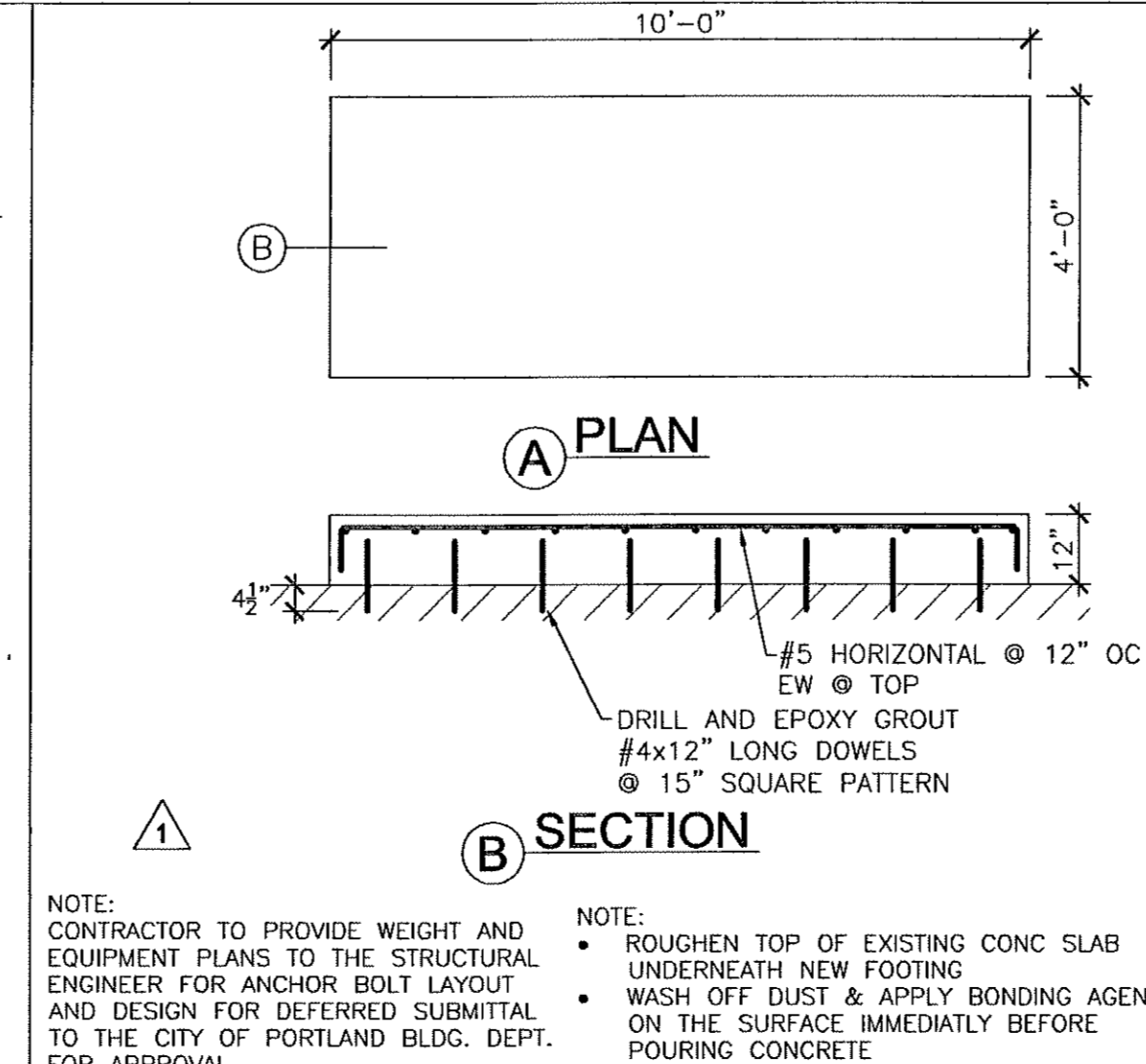
M PLATFORM DETAIL
S1.3 SCALE: 1-1/2" = 1'-0"



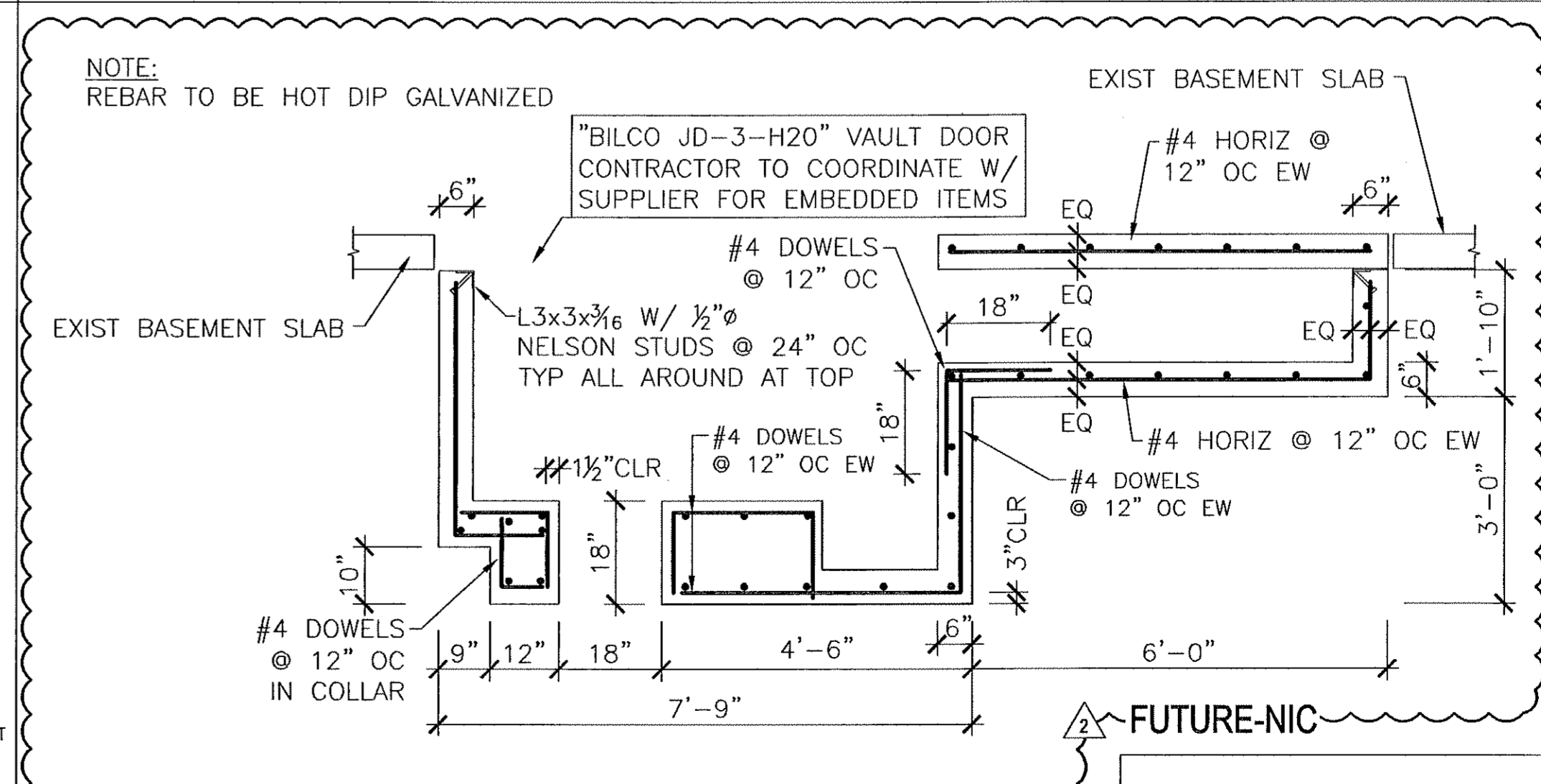
H FOUNDATION FOR NEW WCU-4 (750 TON) CHILLER
S1.3 SCALE: 3/8" = 1'-0"



I FOUNDATION FOR NEW ECP-P11, ECP-P9, ECP-P10, ECP-P5A, ECP-P5B, ECP-P6, ECP-P7, ECP-P8, ECP-P4
S1.3 SCALE: 3/8" = 1'-0"



J FOUNDATION FOR NEW HEAT EXCHANGER ECONOMIZER
S1.3 SCALE: 3/8" = 1'-0"



K INJECTION WELL VAULT SECTION
S1.3 SCALE: 1/2" = 1'-0"

2	06/29/08	ISSUED FOR CONSTRUCTION
1	07/10/08	BID CLARIFICATION FOR PERMIT SET
0	05/03/08	ISSUED FOR BID & PERMIT
no	date	by revisions

SJO CONSULTING ENGINEERS 15675 SW BEQUITHA PKWY, SUITE 140
PORTLAND, OR 97224 PH: 503-228-3021 FAX: 503-228-5028

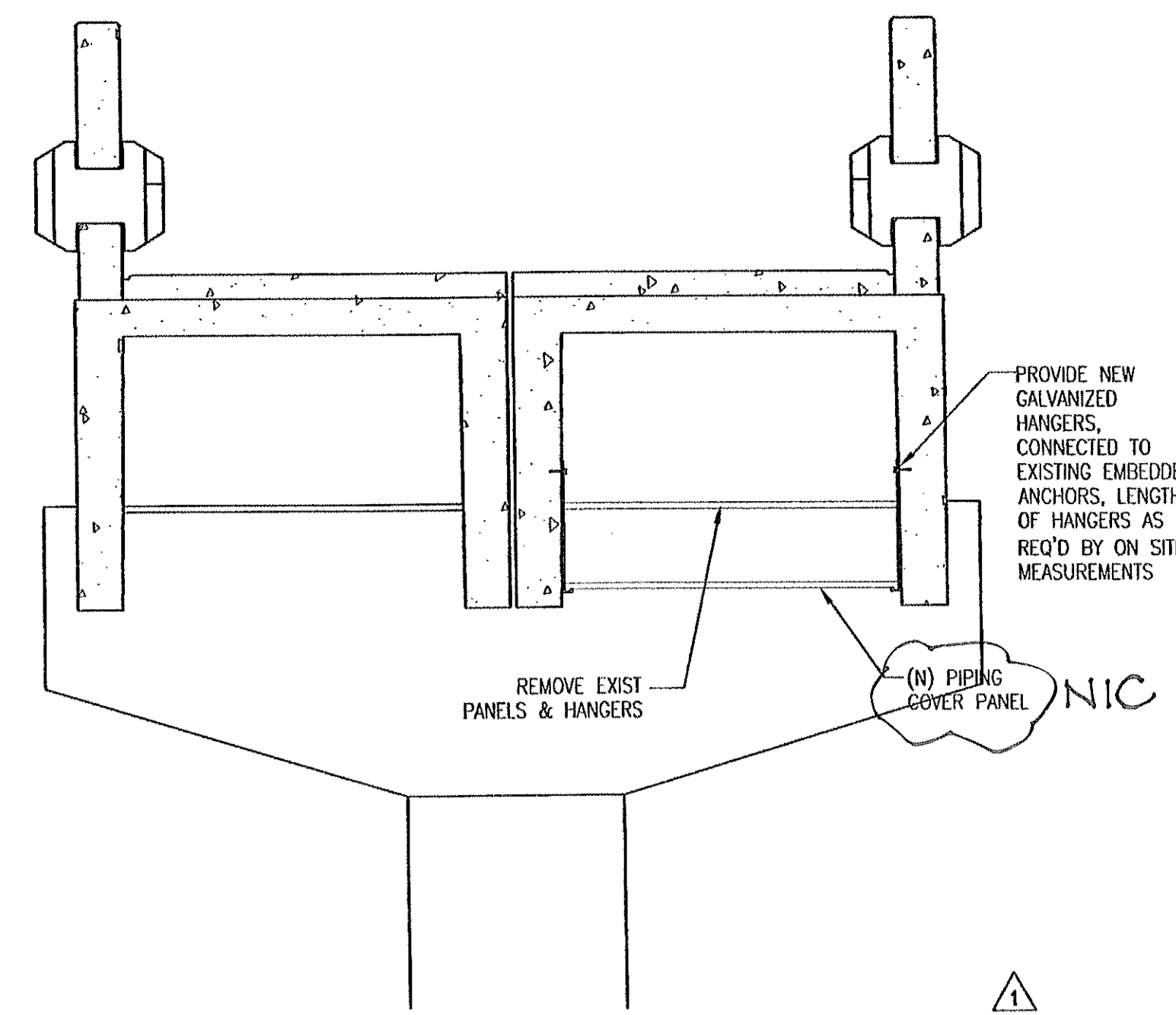
PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

dwg. title
PIPING STRUCTURAL DETAILS
B. EB. 05.

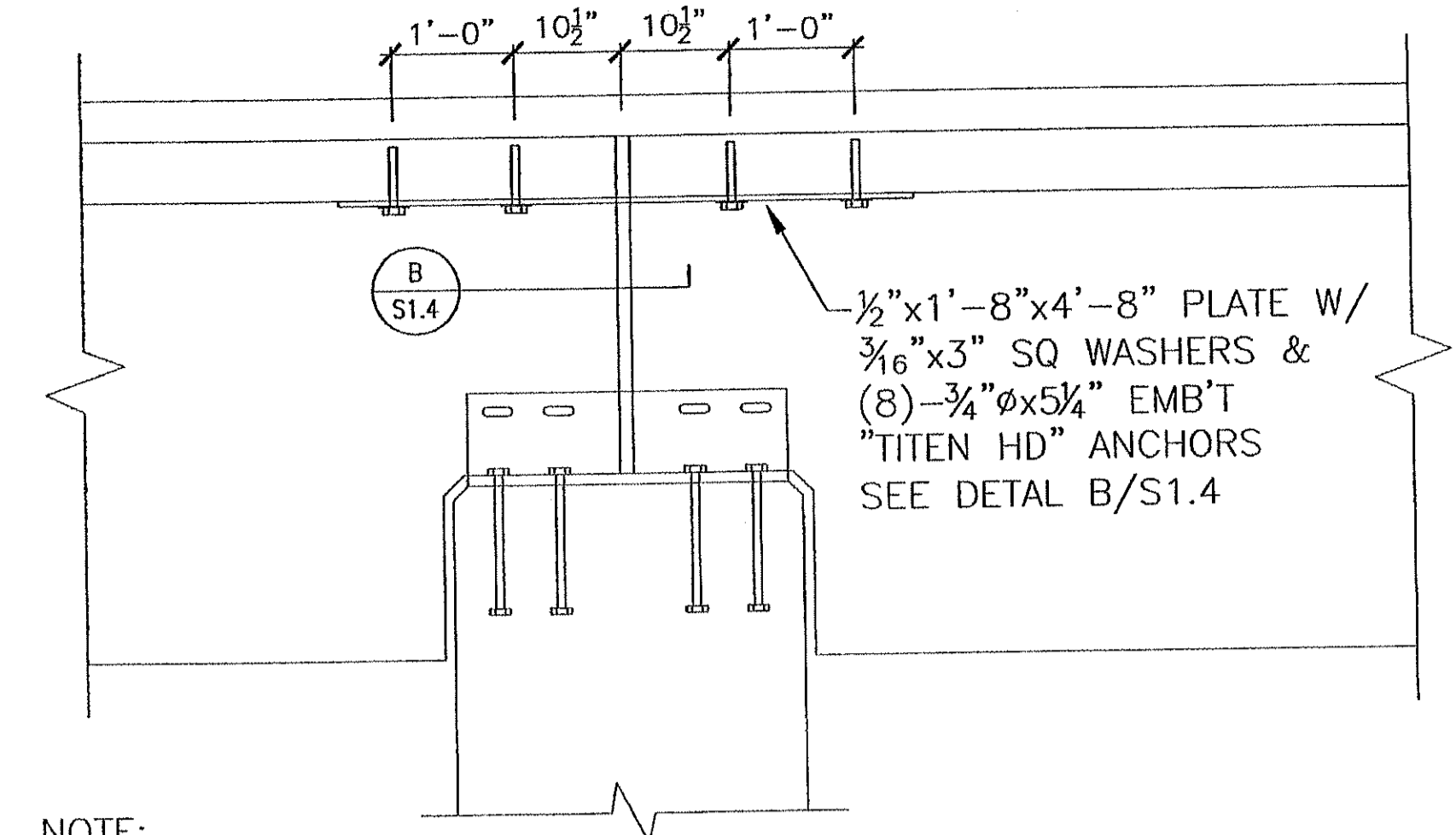
designed	date
drawn	05-13-08
approved	date
05-13-08	
project no.	0959-0700
drawing no.	
S1.3	

PROGRESSIVE CONSULTANTS, INC.
8100 NE PARKWAY DRIVE, SUITE #40
WANCOLVER, WA 98662
(360) 254-8400 FAX (360) 254-3334

REGISTERED PROFESSIONAL ENGINEER
9865
OREGON
JULIUS S. HORNBERG



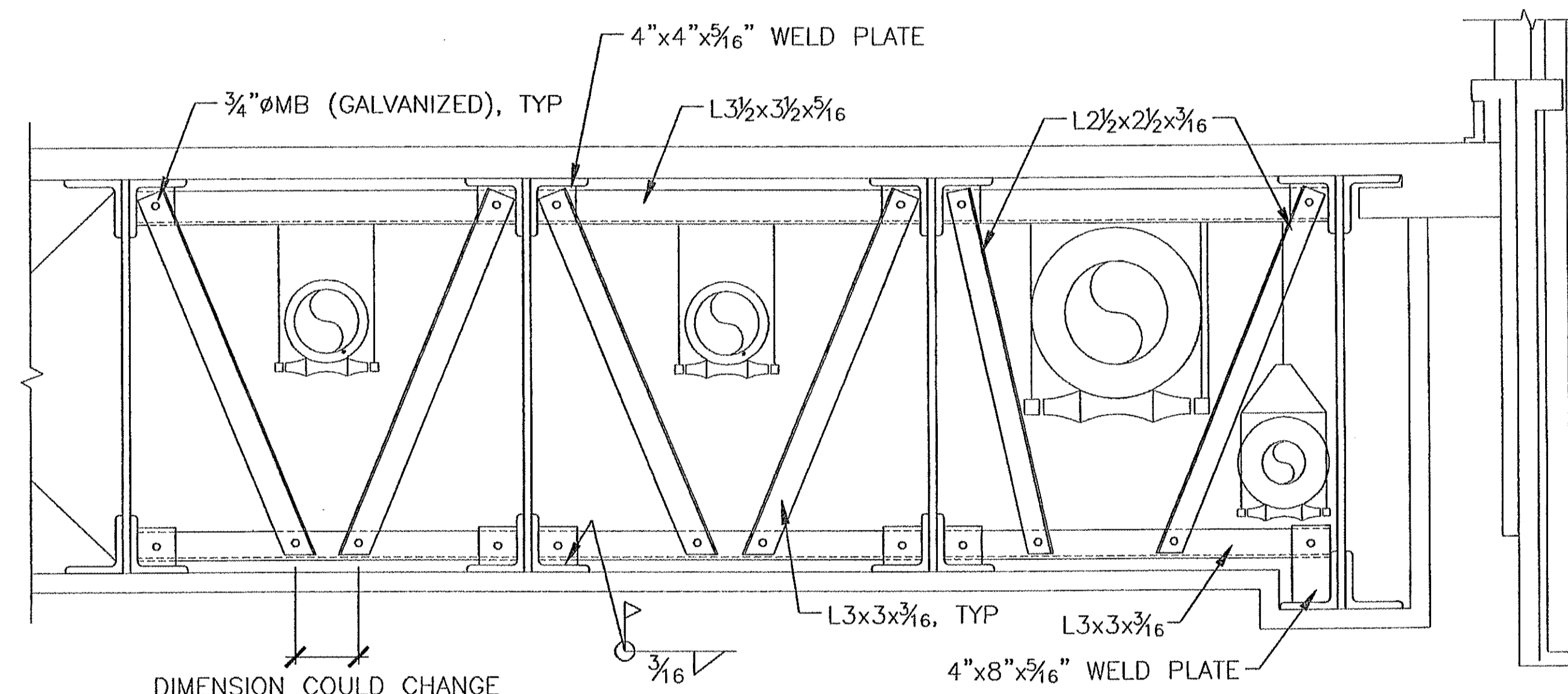
C
S1.4
UNDER PIPERUN SUPPORT FOR RESUPPORTING EXISTING SOFFIT
SCALE: 1/2" = 1'-0"



A
S1.4
PLATE ATTACHMENT
SCALE: 3/4" = 1'-0"

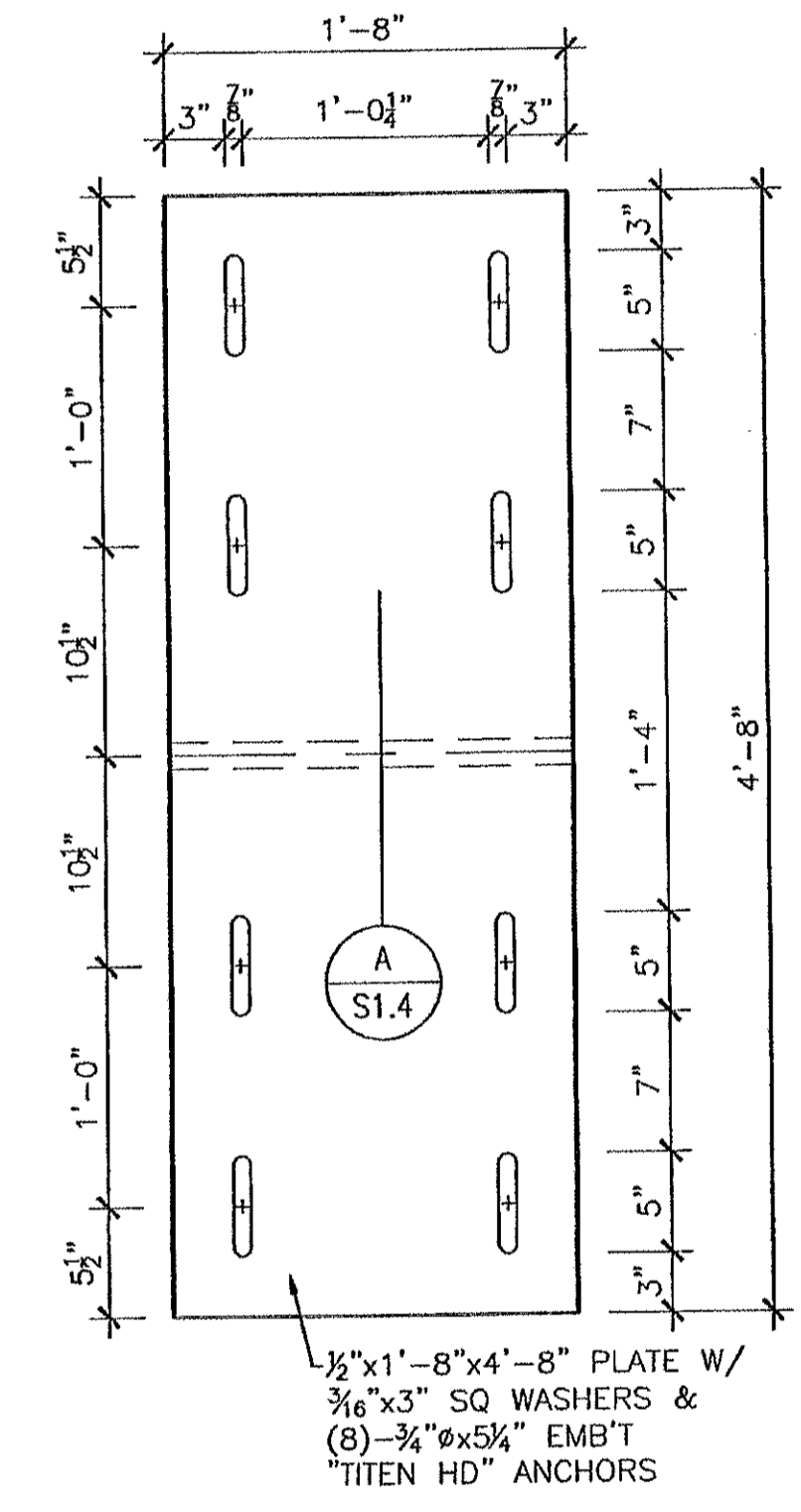
NOTE:
TO BE INSTALLED BETWEEN BRIDGE GIRDERS OVER BRIDGE SUPPORT ALONG SW MONTGOMERY ST. ONLY ABOVE PROPOSED PIPE RUN!

NOTE:
CONNECTION PLATES TO BE ADDED OVER THE 2ND, 3RD, & 4TH BRIDGE SUPPORTS (GOING WEST TO EAST ON SW MONTGOMERY STREET FROM "CRAMER HALL" TOWARDS "SCHOOL OF BUSINESS ADMINISTRATION & EDUCATION") AND ONLY ABOVE THE NEWLY INSTALLED PIPERUN.



D
S1.4
EXISTING TRUSS BRACING @ PIPE SUPPORTS BETWEEN CRAMER HALL AND MONTGOMERY STREET BRIDGE
SCALE: 1" = 1'-0"

NOTE:
BRACING TO BE INSTALLED CLOSE TO PANEL POINTS AT TOP FLANGE



B
S1.4
CONNECTION PLATE
SCALE: 1" = 1'-0"

NOTE:
CONNECTION PLATES TO BE ADDED OVER THE 2ND, 3RD, & 4TH BRIDGE SUPPORTS (GOING WEST TO EAST ON SW MONTGOMERY STREET FROM "CRAMER HALL" TOWARDS "SCHOOL OF BUSINESS ADMINISTRATION & EDUCATION") AND ONLY ABOVE THE NEWLY INSTALLED PIPERUN.

NOTE: PLATES AND WASHERS TO BE GALVANIZED

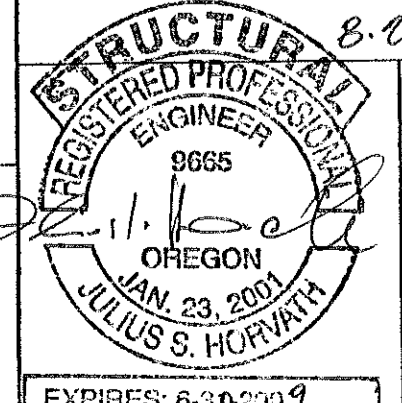
2	08/29/08	ISSUED FOR CONSTRUCTION
1	07/10/08	BID CLARIFICATION FOR PERMIT SET
0	05/23/08	ISSUED FOR BID & PERMIT
no	date	by
		revisions

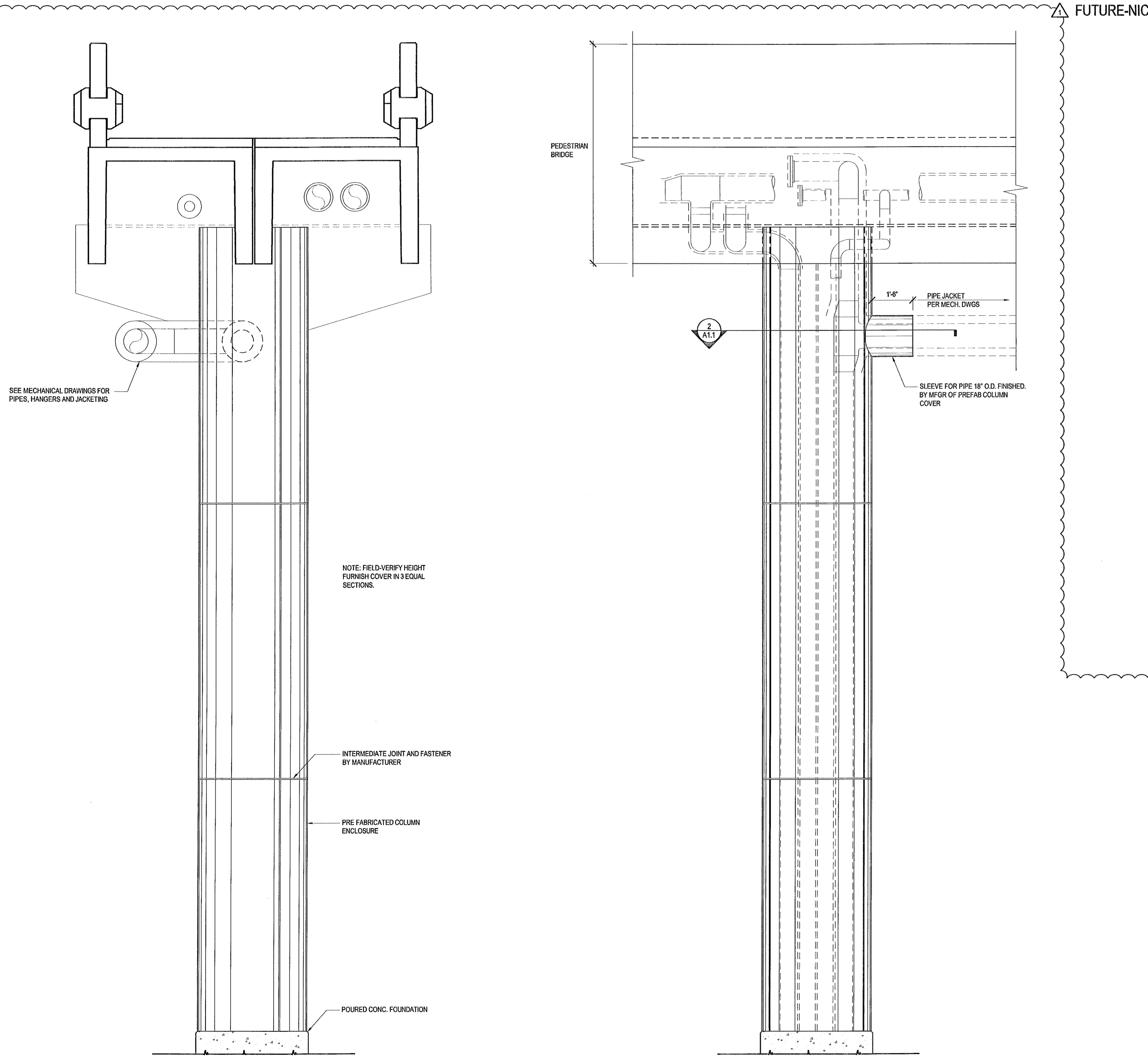
SJO
CONSULTING ENGINEERS
15575 SW BEGUINIA PKWY, SUITE 140
PORTLAND, OR 97224
PHONE: 503-254-8400 FAX: 503-254-8408

PROJECT:
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

designed		date
drawn		date
approved		date
project no.		10809-07001
drawing no.		S1.4

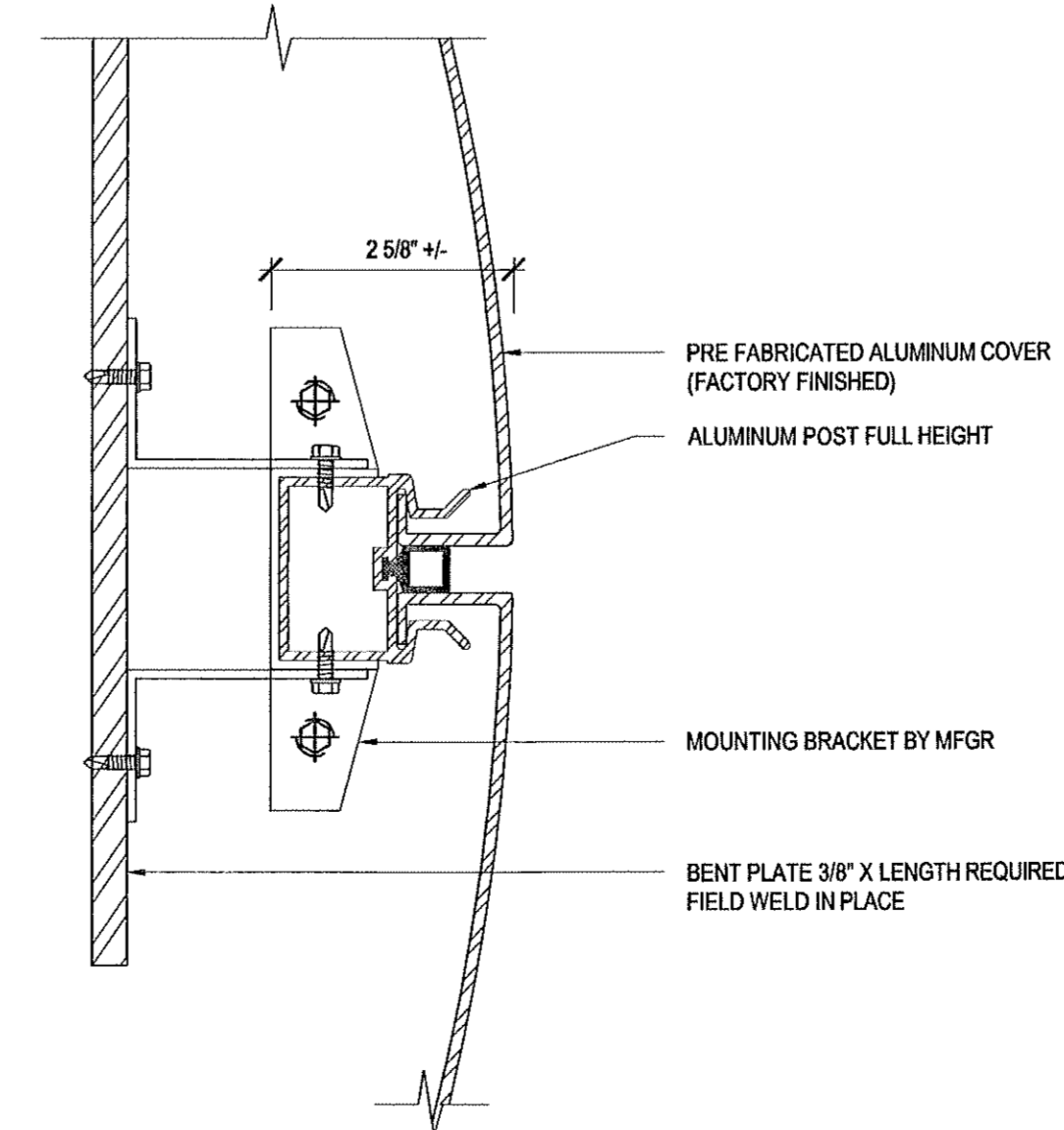
PROGRESSIVE CONSULTANTS, INC.
8100 NE PARKWAY DRIVE, SUITE #40
VANCOUVER, WA 98662
(360) 254-8400 FAX (360) 254-3334



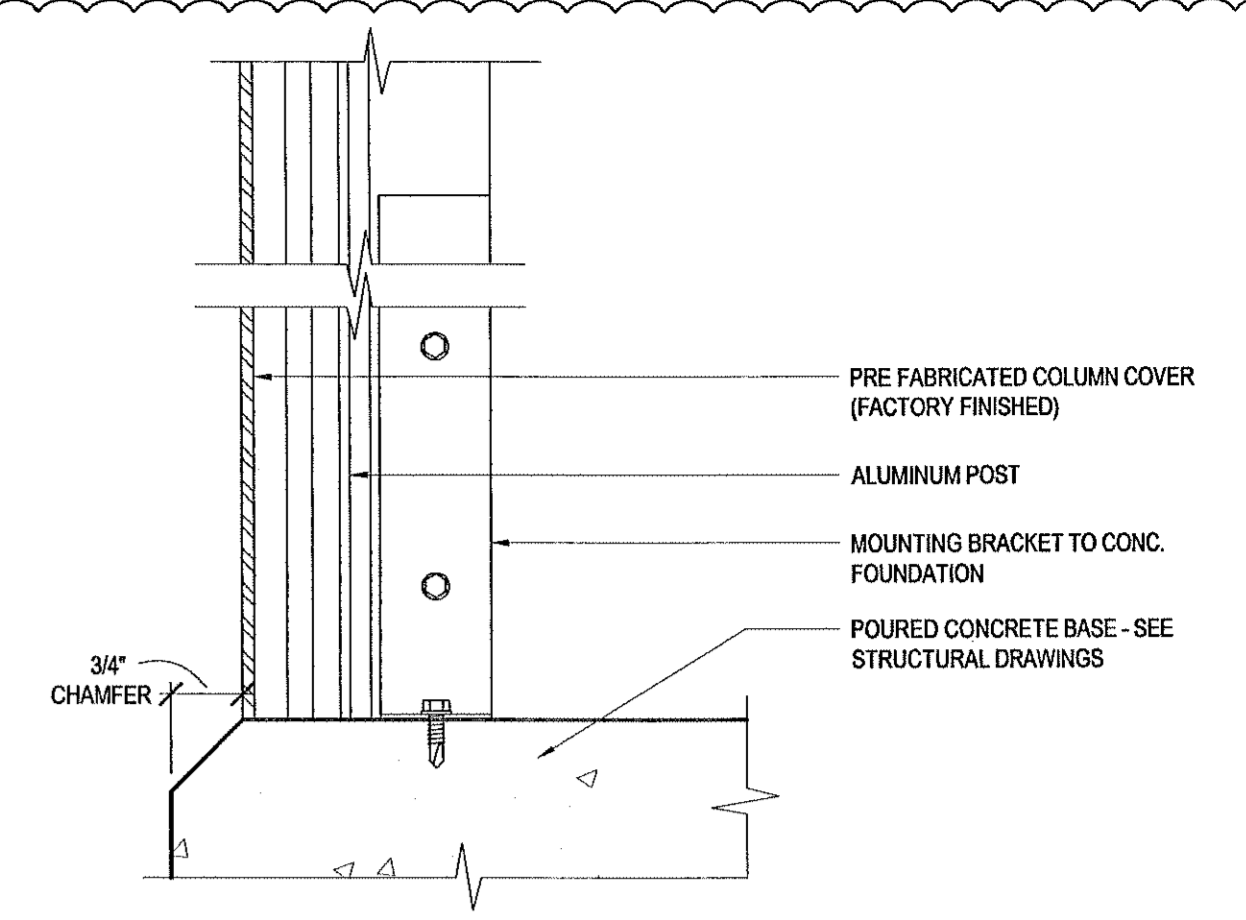


6 ELEVATION VIEW @ COLUMN
SCALE: 1/2"=1'-0"

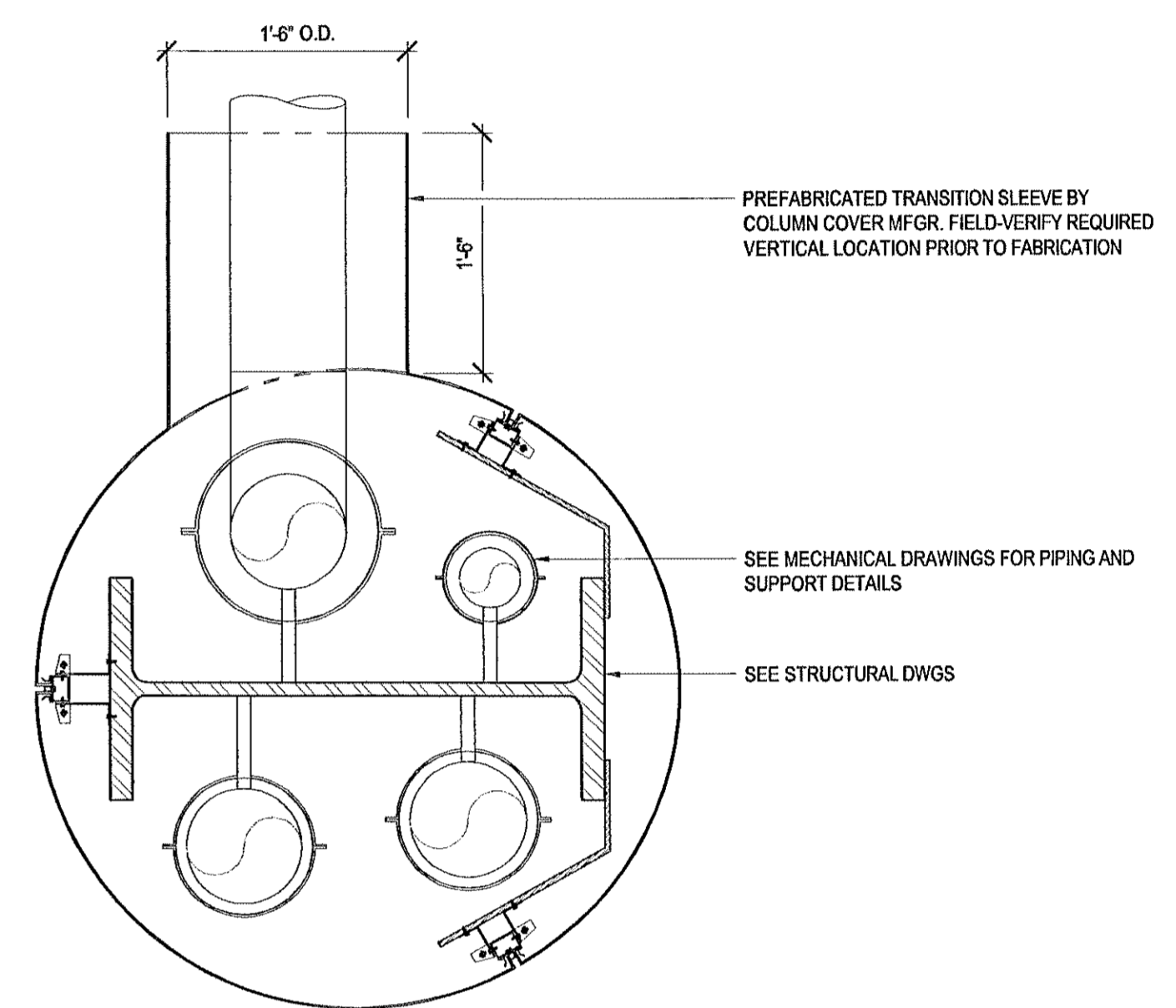
5 OVERALL ELEVATION
SCALE: 1/2"=1'-0"



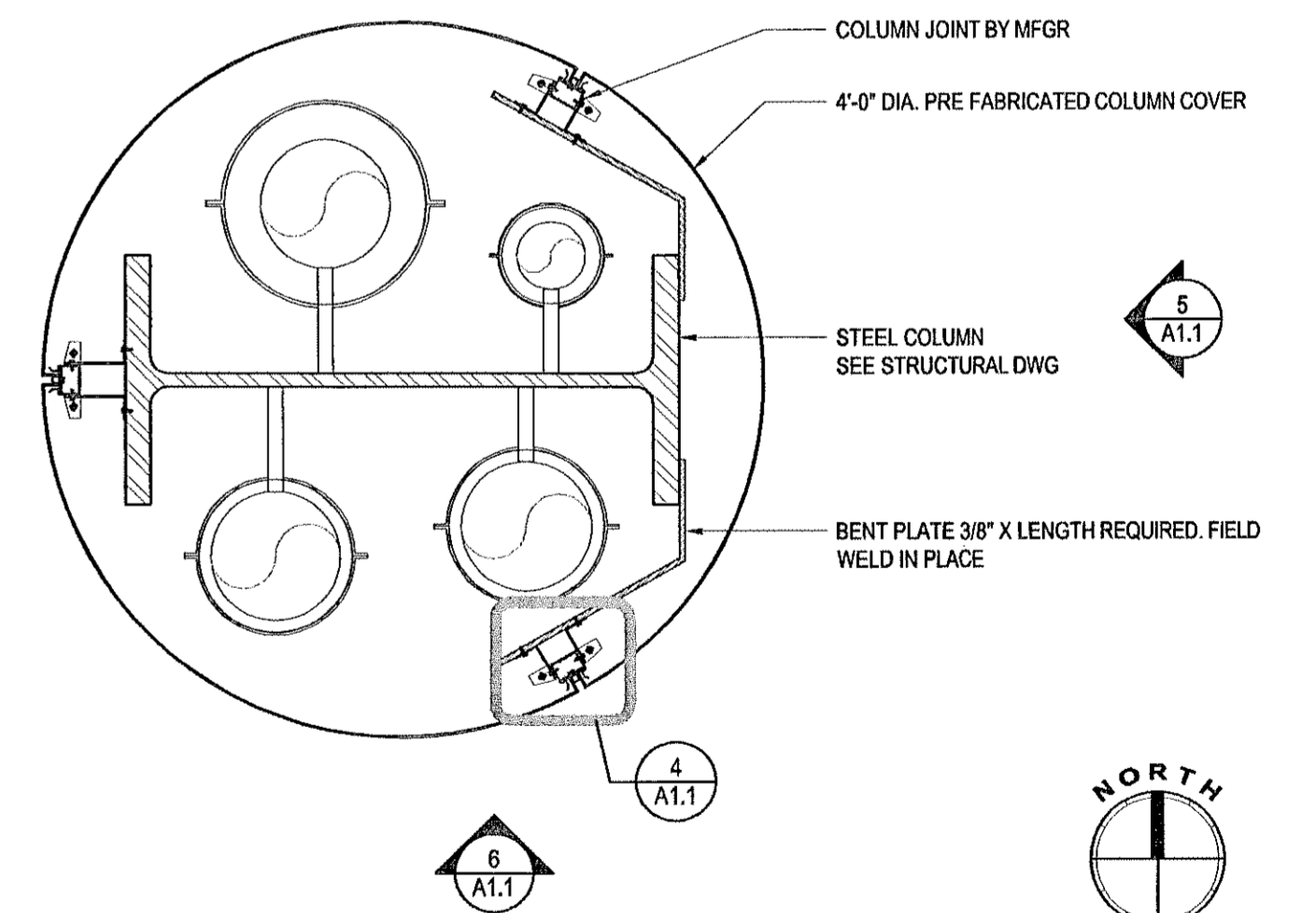
4 COLUMN CLIP DETAIL
SCALE: 6"=1'-0"



3 BASE DETAIL
SCALE: 6"=1'-0"



2 PLAN VIEW @ BRIDGE LEVEL
SCALE: 1"=1'-0"



1 PLAN VIEW
SCALE: 1"=1'-0"

1	06/29/08	ISSUED FOR CONSTRUCTION
0	05/21/08	ISSUED FOR BID & PERMIT
no.	date	by
		revisions

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CONSULTING ENGINEERS
15575 SW SECURITA PKWY, SUITE 140
PORTLAND, OREGON 97224
PH: 503-228-3821 FAX: 503-228-3828

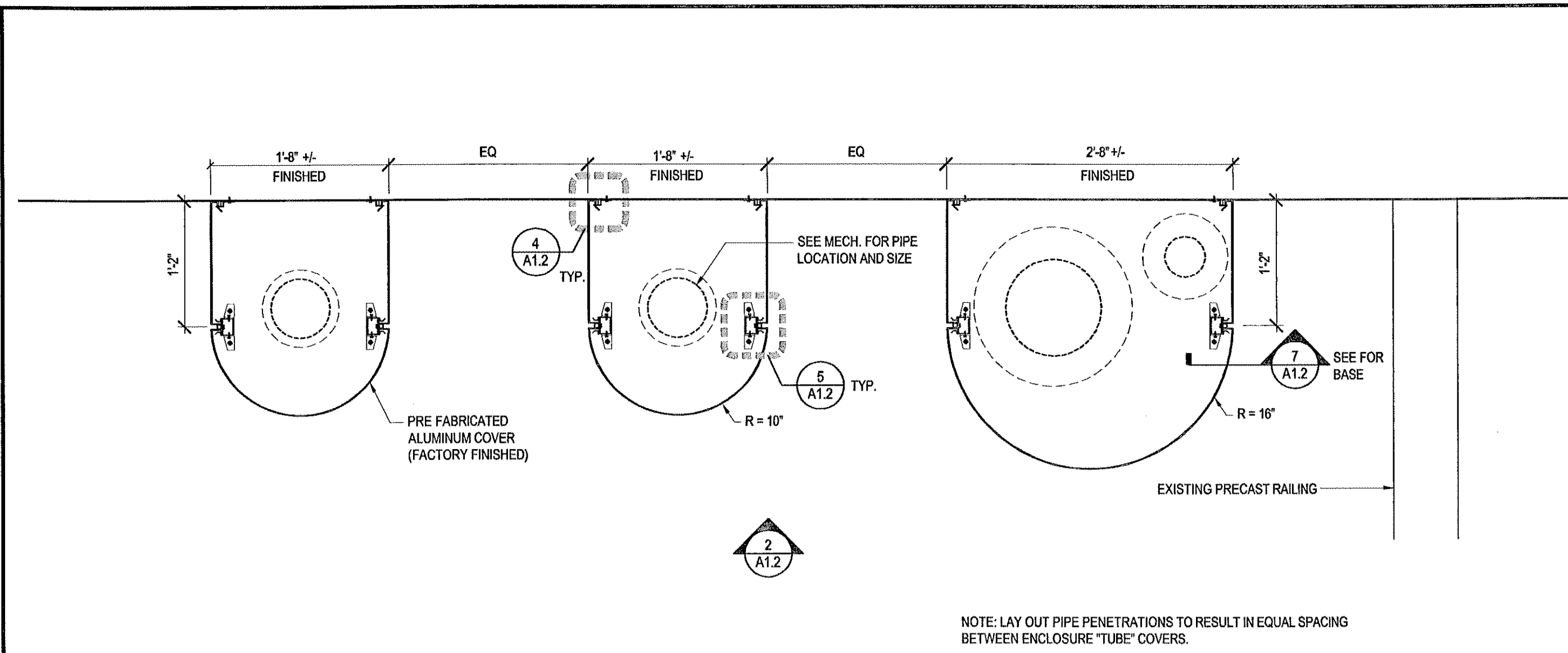
PROJECT
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

DWG. TITLE
**ASRC Walkway Chase
And Column Details**

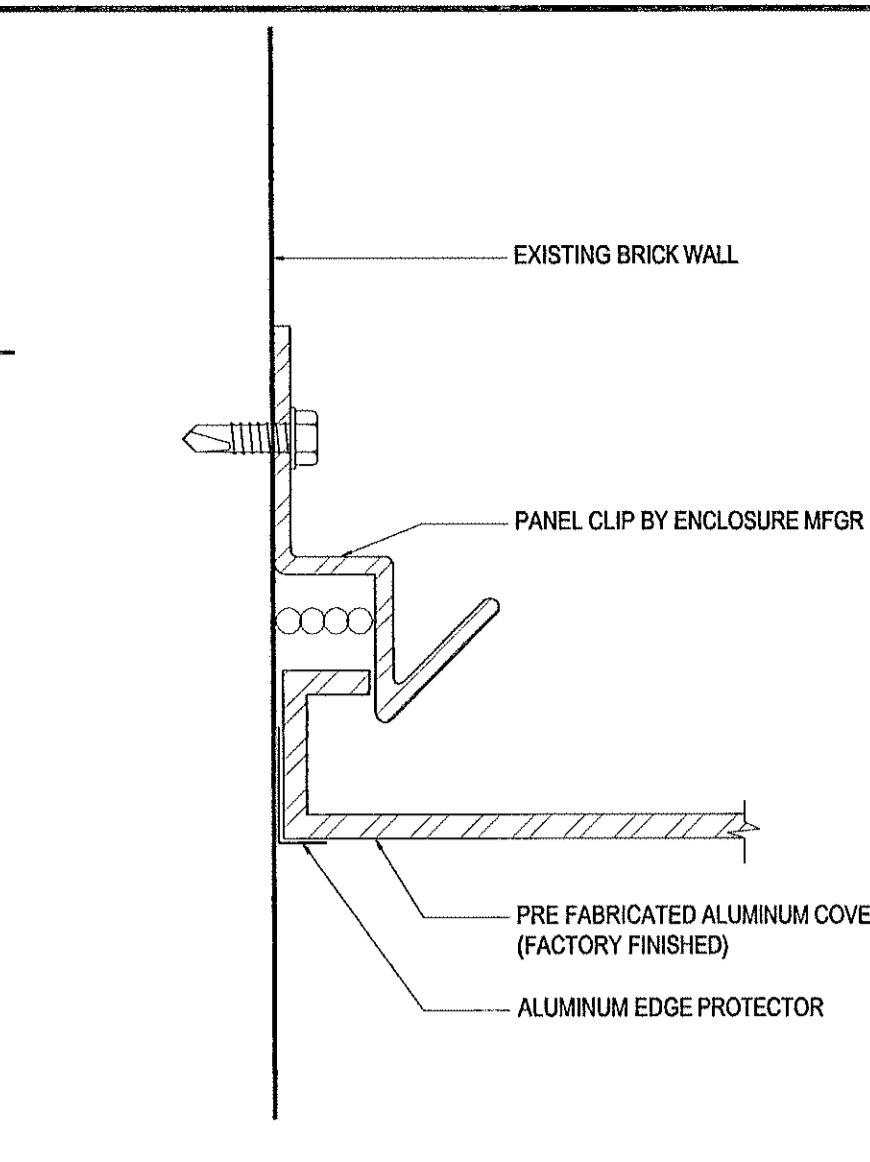
DESIGNED	DATE
DRAWN	DATE
BY	DATE
APPROVED	DATE
PROJECT NO.	10000-01001
DRAWING NO.	



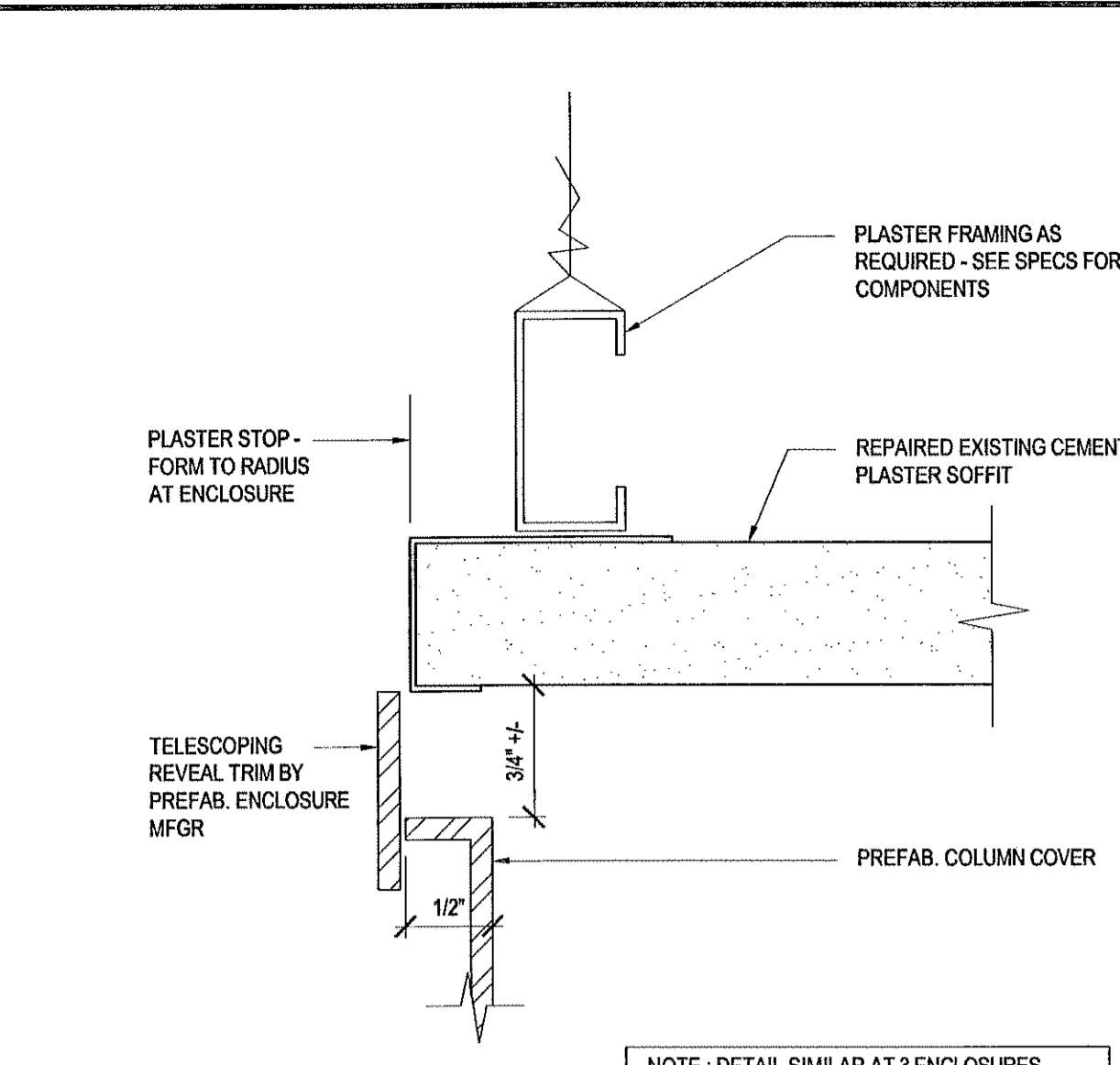
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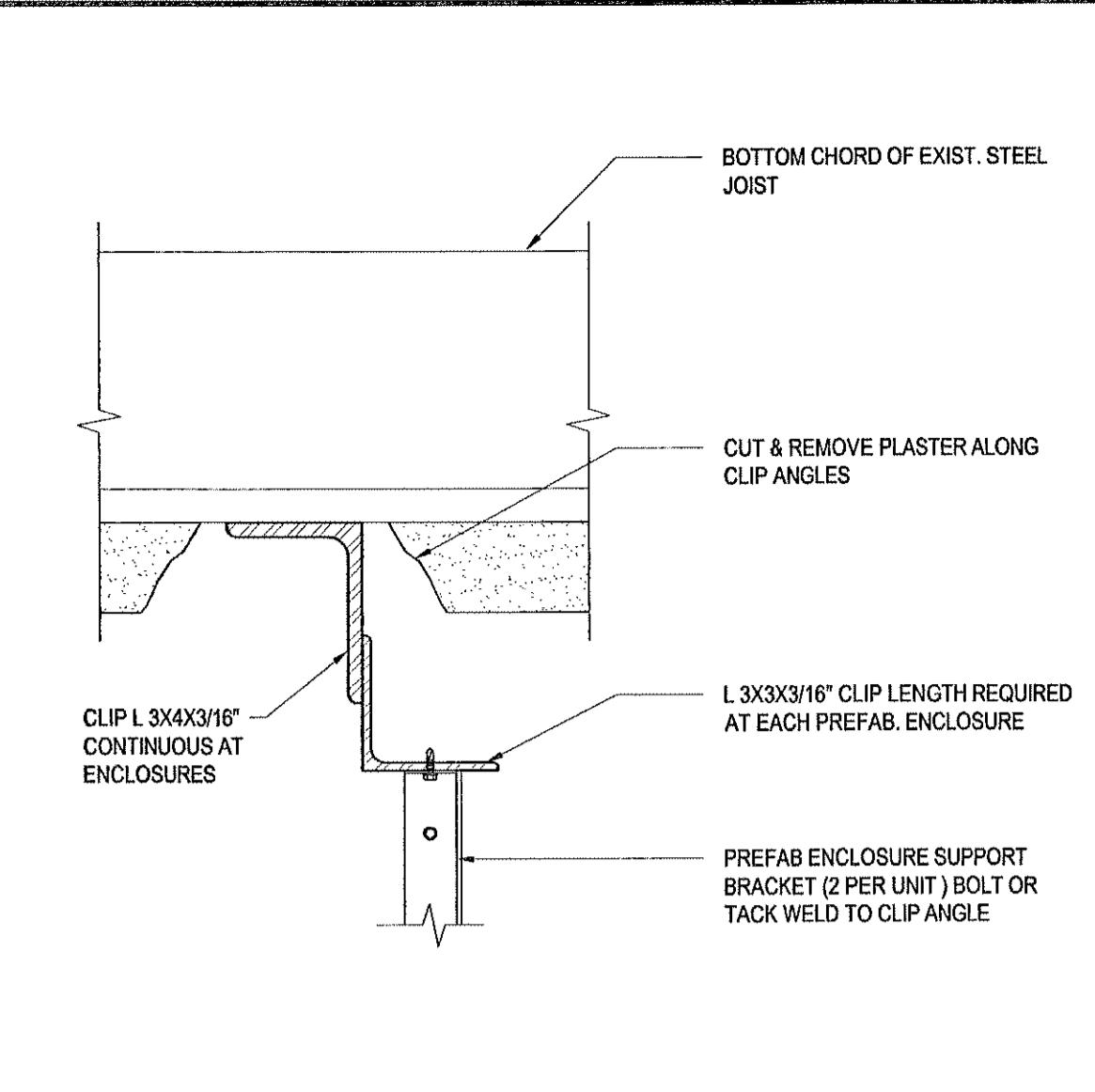
1 PLAN AT CRAMER HALL
SCALE: 1/4"=1'-0"



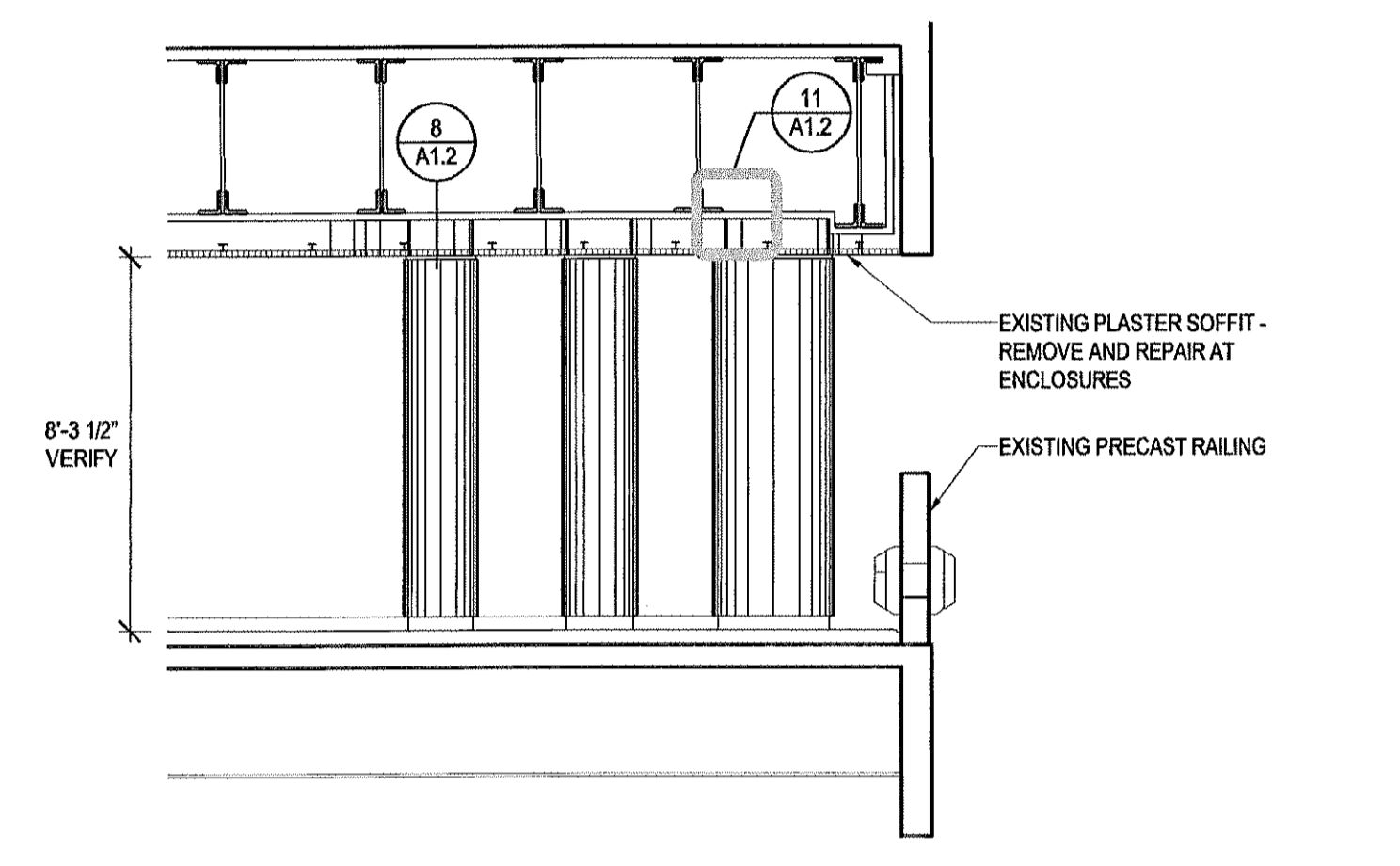
4 WALL DETAIL @ CRAMER
SCALE: NOT TO SCALE



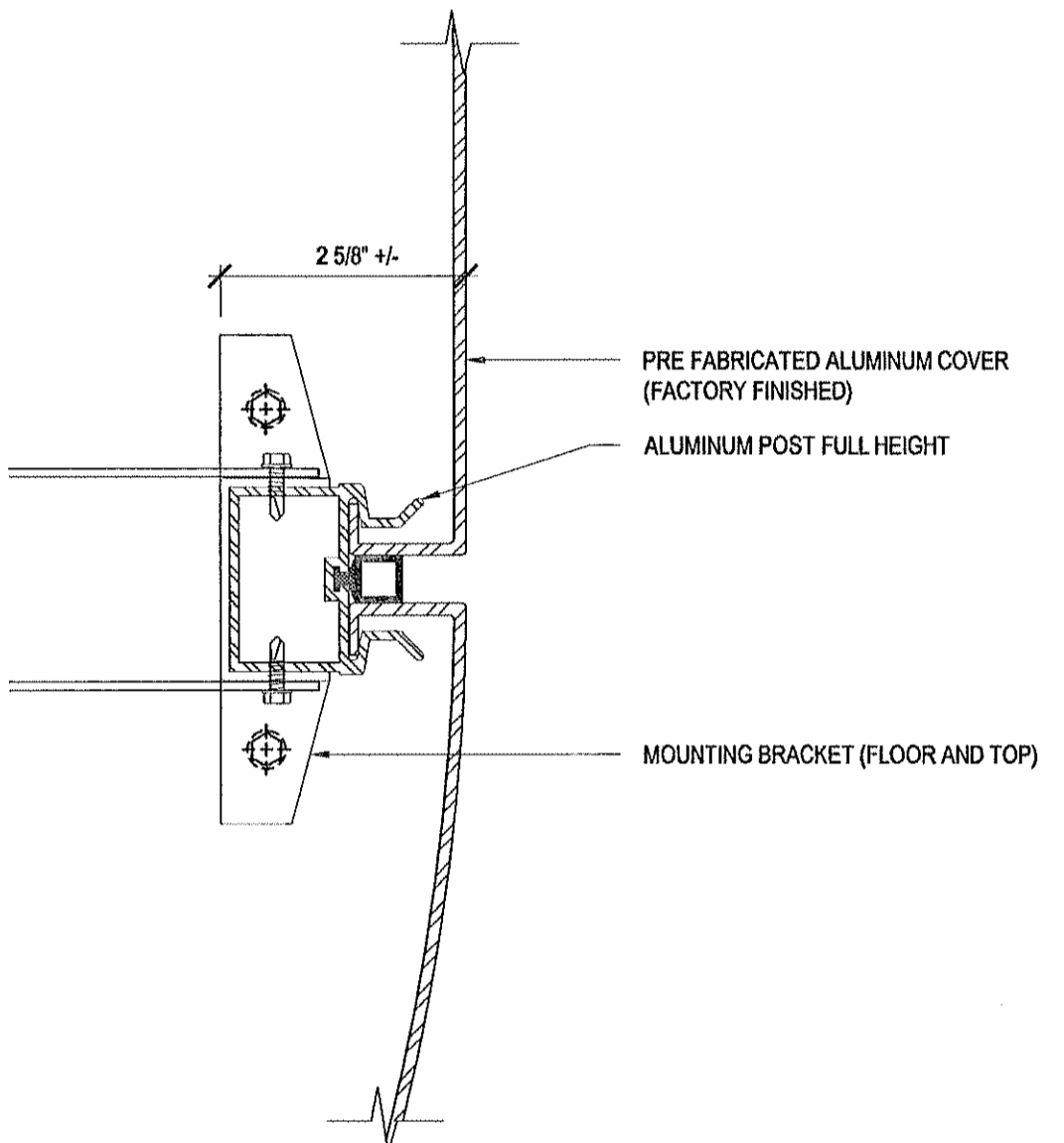
8 DETAIL @ PLASTER SOFFIT
SCALE: 1/4"=1'-0"



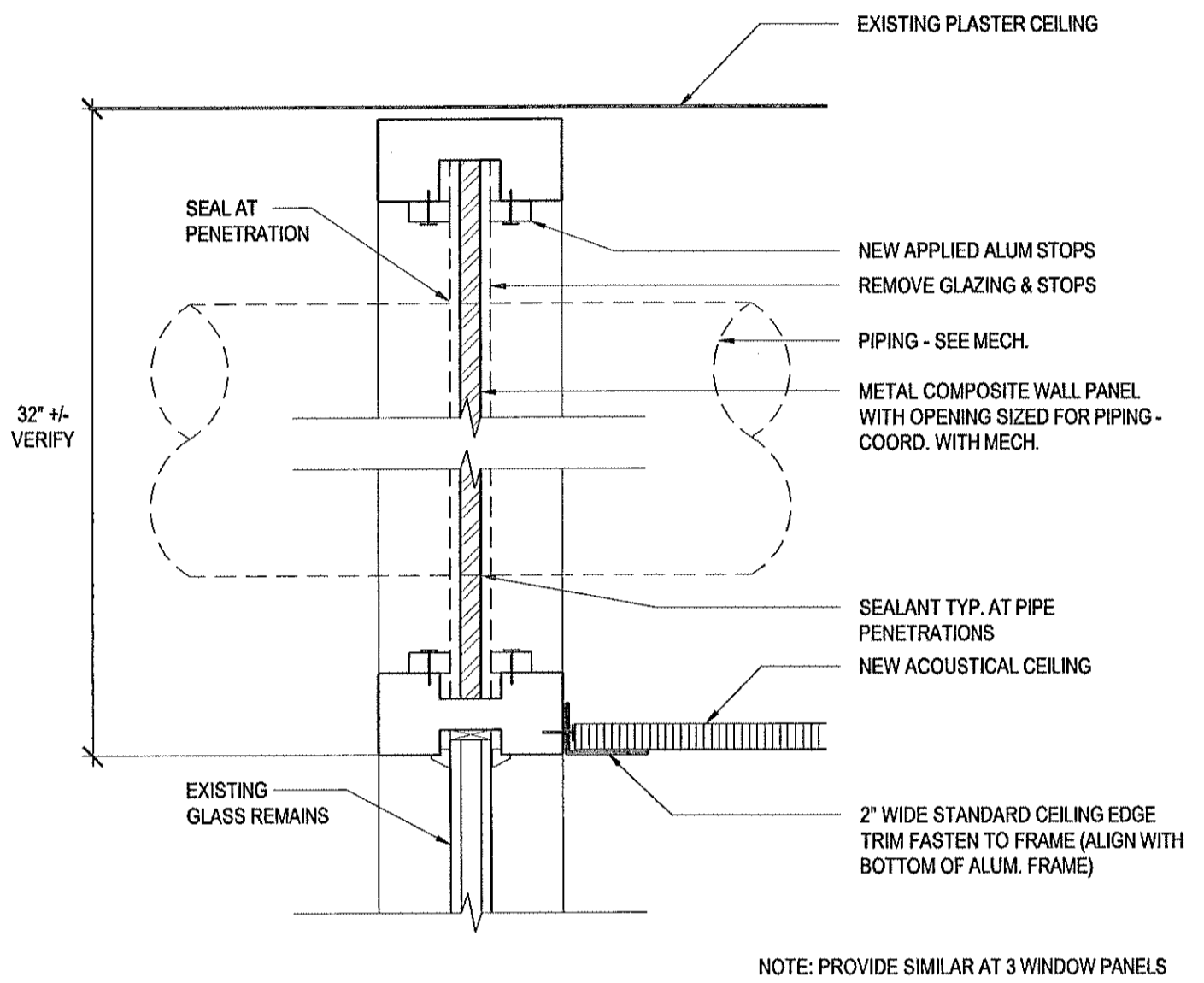
12 PREFAB PIPE ENCLOSURE BRACKETS
SCALE: 3/4"=1'-0"



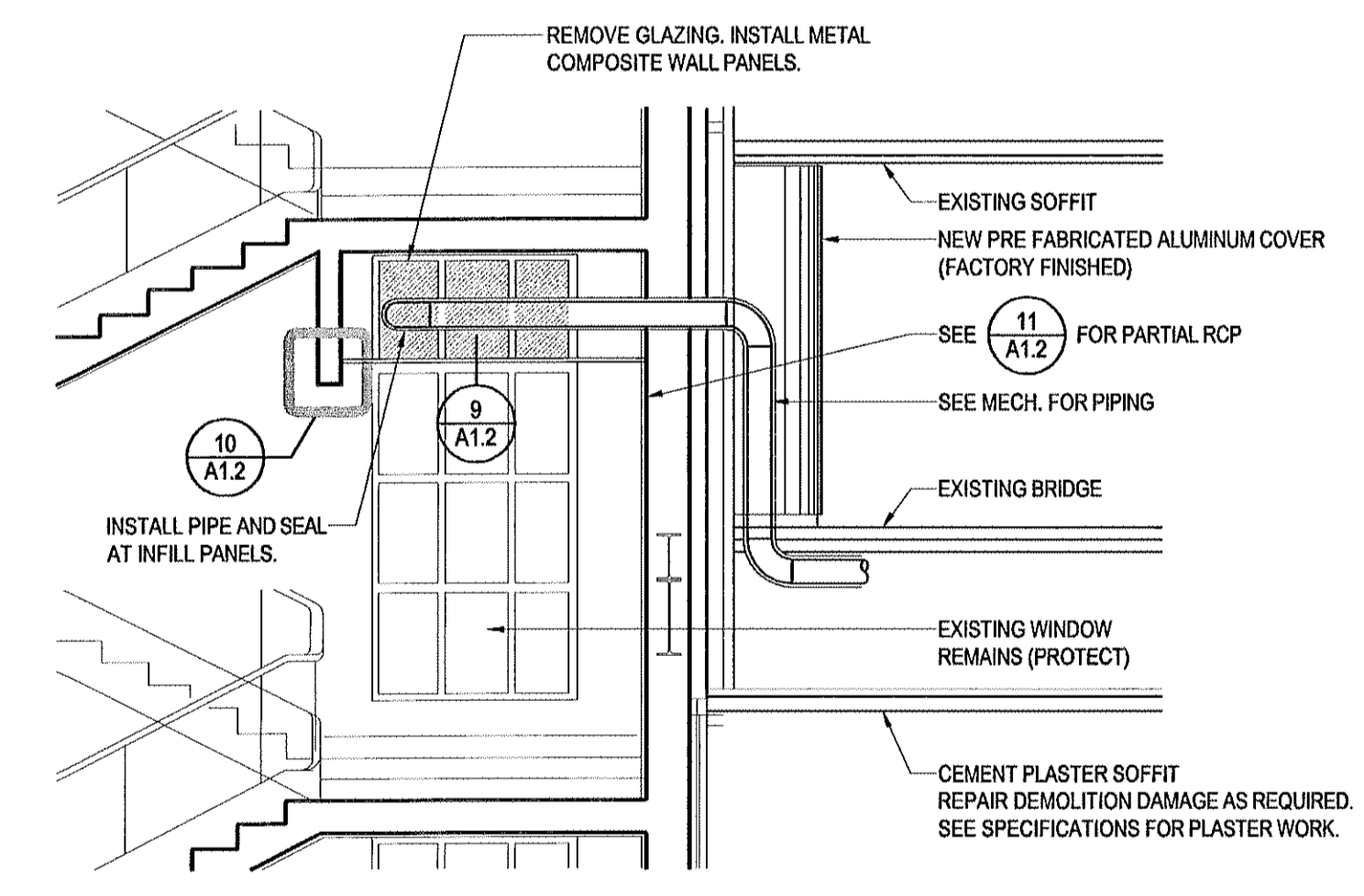
2 ELEVATION AT CRAMER HALL
SCALE: 1/4"=1'-0"



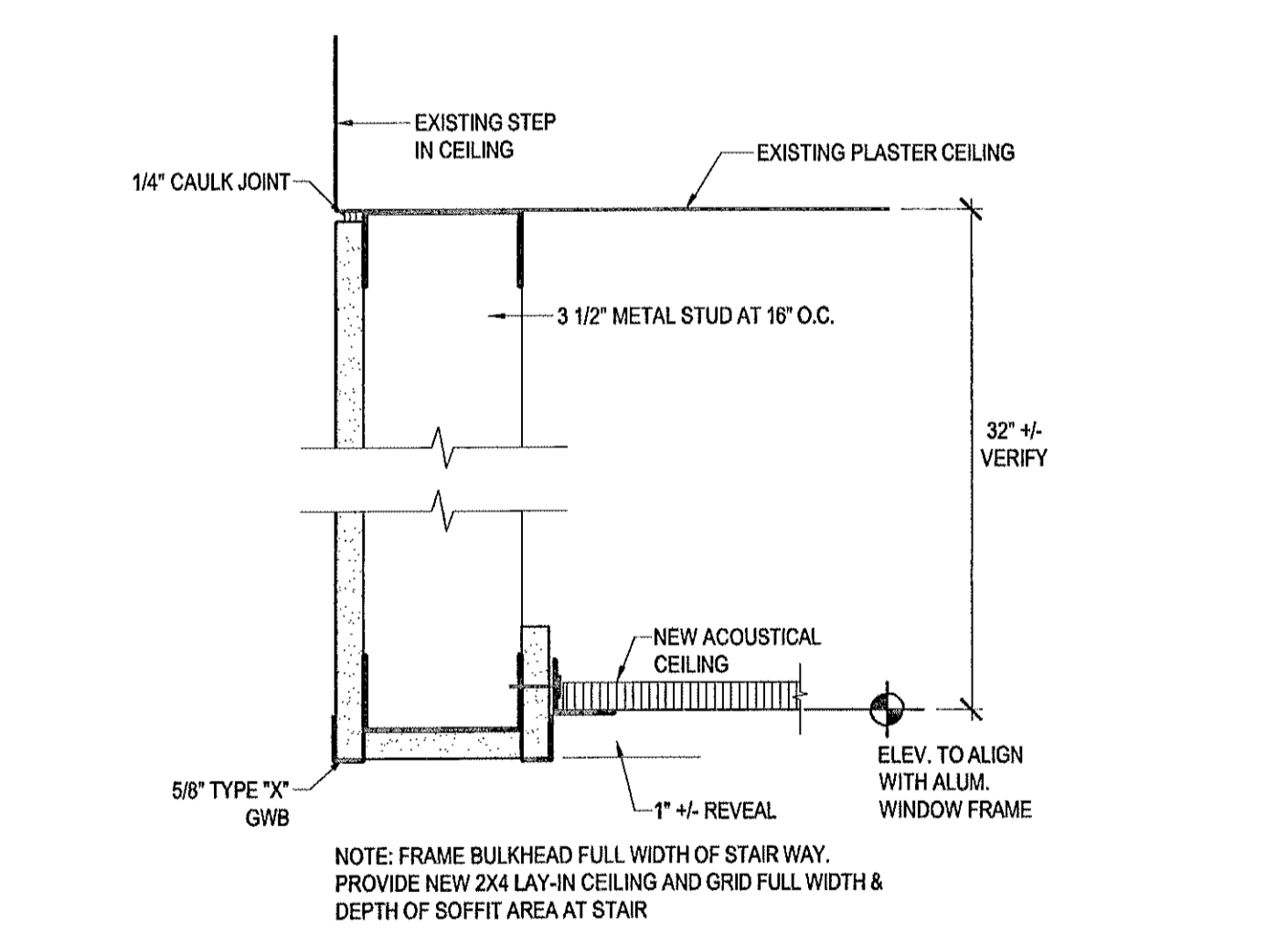
5 ALUM. REVEAL JOINT @ CRAMER
SCALE: 6"=1'-0"



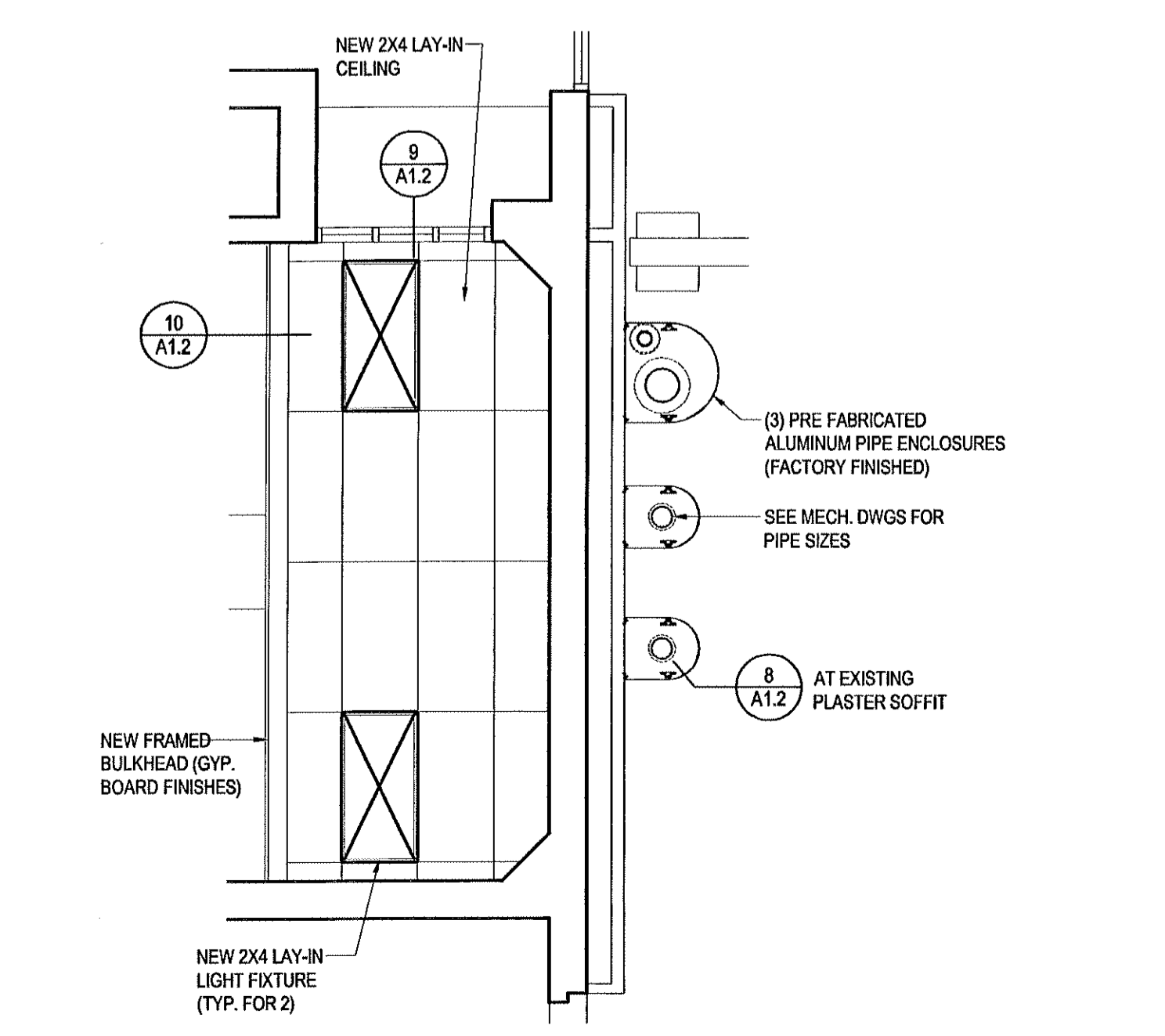
9 PIPE PENETRATION @ WINDOW
SCALE: 3/4"=1'-0"



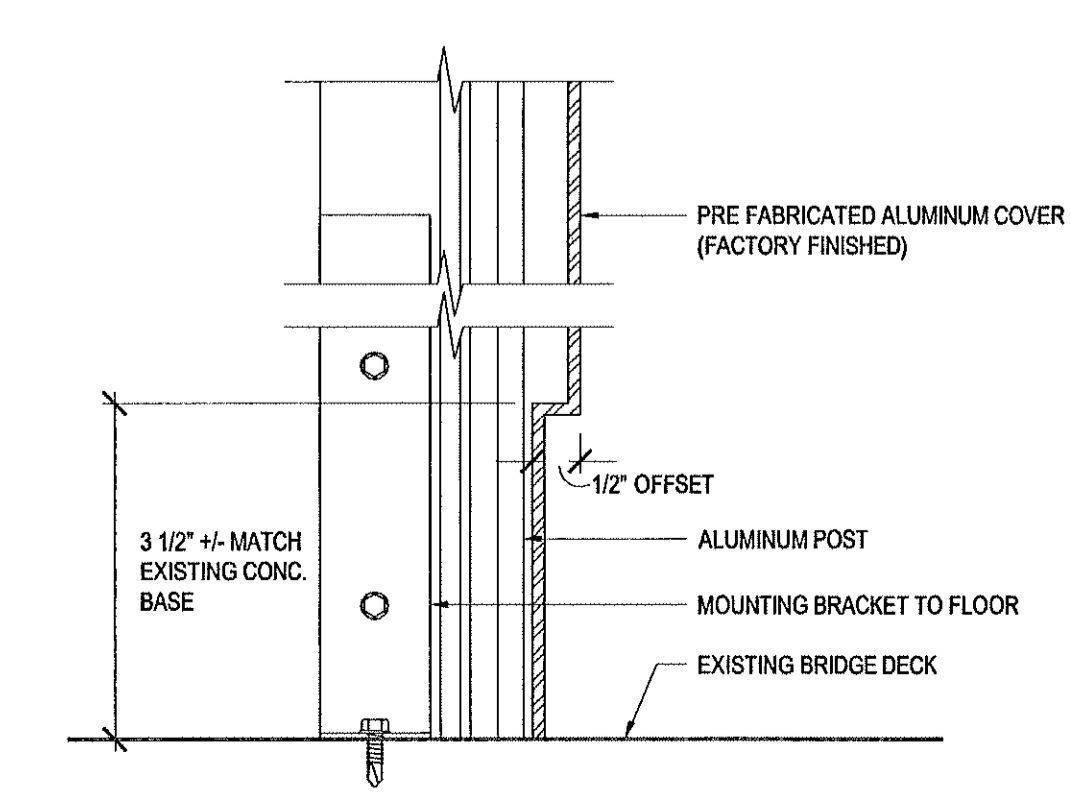
3 NEW SOFFIT AT INTERIOR PIPE RUNS
SCALE: 1/4"=1'-0"



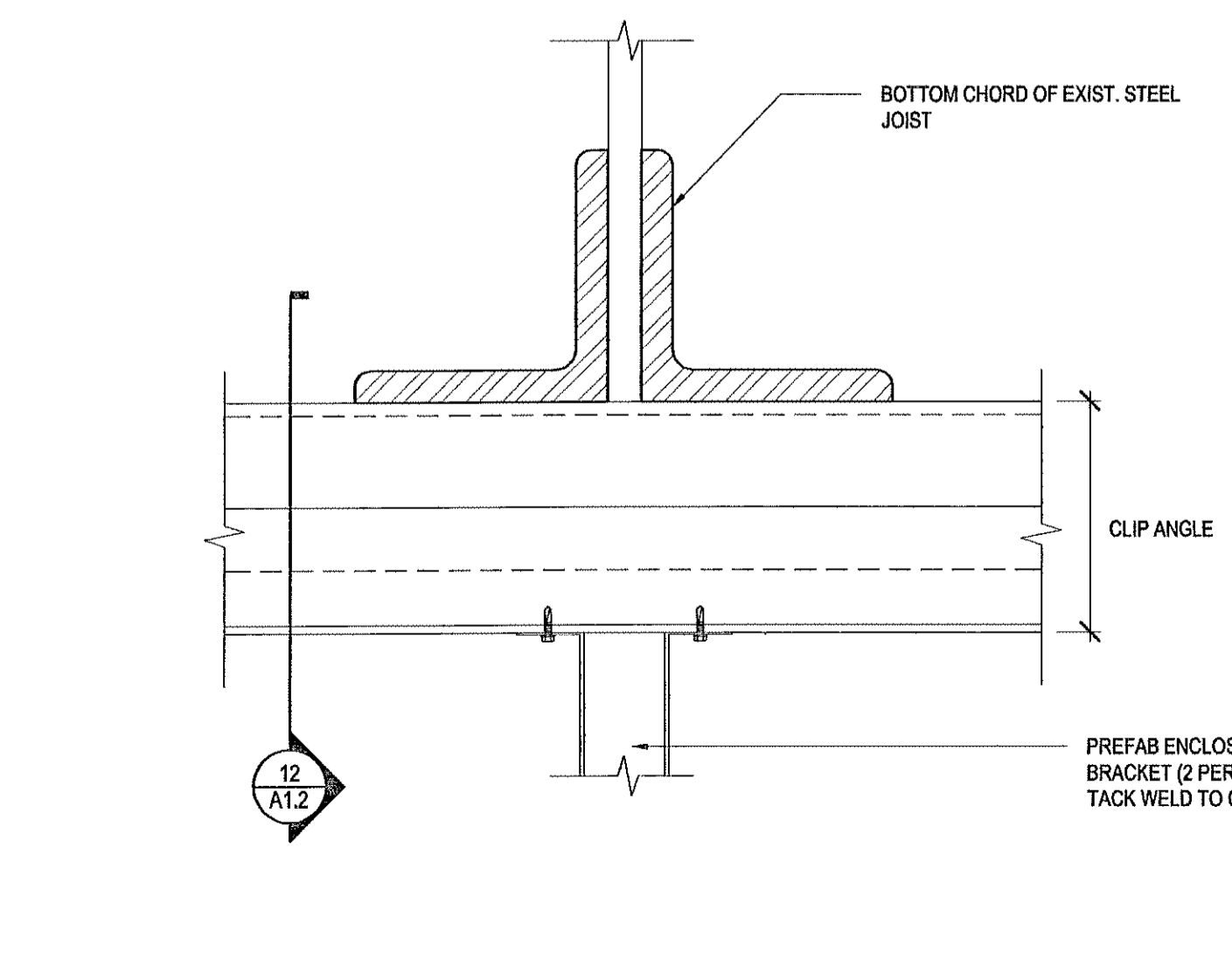
10 CEILING BULKHEAD DETAIL
SCALE: 3/4"=1'-0"



11 REFLECTED CEILING PLAN - CRAMER HALL STAIR
SCALE: 1/4"=1'-0"



7 COVER BASE DETAIL
SCALE: 6"=1'-0"



11 PREFAB PIPE ENCLOSURE BRACKETS
SCALE: 3/4"=1'-0"

1	06/29/08	ISSUED FOR CONSTRUCTION
0	05/23/08	ISSUED FOR BID & PERMIT
no.	date	by
		revisions

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WINZLER & KELLY

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PORTLAND, OR 97224
PH: 503-228-3921 FAX: 503-228-3928

project
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

dwg. title
**Cramer Hall
Pipe Chase Details**

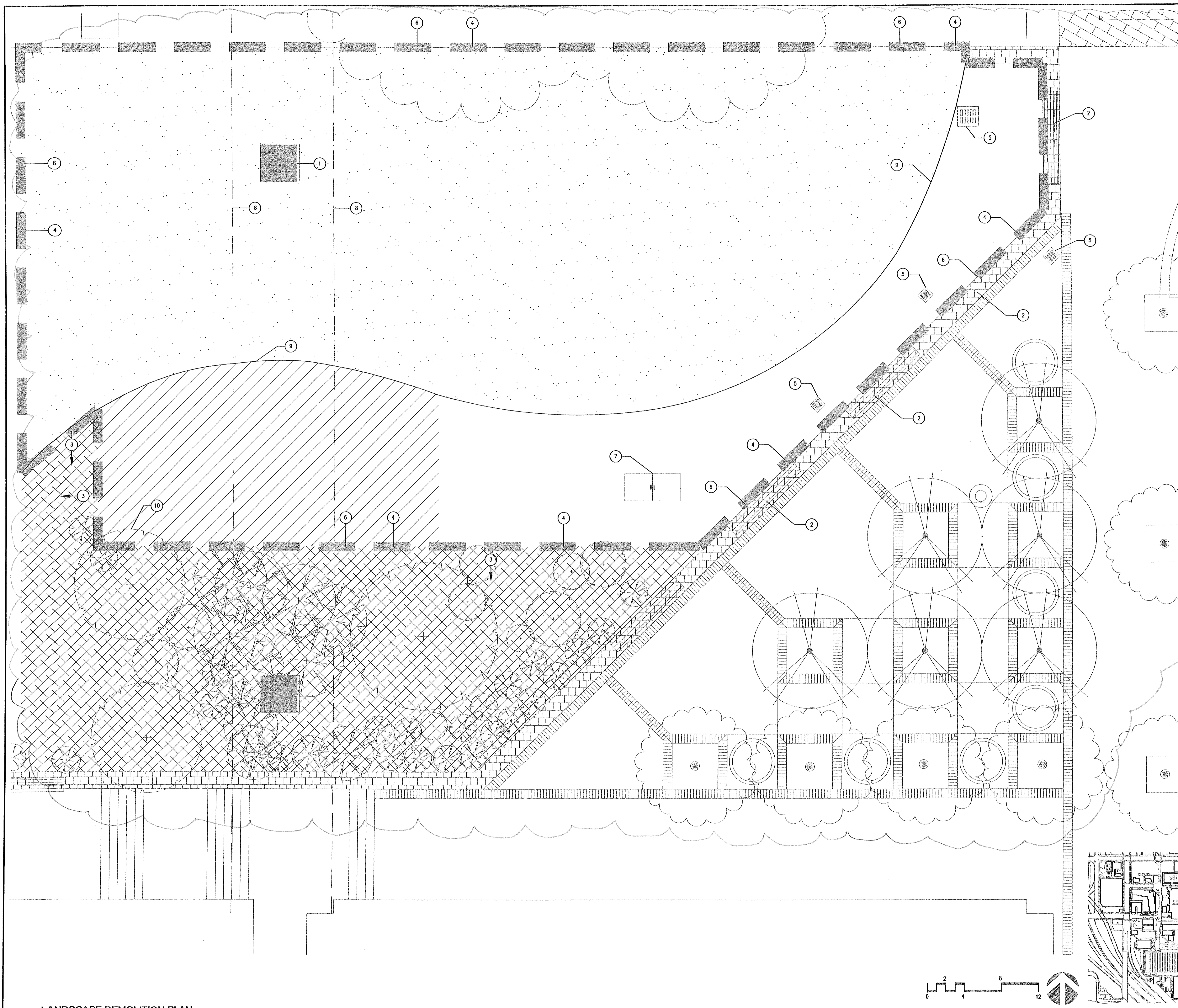
designed	date
drawn	date
approved	date
project no.	
drawing no.	

A1.2

REGISTERED ARCHITECT
PORTLAND, OREGON
STATE OF OREGON

Full Olson Wecker
architects inc.
318 SW WASHINGTON ST. 3RD. PORTLAND, OR 97204
503.228.3921 FAX 503.228.3928

TIME: 12:18:24 DATE: 05/23/08 FILENAME: \\file03\projects\Portland State University\07039 PSU Campus Loop Phase 1\03 Design Phase\Drawings\A102.dwg.DWG



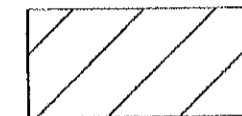



LANDSCAPE DEMOLITION NOTE

- 1 PRESERVE AND PROTECT SKYBRIDGE COLUMN
- 2 PRESERVE AND PROTECT EXISTING SEAT WALL AND BENCH
- 3 PRESERVE AND PROTECT PLANTING BEYOND CONSTRUCTION ZONE
- 4 PROVIDE TEMPORARY CONSTRUCTION FENCING ALONG EDGE OF CONSTRUCTION ZONE.
- 5 PRESERVE AND PROTECT EXISTING AREA DRAINS. PRESERVE OR REPLACE STORM PIPE.
- 6 APPROXIMATE EDGE OF CONSTRUCTION ZONE
- 7 36"x72" ACCESS HATCH TO EXISTING VAULT
- 8 OUTLINE OF EXISTING SKYBRIDGE ABOVE
- 9 LAWN EDGE
- 10 TAKE ALL MEASURES NECESSARY TO PRESERVE AND PROTECT EXISTING REDWOOD TREE.

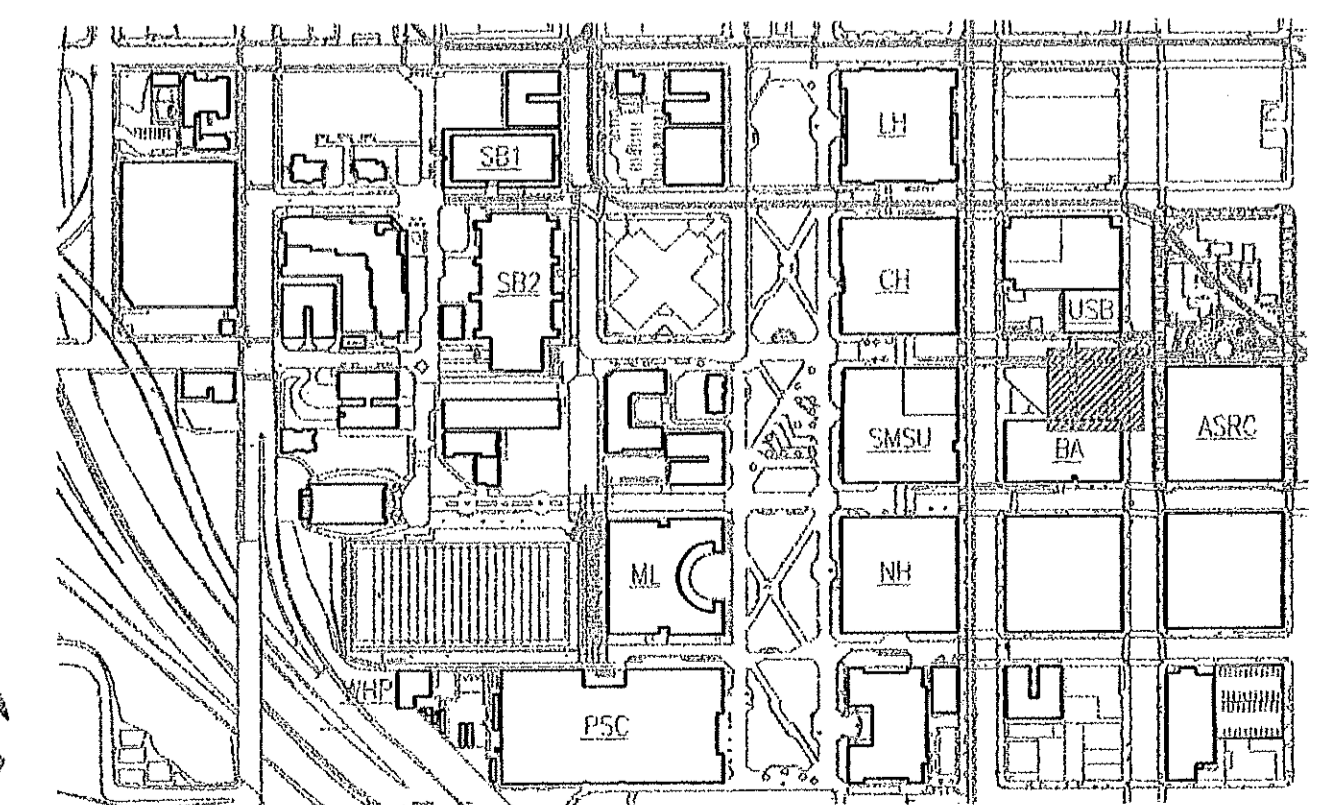
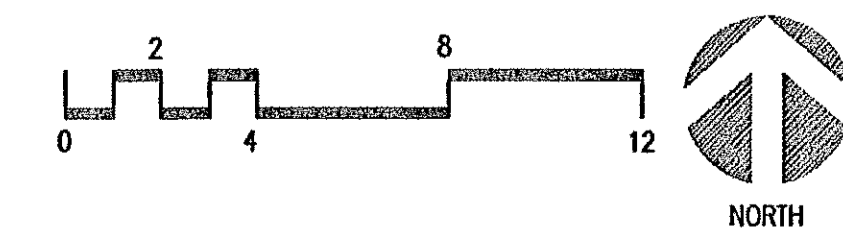
IRRIGATION SYSTEM NOTE

FIELD LOCATE EXISTING IRRIGATION MATERIALS. CUT, CAP, AND MARK LOCATIONS OF ALL IRRIGATION MATERIALS THAT A-BUT CONSTRUCTION ZONE.


LANDSCAPE DEMOLITION LEGEND

-  SALVAGE AND HANDOVER EXISTING PLANTS IN INDICATED AREA TO OWNER.
-  EXISTING PLANTING BED TO BE UNDISTURBED: KEEP ALL CONSTRUCTION ACTIVITIES AND STORAGE OUT OF THIS AREA.
-  EXISTING LAWN
-  EDGE OF CONSTRUCTION ZONE. PROVIDE TEMPORARY CONSTRUCTION FENCING ALL ALONG. PROVIDE ACCESS GATE AS DIRECTED IN FIELD

FUTURE NIC

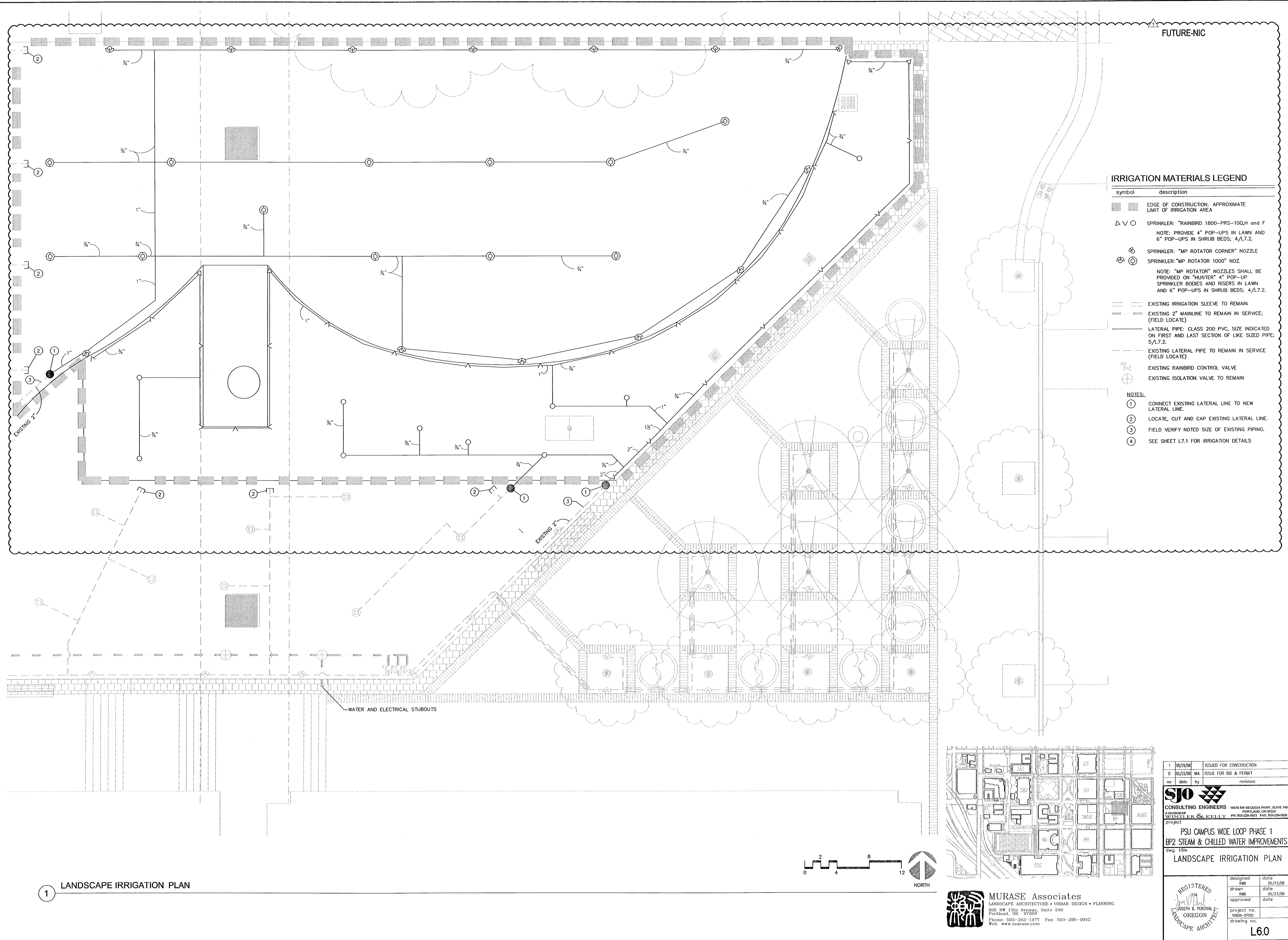


1 LANDSCAPE DEMOLITION PLAN

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no	date	by
		revisions
		
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project PSU CAMPUS WIDE LOOP PHASE 1 BP2 STEAM & CHILLED WATER IMPROVEMENTS dwg. title LANDSCAPE DEMOLITION PLAN		
designed	date	
drawn	date	
approved	date	
project no.		
drawing no.		
L50		

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REGISTERED
 174
 LANDSCAPE ARCHITECT
 JOSEPH & PERONA
 OREGON

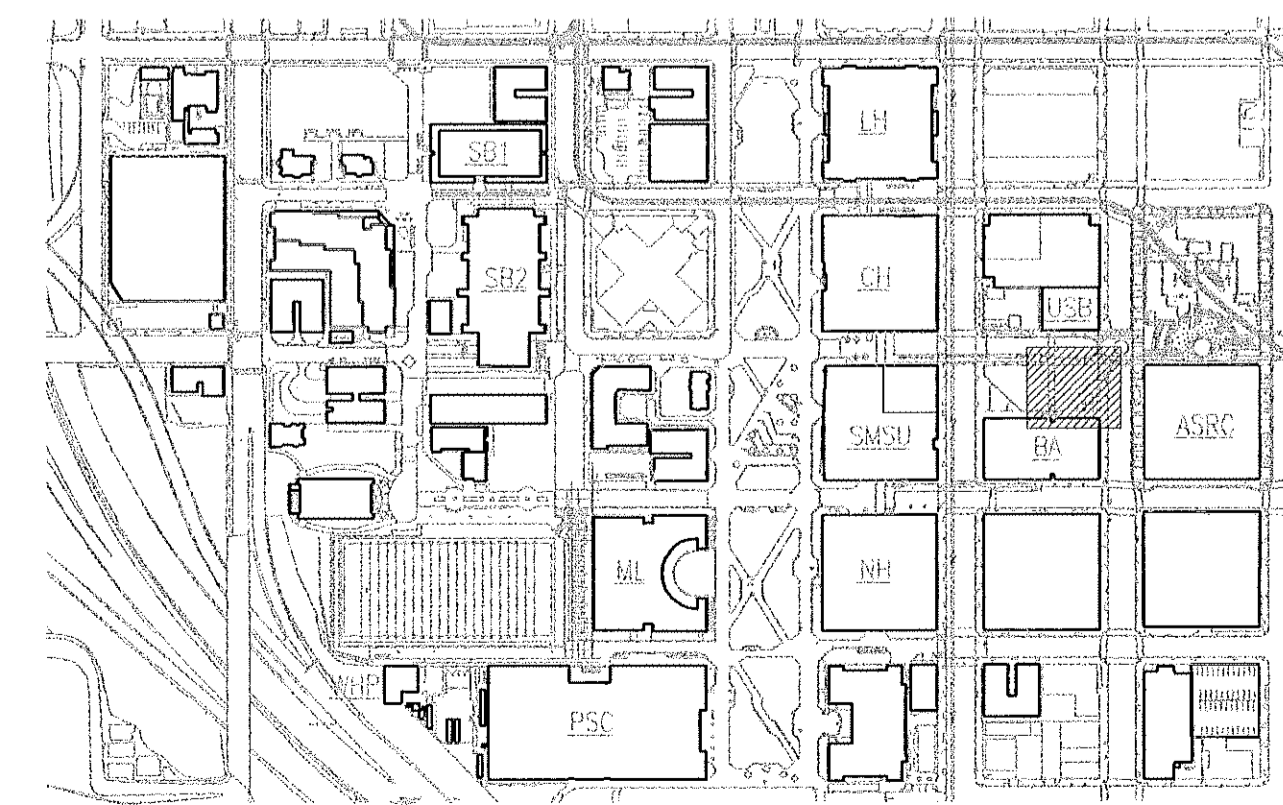
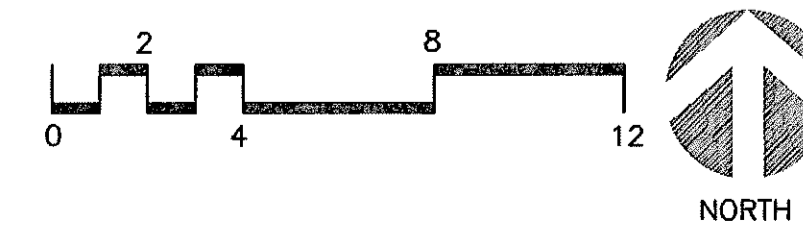


IRRIGATION MATERIALS LEGEND

symbol	description
	EDGE OF CONSTRUCTION: APPROXIMATE LIMIT OF IRRIGATION AREA
	SPRINKLER: "RAINBIRD 1800-PRS-100,H and F" NOTE: PROVIDE 4" POP-UPS IN LAWN AND 6" POP-UPS IN SHRUB BEDS; 4/L7.2.
	SPRINKLER: "MP ROTATOR CORNER" NOZZLE
	SPRINKLER: "MP ROTATOR 1000" NOZ. NOTE: "MP ROTATOR" NOZZLES SHALL BE PROVIDED ON "HUNTER" 4" POP-UP SPRINKLER BODIES AND RISERS IN LAWN AND 6" POP-UPS IN SHRUB BEDS; 4/L7.2.
	EXISTING IRRIGATION SLEEVE TO REMAIN
	EXISTING 2" MAINLINE TO REMAIN IN SERVICE (FIELD LOCATE)
	LATERAL PIPE: CLASS 200 PVC, SIZE INDICATED ON FIRST AND LAST SECTION OF LIKE SIZED PIPE; 5/L7.2.
	EXISTING LATERAL PIPE TO REMAIN IN SERVICE (FIELD LOCATE)
	EXISTING RAINBIRD CONTROL VALVE
	EXISTING ISOLATION VALVE TO REMAIN

- NOTES:**
- CONNECT EXISTING LATERAL LINE TO NEW LATERAL LINE.
 - LOCATE, CUT AND CAP EXISTING LATERAL LINE.
 - FIELD VERIFY NOTED SIZE OF EXISTING PIPING.
 - SEE SHEET L7.1 FOR IRRIGATION DETAILS

1 LANDSCAPE IRRIGATION PLAN



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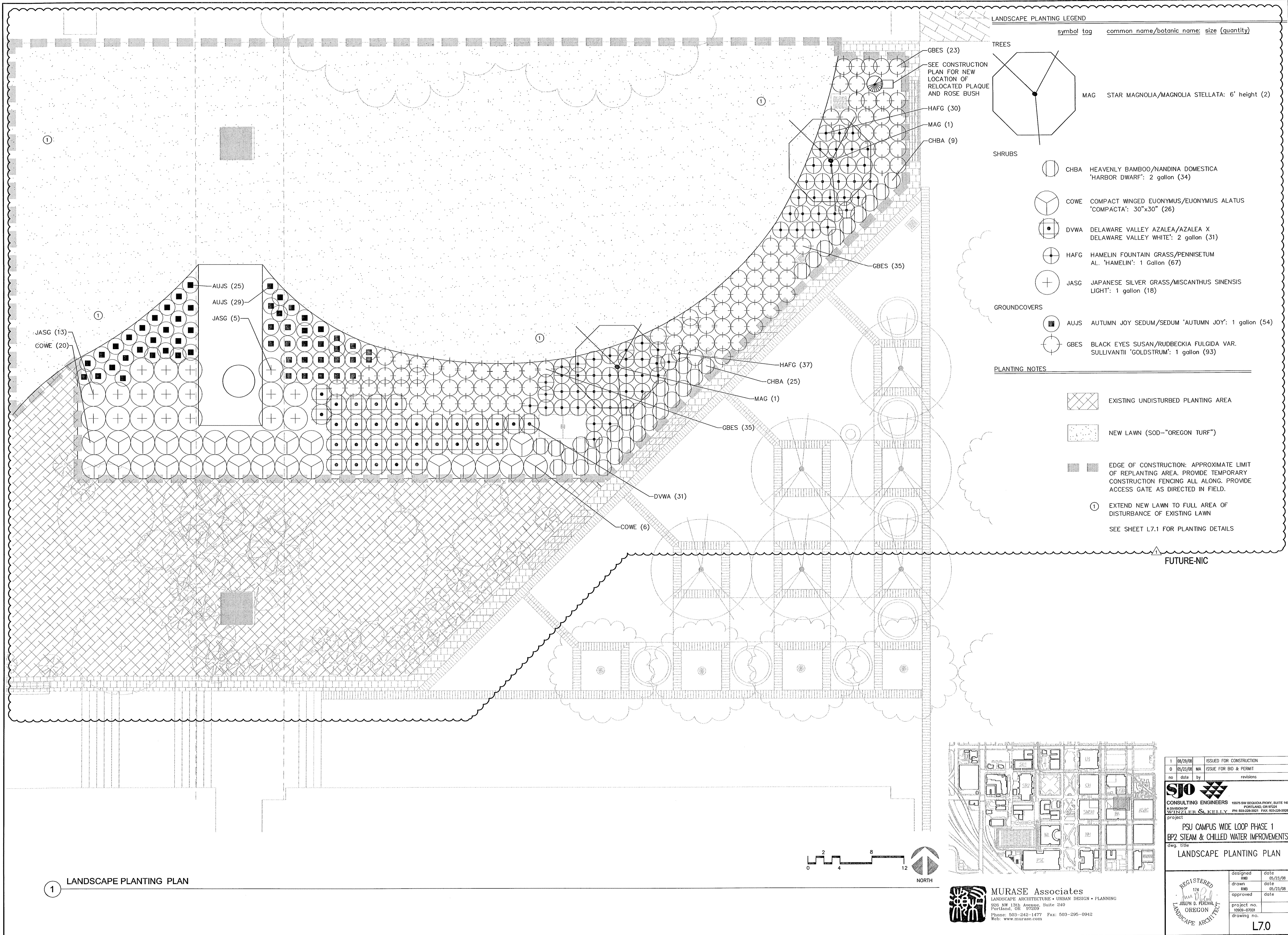
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PORTLAND, OR 97224
PH: 503-228-3821 FAX: 503-228-3828

project
PSU CAMPUS WDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS
dwg. title
LANDSCAPE IRRIGATION PLAN

REGISTERED LANDSCAPE ARCHITECT JOSPH D. PERKINS 10899-07021	designed	date
	drawn	date
	approved	date
Project no.	10899-07021	
drawing no.	L6.0	

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LANDSCAPE PLANTING LEGEND

symbol tag common name/botanic name: size (quantity)

- TREES
- MAG STAR MAGNOLIA/MAGNOLIA STELLATA: 6' height (2)

- SHRUBS
- CHBA HEAVENLY BAMBOO/NANDINA DOMESTICA 'HARBOR DWARF': 2 gallon (34)
 - COWE COMPACT WINGED EUONYMUS/EUONYMUS ALATUS 'COMPACTA': 30"x30" (26)
 - DVWA DELAWARE VALLEY AZALEA/AZALEA X DELAWARE VALLEY WHITE: 2 gallon (31)
 - HAFG HAMELIN FOUNTAIN GRASS/PENNISETUM AL. 'HAMELIN': 1 Gallon (67)
 - JASG JAPANESE SILVER GRASS/MISCANTHUS SINENSIS LIGHT: 1 gallon (18)

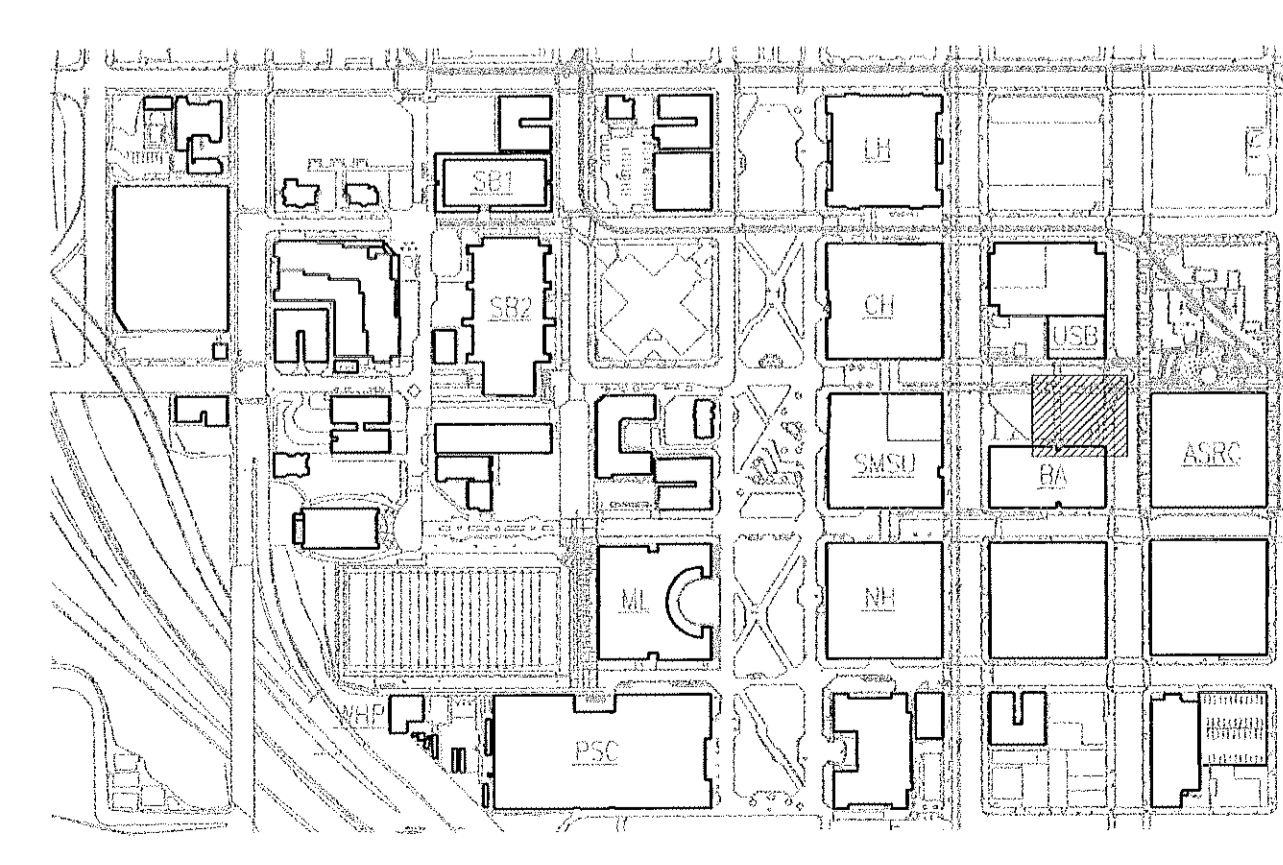
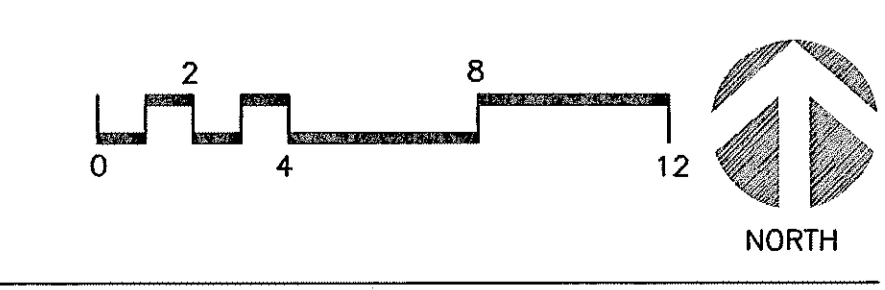
- GROUNDCOVERS
- AUJS AUTUMN JOY SEDUM/SEDUM 'AUTUMN JOY': 1 gallon (54)
 - GBES BLACK EYES SUSAN/RUDEBECKIA FULGIDA VAR. SULLIVANTII 'GOLDSTRUM': 1 gallon (93)

PLANTING NOTES

- EXISTING UNDISTURBED PLANTING AREA
- NEW LAWN (SOD-"OREGON TURF")
- EDGE OF CONSTRUCTION: APPROXIMATE LIMIT OF REPLANTING AREA. PROVIDE TEMPORARY CONSTRUCTION FENCING ALL ALONG. PROVIDE ACCESS GATE AS DIRECTED IN FIELD.
- ① EXTEND NEW LAWN TO FULL AREA OF DISTURBANCE OF EXISTING LAWN
SEE SHEET L7.1 FOR PLANTING DETAILS

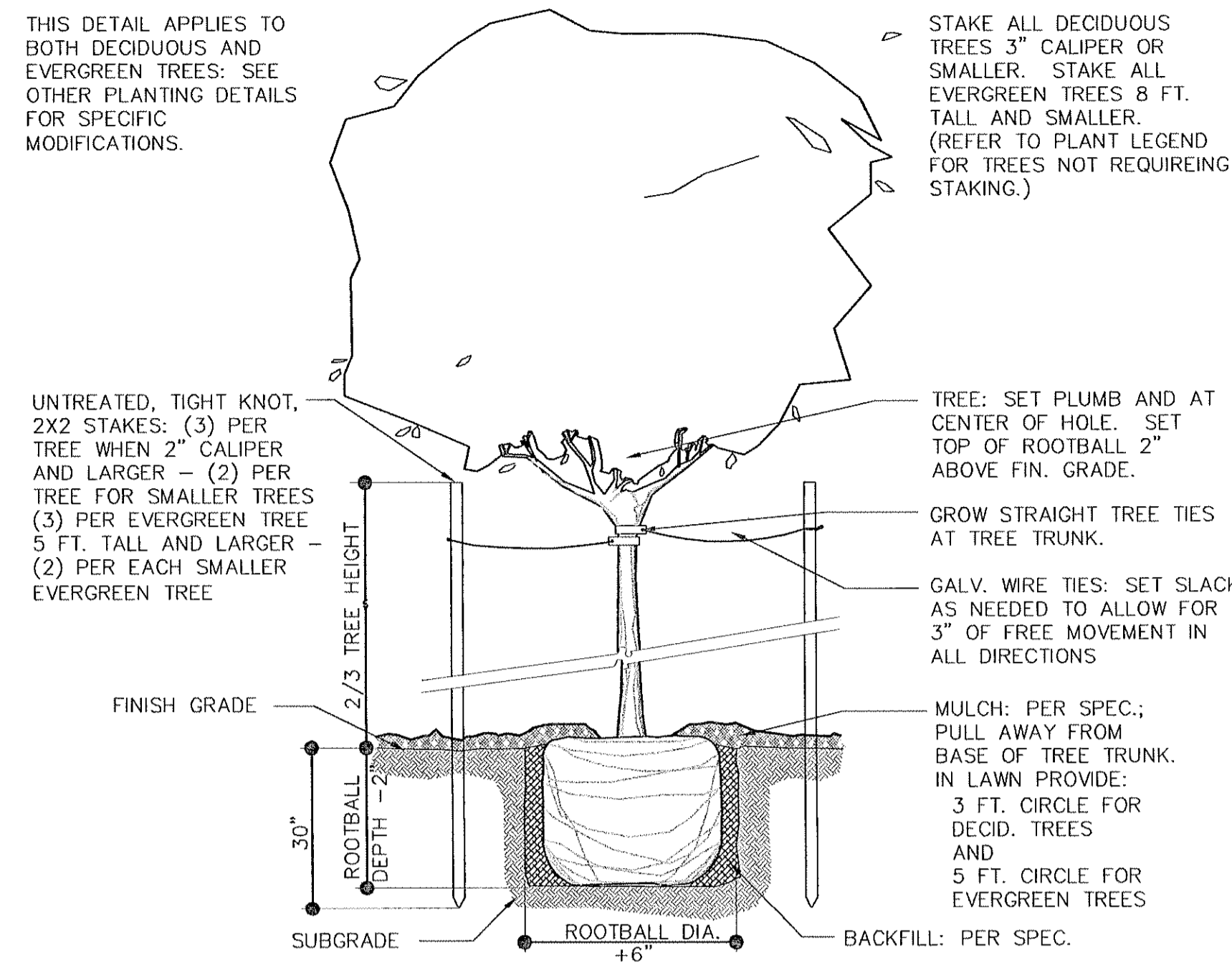
FUTURE-NIC

1 LANDSCAPE PLANTING PLAN



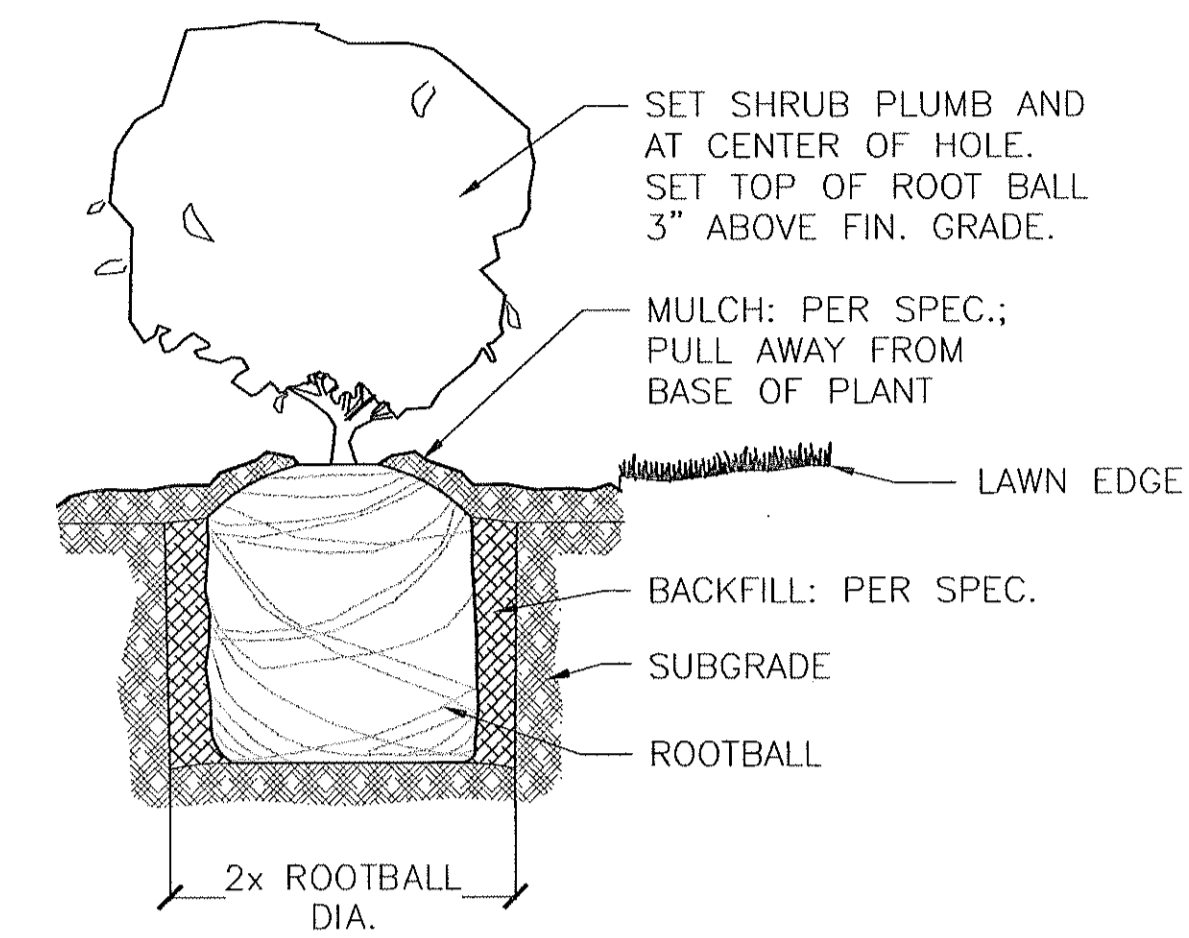
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project PSU CAMPUS WIDE LOOP PHASE 1 BP2 STEAM & CHILLED WATER IMPROVEMENTS		
dwg. title LANDSCAPE PLANTING PLAN		
designed	date	
RB	05/23/08	
drawn	date	
RB	05/23/08	
approved	date	
project no.		
10009-07001		
drawing no.		
L7.0		

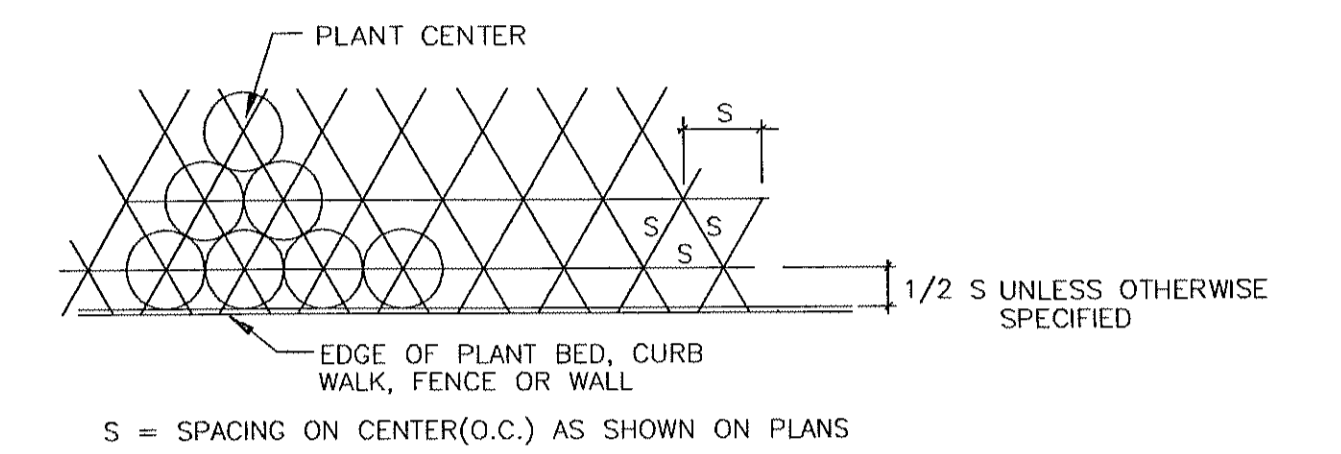


1 TREE STAKING AND PLANTING
n.t.s. DP-003a.dwg

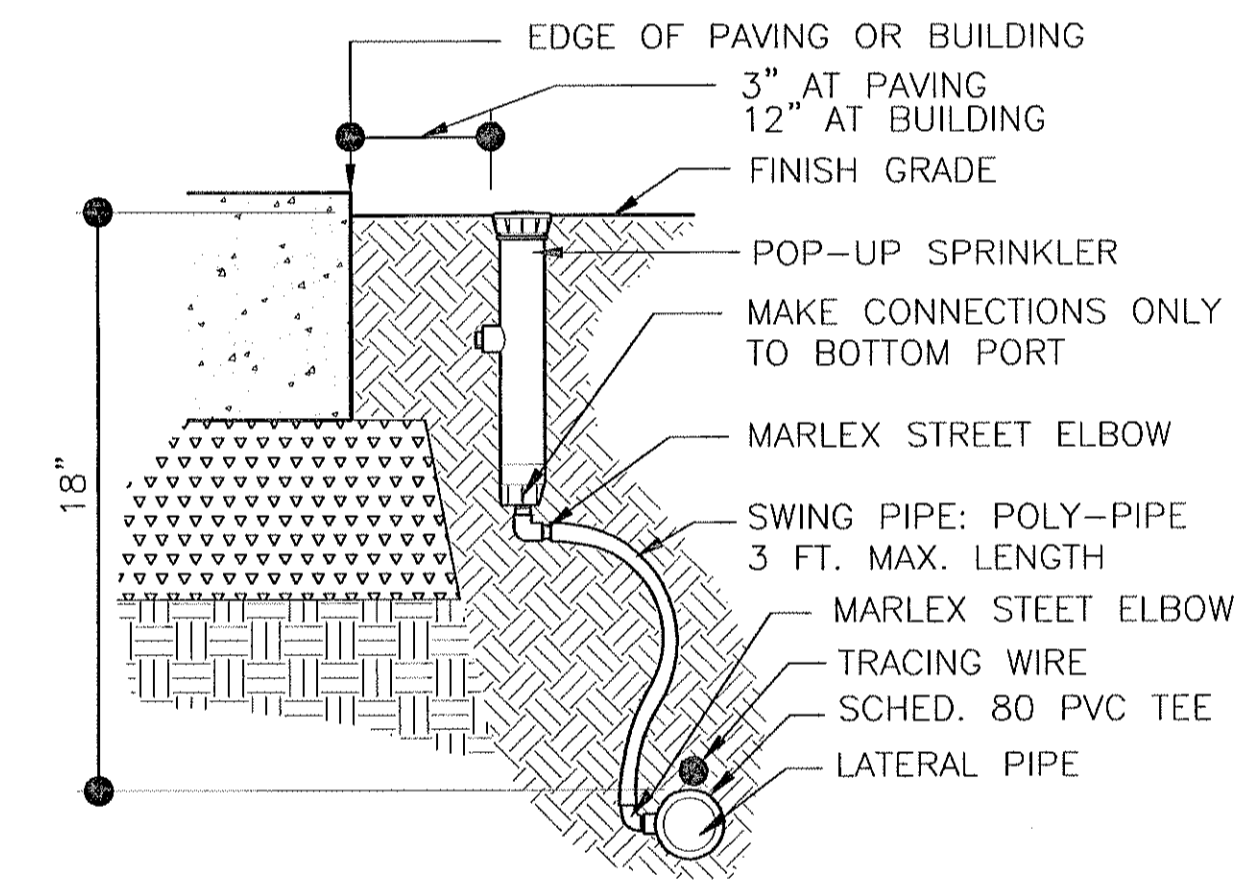
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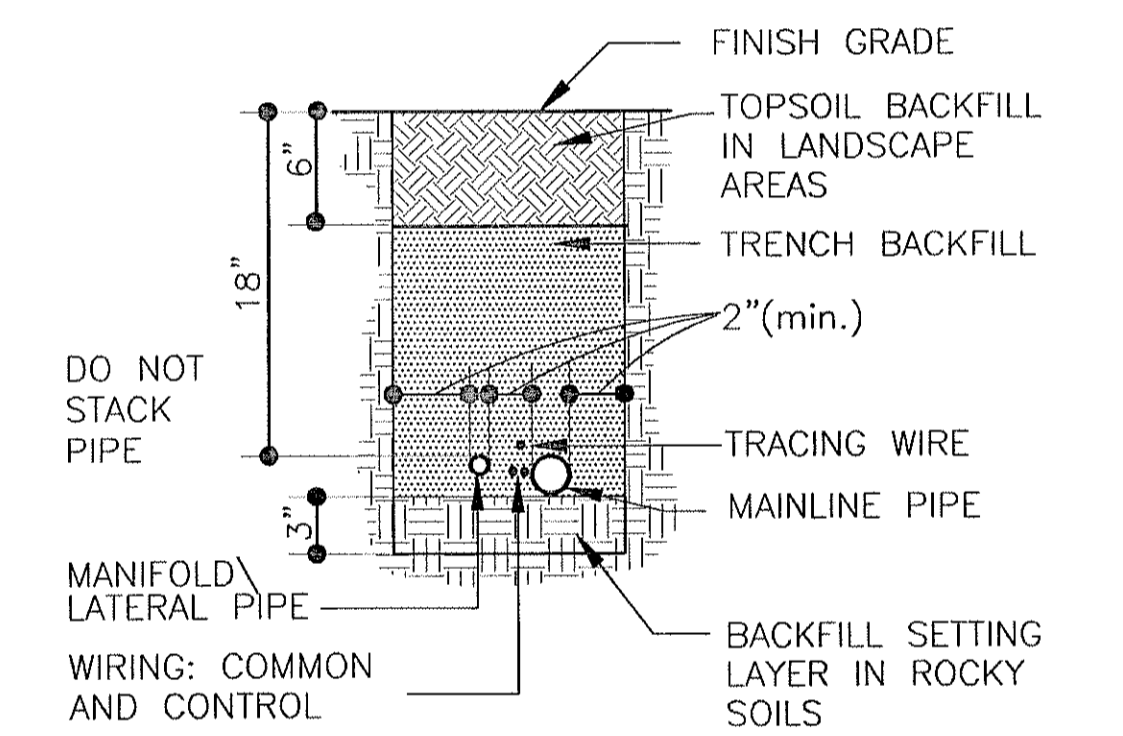
2 SHRUB PLANTING DETAIL
n.t.s. DP-001a.dwg



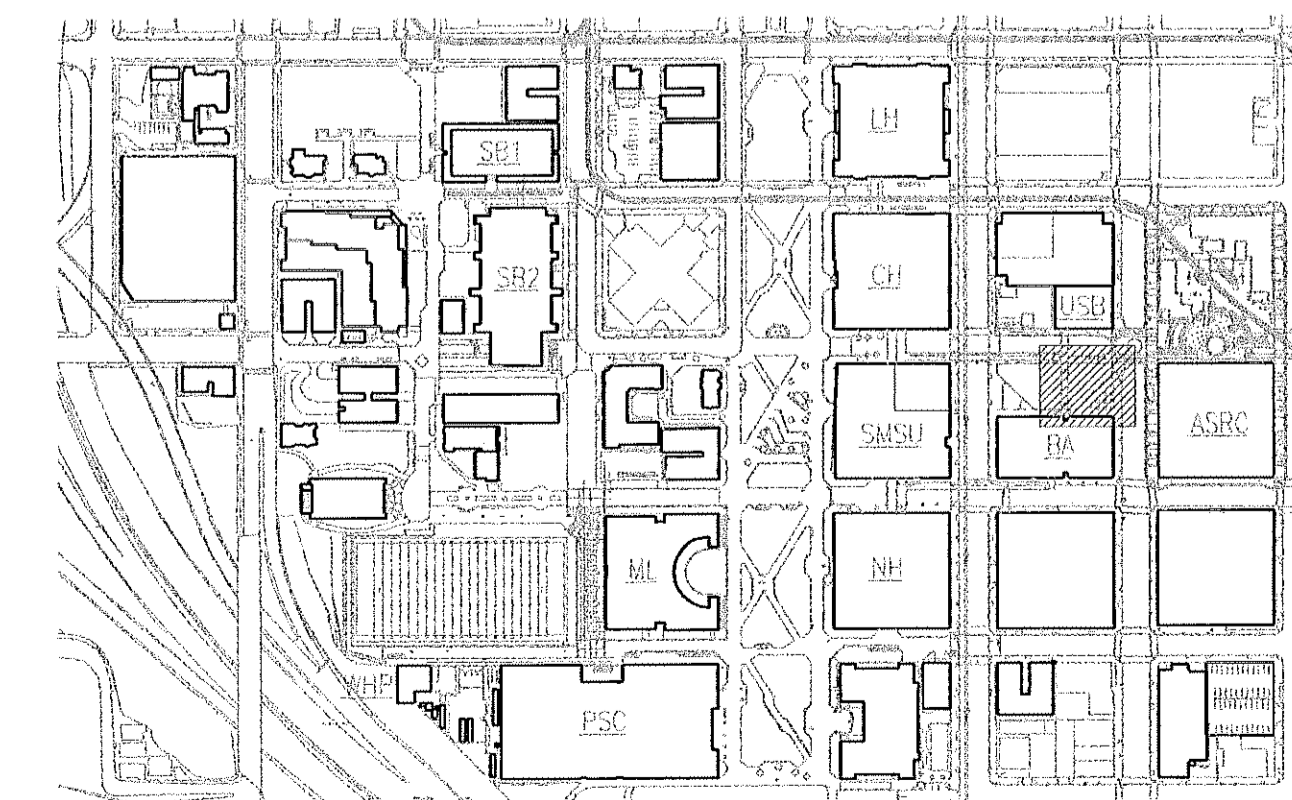
3 PLANT SPACING PLAN
n.t.s. DP-002u.dwg



4 SPRINKLER (typical)
n.t.s.



5 IRRIGATION TRENCH SECTION
n.t.s.



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project		
PSU CAMPUS WIDE LOOP PHASE 1		
BP2 STEAM & CHILLED WATER IMPROVEMENTS		
dwg. title		
LANDSCAPE PLANTING AND IRRIGATION DETAILS		
designed	date	
drawn	date	
approved	date	
project no.		
drawing no.		
L7.1		

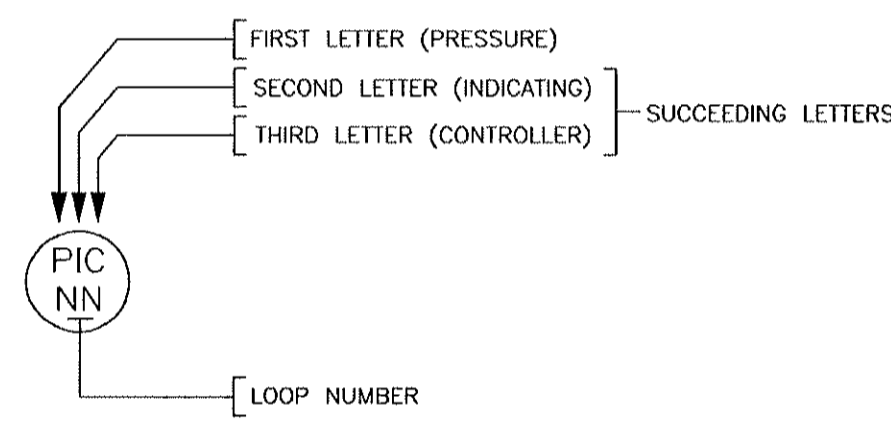
PROCESS PIPING LEGENDS AND ABBREVIATIONS

INSTRUMENT SOCIETY OF AMERICA TABLE

	FIRST LETTER(S)		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
C	CONDUCTIVITY			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL		DAMPER	
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			
G	USERS CHOICE(*)		GLASS, GAUGE		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE	RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	USERS CHOICE(*)		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
O	USERS CHOICE(*)		ORIFICE		
P	PRESSURE (OR VACUUM)		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT(*)	INTEGRATE			
R	RADIATION		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE(*)		MULTIFUNCTION(*)	MULTIFUNCTION(*)	MULTIFUNCTION(*)
V	VIBRATION			VALVE	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED(*)		UNCLASSIFIED(*)	UNCLASSIFIED(*)	UNCLASSIFIED(*)
Y	EVENT, STATE OR PRESENSE			RELAY OR COMPUTE(*)	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

INSTRUMENTATION ABBREVIATION



EXAMPLES

- LS - LEVEL SWITCH
- LT - LEVEL TRANSMITTER
- LI - LEVEL INDICATING TRANSMITTER
- RY - TIME DELAY RELAY

TYPICAL INSTRUMENT ABBREVIATIONS (THIS WORK)

- OGA - GAS LEVEL SENSOR/TRANSMITTER
- NIT - BTU INDICATING TRANSMITTER

INSTRUMENT/SIGNAL LEGEND

- — — ELECTRONIC: DISCRETE
- A — — ELECTRONIC: ANALOG
- PF — — ELECTRONIC: PULSE FREQUENCY
- (2) — — INDICATES TWO SIGNALS TYP
- P — — PNEUMATIC
- H — — HYDRAULIC
- PI O — FIELD MOUNTED COMPONENT
- PI D — PANEL MOUNTED COMPONENT
- PI G — BACK PANEL MOUNTED COMPONENT
- PI O — AUX. LOCATION MOUNTED COMPONENT
- PI O — AUX. LOCATION BACK PANEL COMPONENT
- PI O — SHARED DISPLAY, SHARED CONTROL FIELD MOUNTED
- PI O — SHARED DISPLAY, SHARED CONTROL PRIMARY LOCATION
- PI O — SHARED DISPLAY, SHARED CONTROL AUX. LOCATION
- PI O — PLC INPUT OR OUTPUT
- PI O — PLC AUXILIARY PANEL
- R O — COMPUTER FUNCTION
- I — INTERLOCK
- O — FLOW RATE POINT
- TB — TERMINAL BOX

PIPE SUPPORT TAG LEGEND

DESIGNATIONS FOR DETAIL AND GENERAL LOCATIONS OF PIPE SUPPORTS

- A — PIPE ANCHOR
- G — PIPE GUIDE
- H — HANGER
- RG — ROLLER GUIDE
- RS — ROLLER SUPPORT
- S — VERTICAL SUPPORT
- SH — SPRING HANGER ASSEMBLY
- (XXX) — INDICATE KNOWN LOADS TO BE SUPPORTED

ACTUATOR LEGEND

- SYMBOL DESCRIPTION
- P — PNEUMATIC
- PZ — PNEUMATIC WITH POSITIONER
- PS — PNEUMATIC WITH SOLENOID
- E — ELECTRIC
- EZ — ELECTRIC W/ POSITIONER WITH AIR SET
- H — HYDRAULIC
- M — DIAPHRAGM
- M — MOTORIZED
- OS & Y — OUTSIDE SCREW & YOKE (OS & Y)
- MO — MANUAL CHAIN OPERATOR
- AS — AIR SET WITH SET GAUGE PRESSURE
- PSI — PRESSURE REGULATING W/ PRESS. INDICATOR

SYMBOL LEGEND

- S — SOLENOID VALVE
- CV — CHECK VALVE
- BCV — BALL CHECK VALVE
- WCV — WAFFER CHECK VALVE
- GV — GATE VALVE
- NCV — GATE VALVE (NORMALLY CLOSED)
- BV — BALL VALVE
- NCBV — BALL VALVE (NORMALLY CLOSED)
- DV — DIAPHRAGM VALVE
- NCDV — DIAPHRAGM VALVE (NORMALLY CLOSED)
- GV — GLOBE VALVE
- BFV — BUTTERFLY VALVE
- 3WV — 3 WAY VALVE
- BV — BALANCING VALVE
- TDV — TRIPLE DUTY VALVE
- PLV — PLUG VALVE
- PRV — PRESSURE REGULATOR VALVE
- RPRV — REDUCED PRESSURE BACKFLOW PREVENTER
- HR — HIGH POINT AIR VENT (AAV)
- F — FLANGE
- U — UNION
- ID — ISOLATION DIAPHRAGM
- MC — MALE HOSE CONNECTION
- FC — FEMALE HOSE CONNECTION
- RT — ROTAMETER
- F — FILTER
- FH — FLEXIBLE HOSE
- LD — LEAK DETECTOR
- CS — COVER SWITCH
- POC — POINT OF CONNECTION
- DL — DRIP LEG
- FR — FILTER, REGULATOR
- HB — HOSE BIBB
- T — TRAP
- M — MOTOR
- PS — CONDENSATE PUMP STATION
- DM — DISC METER
- TM — TURBINE METER
- VM — VORTEX METER
- SD — SUCTION DIFFUSER
- PP — PETE'S PLUG
- ITM — INSERTION TURBINE METER

ABBREVIATIONS

- AB — ADDITIVE BID ITEM
- AAV — AUTOMATIC AIR VENT
- AFF — ABOVE FINISHED FLOOR
- BOI — BOTTOM OF INSULATION
- BOP — BOTTOM OF PIPE
- BOS — BOTTOM OF SLUMP/STEEL
- BR — BOILER
- BW — BUTT WELD
- CFCI — CONTRACTOR FURNISHED CONTRACTOR INSTALLED
- CH — CHILLER
- CO — CLEANOUT
- CS — CARBON STEEL
- DN — DOWN
- ESO — EMERGENCY SHUT-OFF
- EWS — EMERGENCY EYEWASH/SHOWER
- EXIST — EXISTING
- FC — FAIL CLOSE
- FLG — FLANGE
- FLP — FAIL LAST POSITION
- FO — FAIL OPEN
- FR — FILTER/REGULATOR
- FRL — FILTER/REGULATOR/LUBRICATOR
- HT — HEAT TRACE
- INS — INSULATION
- LVL — LEVEL
- NC — NORMALLY CLOSED
- NC — NOT-IN-CONTRACT
- NO — NORMALLY OPEN
- NR — NOT REQUIRED
- OFCI — OWNER FURNISHED CONTRACTOR INSTALLED
- OFIO — OWNER FURNISHED OWNER INSTALLED
- PSV — PRESSURE SAFETY VALVE
- POC — POINT OF CONNECTION
- RF — RAISED FACE
- SP — SETPOINT
- STL — STEEL
- SS — STAINLESS STEEL
- SST — SANITARY STAINLESS STEEL
- SW — SOCKET WELD
- TBD — TO BE DETERMINED
- TOP — TOP OF PIPE
- (D) — DEMO
- (E) — EXISTING
- (F) — FUTURE
- (N) — NEW
- (R) — RELOCATED

FLUID IDENTIFICATION

- BFW — BOILER FEED WATER
- CA — COMPRESSED AIR
- CWS — CHILLED WATER SUPPLY
- CWR — CHILLED WATER RETURN
- CWR SEC — CHILLED WATER RETURN SECONDARY
- CNWS — CONDENSOR WATER SUPPLY
- CNWR — CONDENSOR WATER RETURN
- CR — CONDENSATE RETURN
- DHW — DOMESTIC HOT WATER
- DHWR — DOMESTIC HOT WATER RETURN
- DR — DRAIN
- DW — DOMESTIC WATER
- FOR — FUEL OIL RETURN
- FOS — FUEL OIL SUPPLY
- HPS — HIGH PRESSURE STEAM
- HW — HOT WATER
- HWR — HOT WATER RETURN
- IA — INSTRUMENT AIR
- LPS — LOW PRESSURE STEAM
- NG — NATURAL GAS
- OF — OVERFLOW
- PCR — PUMPED CONDENSATE RETURN
- WW — WELL WATER
- WWR — WELL WATER RETURN

PSU BUILDING IDENTIFICATION

- AB — ART BUILDING
- BH — THE BROADWAY
- BLKS — BLACKSTONE
- CR — CRAMER HALL
- CLY — CLAY STREET BUILDING
- CPL — CARPOOL PARKING LOT
- CPSO — CAMPUS SECURITY BUILDING
- ED — ENGINEERING BUILDING
- ED — SCHOOL OF EDUCATION (GRADUATE)
- EH — EAST HALL
- FAB — FORTH AVENUE BUILDING
- FBC — FIFTH AVENUE BUILDING
- HCCD — HELEN GORDON CHILD DEVELOPMENT CENTER
- HH — HARDER HOUSE
- HOFF — GEORGE C. HOFFMANN HALL
- HSB — HARRISON STREET BUILDING
- KHSE — KONOHA HOUSE
- KA — KING ALBER BUILDING
- LH — LINCOLN HALL
- LIB-E — LIBRARY EAST (SMSU)
- ML — MURPHY PRICE MILLAR LIBRARY
- MONT — MONTGOMERY COURT
- NASC — NATIVE AMERICAN STUDENT & COMMUNITY CENTER
- NH — NEUBERGER HALL
- OND — ONDINE RESIDENCE
- PCAT — PORTLAND CENTER FOR ADVANCED TECHNOLOGY
- PKWY — PARKWAY BUILDING
- PS1 — PARKING 1
- PS2 — PARKING 2
- PS3 — PARKING 3
- PSC — PETER W. STOTT CENTER
- SB1 — SCIENCE 1
- SB2 — SCIENCE 2
- SBA — SCHOOL OF BUSINESS ADMINISTRATION
- SBS — SIMON BENSON HOUSE
- SEAS — SEAS ANEX (AKA CECS ANNEX)
- SH — SHATTUCK HALL
- SH — STEPHEN E. EPFLER HALL
- SMSU — SMITH MEMORIAL STUDENT UNION
- STFD — STRATFORD BUILDING
- STHL — SAINT HELENS BUILDING
- UCB — UNIVERSITY CENTER BUILDING
- UBP — UNIVERSITY HONOR PROGRAM
- UP — UNIVERSITY PLACE
- URBN — URBAN CENTER
- USB — UNIVERSITY SERVICES BUILDING
- LITS/UNT — LITLITUS BUILDING
- WH — WEST HALL
- WHP — WEST HEATING PLANT
- XSB — SCHOOL OF EXTENDED STUDIES

PIPING TAGS

- XX" XXX — FLUID PIPE SIZE
- (D) — DEMO PIPE - AND/OR SHOWN HATCHED
- (E) — EXISTING PIPE - AND/OR SHOWN LIGHT
- (N) — INDICATES NEW PIPE - AND/OR SHOWN BOLD
- (F) — INDICATES FUTURE PIPE - AND/OR SHOWN LIGHT

PIPE LINE LEGEND

- — — NEW (BOLD)
- — — PRIMARY EXIST/FUTURE (LIGHT)
- — — INSULATED
- x - x - x - HEAT TRACED & INSULATED

VALVE TAGS

- XX — VALVE IDENTIFICATION NUMBER

1	08/29/08	ISSUED FOR CONSTRUCTION
0	05/23/08	ISSUED FOR BID & PERMIT
no.	date	by
		revisions

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project
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

dwg. title
**MECHANICAL
LEGEND, SYMBOLS, ABBREVIATIONS**

designed	date
drawn	date
mtc	10/06/07
approved	date
project no.	
10009-07001	
drawing no.	

EXPIRES: 12/31/09 **MO.1**

NOTE: NOT ALL SYMBOLS & ABBREVIATIONS USED.

UTILITY PIPING AND INSULATION SCHEDULE																								
SYSTEM ID	SERVICE	LOCATION	SIZE	DESIGN PRESS. PSIG	DESIGN TEMP. F	PIPE SPECIFICATIONS					FITTING SPECIFICATIONS					INSULATION TYPE		PRESSURE TEST PROCEDURE						
						MAT'L	ASTM STD.	GRADE / PROC. TYPE	WALL THK.	END PREP.	FITTING	FLANGES RATINGS, FACE, STD. TYPE	GASKETS	BOLT / NUT MAT'L	UTILITY AREA	OUTSIDE / TRENCH	THICKNESS (IN)	INSTALL. CODE	TYPE	MEDIUM	TEST PRES.	TEST TEMP (F)	DURATION	
CWS CWR	CHILLED WATER - SUPPLY CHILLED WATER - RETURN	ALL AREAS	2" and <	80	50	CS	A53	B	SCH. 40	THREADED	THREADED	150#, RF, A105	EPDM	ZINC PLATED	E, D**	G	3/4	B31.9	H	WATER	120	AMB	4 HRS.	
		ALL AREAS	1/2" to 12"	80	50	CS	A53	B	SCH. 40	GROOVED	GROOVED	150#, RF, A105	EPDM	ZINC PLATED	E, D**	G	2 1/2 *	B31.9	H	WATER	120	AMB	4 HRS.	
		ALL AREAS	14" and >	80	50	CS	A53	B	SCH. 40	GROOVED	GROOVED	150#, RF, A105	EPDM	ZINC PLATED	E, D**	G	2	B31.9	H	WATER	120	AMB	4 HRS.	
		U/G TRENCH	2 1/2" to 12"	80	50	CS	A53	B	SCH. 40	BEVELED	WELDED	150#, RF, A105	EPDM	ZINC PLATED	E, D**	H	SEE DETAIL	B31.9	H	WATER	120	AMB	4 HRS.	
DW	DOMESTIC WATER	UTILITY AREA	1/2" to 3"	80	50	CU	B88	L		SOLDERED		150#, RF, A105	BUNA-N	304 SS	E		1	B31.9	H	WATER	120	AMB	4 HRS.	
PCR CR	PUMPED CONDENSATE CONDENSATE RETURN	ALL AREAS	2" and <	50	300	CS	A53	B	SCH. 80	PLAIN	WELDED	3000# SW	FLEXITALLIC CG	CS	B	A*, B	1 1/2	B31.1	H	WATER	75	100	4 HRS.	
		ALL AREAS	2 1/2" and >	50	300	CS	A53	B	SCH. 40	BEVELED	WELDED	150#, RF, A105	FLEXITALLIC CG	CS	B	A*, B	3	B31.1	H	WATER	75	100	4 HRS.	
		U/G TRENCH	2 1/2" and >	50	300	CS	A53	B	SCH. 40	BEVELED	WELDED					H	SEE DETAIL	B31.1	H	WATER	75	100	4 HRS.	
BF	BOILER FEED WATER	UTILITY AREA	3" and >	50	300	CS	A53	B	SCH. 40	BEVELED	WELDED	150#, RF, A105	FLEXITALLIC CG	CS	B		3	B31.1	H	WATER	75	100	4 HRS.	
LPS	LOW PRESSURE STEAM (10 psi) (FUTURE 125 psi SYSTEM)	ALL AREAS	2" and <	125	350	CS	A53	B	SCH. 40	PLAIN	3000# SW	150#, RF, A105	FLEXITALLIC CG	CS	B	A*, B	2 1/2	B31.1	H	WATER	188	100	4 HRS.	
		ALL AREAS	2 1/2" to 4"	125	350	CS	A53	B	SCH. 40	BEVEL	WELDED	150#, RF, A105	FLEXITALLIC CG	CS	B	A*, B	3	B31.1	H	WATER	188	100	4 HRS.	
		ALL AREAS	6" and >	125	350	CS	A53	B	SCH. 40	BEVEL	WELDED	150#, RF, A105	FLEXITALLIC CG	CS	B	A*, B, C*	3.5	B31.1	H	WATER	188	100	4 HRS.	
NG	NATURAL GAS	ALL AREAS	1/2" to 1 1/2"	15	150	CS	A106	B/S	SCH. 80	THREADED	THREADED	150#, RF, A105, SW	FLEXITALLIC CG	CAD/ZINC PLATED				OMSC	P	AIR	60	AMB	30 MINS	
		ALL AREAS	2" to 6"	15	150	CS	A106	B/S	SCH. 80	BEVEL	WELDED	150#, RF, A105, WN	FLEXITALLIC CG	CAD/ZINC PLATED				OMSC	P	AIR	60	AMB	30 MINS	
WW	WELL WATER - SUPPLY	UTILITY AREA	2" and <	80	60	CS	A53	B	SCH. 40	THREADED	THREADED	150#, RF, A105	EPDM	ZINC PLATED	E ***		1	B31.9	H	WATER	120	AMB	4 HRS.	
WWR	WELL WATER - RETURN ***	UTILITY AREA	2 1/2" and >	80	60	CS	A53	B	SCH. 40	GROOVED	GROOVED	150#, RF, A105	EPDM	ZINC PLATED	E ***		1	B31.9	H	WATER	120	AMB	4 HRS.	

NOTE:
 * = WHERE INDICATED
 ** = ABI (ADDITIVE BID ITEM)
 *** = NO INSULATION FOR WWR

ABBREVIATION:
 BW - BUTT WELD
 CS - CARBON STEEL
 ERW - ELECTRIC RESIST. WELDED
 FF - FLAT FACE
 GALV - GALVANIZED STEEL
 GRV - GROOVED
 H - HYDRAULIC
 CU - COPPER

OMSC - OREGON MECH SPECIALTY CODE
 P - PNEUMATIC
 PTFE - TEFLO
 RF - RAISED FACE
 S - SEAMLESS
 SCH - STAND. PIPE SCHED.
 SCR - SCREWED
 SO - SLIP ON

SS - STAINLESS STEEL
 SW - SOCKET WELD
 THD - THREADED
 WI - WHERE INDICATED
 WN - WELD NECK
 U/G - UNDERGROUND

INSULATIONS:
 A = GLASS FIBER / ALUMINUM JACKET (CAL-SIL INSERTS AT SUPPORTS)
 B = GLASS FIBER / ALUMINUM CLAD JACKET (CAL-SIL INSERTS AT SUPPORTS)
 C* = GLASS FIBER / SS JACKET (CAL-SIL INSERTS AT SUPPORTS)
 D** = CLOSED CELL / PVC JACKET (HIGH DENSITY CLOSED CELL AT SUPPORTS), ABI #4 (BLUE JACKET COLOR FOR CHILLED WATER)
 E = CLOSED CELL / ALL SERVICE JACKET (HIGH DENSITY CLOSED CELL AT SUPPORTS)
 G = CLOSED CELL / PVC JACKET & HEAT TRACED (HIGH DENSITY CLOSED CELL AT SUPPORTS)
 H = INORGANIC GRANULAR INSULATION (GILSULATE 500w)

VALVE SPECIFICATION SCHEDULE																					
SYSTEM ID	SERVICE	VALVE ID	TYPE	SIZE	VALVE MAX. PRESS. (PSIG)	VALVE OP. TEMP. (F)	MATERIAL OF CONSTRUCTION					TYPE OF CONSTRUCTION					MANUFACTURER	MODEL NO.	ALTERNATE MANUFACTURER / MODEL NO.	ALTERNATE MANUFACTURER / MODEL NO.	COMMENTS
							BODY	TRIM	BALL / DISC	SEATS	PACKG.	BODY / CLASS	CONNECTION	OPERATOR							
CWS CWR	CHILLED WATER - SUPPLY CHILLED WATER - RETURN	AVV	AIR VENT	3/4"	150	250	SS	SS	SS	SS			THD	FLOAT	ARMSTRONG	11-AV					
		B2	BALL, 3-PC	1/4" - 3"	150 SAT	390	BRONZE	SS	SS	RP1FE	RP1FE	150#	THD	LEVER	APOLLO	82-140					
		BV1	BALANCING VALVE	1/2" - 3"	300 WOG	250	BRONZE	BRASS	SS	TFE	EPDM	125#	THD	KNOB	B&G	CB (A-549 G)					
		BV2	SETTER	2 1/2" - 8"	175 WOG	250	CI	BRASS	BRONZE		EPDM	125#	FLG/GROOVED	KNOB	B&G	CB (A-547 E)					
		BV3	AUTO BAL. VALVE	4" - 12"	400	200	CS	SS	SS			150#	FLG/GROOVED	GRISWOLD CONTROLS							
		C1	SWING CHECK	1/2" - 3"	185	200	BRONZE	BRONZE	BRONZE	CI		150#	THD	SWING	CRANE	37				Confirm flow rates for sizing	
		C2	SWING CHECK	2" - 12"	190	200	CI	BRONZE	BRONZE CMP	CI		125#	FLG	SWING	CRANE	373			MUELLER		
		F1	BUTTERFLY	2" - 48"	250	200	CS	SS	SS	TFE	TFE	150#	LUG	LEVER	FLOWSEAL	ILA-122TG-B			FNW	MUELLER	Gear operated for 4" and larger
		F2	BUTTERFLY	2" - 12"	133	180	DI	SS	DI / EPDM	DI		150#	GROOVED	LEVER	MUELLER STEAM	59G-E-N-6-E-3			FNW	MUELLER	Gear operated for 4" and larger
		F3	BUTTERFLY	2" - 24"	150	275	DI	SS	SS	EPDM	PTFE	150#	WAFER	LEVER	APOLLO	141			FNW	MUELLER	Gear operated for 4" and larger
		S2	STRAINER	2" - 12"	150	560	CS	304SS				150#	FLG		MUELLER	781					Provide blowoff valve
		S3	STRAINER	2" - 12"	150	560	CS	304SS				150#	FLG		MUELLER	781					
		DW	DOMESTIC WATER	B2	BALL, 3-PC	1/4" - 3"	150 SAT	390	BRONZE	SS	SS	RP1FE	RP1FE	150#	THD	LEVER	APOLLO	82-140		FNW	
RPBP	RED. PRESS BACKF. STRAINER			1" - 2"	175	180	BRONZE	SS	SS	SILICON		150#	THD		APOLLO/COMBRACO	40-200		WILKINS	FEBCO	W/ APPROVAL FROM LOCAL JURISDICTION	
S1	STRAINER			1/2" - 2"	200	150	BRONZE	SS	SS			125#	THD		MUELLER	351M					
PCR CR	PUMPED CONDENSATE CONDENSATE RETURN	B2	BALL, 3-PC	1/4" - 3"	150 SAT	390	BRONZE	SS	SS	RP1FE	RP1FE	150#	THD	LEVER	APOLLO	82-140					
		C2	SWING CHECK	2" - 12"	190	200	CI	BRONZE	BRONZE CMP	CI		125#	FLG	SWING	CRANE	373					
		C4	SPRING CHECK	1/2" - 2"	200	210	CI	SS	SS			150#	THD	SS SPRING	MUELLER	303					
		G2	GATE	2" - 24"	150	150	CS	SS	HF	SS	GRAPHITE	150#	FLG	OS & Y	CRANE	47					
LPS	LOW PRESSURE STEAM (10 psi) (FUTURE 125 psi SYSTEM)	B2	BALL, 3-PC	1/4" - 3"	150 SAT	390	BRONZE	SS	SS	RP1FE	RP1FE	150#	THD	LEVER	APOLLO	82-140					
		C2	GATE	2" - 24"	150	150	CS	SS	HF	SS	GRAPHITE	150#	FLG	OS & Y	CRANE	47					
		S2	STRAINER	2" - 12"	150	560	CS	304SS				150#	FLG		MUELLER	781				Provide blowoff valve	
NG	NATURAL GAS	PL2	PLUG	1" - 6"	150	120	SEM-STL				125#	FLG	WRENCH	HOMESTEAD	622			NOROSTRON		LUBRICATED PLUG, UL LISTED	
WW WWR	WELL WATER - SUPPLY WELL WATER - RETURN	B2	BALL, 3-PC	1/4" - 3"	150 SAT	390	BRONZE	SS	SS	RP1FE	RP1FE	150#	THD	LEVER	APOLLO	82-140					
		C1	SWING CHECK	1/2" - 3"	185	200	BRONZE	BRONZE	BRONZE	CI		150#	THD	SWING	CRANE	37					
		C2	SWING CHECK	2" - 12"	190	200	CI	BRONZE	BRONZE CMP	CI		125#	FLG	SWING	CRANE	373					
		F1	BUTTERFLY	2" - 48"	250	200	CS	SS	SS	TFE	TFE	150#	LUG	GEAR	FLOWSEAL	ILA-122TG-B					Gear operated for 4" and larger
		F2	BUTTERFLY	2" - 12"	133	180	DI	SS	DI / EPDM	DI		150#	GROOVED	LEVER	MUELLER STEAM	59G-E-N-6-E-3			FNW	MUELLER	Gear operated for 4" and larger
F3	BUTTERFLY	2" - 24"	150	275	DI	SS	SS	EPDM	PTFE	150#	WAFER	LEVER	APOLLO	141			FNW	MUELLER	Gear operated for 4" and larger		

1	08/29/08	ISSUED FOR CONSTRUCTION
0	05/23/08	ISSUED FOR BID & PERMIT
no	date	by
		revisions

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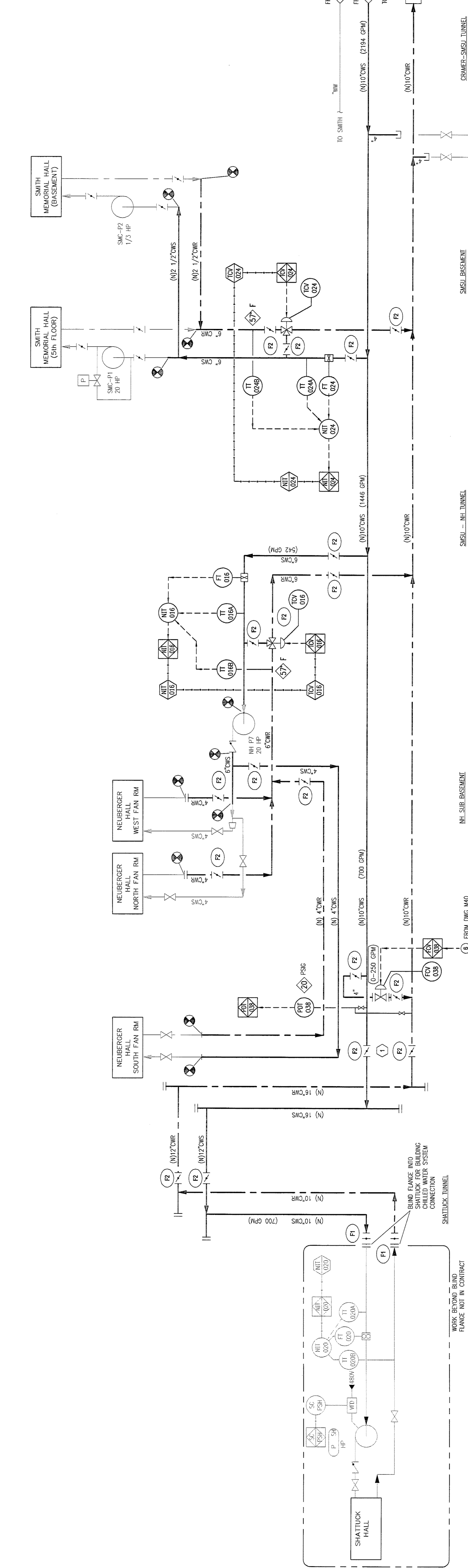
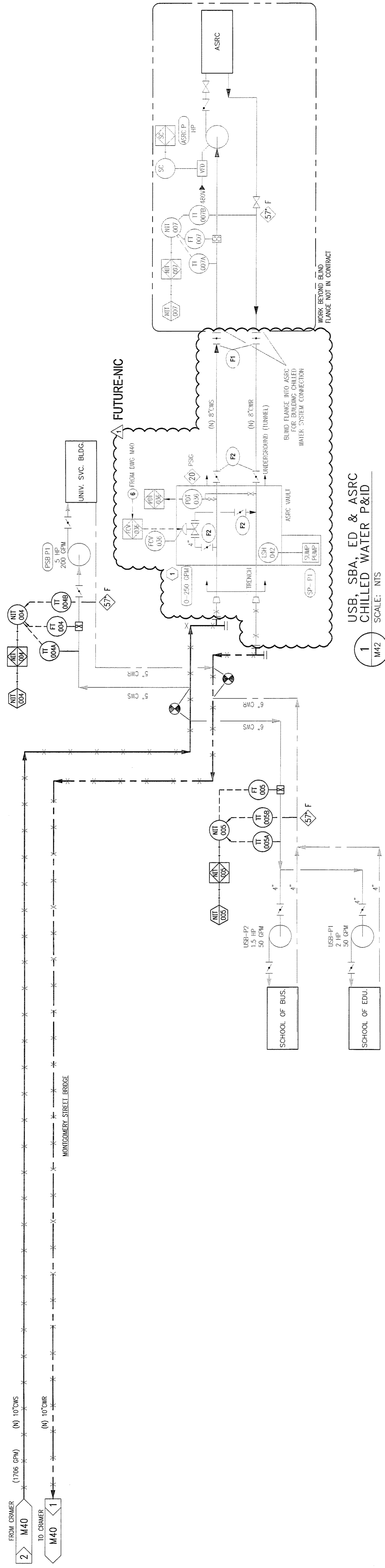
project
PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

dwg. title
MECHANICAL
PIPE SCHEDULES

designed	date
drawn	date
checked	date
approved	date
project no.	10909-07001
drawing no.	

EXPRESS: 12/11/07

MO.2



1	10/23/06	ISSUED FOR CONSTRUCTION
0	10/23/06	ISSUED FOR BID & PERMIT
	no.	date
	by	revision

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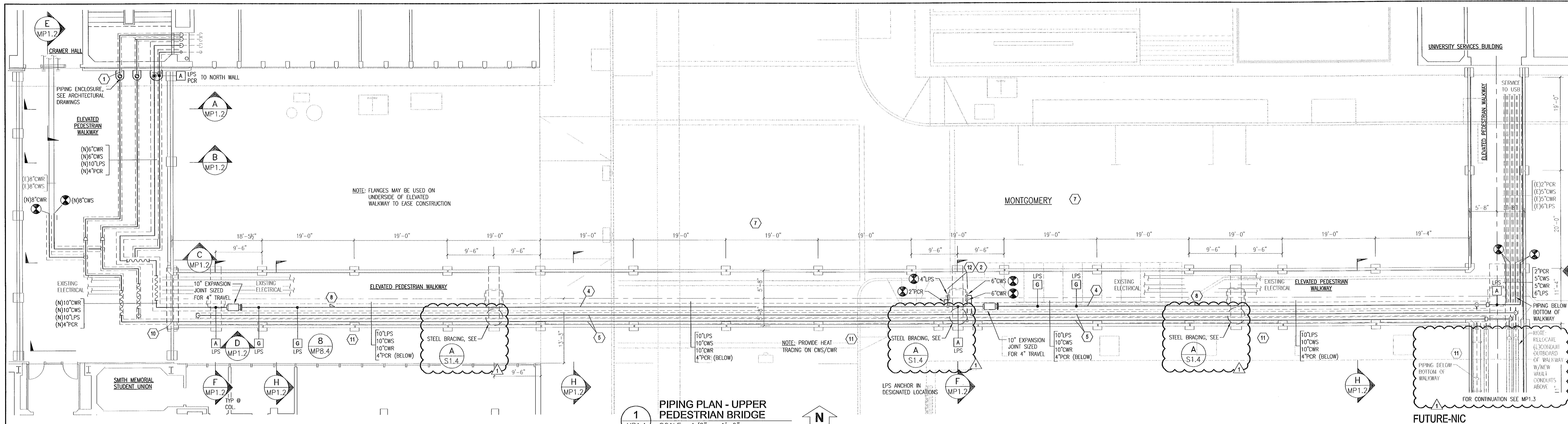
Project: PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

designed: _____ date: _____
drawn: _____ date: 10/19/07
approved: _____ date: _____
Project no: 10000-0001
drawing no: M42

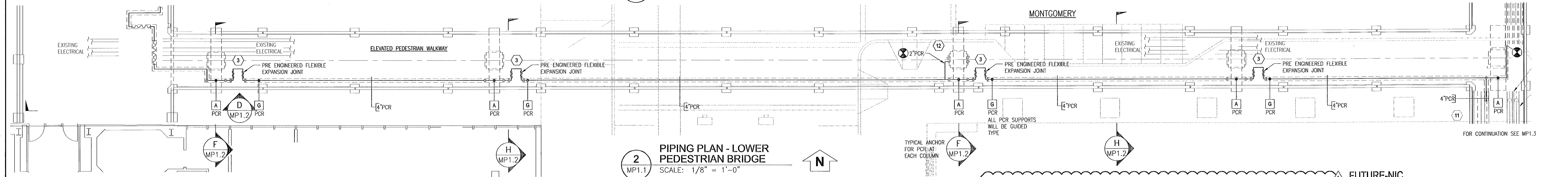
DESIGNED BY: _____
DRAWN BY: _____
CHECKED BY: _____
APPROVED BY: _____

KEYED NOTES:
① FLOW THROUGH LOOP REMAINS W/IN SHUTTLE, HOWEVER AT LEAST MINIMUM FLOW FROM CHILLER BASED ON BUILDING LOOPS.

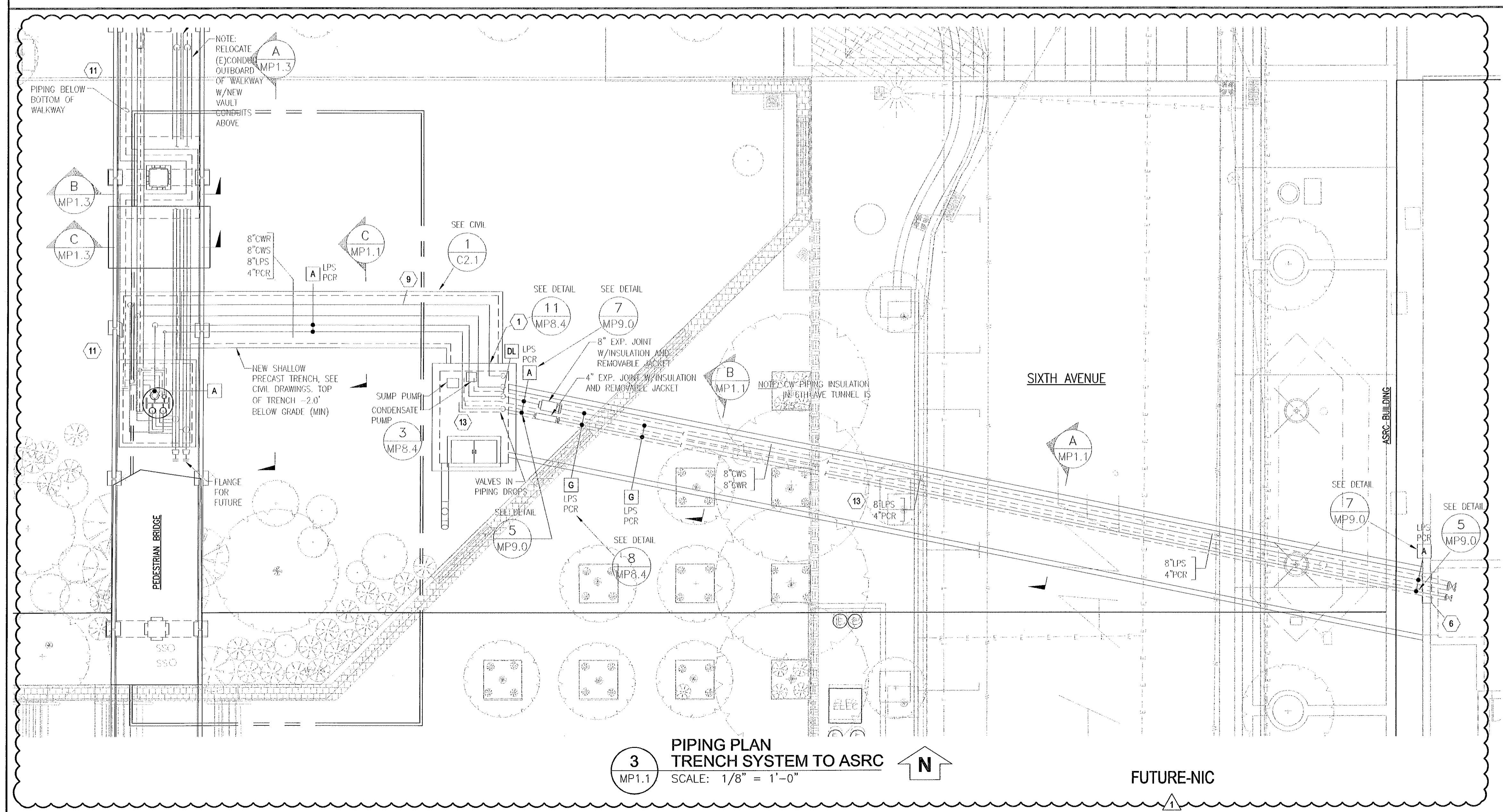
2
SMITH, NEUBERGER, SHATTUCK CHILLED WATER P&ID
SCALE: 1/4" = 1'



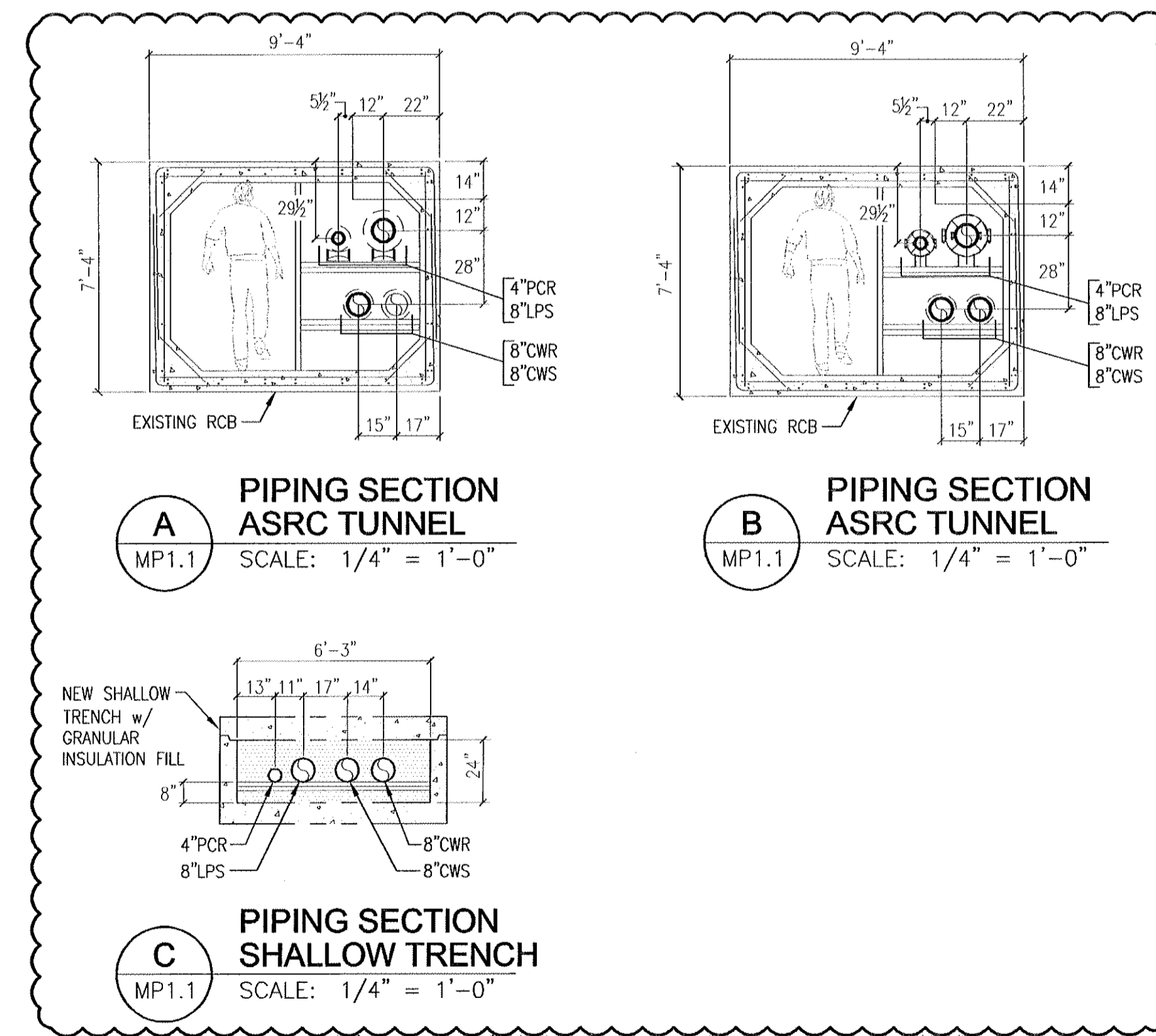
1 PIPING PLAN - UPPER PEDESTRIAN BRIDGE
SCALE: 1/8" = 1'-0"



2 PIPING PLAN - LOWER PEDESTRIAN BRIDGE
SCALE: 1/8" = 1'-0"



3 PIPING PLAN TRENCH SYSTEM TO ASRC
SCALE: 1/8" = 1'-0"

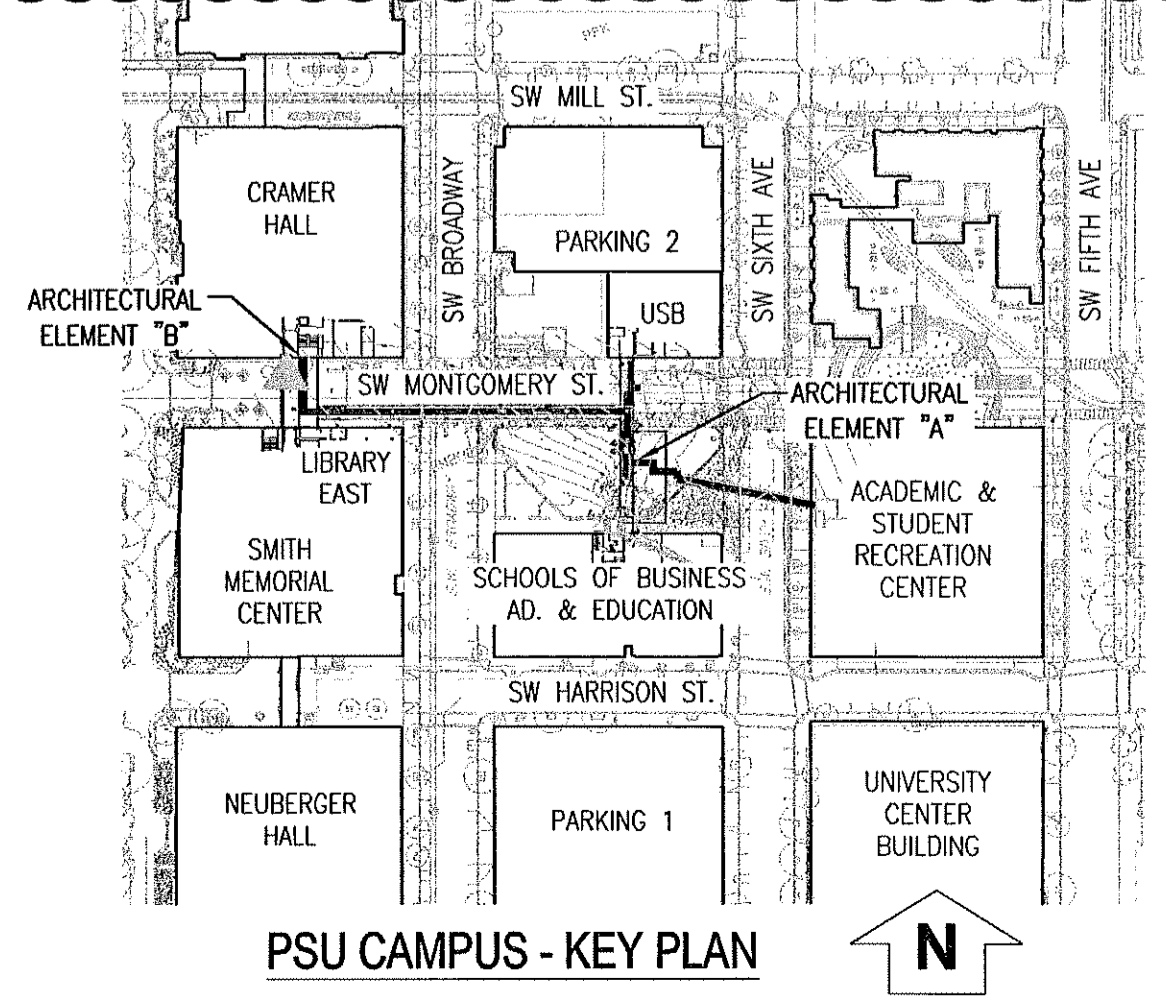


A PIPING SECTION ASRC TUNNEL
SCALE: 1/4" = 1'-0"

B PIPING SECTION ASRC TUNNEL
SCALE: 1/4" = 1'-0"

C PIPING SECTION SHALLOW TRENCH
SCALE: 1/4" = 1'-0"

- KEYED NOTES:**
- 1 CORE DRILL AND SLEEVE FOR PIPING. LOCATE REBAR BEFORE DRILLING. SEAL WATERIGHT.
 - 2 RETURN EXISTING ENCLOSURE TO ORIGINAL CONDITION.
 - 3 EXPANSION JOINT FOR 4" PCR COORDINATE LENGTH TO STAY INSIDE OR WALKWAY STRUCTURE.
 - 4 STEAM LINE AND CONDENSATE LINE FLANGES ALLOWED FOR INSTALLATION. CONTRACTOR TO PROVIDE INSTALLATION DRAWING OF STEAM LINE FOR APPROVAL. PRE-INSULATION AND JACKETING OF STEAM LINE IS RECOMMENDED.
 - 5 CWS/CWR LINE TO HAVE 2 SUPPORTS PER 20 FT. SECTION. PRE-INSULATED AND JACKETED SECTIONS ARE RECOMMENDED.
 - 6 OPENINGS PROVIDED BY OTHERS. COORDINATE WITH ASRC CONTRACTOR.
 - 7 COORDINATE LANE CLOSURES AND FLAGGING, IF REQUIRED, WITH CITY.
 - 8 SLOPE LPS (STEAM) LINE 1" PER 100'
 - 9 ALL WELDED PIPE AND GRANULAR INSULATION (TYPE "H") FILL IN TRENCH (SEE SPECIFICATIONS).
 - 10 SEE STRUCTURAL FOR CARBON EPOXY WRAP AND NEW CORING DETAIL.
 - 11 ABI-5 REPLACEMENT OF EXISTING UNDERWALKWAY PANEL SYSTEM PER STRUCTURAL DETAIL F/S1.3.
 - 12 PROVIDE BRANCH VALVES ON 4"LPS, 2"PCR, 6"CWS AND 6"CWR.
 - 13 TYPE "A" INSULATION/JACKET ON LPS AND PCR. TYPE "G" INSULATION/JACKET ON CWS AND CWR.



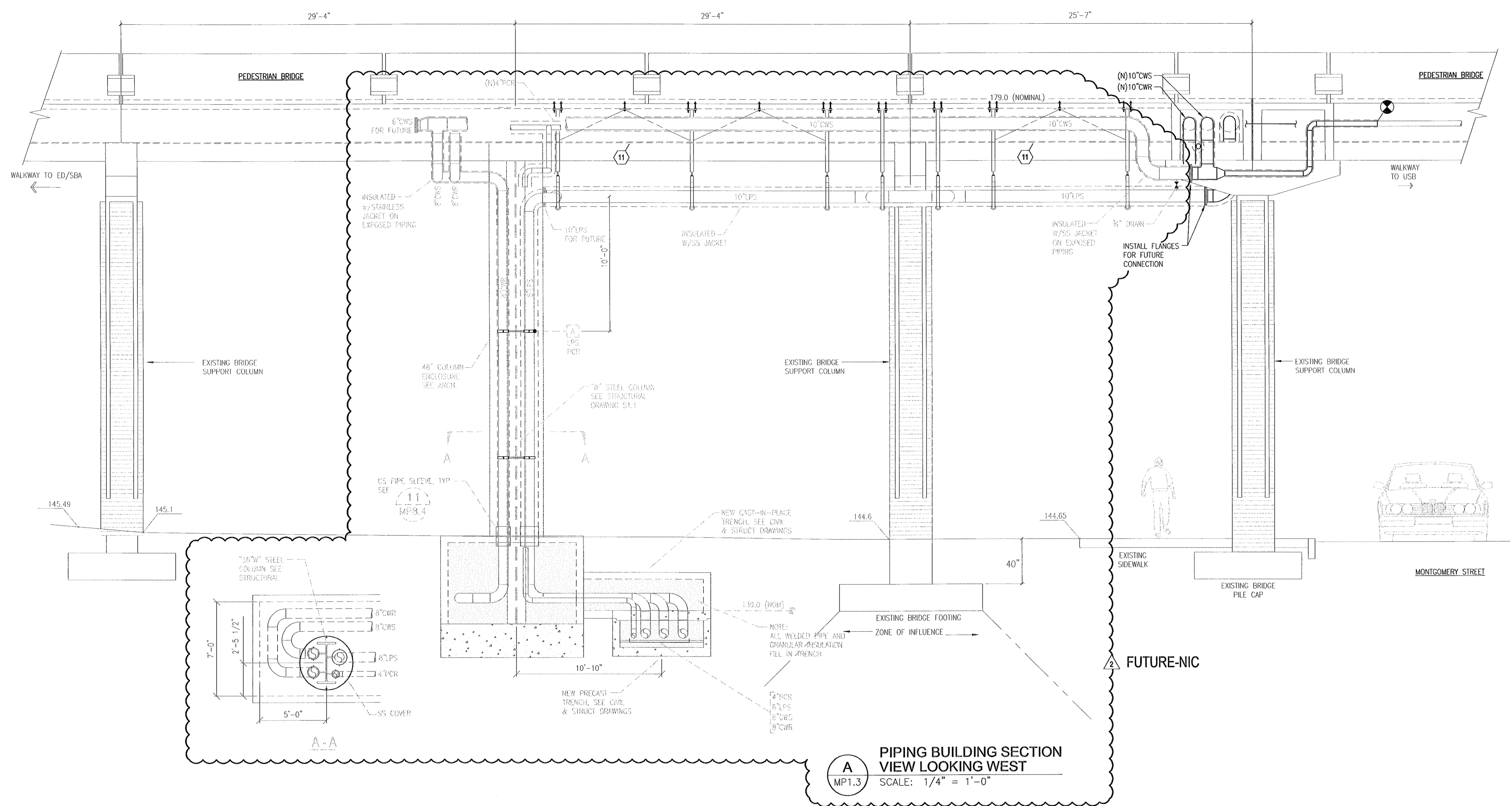
PSU CAMPUS - KEY PLAN

2	08/29/08	ISSUED FOR CONSTRUCTION
1	07/10/08	RSF PIPING CHANGES
0	05/23/08	RSF ISSUED FOR BID & PERMIT
no	date	by revisions

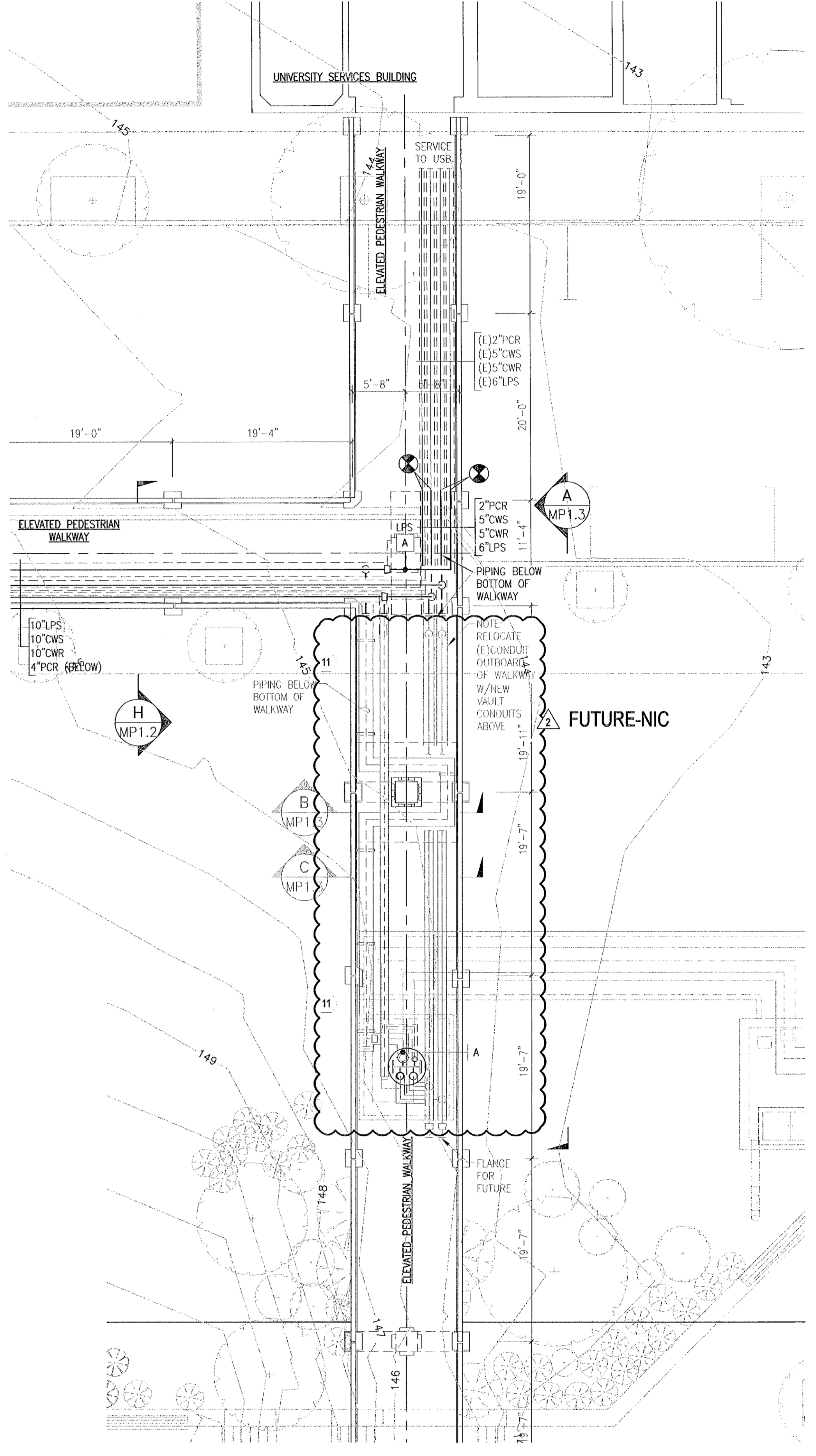
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WINZLER & KELLY

PROJECT
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**
dwg. title

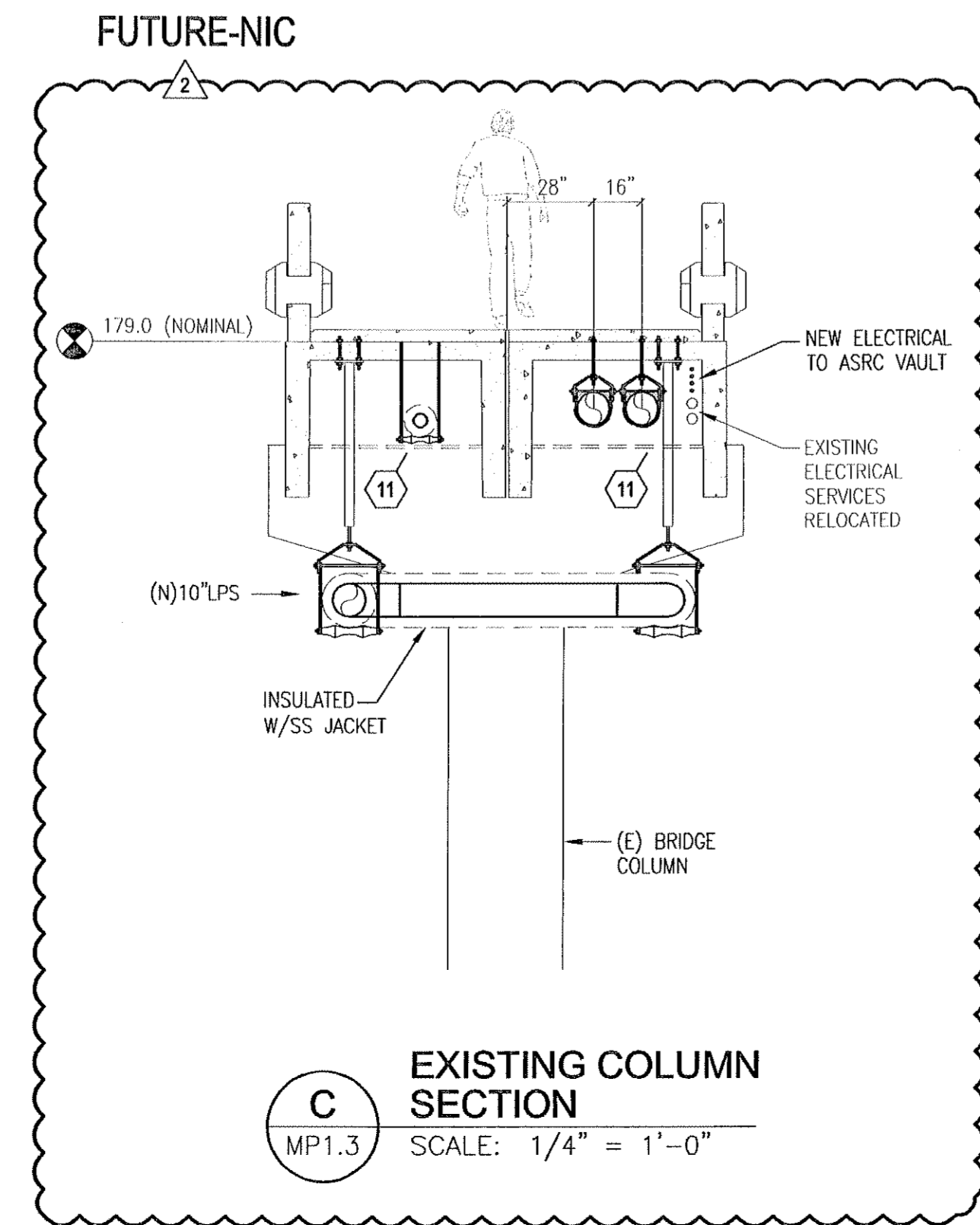
designed	date
drawn	date
approved	date
project no.	1099-0000
drawing no.	MP1.1



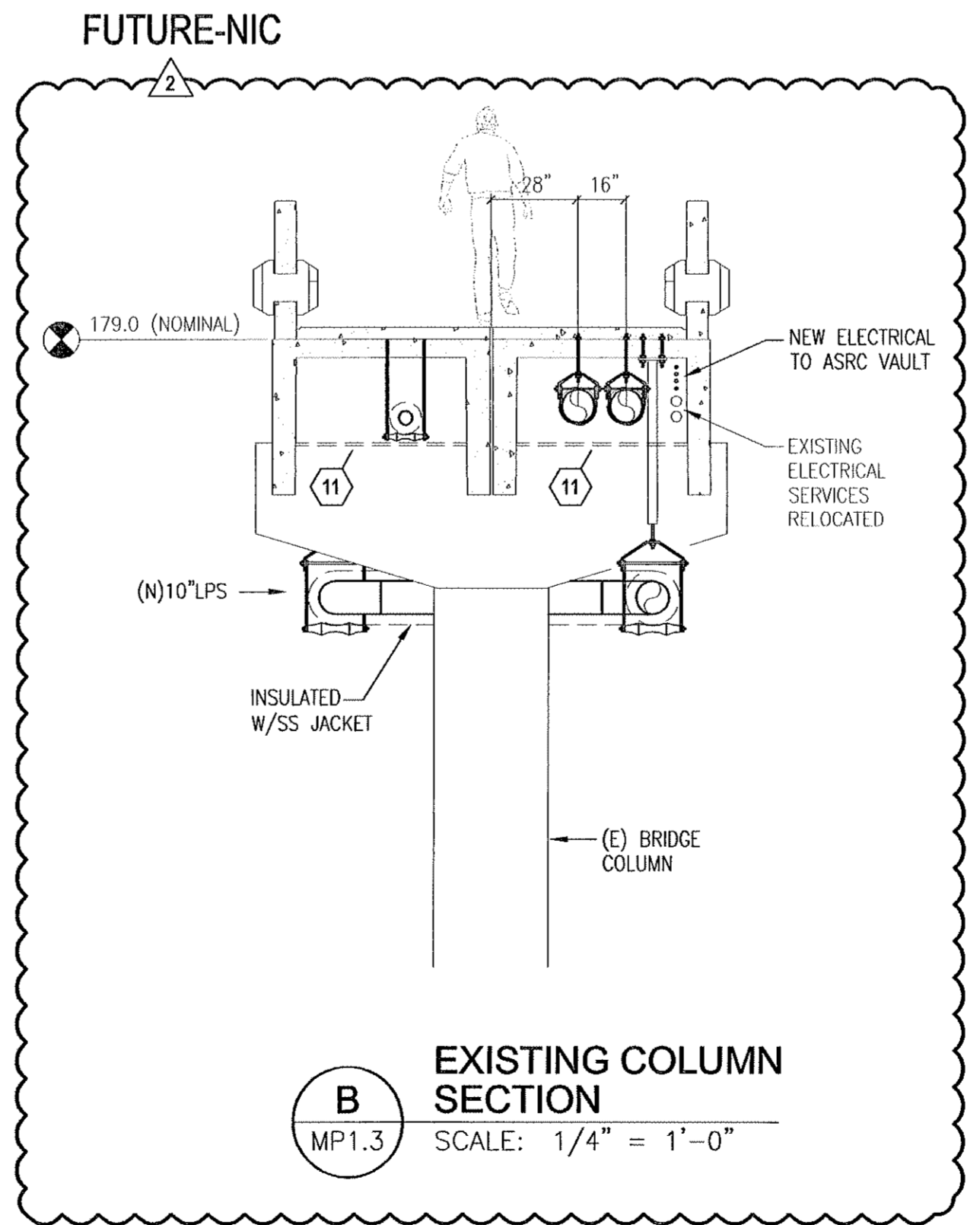
A
PIPING BUILDING SECTION
VIEW LOOKING WEST
 SCALE: 1/4" = 1'-0"



1
MP1.3
PIPING PLAN
PEDESTRIAN BRIDGE
 SCALE: 1/8" = 1'-0"



C
MP1.3
EXISTING COLUMN
SECTION
 SCALE: 1/4" = 1'-0"



B
MP1.3
EXISTING COLUMN
SECTION
 SCALE: 1/4" = 1'-0"

KEYED NOTES:
 (H) SEE NOTE ON MP1.1

2	08/29/08	RSF	ISSUED FOR CONSTRUCTION
1	07/10/08	RSF	PIPING CHANGES
0	05/23/08	RSF	ISSUED FOR BID & PERMIT
no	date	by	revisions

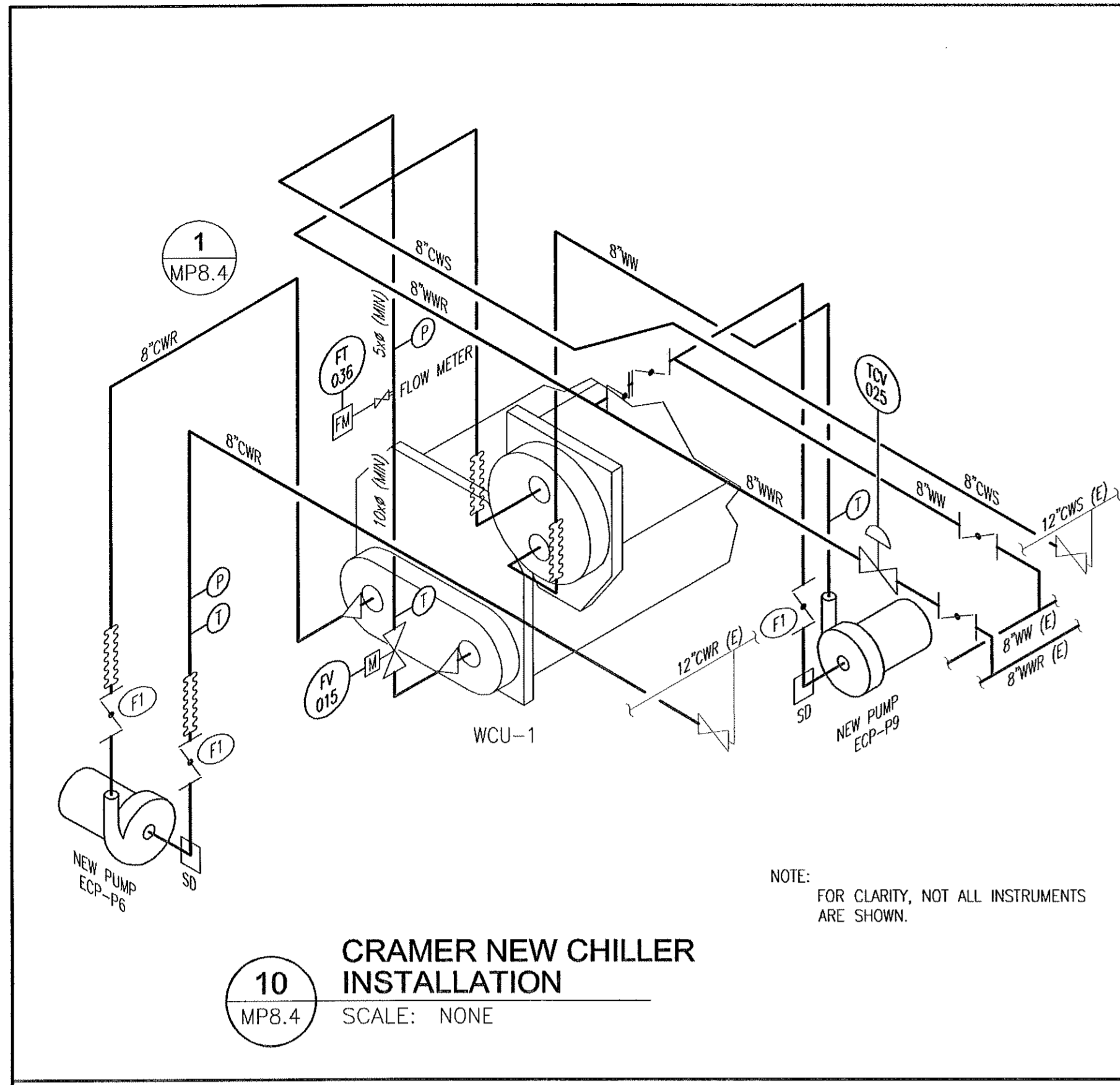
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PROJECT
PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS

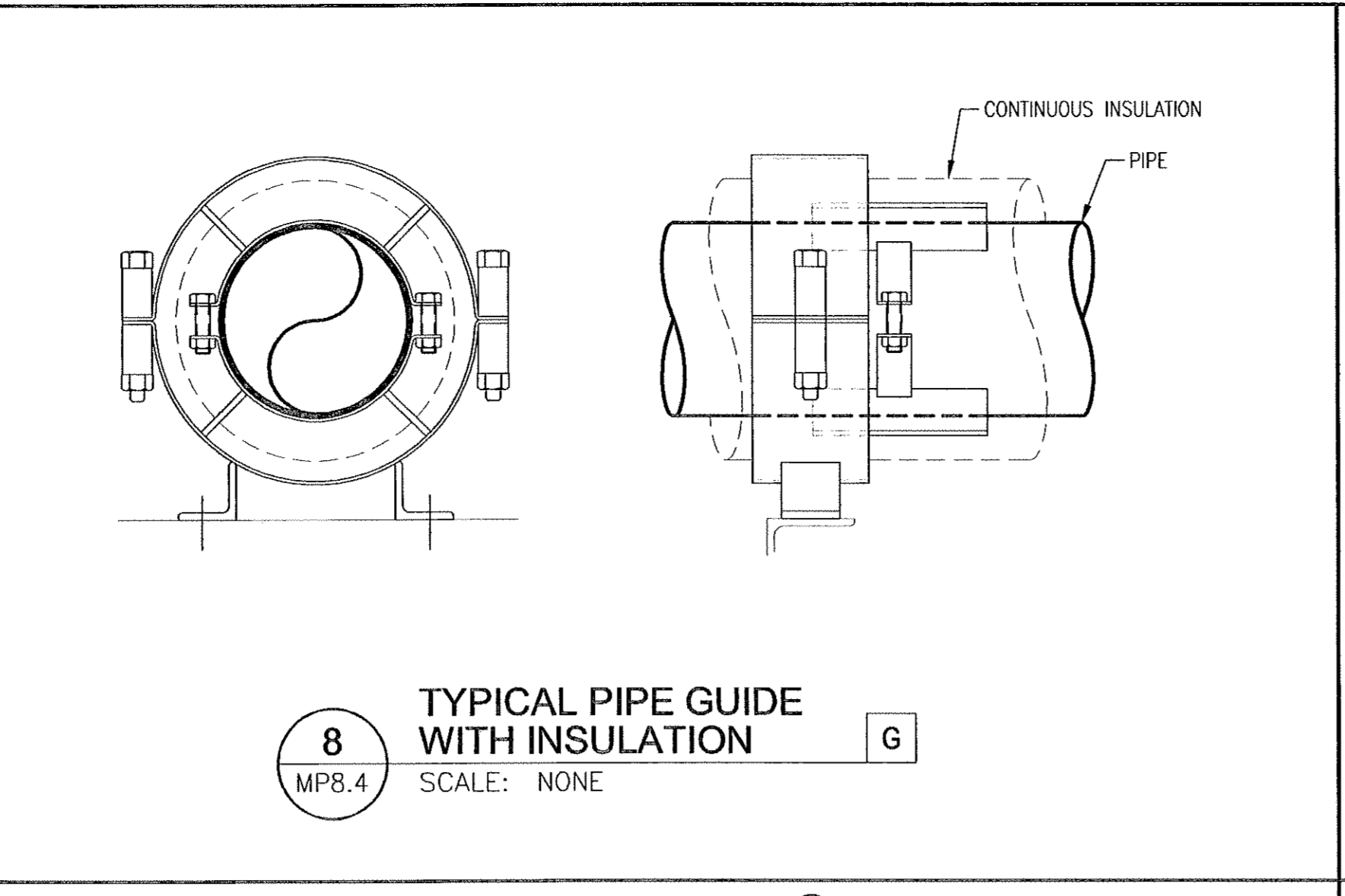
dwg. title
ASRC PIPING PLAN
AND ELEVATIONS

designed	date
drawn	date
approved	date
project no.	
drawing no.	

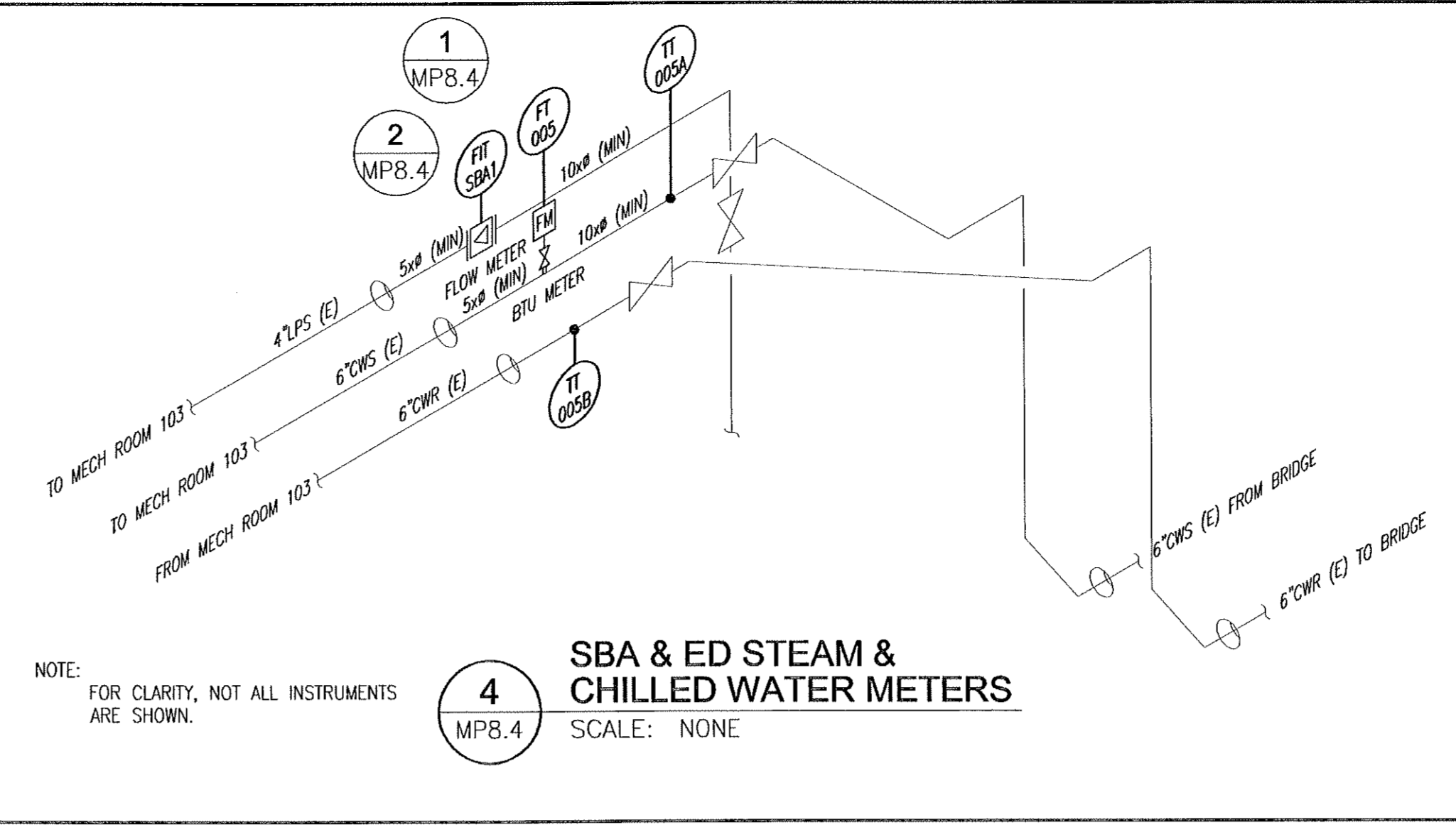
MP1.3



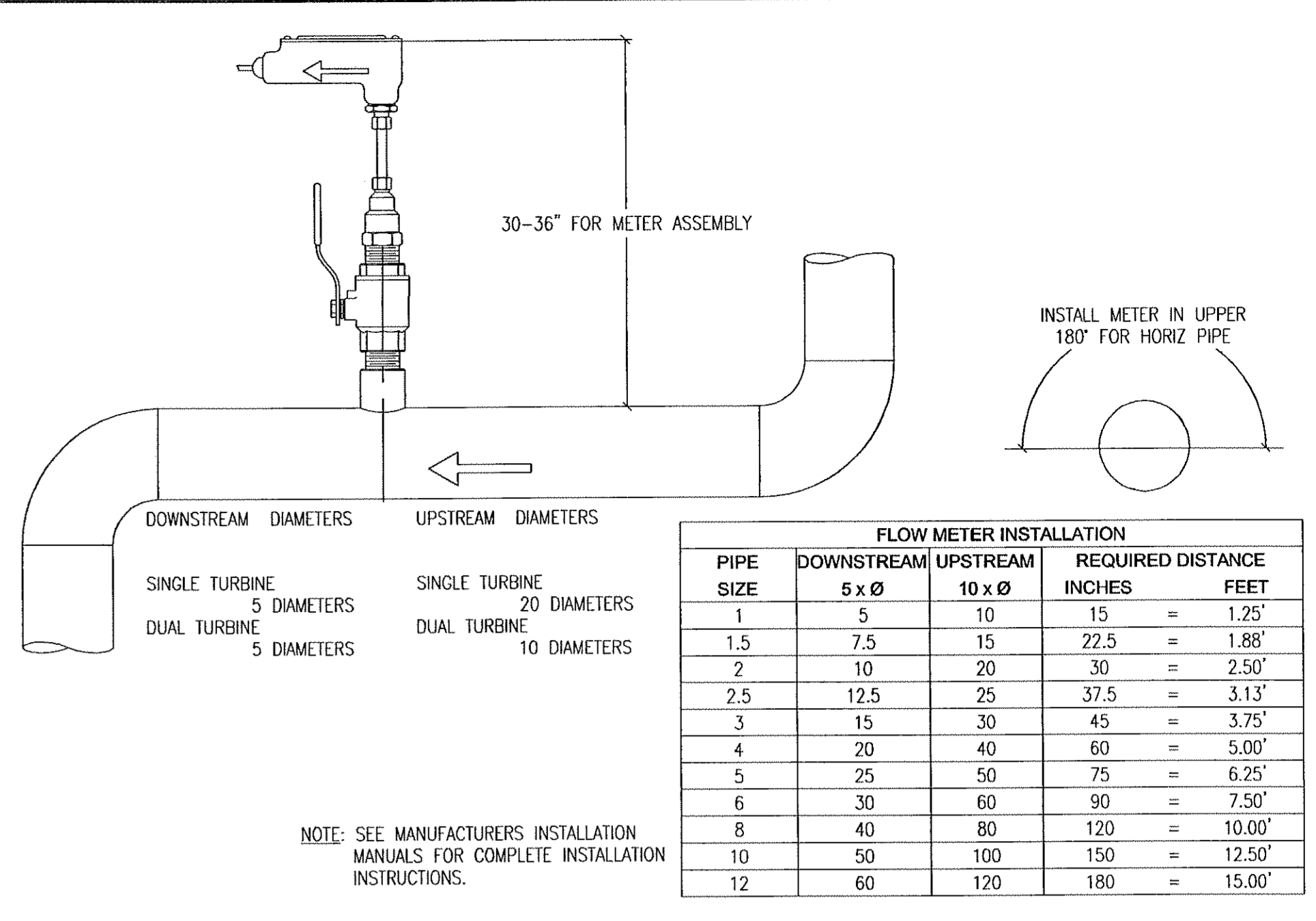
10 CRAMER NEW CHILLER INSTALLATION
MPB.4 SCALE: NONE



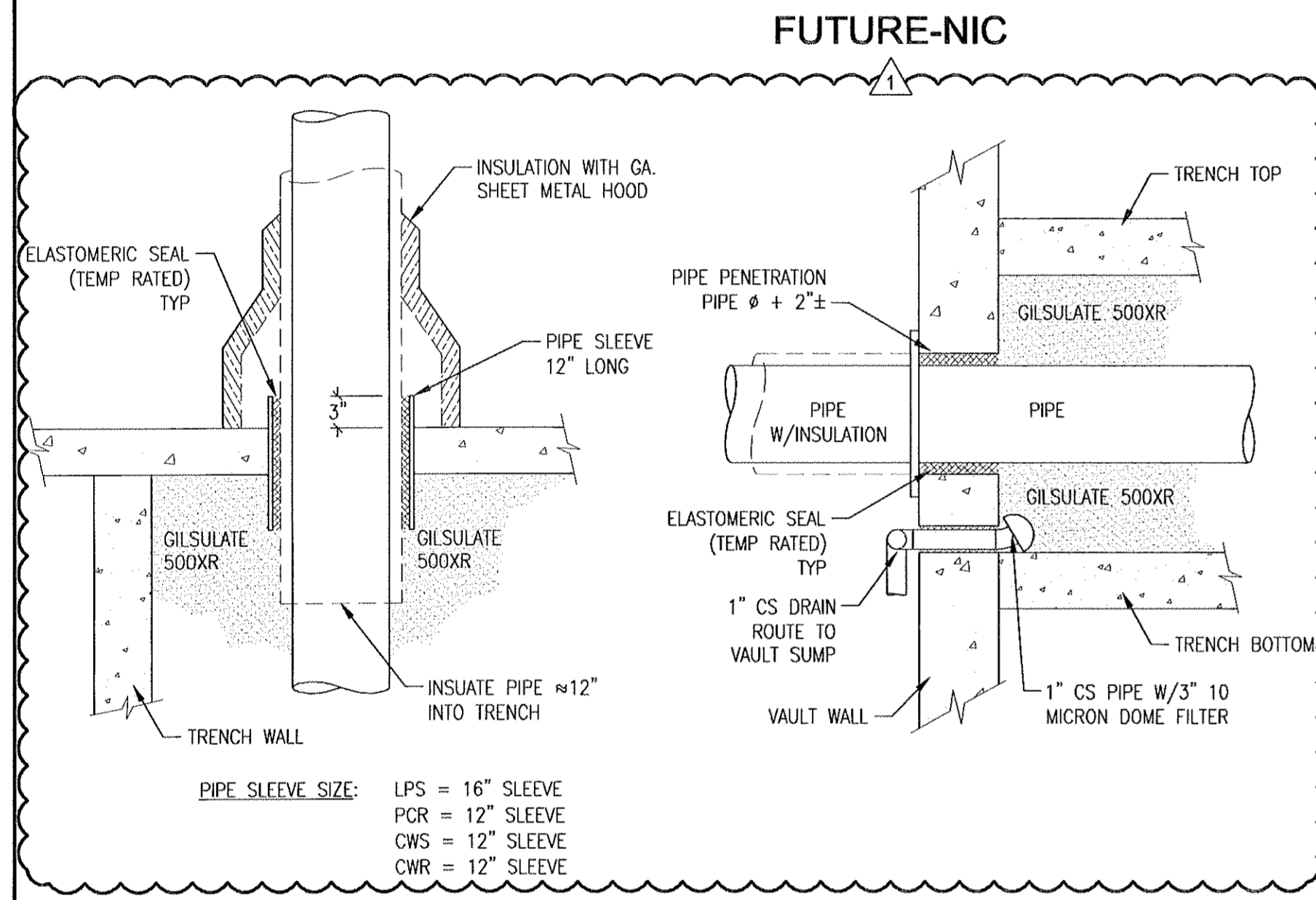
8 TYPICAL PIPE GUIDE WITH INSULATION
MPB.4 SCALE: NONE



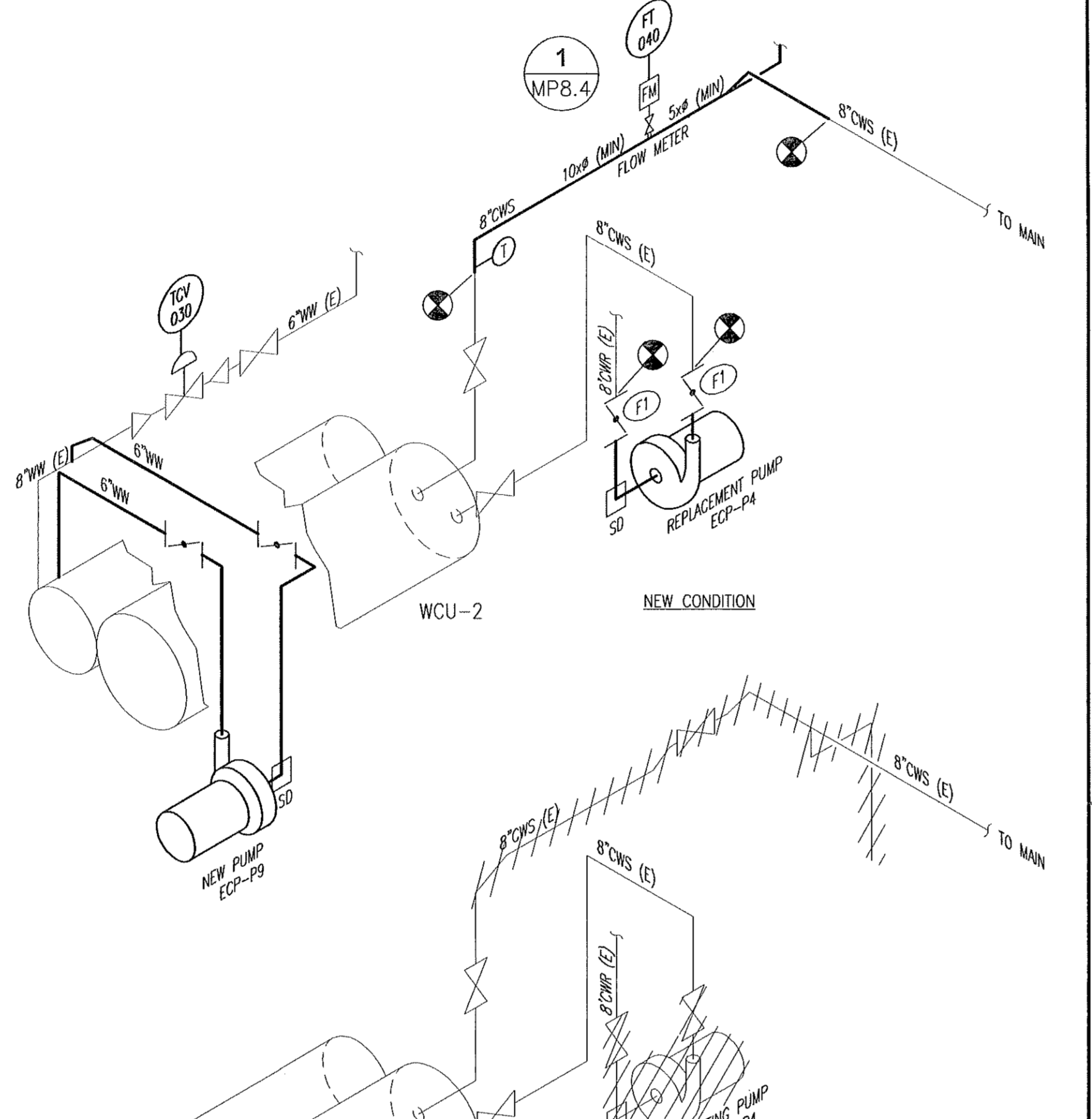
4 SBA & ED STEAM & CHILLED WATER METERS
MPB.4 SCALE: NONE



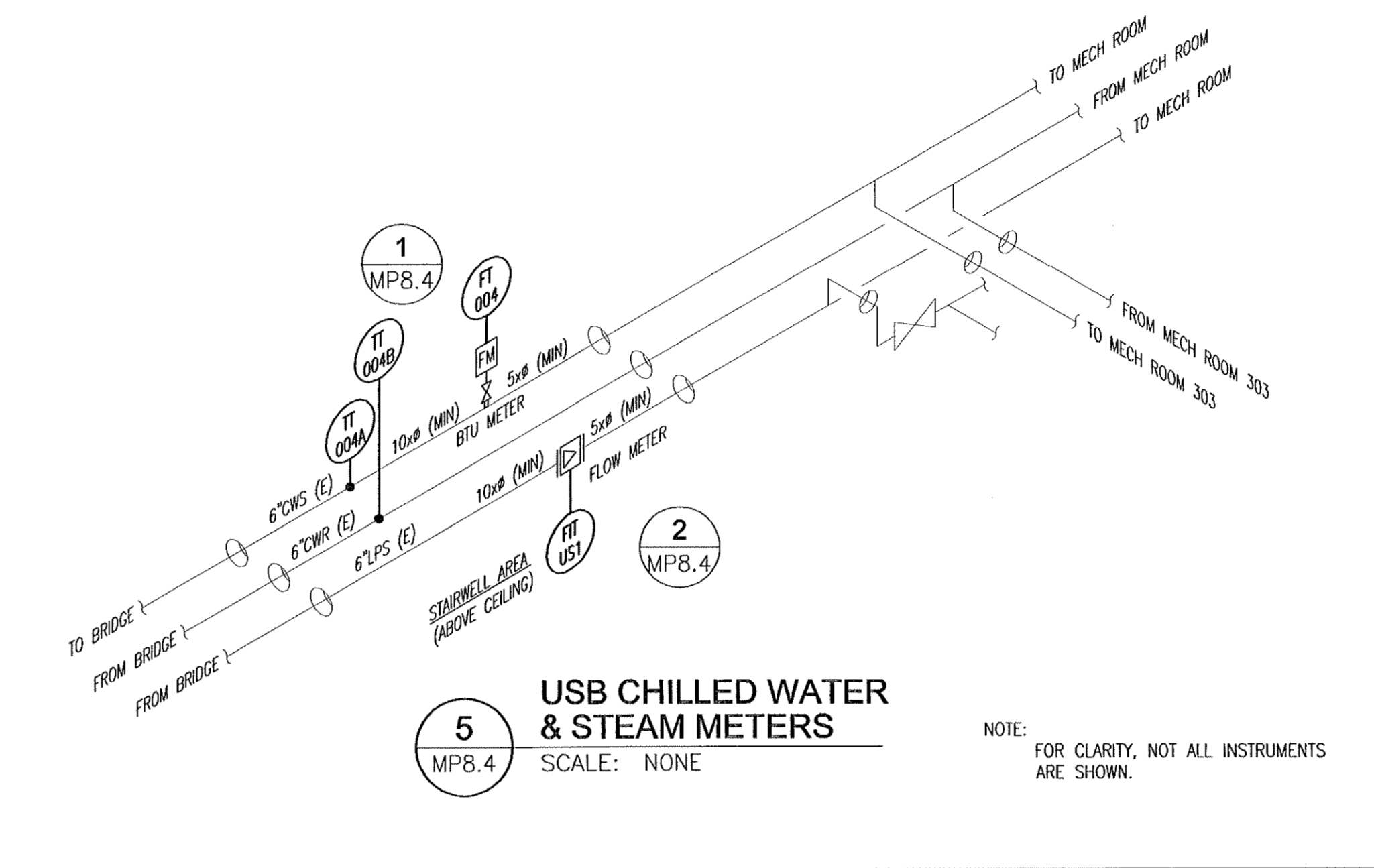
1 CHILLED WATER FLOW METER INSTALLATION
MPB.4 SCALE: NONE



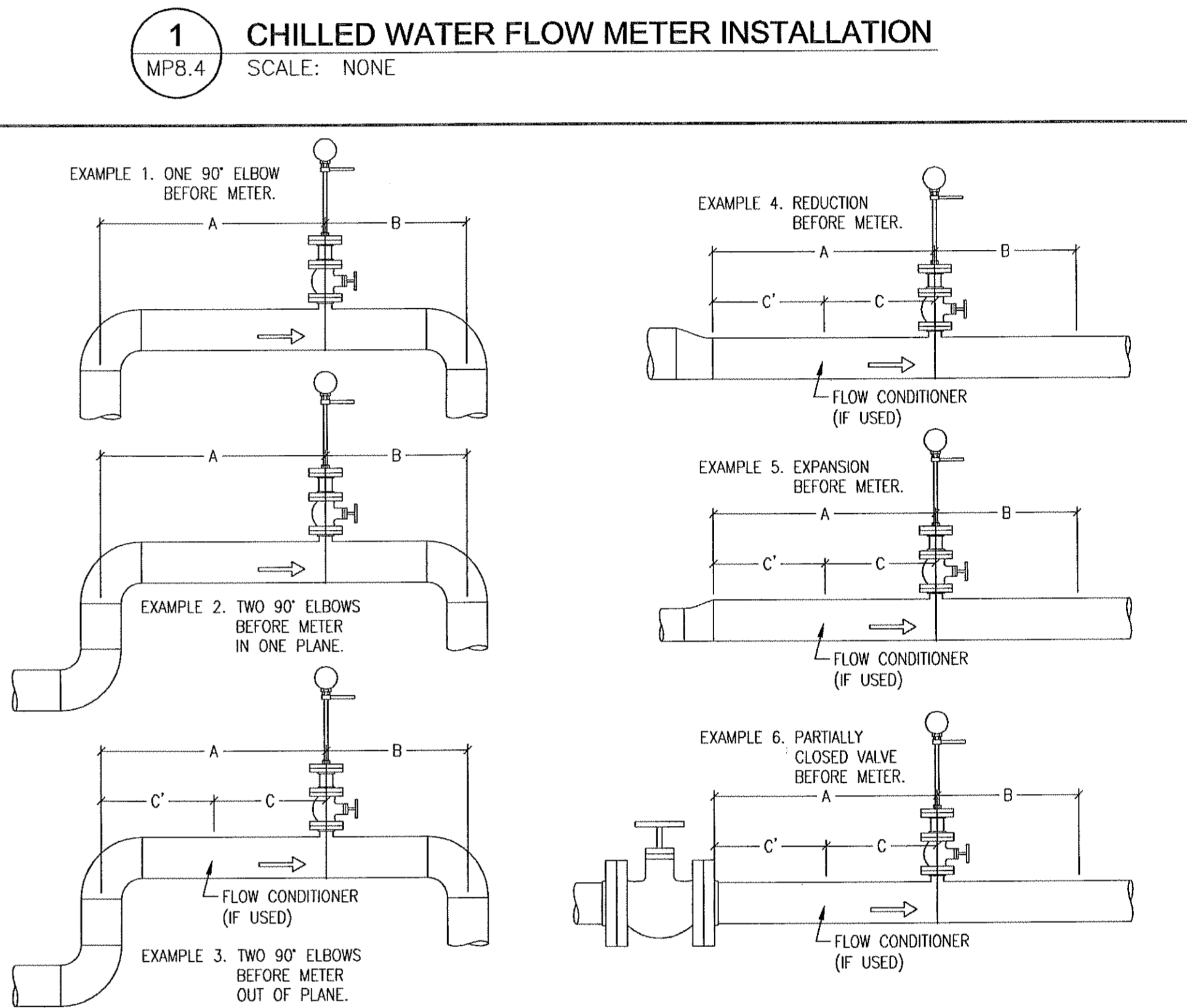
11 TRENCH & VAULT PENETRATION DETAIL
MPB.4 SCALE: NONE



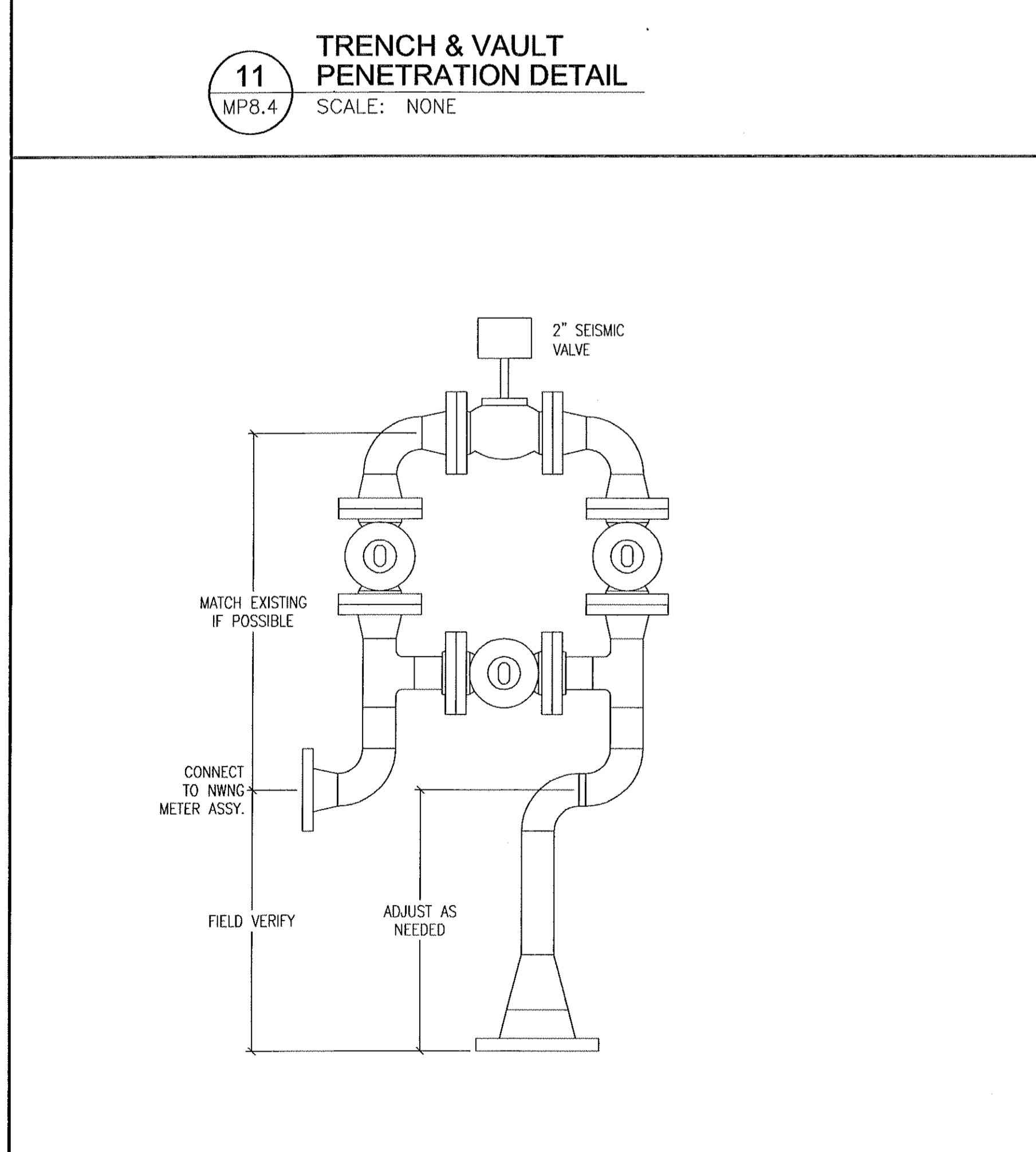
5 USB CHILLED WATER & STEAM METERS
MPB.4 SCALE: NONE



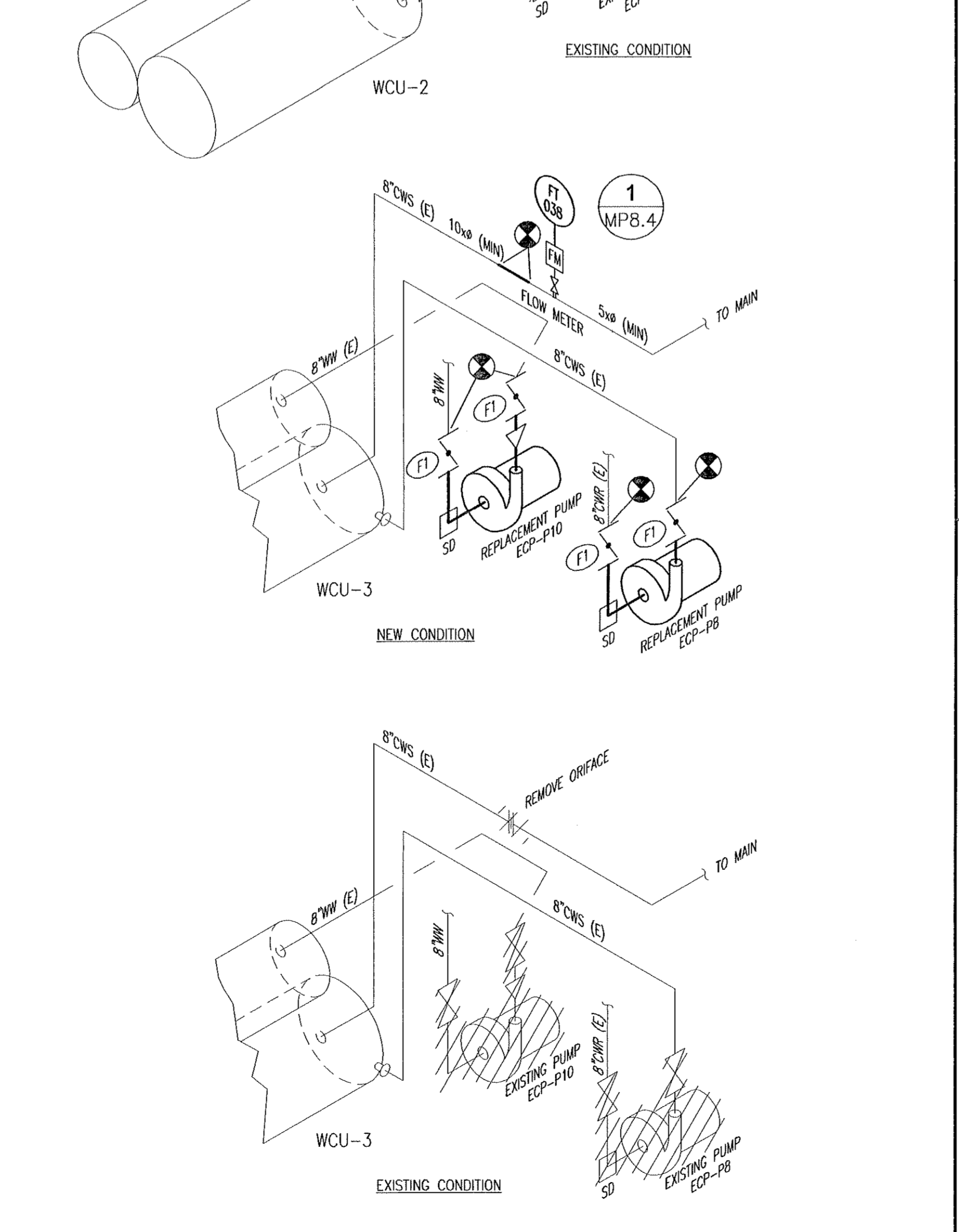
4 SBA & ED STEAM & CHILLED WATER METERS
MPB.4 SCALE: NONE



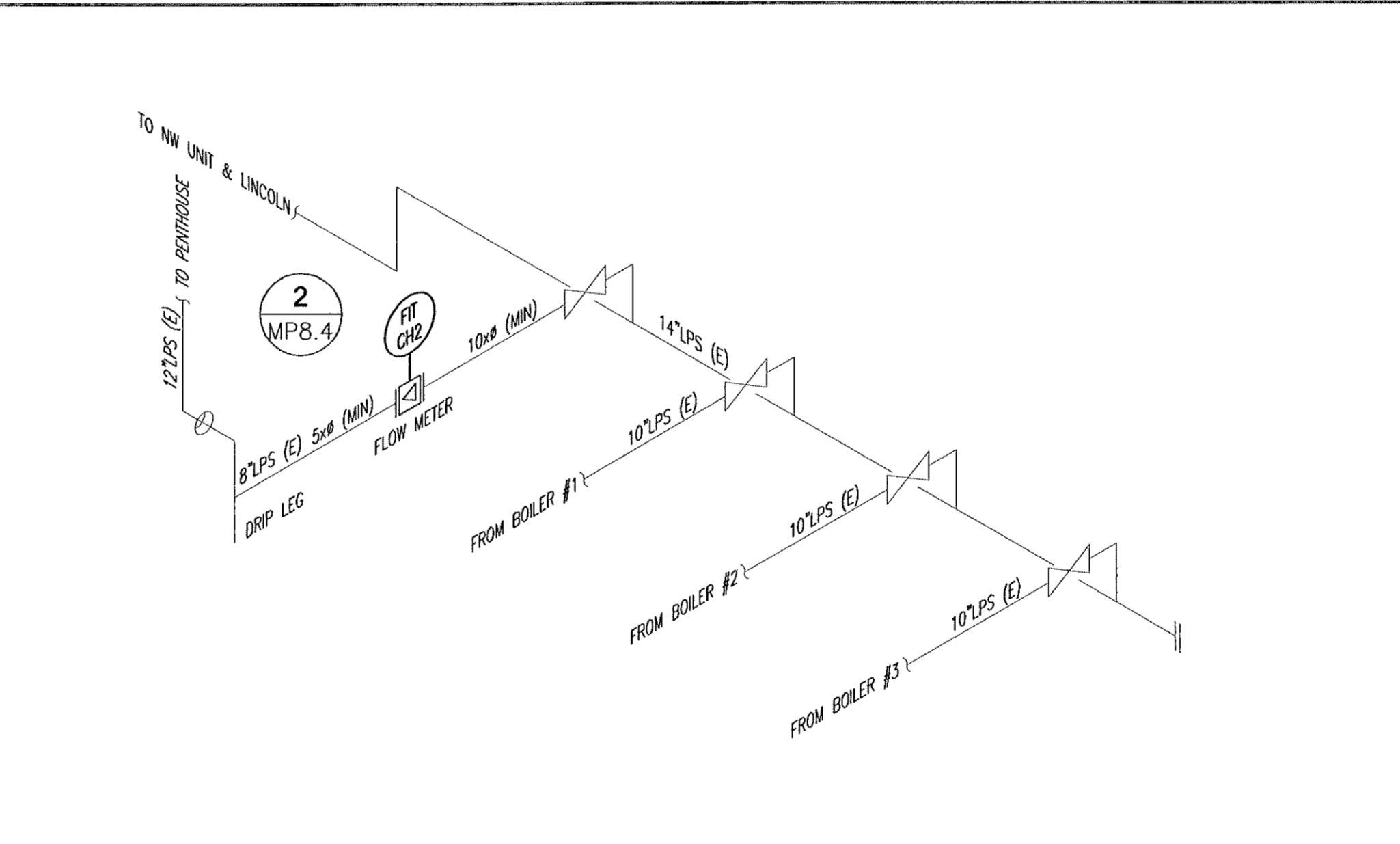
2 STEAM FLOW METER INSTALLATION
MPB.4 SCALE: NONE



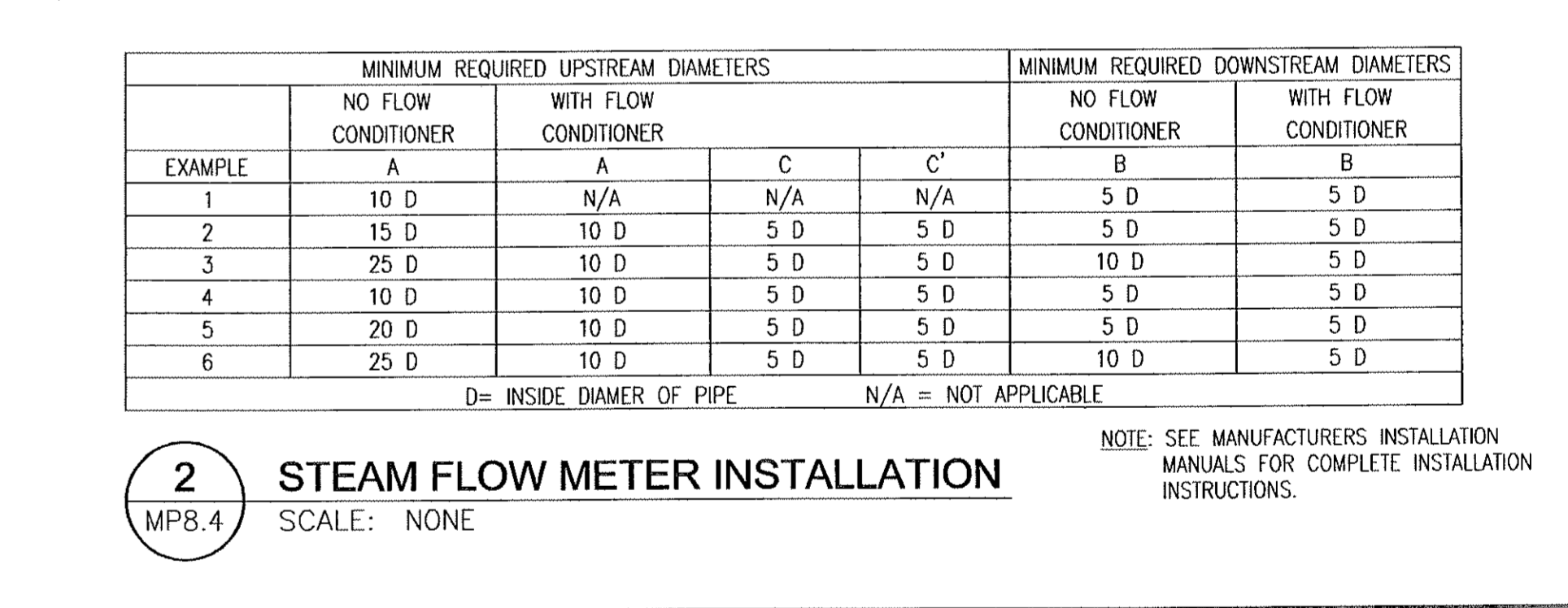
12 SEISMIC VALVE INSTALLATION ON FIRM GAS
MPB.4 SCALE: 1 1/2" = 1'-0"



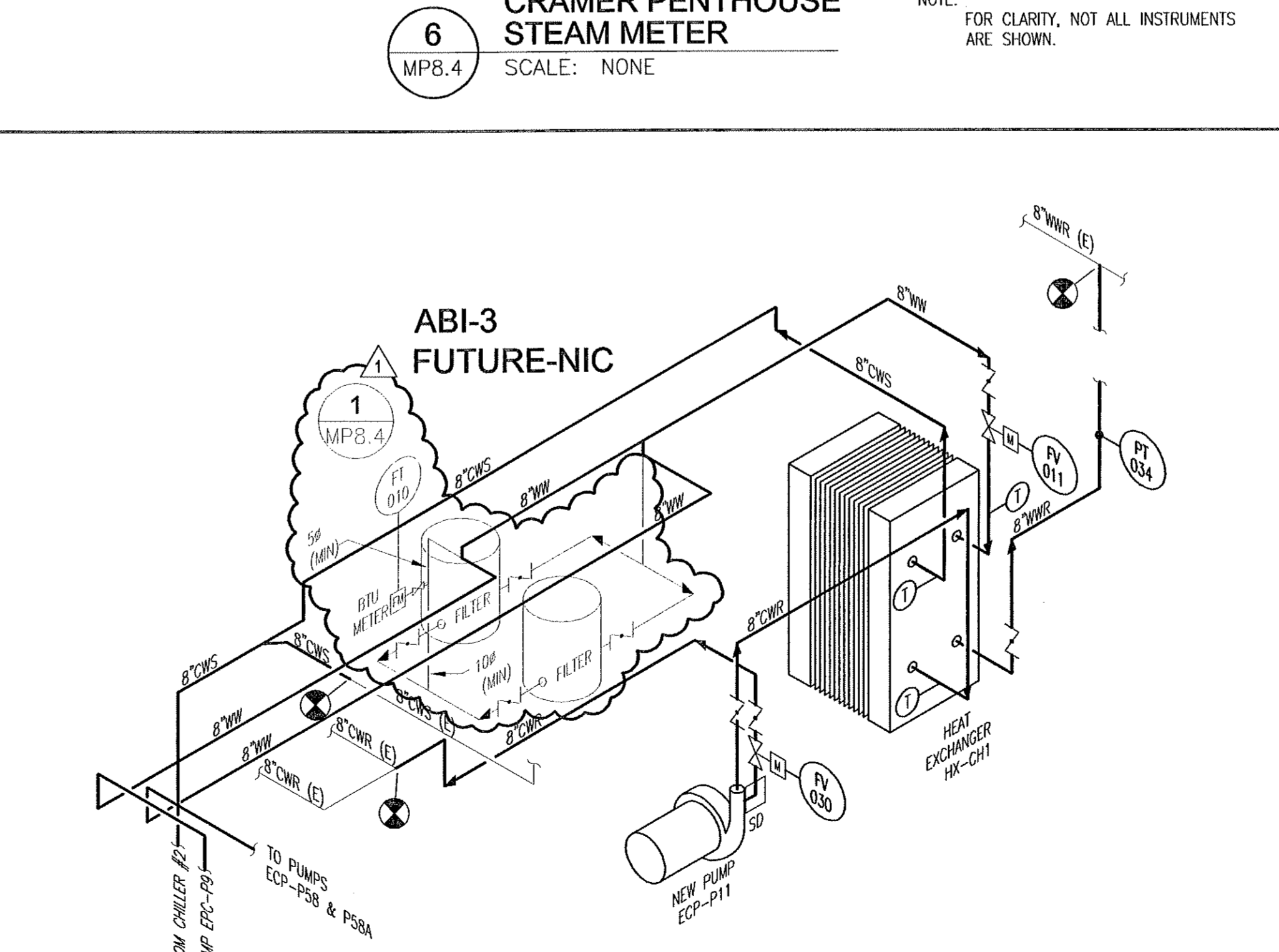
9 CRAMER CHILLERS METER INSTALLATION
MPB.4 SCALE: NONE



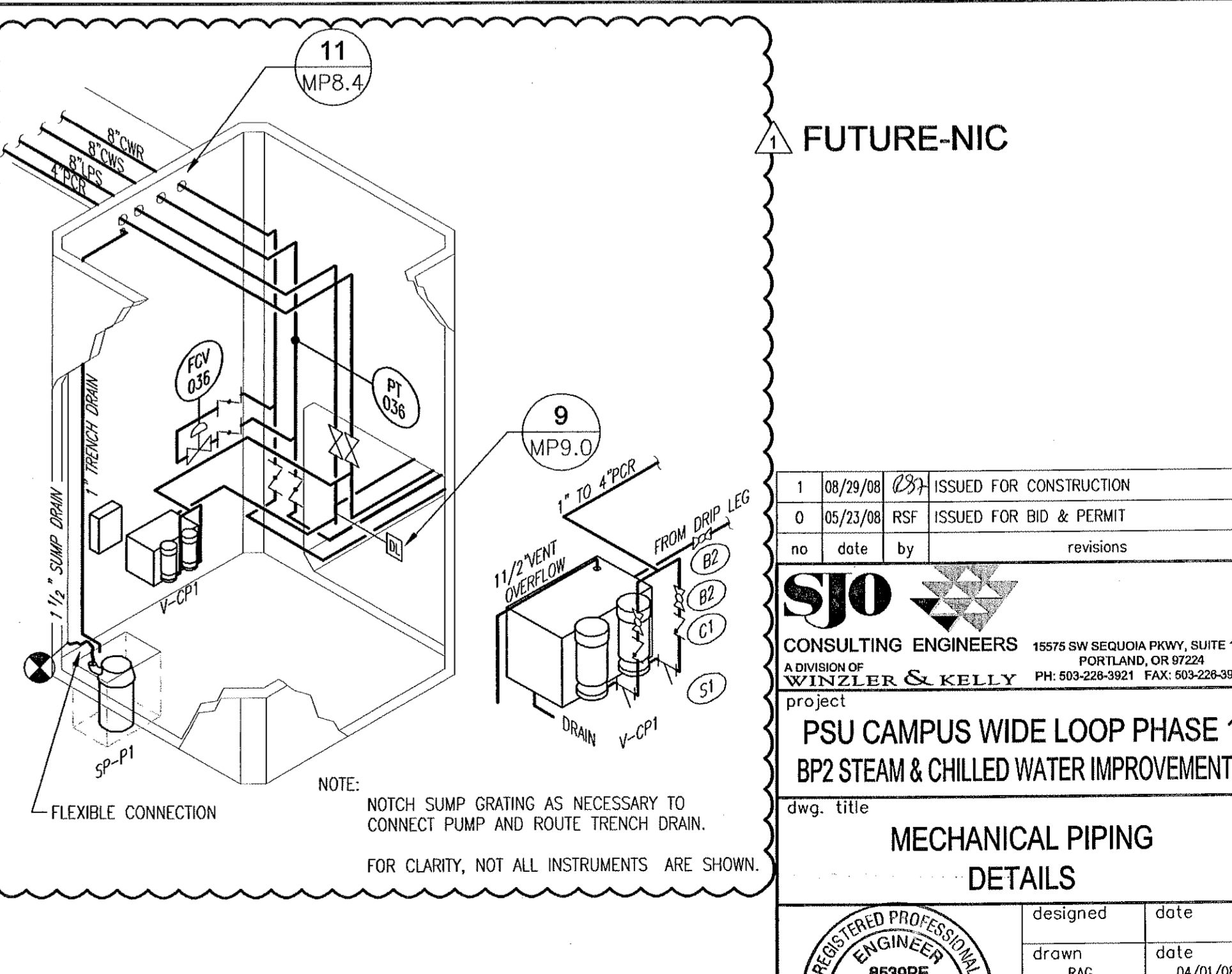
6 CRAMER PENTHOUSE STEAM METER
MPB.4 SCALE: NONE



11 FUTURE-NIC
MPB.4 SCALE: NONE



7 CRAMER HEAT EXCHANGER FILTERS, AND PUMP
MPB.4 SCALE: NONE



3 ASCR VAULT - SUMP AND CONDENSATE PUMP
MPB.4 SCALE: NONE

FUTURE-NIC

1	08/29/08	231	ISSUED FOR CONSTRUCTION		
0	05/23/08	RSF	ISSUED FOR BID & PERMIT		
no	date	by	revisions		

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18575 SW BELMONT PKWY, SUITE 140
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WINZLER & KELLY
PROJECT
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**
dwg. title

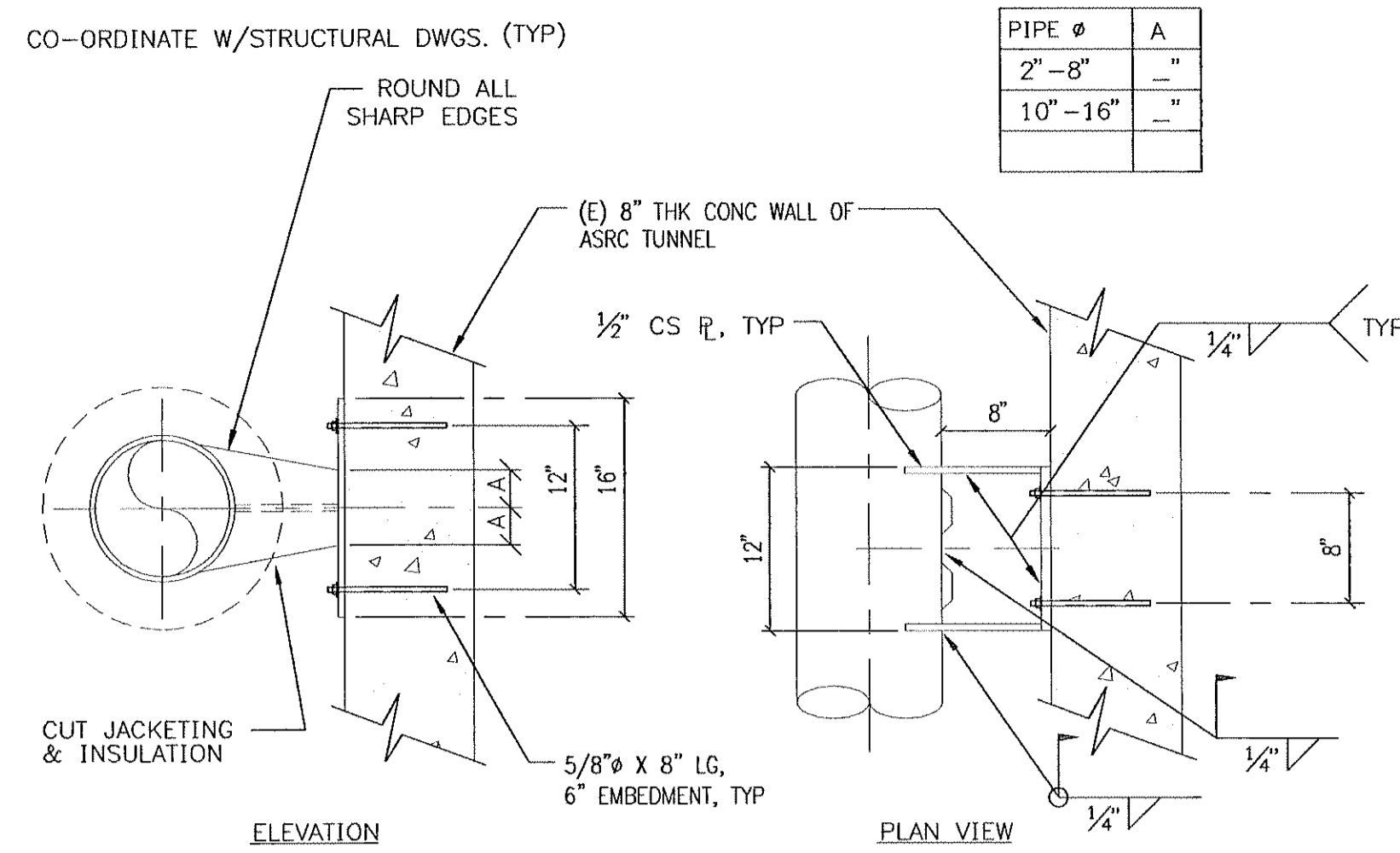
MECHANICAL PIPING DETAILS

designed	date
drawn	date
checked	date
approved	date
project no.	
drawing no.	

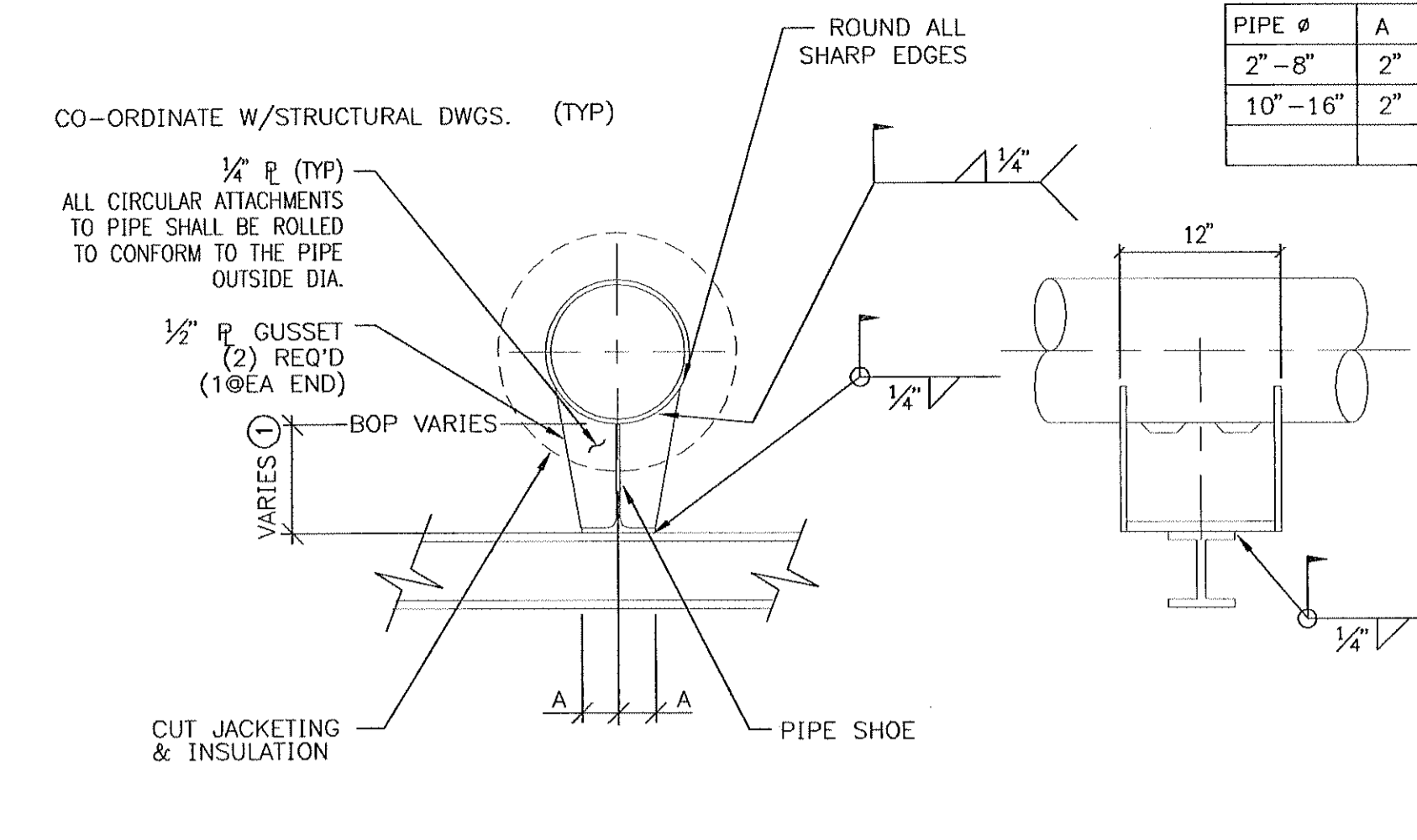
MPB.4

REGISTERED PROFESSIONAL ENGINEER
B.S.M.P.E.
OREGON
AUG 22, 1978
DANIEL S. FITZGERALD

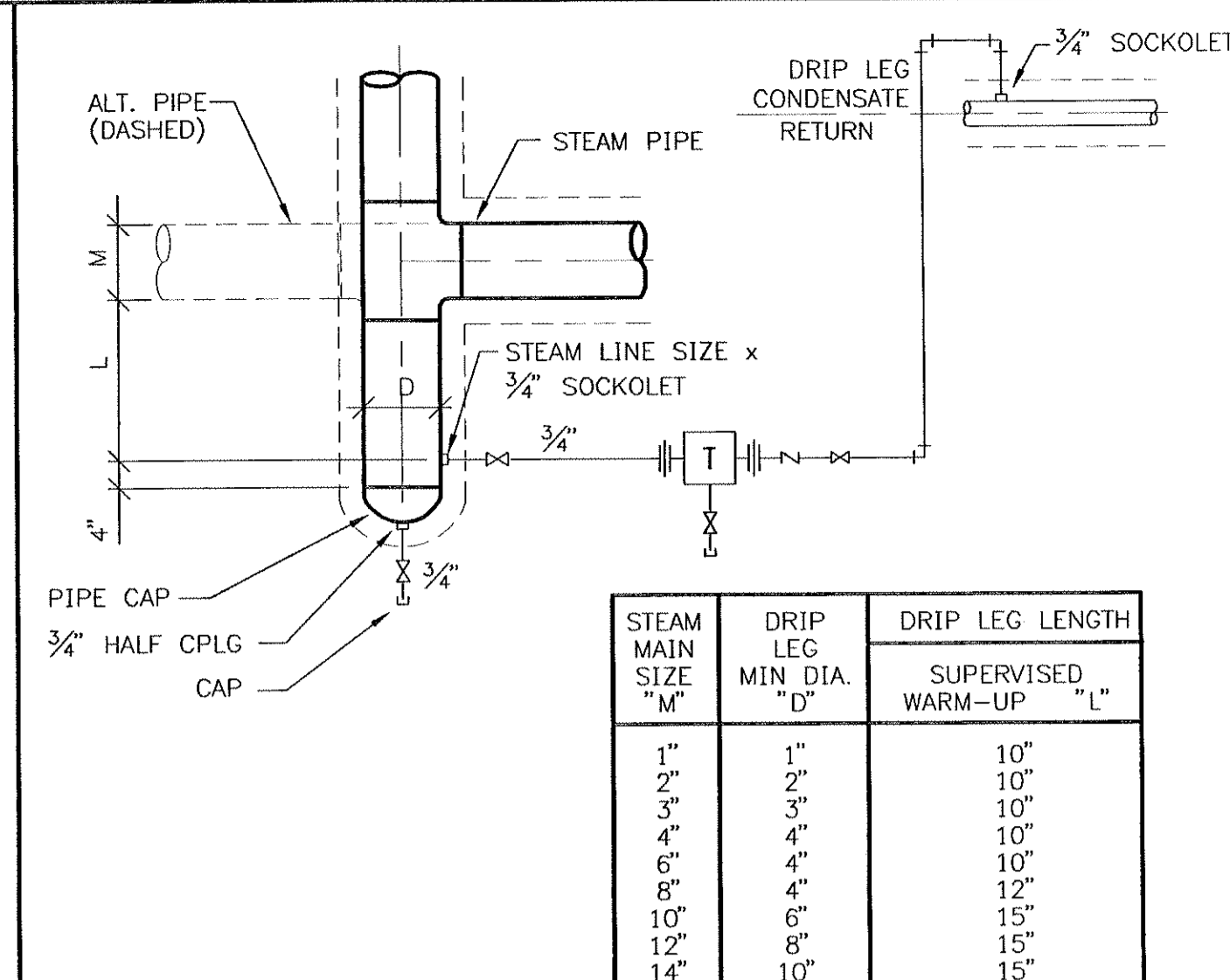
EXP: 12/31/09



7 LPS PIPE ANCHOR
MP9.0 SCALE: NONE

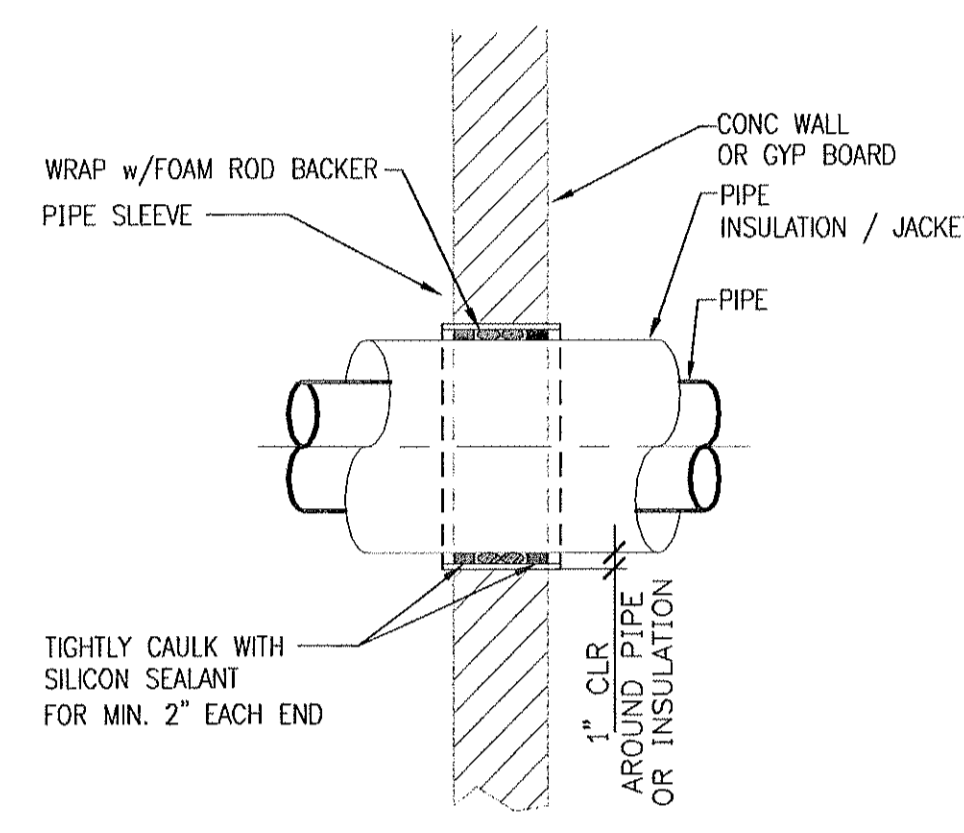


4 LPS & PCR PIPE ANCHOR
MP9.0 SCALE: NONE



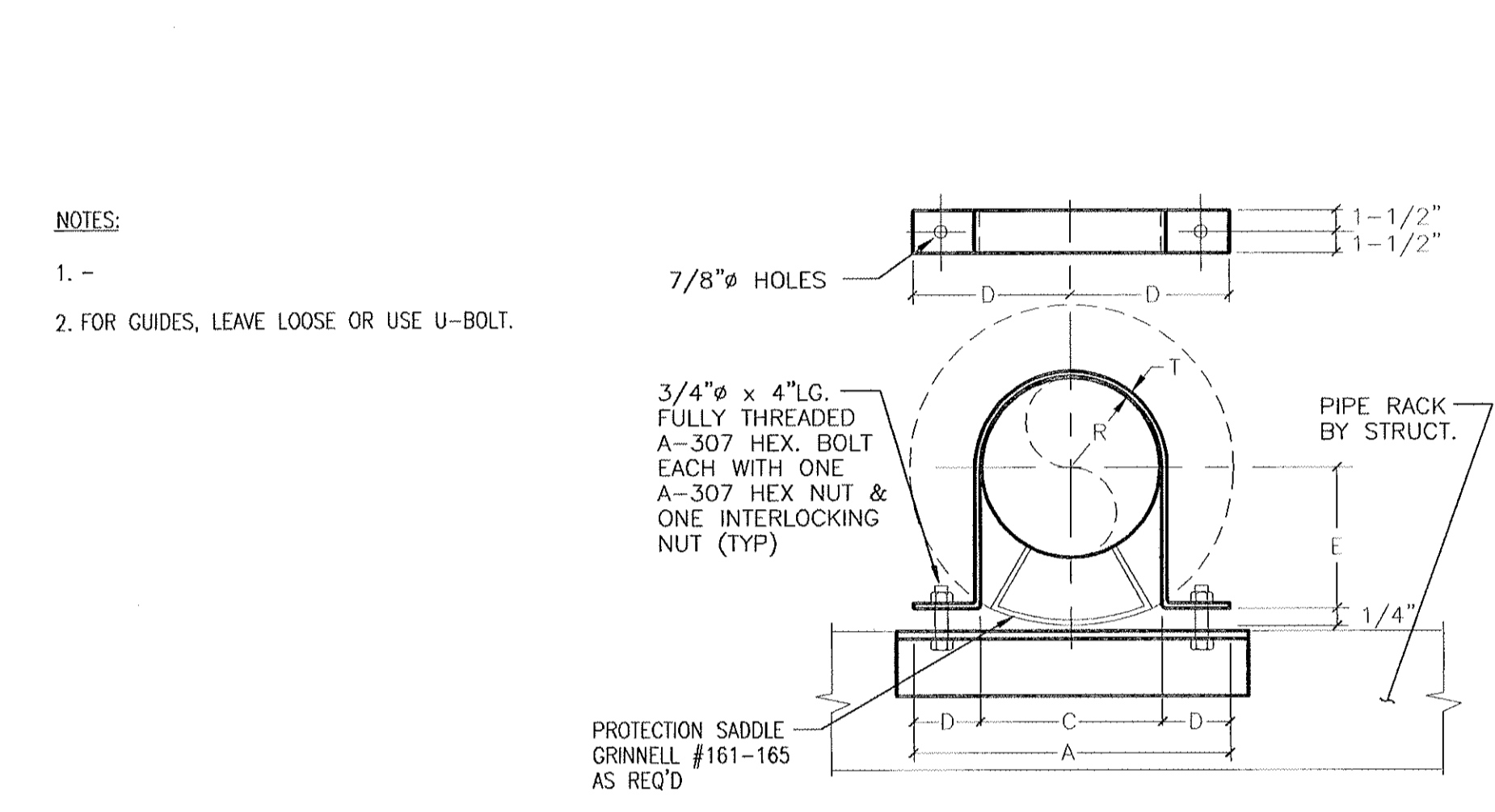
1 TYPICAL DRIP LEG STEAM TRAP DETAIL
MP9.0 SCALE: 1/2\"/>

STEAM MAIN SIZE \"M\"	DRIP LEG MIN DIA. \"D\"	DRIP LEG LENGTH SUPERVISED WARM-UP \"L\"
1\"	1\"	10\"
2\"	2\"	10\"
3\"	3\"	10\"
4\"	4\"	10\"
6\"	4\"	12\"
8\"	4\"	10\"
10\"	6\"	15\"
12\"	8\"	15\"
14\"	10\"	15\"



8 EXTERIOR WALL PENETRATION
MP9.0 SCALE: 1/2\"/>

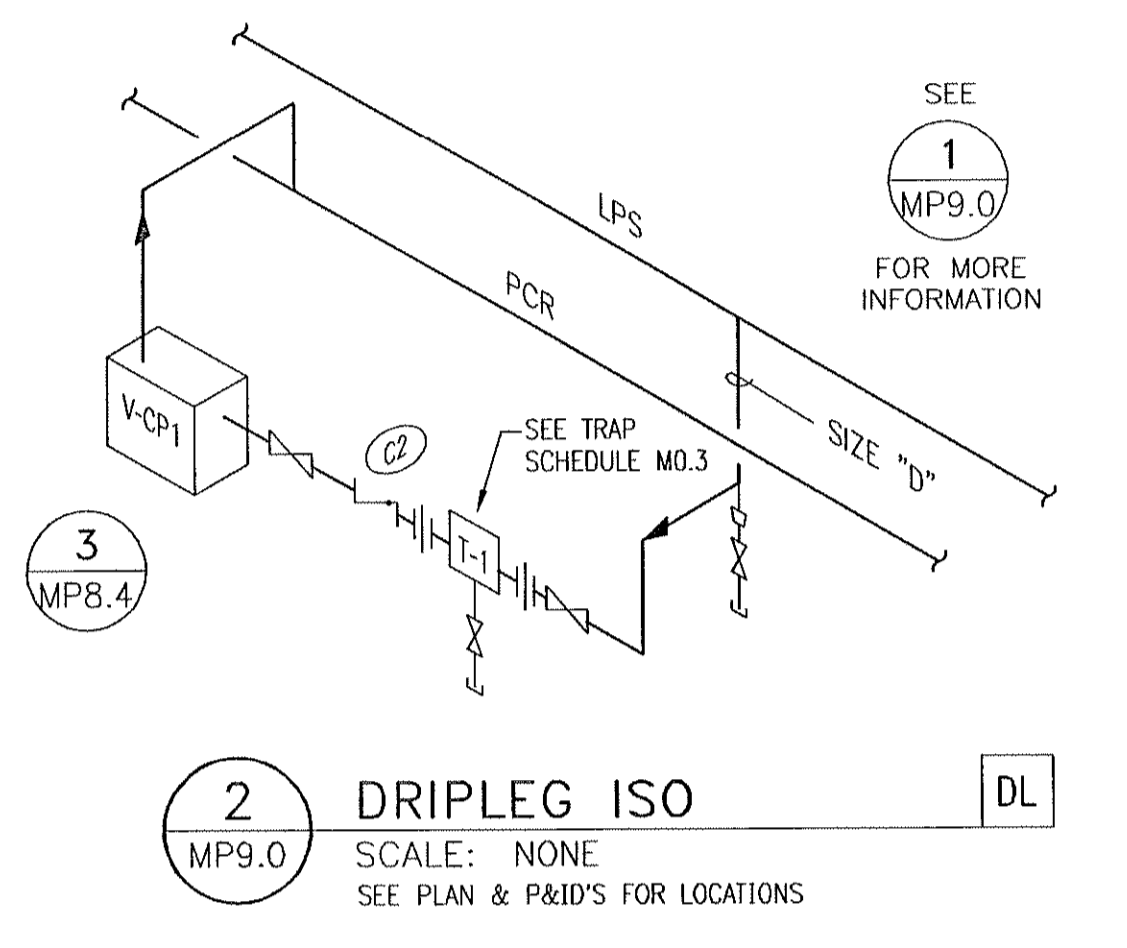
- NOTE:
- NOT ALL PIPE IS INSULATED SEE PIPING SCHEDULE.
 - SEE ALSO ARCHITECT & STRUCTURAL PENETRATION DETAILS.



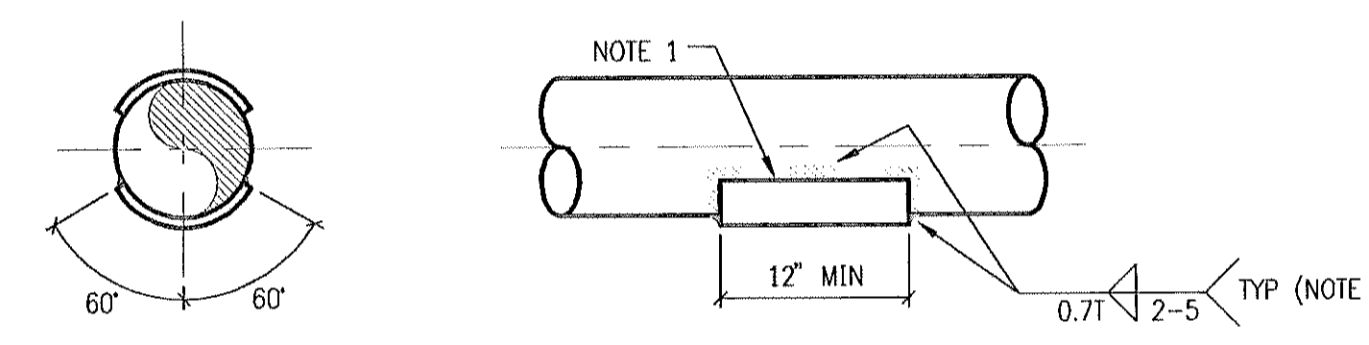
5 ANCHOR TYPE HOLD DOWN ALL EXCEPT LPS & PCR
MP9.0 SCALE: NONE

PIPE SIZE	A	B	C	D	E *	R	T
2	9 3/8	3 3/16	2 3/8	3 1/2	15/16	1 3/16	1/4
3	10 1/2	3 3/4	3 1/2	3 1/2	1 1/2	1 3/4	3/8
4	11 1/2	4 1/4	4 1/2	3 1/2	2	2 1/4	3/8
6	13 5/8	5 5/16	6 5/8	3 1/2	3 1/16	3 5/16	3/8
8	16	6 1/2	8 5/8	3 11/16	4 1/16	4 5/16	3/8
10	19	8	10 3/4	4 1/8	5 1/8	5 3/8	3/8
12	21	9	12 3/4	4 1/8	6 1/8	6 3/8	1/2
14	23	10	14	4 1/2	6 3/4	7	1/2
16	25	11	16	4 1/2	7 3/4	8	1/2

* = PLUS INSULATION THICKNESS

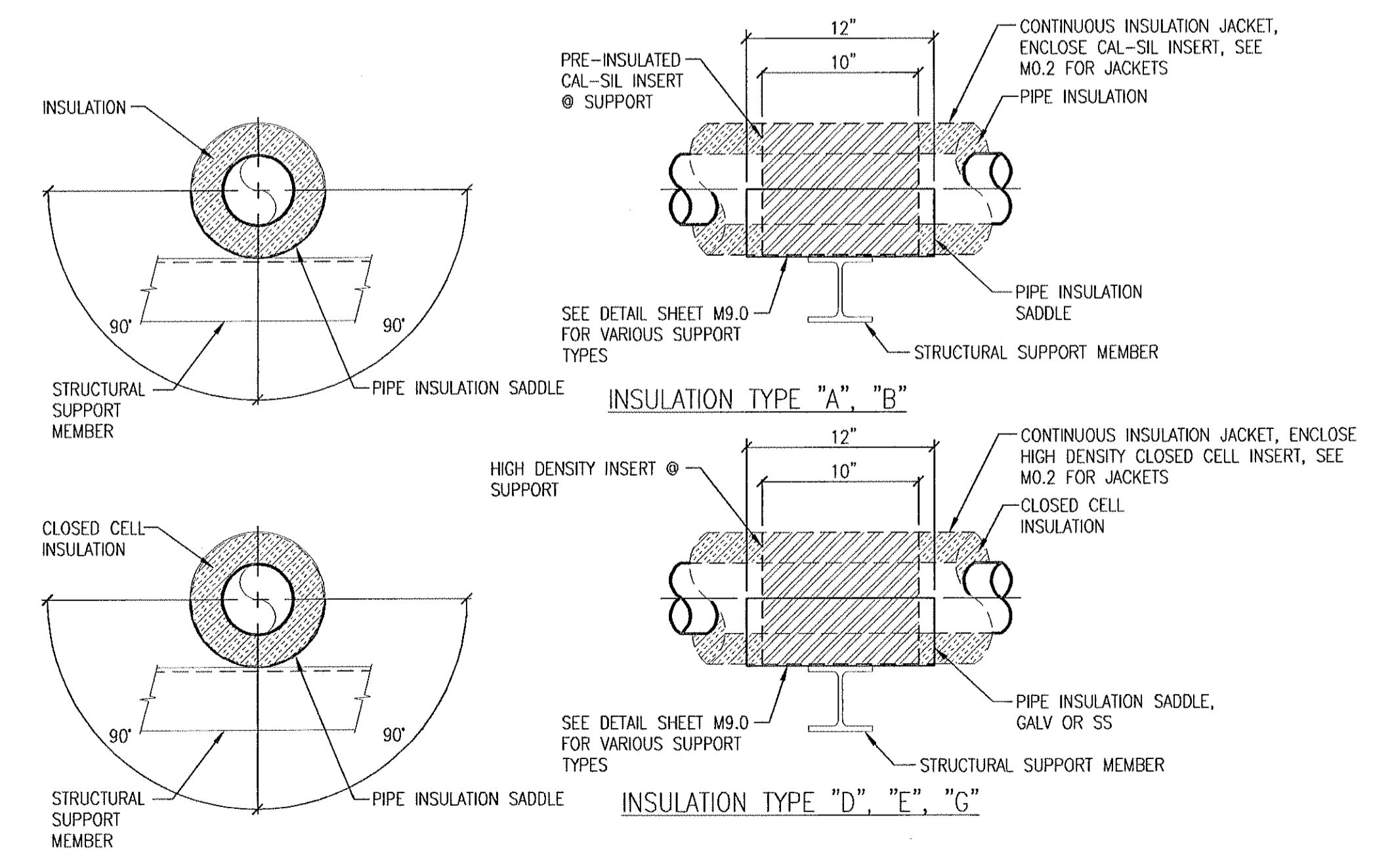


2 DRIPLEG ISO
MP9.0 SCALE: NONE
SEE PLAN & P&ID'S FOR LOCATIONS



3 WELDING SADDLE
MP9.0 SCALE: NONE

- NOTES:
- WELDING SADDLES WILL BE MADE FROM HALF PIPE OF THE SAME MATERIAL AND SHAPED TO SUIT OUTSIDE DIAMETER OF PIPE.
 - IN CASES WHERE A CONTINUOUS FILLET WELD IS APPLIED, A 1/8\"/>



6 PIPE INSULATION SADDLE
MP9.0 SCALE: NONE

1	08/29/08	237	ISSUED FOR CONSTRUCTION
0	05/23/08	RSF	ISSUED FOR BID & PERMIT
no	date	by	revisions

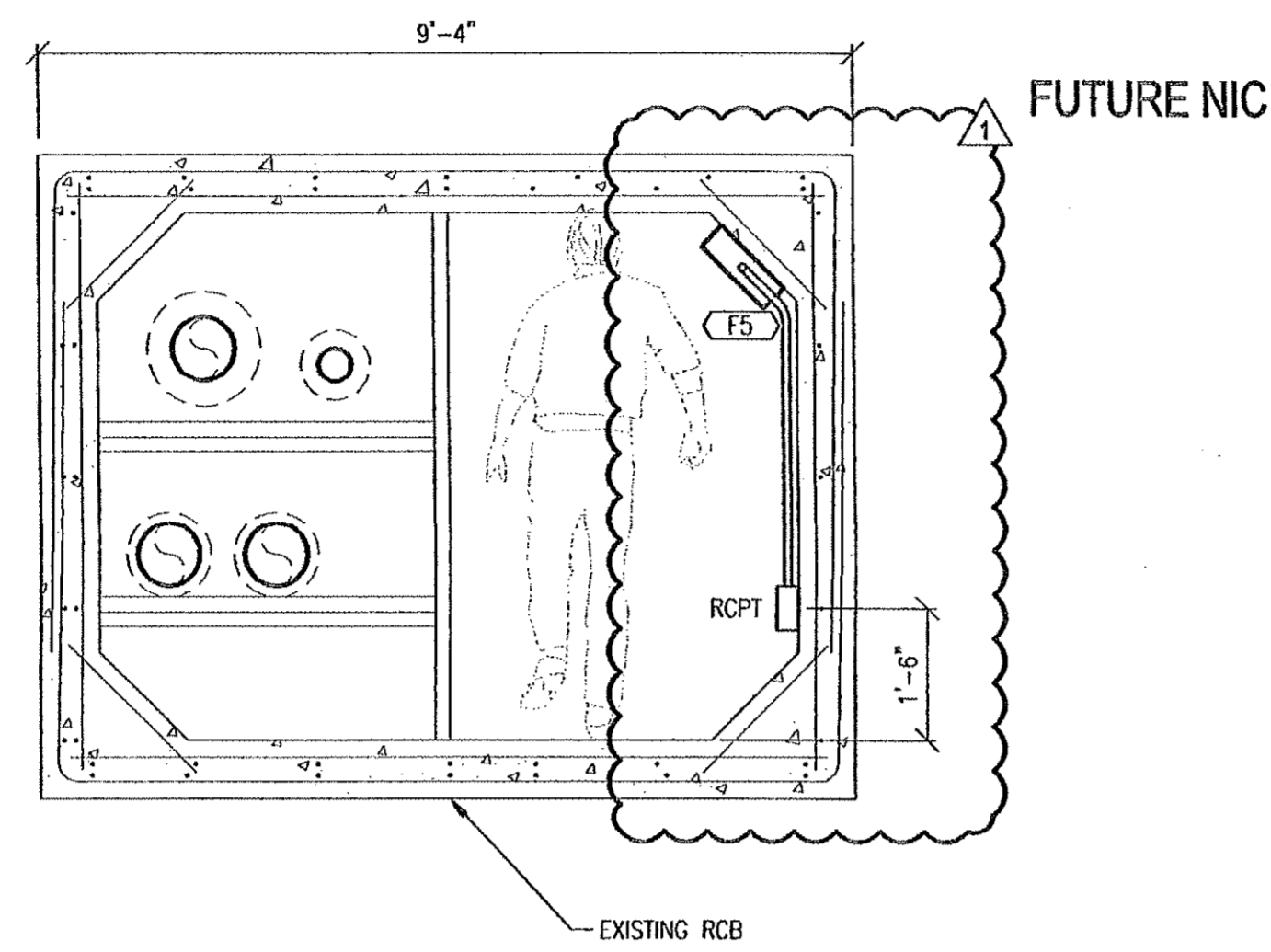
SJO
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A DIVISION OF WINZLER & KELLY
16575 SW SEQUOIA PKWY, SUITE 100
PORTLAND, OR 97224
PH: 503-228-2821 FAX: 503-228-2820

project
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

dwg. title
PIPING DETAILS

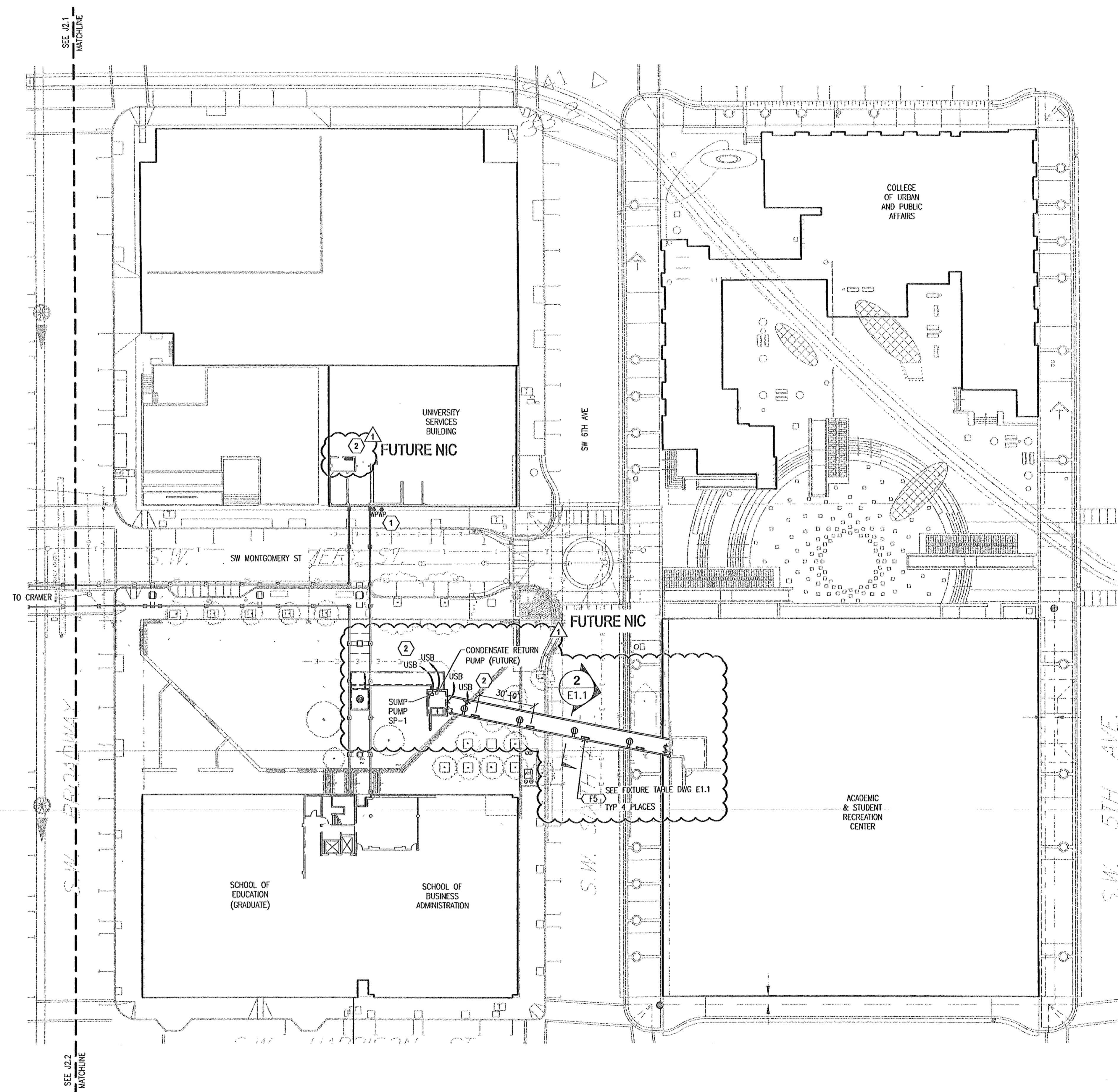
designed	date
drawn	date
approved	date
project no.	
drawing no.	

MP9.0



2 LIGHT AND RECEPTACLE MOUNTING
E1.1 SCALE: NONE

FIXTURE		MOUNTING			
KEY	SYMBOL	TYPE	METHOD	BOT OF FIXTURE	DETAIL
(FS)	[Symbol]	WALL MOUNT 1'x2', LAMP CF4	SURFACE, WALL	6'-0" OR NEAR CEILING WHICHEVER IS HIGHER	2/E1.1, 2/E2.2



1 EAST CAMPUS
POWER AND LIGHTING PLAN
E1.1 SCALE: 1" = 30'-0"

GENERAL NOTES:
1. INSTRUMENTS INSTALLED ON CHILLED WATER AND STEAM SYSTEMS IN BUILDING BASEMENTS.

KEYED NOTES:
1. RECEPTACLE AND TEMPERATURE CONTROLLER FOR HEAT TRACING CHILLED WATER PIPING. HEAT TRACE ALL CHILLED WATER LINES ABOVE GROUND FROM ASRC TUNNEL TO USB AND CRAMER. POWER FROM CB PANEL IN USB.
2. CIRCUITS FOR TUNNEL RECEPTABLES, LIGHTS AND TUNNEL EXHAUST FAN ROUTED FROM THIRD FLOOR - USB IN JANITOR CLOSET. FIELD VERIFY AVAILABLE CIRCUITS.

REFERENCE DRAWINGS:
M30 - CRAMER STEAM P&ID
M31 - WHP STEAM P&ID
M40 - CHILLED WATER P&ID
M41 - CHILLED WATER P&ID
M42 - CHILLED WATER P&ID

1	05/29/08	GAS	ISSUED FOR CONSTRUCTION
0	05/23/08	GAS	ISSUED FOR BID & PERMIT
no	date	by	revisions

SJO
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PHONE: 503-228-3121 FAX: 503-228-3128

project:
**PSU CAMPUS WIDE LOOP PHASE 1
BP2 STEAM & CHILLED WATER IMPROVEMENTS**

dwg. title:
**ASRC ELECTRICAL
POWER AND LIGHTING PLAN**

designed	date
drawn	date
approved	date
project no.	10909-07001
drawing no.	E1.1

REGISTERED PROFESSIONAL ENGINEER
10,183
OREGON
GARY A. SEDITY
EPC 024, LeO

1" = 30'-0" 30' 0 30' 60' 90'

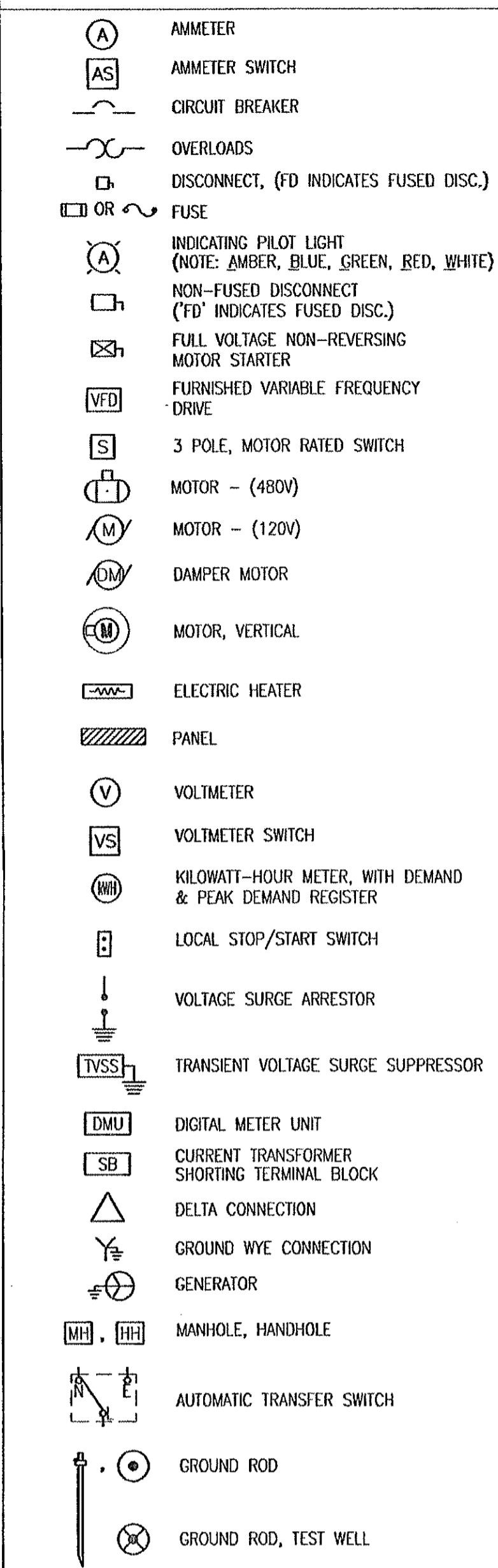
ABBREVIATIONS

A - AMP
 ABT - ADDITIVE BID ITEM
 AC - ASPHALT CONCRETE
 AF - AMPERE - FRAME
 AFF - ABOVE FINISHED FLOOR
 AFG - ABOVE FINISHED GRADE
 AC - AMPERE INTERRUPTING CAPACITY
 AS - AMMETER SWITCH
 AT - AMPERE - TRIP
 AUTO - AUTOMATIC
 AWG - AMERICAN WIRE GAUGE
 B.C. - BARE COPPER
 BLDG - BUILDING
 BMS - BUILDING MANAGEMENT SYSTEM
 BOT - BOTTOM
 C, OR CNDT - CONDUIT
 C - COMMON
 CB - CIRCUIT BREAKER
 CCT - CONTROL CIRCUIT XFMR
 CFCI - CONTRACTOR FURNISHED CONTRACTOR INSTLD.
 CL - CLASS
 CNDT - CONDUCTOR
 CNL - CONTROL
 CON - CONTROL, CONTROLLER
 C.O. - CONDUIT ONLY
 CR - CONTROL RELAY
 CRKT - CIRCUIT
 CT - CURRENT XFMR
 (D) - DEMOLISH OR REMOVE
 DF - DRINKING FOUNTAIN
 DIN - DEUTSCHE INDUSTRIE NORM
 DIST - DISTRIBUTION
 DIV - DIVISION
 DPOI - DOUBLE POLE DOUBLE THROW
 DPX - DUPLEX
 DPST - DOUBLE POLE SINGLE THROW
 DR - DOOR
 DWG - DRAWING
 EF - EXHAUST FAN
 EMT - ELECTRICAL METALLIC TUBING
 EOL - END OF LINE
 EP - EXPLOSION PROOF
 EPWR - EMERGENCY POWERED
 EQP - EQUIPMENT
 (E) OR EXST - EXISTING
 FA - FIRE ALARM
 FACP - FIRE ALARM CONTROL PANEL
 FASCP - FIRE ALARM SECURITY PANEL
 FCP - FAN CONTROL PANEL
 FCR - FAN CONTROL RELAY
 FD - FUSED DISCONNECT
 FXT - FIXTURE
 FLA - FULL LOAD AMPS
 FLUOR - FLUORESCENT
 FS - FLOW SWITCH
 FU - FUSE
 FVNR - FULL VOLTAGE NON-REVERSING
 FVR - FULL VOLTAGE REVERSING
 GB - GROUND BUS BAR
 GEN - GENERATOR
 GFCI - GROUND FAULT CIRCUIT INTERRUPTER
 GFI - GROUND FAULT INTERRUPTER
 GND - GROUND
 GOVT - GOVERNMENT
 GP - GROUP
 HH - HANDHOLE
 HDA - HAND-OFF-AUTO
 HP - HORSE POWER
 HV - HIGH VOLTAGE
 IC - INTERCOM SYSTEM
 IG - ISOLATED GROUND
 IOTC - INSTANT ON TRIP CLOSE
 JBOX - JUNCTION BOX (TYP. CNDT BODY)
 KCM - THOUSAND CIRCULAR MILS
 KW - KILO-WATT
 KVA - KILO-VOLT-AMPERE
 KWAR - KILO-WATT-AMPERE-REACTIVE
 KW - KILOWATT
 KWH - KILOWATT HOUR
 LAN - LOCAL AREA NETWORK
 LCC - LIGHTING CONTROL CONTACTOR
 LCP - LIGHTING CONTROL PANEL
 L/O - LIGHT OUT
 LS - LEVEL SWITCH
 LT - LONG TIME
 LV - LOW VOLTAGE
 mA - MILLI-AMPS
 MAC - MAGNETIC
 MAX - MAXIMUM
 MB - MASTERBOX
 MCB - MAIN CIRCUIT BREAKER

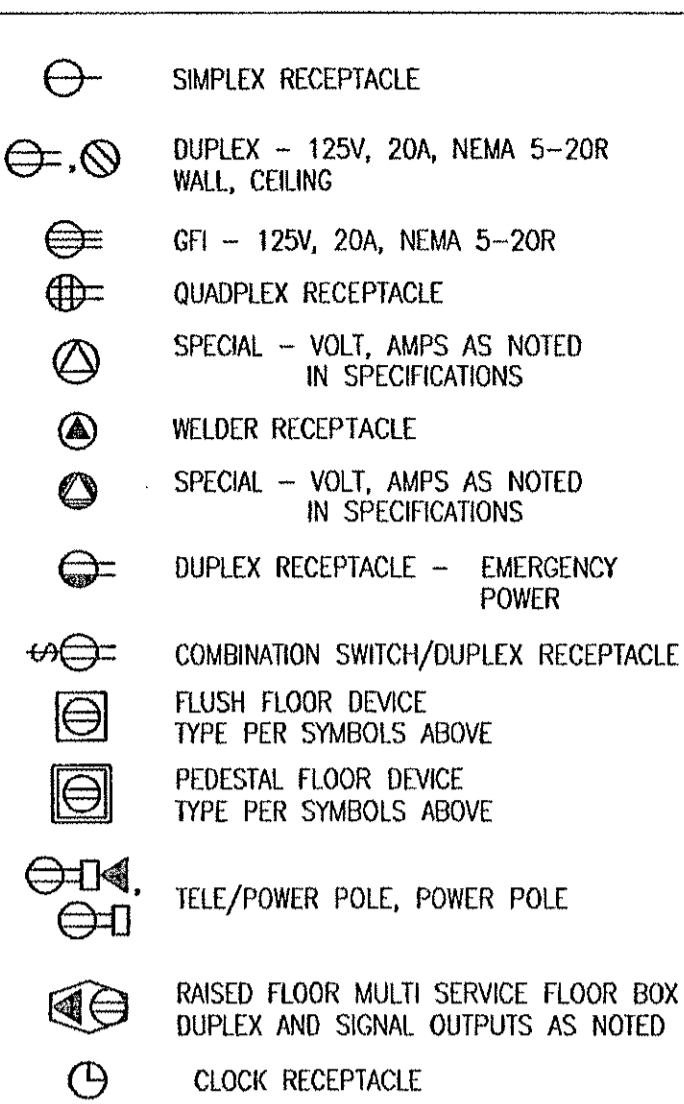
MCC - MOTOR CONTROL CENTER
 MCP - MOTOR CRKT PROTECTOR CB
 MDP - MAIN DISTRIBUTION PANEL
 MH - MANHOLE
 MN - MINIMUM
 MLO - MAIN LUGS ONLY
 MTD - MOUNTED
 MTC - MOUNTING
 N - NORTH
 (N) - NEW
 NC - NORMALLY CLOSED
 NA - NOT APPLICABLE
 NEMA - NATIONAL ELECTRICAL MANUFACTURER ASSOCIATION
 NEUT - NEUTRAL
 NFD - NON-FUSED DISCONNECT
 NFPA - NATIONAL FIRE PROTECTION ASSOCIATION
 NO - NORMALLY OPEN
 OC - ON CENTER
 OFC - OIL-FUSED CB
 OFCI - OWNER FURNISHED CONTRACTOR INSTALLED
 OHD - OVERHEAD
 OHP - OVERHEAD POWER/COMMUNICATION LINES
 OL - OVERLOAD RELAY (THERMAL)
 P - POLE
 PA - PUBLIC ADDRESS
 PB - PULL BOX
 PBS - PUSH BUTTON STATION
 PEC - PHOTOELECTRIC CELL
 PF - POWER FACTOR
 PFC - POWER FACTOR CORRECTION
 PH OR 4 - PHASE
 PLCS - PLACES
 PMH - POWER MANHOLE
 PNL - PANEL
 POC - POINT OF CONNECTION
 PP - POWER POLE
 PS - PRESSURE SWITCH
 PVC - POLYVINYL CHLORIDE
 QTY - QUANTITY
 (R) - EXISTING TO BE REMOVED
 RCPIT - RECEPTACLE
 RGS - RIGID GALVANIZED STEEL
 (RL) - EXISTING TO BE RELOCATED
 RM - ROOM
 (RR) - EXISTING TO BE REMOVED & REPLACED
 RS - RAPID START
 SHLD - SHIELDED
 SCA - SHORT CIRCUIT AMPERES (AVAILABLE)
 SECP - SECURITY PANEL
 SP - SPARE
 SPDT - SINGLE POLE DOUBLE THROW
 SPST - SINGLE POLE SINGLE THROW
 SV - SOLENOID VALVE
 SW - SWITCH
 SWBD - SWITCHBOARD
 SWGR - SWITCHGEAR
 SYM - SYMMETRICAL
 TB - TERMINAL BOX
 TDR - TIME DELAY RELAY
 TEL - TELEPHONE SYSTEM
 TMH - TELEPHONE MANHOLE
 TSD - TREATMENT, STORAGE, AND DISPOSAL
 TVSS - TRANSIENT VOLTAGE SURGE SUPPRESSION
 TYP - TYPICAL
 UGP - UNDERGROUND POWER CONDUIT OR DUCT
 UGT - UNDERGROUND TELEPHONE CONDUIT OR DUCT
 UL - UNDERWRITER'S LABORATORY
 UOS - UNLESS OTHERWISE SPECIFIED
 V - VOLT
 VA - VOLT-AMPS
 VAC - VOLTAGE - ALTERNATING CURRENT
 VDC - VOLTAGE - DIRECT CURRENT
 VS - VOLTMETER SWITCH
 W - WATT, OR WIRE
 WH - WATER HEATER
 WP - WEATHERPROOF
 WW - WARM WHITE
 XFMR - TRANSFORMER
 XFR - TRANSFER
 XLP - CROSS-LINKED POLYETHYLENE
 ZS - POSITION SWITCH (LIMIT SWITCH)

SYMBOLS

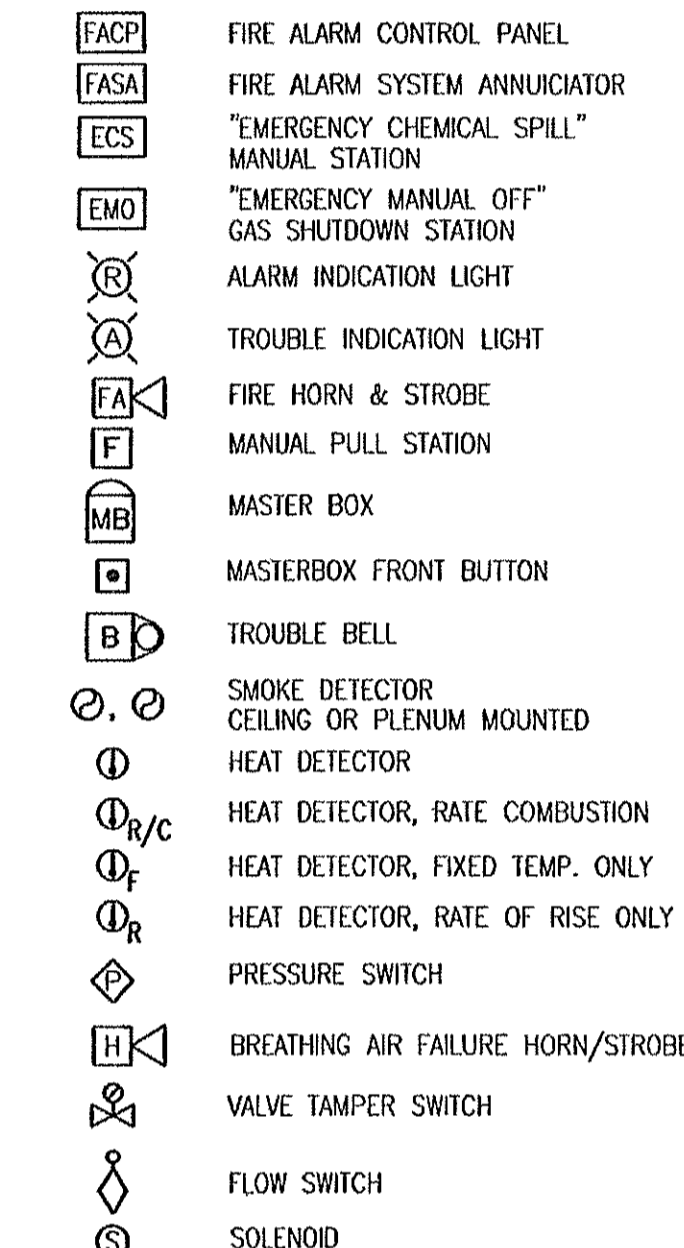
GENERAL



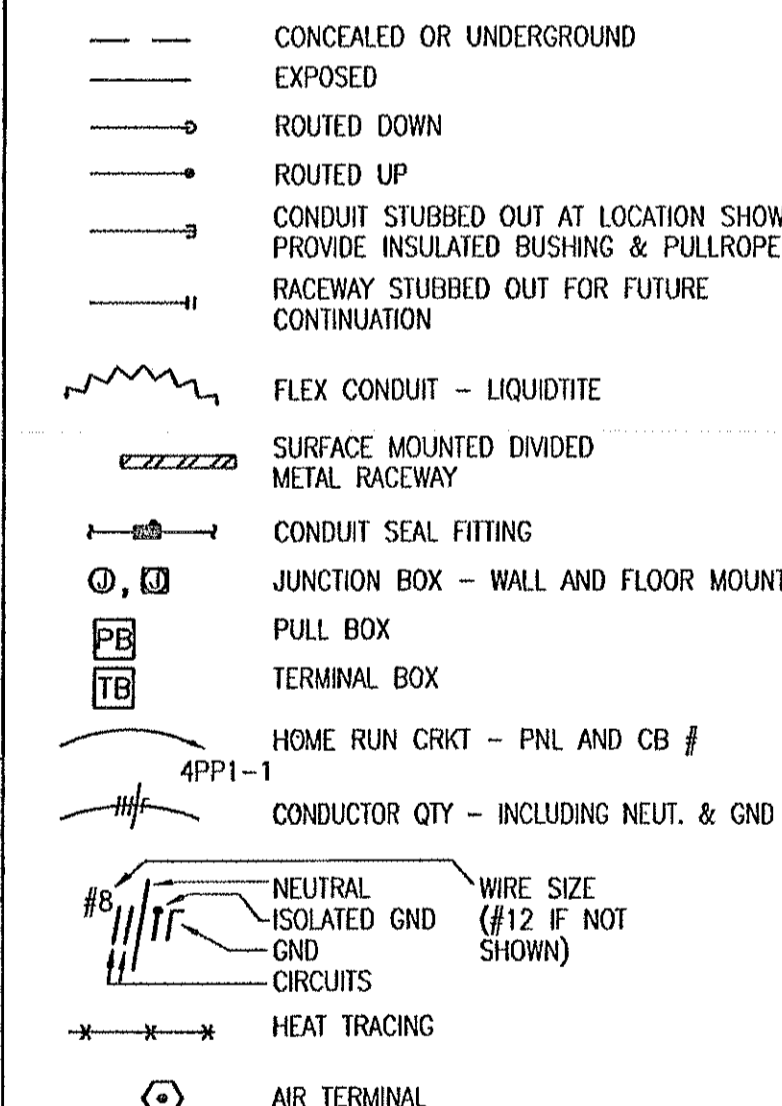
RECEPTACLES



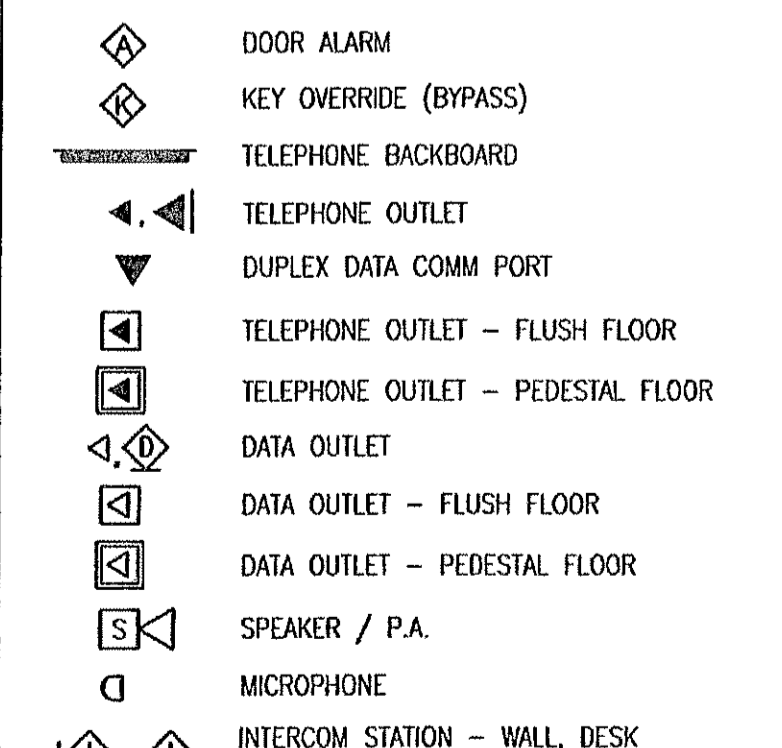
FIRE & GAS ALARM



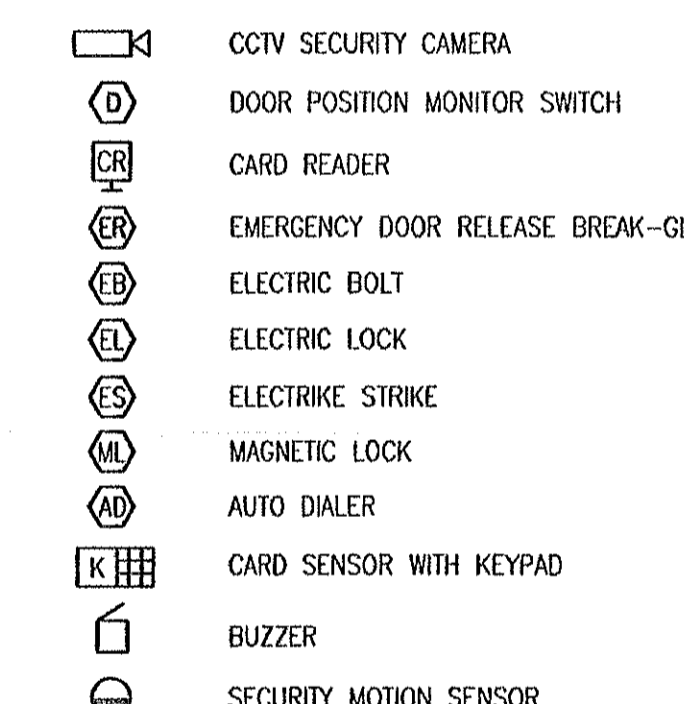
RACEWAY



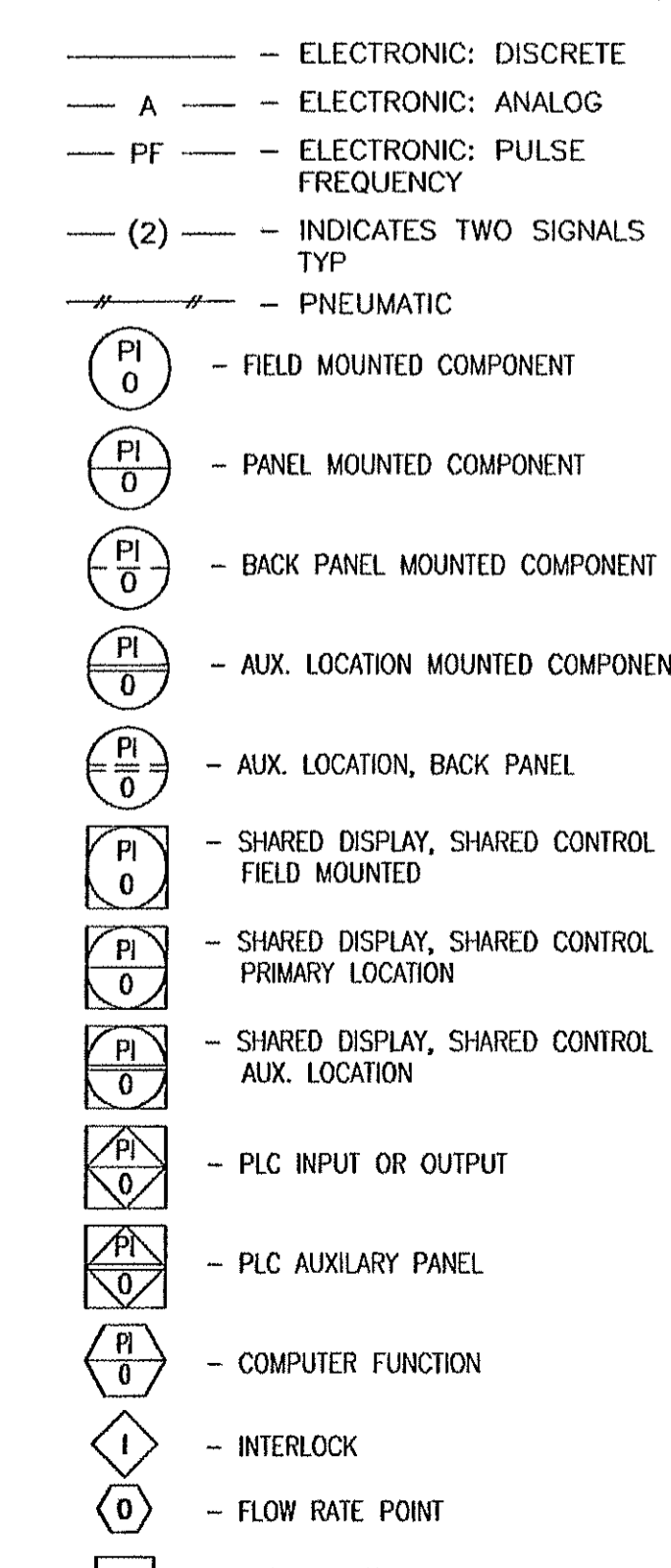
COMMUNICATION



SECURITY



INSTRUMENT/SIGNAL



MULTI-CONDUCTOR CABLE IN CNDT.

Type ID	Qty	Cable Size	Cndt Size
"C" MULTI-COND CRKTS - GREY COLOR JACKET			
J01	1	1-PR-#18	3/4"
J02	2	1-PR-#18	3/4"
J03	3	1-PR-#18	1"
J04	4	1-PR-#18	1"
J05	5	1-PR-#18	1.25"
J06	6	1-PR-#18	1.25"
J07	7	1-PR-#18	1.25"
J08	8	1-PR-#18	1.25"
J09	9	1-PR-#18	1.5"
J10	10	1-PR-#18	1.5"
J11	11	1-PR-#18	1.5"
J12	12	1-PR-#18	2"
J13	13	1-PR-#18	2"
J14	14	1-PR-#18	2"
J15	15	1-PR-#18	2"
"C" MULTI-COND CRKTS - GREY COLOR JACKET			
J51	1	3/C-#18	3/4"
J52	2	3/C-#18	3/4"
J53	3	3/C-#18	1"
J54	4	3/C-#18	1"
J55	5	3/C-#18	1.25"
J56	6	3/C-#18	1.25"
J57	7	3/C-#18	1.25"
J58	8	3/C-#18	1.5"
J59	9	3/C-#18	1.5"
J60	10	3/C-#18	1.5"
J61	11	3/C-#18	2"
J62	12	3/C-#18	2"
J63	13	3/C-#18	2"
J64	14	3/C-#18	2"
J65	15	3/C-#18	2"

MULTI-CONDUCTOR CABLE IN CNDT.

Type ID	Qty	Wire Size	CRKT AREA	CNDT SIZE	OKONITE CAT. No.
M01	1	3/C-#12	0.18	1	202-10-3443
M02	2	3/C-#12	0.36	1.25	202-10-3443
M03	3	3/C-#12	0.54	1.5	202-10-3443
M21	1	3/C-#10	0.23	1.25	202-10-3543
M22	2	3/C-#10	0.46	1.5	202-10-3543
M23	3	3/C-#10	0.69	2	202-10-3543
M41	1	3/C-#8	0.35	1.25	112-10-3644
M42	2	3/C-#8	0.71	2	112-10-3644
M43	3	3/C-#8	1.06	2	112-10-3644
M51	1	3/C-#6	0.50	1.5	112-10-3654
M52	2	3/C-#6	1.01	2.5	112-10-3654
M53	3	3/C-#6	1.51	2.5	112-10-3654
M61	1	3/C-#4	0.57	2	112-10-3664
M65	1	3/C-#2	0.82	2	112-10-3874
M71	1	3/C-#1	1.02	2.5	112-10-3884
M75	1	3/C-#1/0	1.17	2.5	112-10-3894
M81	1	3/C-#2/0	1.37	3	112-10-3904
M85	1	3/C-#4/0	1.89	3.5	112-10-3924
M87	1	3/C-250 KCM	3.08	4	112-10-3929
M89	1	3/C-500 KCM	4.01	5	112-10-3937

TABLE 2 RECOMMENDED DISTANCE (in inches) BETWEEN CONDUIT TRADE SIZES

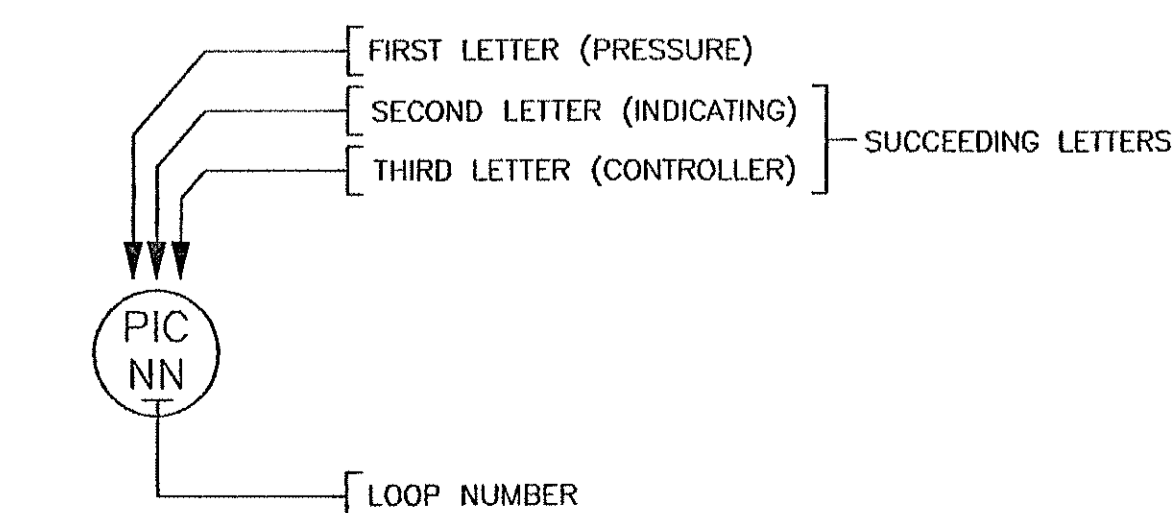
SIZE	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	6"
1/2"	1-3/8"												
3/4"	1-1/2"	1-5/8"											
1"	1-3/4"	1-7/8"	2"										
1-1/4"	2"	2-1/8"	2-1/4"	2-1/2"									
1-1/2"	2-1/8"	2-1/4"	2-3/8"	2-5/8"	2-3/4"								
2"	2-3/8"	2-1/2"	2-3/4"	3"	3-1/8"	3-3/8"							
2-1/2"	2-5/8"	2-3/4"	3"	3-1/4"	3-1/2"	3-3/4"	4"						
3"	3"	3-1/8"	3-3/8"	3-5/8"	3-3/4"	4"	4-3/8"	4-3/4"					
3-1/2"	3-3/8"	3-1/2"	3-5/8"	3-7/8"	4"	4-3/8"	4-5/8"	5"	5-3/8"				
4"	3-3/4"	3-1/8"	4"	4-1/4"	4-3/8"	4-3/4"	5"	5-3/8"	5-3/4"	6"			
4-1/2"	4"	4-1/8"	4-1/4"	4-1/2"	4-3/4"	5"	5-1/4"	5-5/8"	6"	6-1/4"	6-1/2"		
5"	4-3/8"	4-1/2"	4-5/8"	4-7/8"	5"	5-3/8"	5-5/8"	6"	6-1/4"	6-5/8"	7"	7-1/4"	
6"	5"	5-1/8"	5-1/4"	5-1/2"	5-3/4"	6"	6-1/4"	6-5/8"	7"	7-1/4"	7-5/8"	8"	8-1/2"

INSTRUMENT SOCIETY OF AMERICA TABLE

FIRST LETTER(S)	SUCCEEDING LETTERS				
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
C	CONDUCTIVITY			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL			DAMPER
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			
G	USERS CHOICE(*)		GLASS, GAUGE		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE	RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	USERS CHOICE(*)		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
O	USERS CHOICE(*)		ORIFICE		
P	PRESSURE (OR VACUUM)		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT(*)	INTEGRATE			
R	RADIATION		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE(*)		MULTIFUNCTION(*)	MULTIFUNCTION(*)	MULTIFUNCTION(*)
V	VIBRATION			VALVE	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED(*)		UNCLASSIFIED(*)	UNCLASSIFIED(*)	UNCLASSIFIED(*)
Y	EVENT, STATE OR PRESENCE			RELAY OR COMPUTE(*)	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

INSTRUMENTATION ABBREVIATION



EXAMPLES

- LS - LEVEL SWITCH
- LT - LEVEL TRANSMITTER
- LIT - LEVEL INDICATING TRANSMITTER
- KY - TIME DELAY RELAY

ATYPICAL INSTRUMENT ABBREVIATIONS (THIS WORK)

- GGA - GAS LEVEL SENSOR/TRANSMITTER
- NIT - BTU INDICATING TRANSMITTER

1 08/28/08 ISSUED FOR CONSTRUCTION
 0 05/23/08 GAS ISSUED FOR BID & PERMIT
 no date by revisions

SJO
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PROJECT
**PSU CAMPUS WIDE LOOP PHASE 1
 BP2 STEAM & CHILLED WATER IMPROVEMENTS**

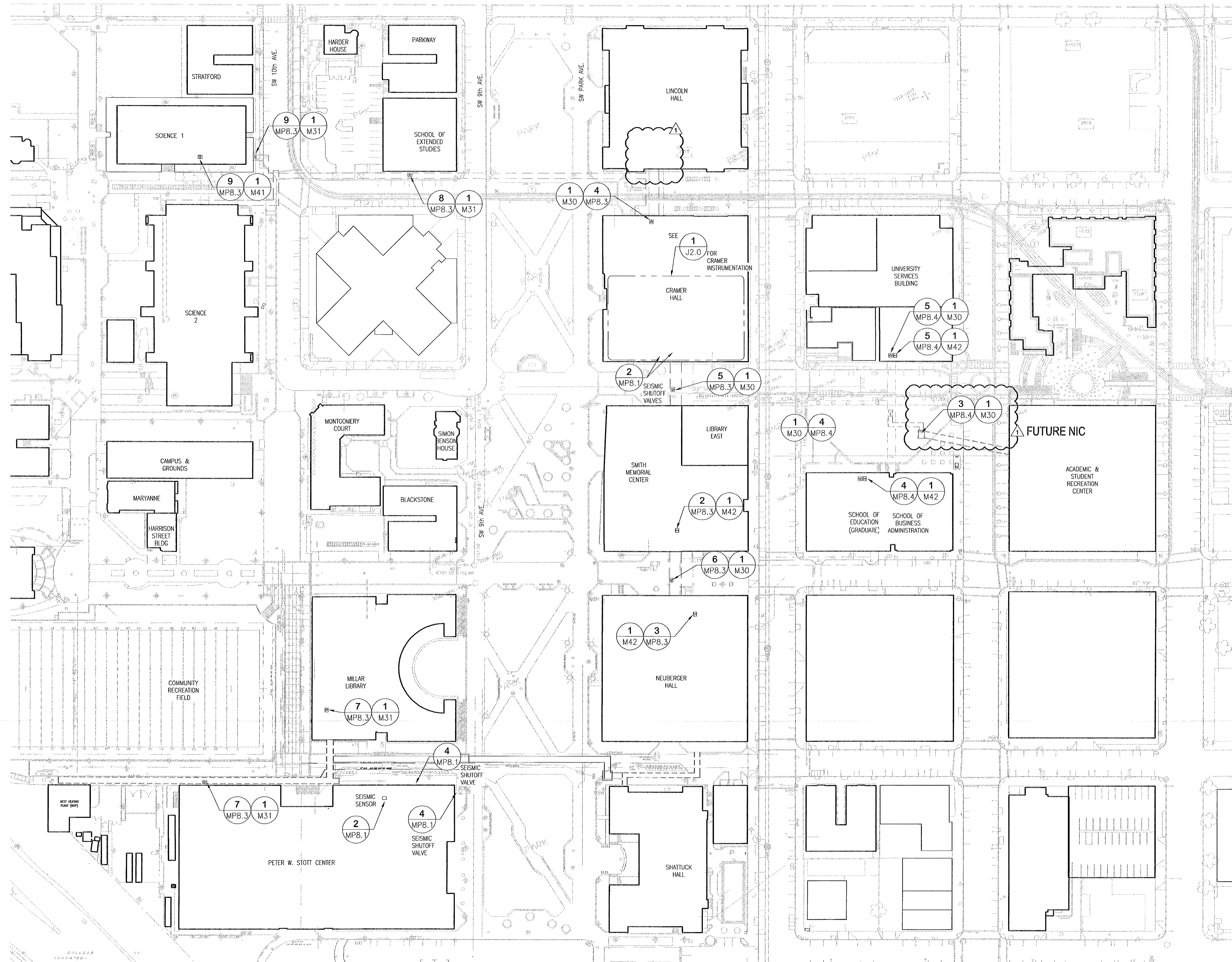
dwg. title
**INSTRUMENTATION LEGEND,
 ABBREVIATIONS & GENERAL NOTES**

designed	date
drawn	date
approved	date
project no.	
drawing no.	

PROJECTED PROFESSIONAL ENGINEER
 OREGON
 JULY 15, 1999
 GARY A. SEDY

J0.1

Sys. No.	TAG	NO	CONFIGURATION/TYPE	INSTRUMENT INFORMATION		LOCATION		PLC INTERFACE				MANUFACTURER			FLUID CHARACTERISTICS			REV. No.		
				Eqp. No.	SERVICE OF APPLICATION	LOC.	PLC I/O	I/O TYPE	SIGNAL	PLC SLOT	PWR REQ'D	WIRE / CABLE	NAME	MOD. NUM.	SERVICE	Flow (GPM) M ³ /hr/Mn	Press. (PSI) M ² /hr/Mn		TEMP. (deg. F) M ² /hr/Mn	DWG No.	COMMENTS
0010	INDUSTRIAL HVAC / VENTILATION																			
0015	FCV	036	FLOW CONTROL VALVE	CWS	CWS/CWR LOOP FLOW CNTRL	ASRC	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF 599	CWS	800/400/0		65/55/45	M42	FUTURE NIC
0015	FCV	038	FLOW CONTROL VALVE	CWS	CWS/CWR LOOP FLOW CNTRL	NH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF 599	CWS	800/400/0		65/55/45	M42	FUTURE NIC
0015	FCV	044	FLOW CONTROL VALVE	WW	WELL WATER DISCH. TO CITY	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	KEYSTONE	222	WW	2000/1400/0	125/10/0	55/55/55	M40	AB1-1
0015	FCV	046	FLOW CONTROL VALVE	WW	INJECTION WELL - FLOW CNTRL	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	KEYSTONE	222	WW	2000/1400/0	125/10/0	55/55/55	M40	AB1-1
0015	FT	001	FLOW XMITR	CH-P1	CWS - CRAMER - BTU	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	600/550/0		80/55/45	M42	NIT-001
0015	FT	002	FLOW XMITR	PSB-P1	CWS - UNIV. SERV. BLDG - BTU	USB	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	200/150/0		80/55/45	M42	NIT-004
0015	FT	005	FLOW XMITR	USB-P2	CWS - SCH. OF BUS. - BTU	SBA	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	600/400/0		80/55/45	M42	NIT-005
0015	FT	010	FLOW XMITR	FL-CH001	COOLING WATER	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	F1210	WW	2000/1400/0		80/55/45	M40	
0015	FT	013	FLOW XMITR	CH-P1	CWS - CRAMER - BTU	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	600/250/0		80/55/45	M40	NIT-013
0015	FT	014	FLOW XMITR	CH-P2	CWS - NEUBERGER HALL - BTU	NH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	800/640/0		80/55/45	M42	NIT-014
0015	FT	024	FLOW XMITR	SM	CWR - SMITH MEM. - BTU	SM	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWR	400/350/0		80/55/45	M42	NIT-024
0015	FT	026	FLOW XMITR	SB1-P1	CWS - SCI BLDG 1 - BTU	SB1	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS	4000/3000/0		80/55/45	M41	NIT-026
0015	FT	036	FLOW XMITR	WCU-1	CWS - CH #1 DISCHARGE	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	F2200	CWS	1500/480/480	60/50/0	60/45/40	M40	
0015	FT	038	FLOW XMITR	WCU-3	CWS - CH #3 DISCHARGE	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	F2200	CWS	1500/300/300	60/50/0	60/45/40	M40	
0015	CL	040	FLOW XMITR	WCU-2	CWS - CH #2 DISCHARGE	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	F2200	CWS	800/250/250	60/50/0	60/45/40	M40	
0015	FT	042	FLOW XMITR	WW	WELL WATER DISCH. TO CITY	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	KEYSTONE	222	WW	2000/1400/0	125/10/0	55/55/55	M40	FUTURE NIC
0015	SV	011	SOLENOID VALVE	HX-1	WELL WATER - COOLING - IN	CH	Y	DO	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	WWS	2000/1400/0		80/55/45	M40	
0015	SV	015	SOLENOID VALVE	WCU-1	CWS - CHILLER #1 OUTF	CH	Y	DO	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	CWS	2000/1400/0		80/55/45	M40	ON/OFF CNTRL
0015	SV	027	SOLENOID VALVE	CH-P1	CWR - HX-CH1 PUMP	CH	Y	DO	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	CWR	1400/0/0	20	55	M40	ON/OFF CNTRL
0015	SV	048	SOLENOID VALVE	CWR	NORTH TUNNEL ISOLATION	CH	Y	DO	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	CWR	1400/0/0	20	55	M41	ON/OFF CNTRL; ADD. BID ITEM
0015	SV	050	SOLENOID VALVE	CWS	NORTH TUNNEL ISOLATION	CH	Y	DO	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	CWS	1400/0/0	20	55	M41	ON/OFF CNTRL; ADD. BID ITEM
0015	LSH	042	LEVEL SWITCH - HIGH	ASRC VAULT	SUMP PUMP	ASRC	Y	DI	120 Vdc	SCU	n/a	#14 AWG	KEYSTONE	222	CWS				M42	
0015	LI	007	LEVEL XMITR	INJ. WELL	INJECTION WELL LEVEL	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M40	
0015	NT	001	BRU METER	CH-P2	CWS - CRAMER - BTU	CH	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	004	BRU METER	PSB-P1	CWS - UNIV. SERV. BLDG - BTU	USB	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	005	BRU METER	USB-P2	CWS - SCH. OF BUS. - BTU	SBA	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	013	BRU METER	CH-P1	CWS - CRAMER - BTU	CH	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M40	
0015	NT	016	BRU METER	PU	CWS - NEUBERGER HALL - BTU	NH	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	018	BRU METER	PU	CWS - NEUBERGER HALL - BTU	NH	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	024	BRU METER	PU	CWS - SMITH MEM.	SM	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M42	
0015	NT	026	BRU METER	SB1-P1	CWS - SCI BLDG 1 - BTU	SB1	Y	AI	4-20 mA	SCU	120Vdc	2/C-#16	ONICON	SYS 10-P1	CWS/CWR				M41	
0015	PDI	071	DIFF. PRESS. XMITR	FL-CH021	WW - FILTER DIFF. PRESS.	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 75-AB37/410CA	WWS	2000/1400/0	20	59/57/55	M40	FUTURE NIC
0015	PDI	072	DIFF. PRESS. XMITR	FL-CH022	WW - FILTER DIFF. PRESS.	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 75-AB37/410CA	WWS	2000/1400/0	20	59/57/55	M40	FUTURE NIC
0015	PI	077	PRESSURE XMITR	INJ. WELL	INJECTION WATER - HEAD PRESS.	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 75-AB37/410CA	WWR	1400/1400/0	20	59/57/55	M40	FUTURE NIC
0015	PI	034	PRESSURE XMITR	WW	CONDENSER WATER PRESSURE	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 131-A2200R	WW	1400/700/0	60/50/0	60/45/40	M42	FUTURE NIC
0015	PDI	036	DIFF. PRESS. XMITR	CWS	CWS - ASRC SYS PRESS.	ASRC	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 131-A2200R	CWS	1000/300/0	60/45/40	60/45/40	M42	FUTURE NIC
0015	PDI	038	DIFF. PRESS. XMITR	CWS	CWS - SYS PRESS. AT NH	NH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 131-A2200R	CWS	1000/300/0	60/45/40	60/45/40	M42	FUTURE NIC
0015	PI	046	PRESSURE XMITR	INJ. WELL	INJECTION WATER - PRESS.	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	E+H	PMP 75-AB37/410CA	WWR	1400/1400/0	20	59/57/55	M40	AB1-1
0015	QGA	002	GAS SENSOR	RFG	CRAMER BASEMENT	CH	Y	DI	...	...	...	...	BACHARACH	HGM300	RFG	n/a	ATMOS	80/70/55	M40	HFC-123
0015	QGA	009	GAS SENSOR	RFG	CRAMER BASEMENT	CH	Y	DI	...	...	...	...	BACHARACH	HGM300	RFG	n/a	ATMOS	80/70/55	M40	HFC-123
0015	QGT	002	GAS XMITR	RFG	CRAMER BASEMENT	CH	Y	AI	RS-485	BMS	120 Vdc	UTP	BACHARACH	RM600	RFG	n/a	ATMOS	80/70/55	M40	HFC-123
0015	QGT	003	GAS XMITR	RFG	CRAMER BASEMENT	CH	Y	AI	RS-485	BMS	120 Vdc	UTP	BACHARACH	RM600	RFG	n/a	ATMOS	80/70/55	M40	HFC-123
0015	SC	ECP-P10	SPEED CONTROL	WCU-1	CONDENSER WATER RECIRC	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	WWS	1500/1000/0		95/57/45	M40	
0015	SC	ECP-P11	SPEED CONTROL	CWR - HX-CH1 PUMP	CWR - HX-CH1 PUMP	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	CWR	1400/700/0	60/20/0	59/57/55	M40	
0015	SC	ECP-P4	SPEED CONTROL	ECP-P4	CWS - CHILLER #2 PRIMARY	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	CWR	1400/700/0	60/20/0	59/57/55	M40	
0015	SC	ECP-P5A	SPEED CONTROL	WW - SUPPLY PUMP	WW - SUPPLY PUMP	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	WWS	1400/700/0	60/20/0	59/57/55	M40	
0015	SC	ECP-P5B	SPEED CONTROL	WW - SUPPLY PUMP	WW - SUPPLY PUMP	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	WWS	1400/700/0	60/20/0	59/57/55	M40	
0015	SC	ECP-P6	SPEED CONTROL	ECP-P6	CWS - CHILLER #1 PRIMARY	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	CWR	1400/700/0	60/20/0	59/57/55	M40	
0015	SC	ECP-P7	SPEED CONTROL	WCU-3	CONDENSER WATER RECIRC	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	WWS	1500/1000/0		95/57/45	M40	
0015	SC	ECP-P8	SPEED CONTROL	ECP-P8	CWS - CHILLER #3 PRIMARY	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	CWS	1400/700/0	60/20/0	59/57/55	M40	
0015	SCV	ECP-P9	SPEED CONTROL	WCU-2	CONDENSER WATER RECIRC	CH	Y	AO	RS-485	BMS	n/a	UTP	ABB	ABB	WWS	1500/1000/0		95/57/45	M40	
0015	TCV	001	TEMP. CONTROL VALVE	ECP-P2	CWS (SEC) CRAMER - BTU	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	CWS/CWR	600/550/0		80/55/45	M40	
0015	TCV	013	TEMP. CONTROL VALVE	CH-P1	CWS (CWS) CRAMER - BTU	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	CWS/CWR	600/250/0		80/55/45	M40	
0015	TCV	016	TEMP. CONTROL VALVE	PU	CWR - NEUBERGER HALL	NH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	CWS/CWR	800/640/0		80/55/45	M42	
0015	TCV	024	TEMP. CONTROL VALVE	SM	CWR - SMITH MEM. - BTU	SM	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	CWS/CWR	400/300/0		80/55/45	M42	
0015	TCV	026	TEMP. CONTROL VALVE	WCU-1	WWR - CHILLER #1 DISCH.	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	WW	500/300/0		80/55/45	M40	
0015	TCV	026	TEMP. CONTROL VALVE	CH#3	WWR - CHILLER #3 DISCH.	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	FLORRITE	VF599	WW	500/300/0		80/55/45	M40	
0015	TCV	030	TEMP. CONTROL VALVE	WCU-2	WWR - CHILLER #2 DISCH.	CH	Y	AO	4-20 mA	SCU	LOOP	2/C-#16	KEYSTONE	222	WWS/WWR	1500/480/480	60	80/55/45	M40	
0015	TT	012	TEMPERATURE XMITR	HX-	COOLING - GRAN TEMP	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	PYROMATION	R11185L483-54C0406- SL-6HN31T-4	WWS	1500/1400/0		80/55/45	M40	INJECTED WATER
0015	TT	029	TEMPERATURE XMITR	HX-CH1	CWS - HX-CH1 DISCH.	CH	Y	AI	4-20 mA	SCU	LOOP	2/C-#16	PYROMATION	R11185L483-54C0406-						



GENERAL NOTES:
 1. INSTRUMENTS INSTALLED ON CHILLED WATER AND STEAM SYSTEMS IN BUILDING BASEMENTS AND TUNNELS.

REFERENCE DRAWINGS:
 M30 - CRAMER STEAM P&ID
 M31 - WHP STEAM P&ID
 M40 - CHILLED WATER P&ID
 M41 - CHILLED WATER P&ID
 M42 - CHILLED WATER P&ID

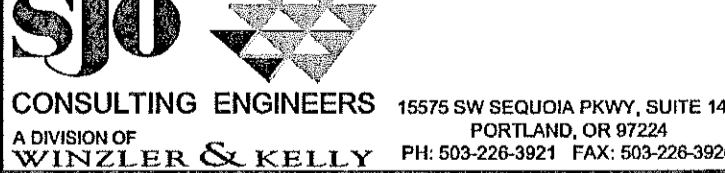
1 NORTH CAMPUS INSTRUMENTATION & CONTROLS
 SCALE: 1" = 30'-0"



1" = 30'-0" 30' 0 30' 60' 90'

REFERENCE DRAWINGS:
 M30 - CRAMER STEAM P&ID
 M31 - WHP STEAM P&ID
 M40 - CHILLED WATER P&ID
 M41 - CHILLED WATER P&ID
 M42 - CHILLED WATER P&ID

1	08/29/08	ASAC	ISSUED FOR CONSTRUCTION
0	05/23/08	GAS	ISSUED FOR BID & PERMIT
no.	date	by	revisions



project
**PSU CAMPUS WIDE LOOP PHASE1
 BP2 STEAM & CHILLED WATER IMPROVEMENTS**

dwg. title
**PSU CAMPUS
 INSTRUMENTATION & CONTROLS**

designed	date
drawn	date
approved	date
project no.	10909-07001
drawing no.	J1.0

