INVITATION TO BID
No. TB157697B

High Temperature Test Experiment Equipment

BID DUE DATE AND TIME:
February 28, 2012 (2:00 PM, PST)

OSU Procurement and Contract Services Offices are open from 8:00 am – 12:00 noon and 1:00 pm – 5:00 pm.
Offices are closed during the 12:00 noon – 1:00 pm lunch hour.

SUBMITTAL LOCATION:

Oregon State University
Procurement and Contract Services
644 SW 13th Avenue
Corvallis, Oregon 97333

1.0 GENERAL

1.01 SCHEDULE OF EVENTS:

- Invitation to Bid Issue Date ..... February 6, 2012
- Deadline for Request for Clarification or Change ..... February 16, 2012 (5:00 pm, PST)
- Bid Due Date and Time ..... February 28, 2012 (2:00 pm, PST)

This Schedule of Events is subject to change. Any changes will be made through the issuance of Written Addenda.

1.02 PRE-BID CONFERENCE:

A Pre-Bid Conference will not be held.

1.03 ISSUING OFFICE:

The Procurement and Contract Services (PaCS) department of Oregon State University (OSU) is the issuing office and is the sole point of contact for this Invitation to Bid. Address all concerns or questions regarding this Invitation to Bid to the Administrative Contact identified below:

1.04 ADMINISTRATIVE CONTACT:

Name:	Tamara Bronson
Title:	Procurement Supervisor
Telephone:	541-737-8044
Fax:	541-737-2170
E-Mail:	tamara.bronson@oregonstate.edu

1.05 DEFINITIONS:

As used in this Invitation to Bid, the terms set forth below are defined as follows:

a. "Addenda" means an addition to, deletion from, a material change in, or general interest explanation of the Invitation to Bid.
b. "Exhibits" means those documents which are attached to and incorporated as part of the Invitation to Bid.
c. "Bid" means an offer, binding on the Bidder and submitted in response to an Invitation to Bid.
d. "Bidder" means an entity that submits a Bid in response to an Invitation to Bid.
e. "Bid Due Date and Time" means the date and time specified in the Invitation to Bid as the deadline for submitting Bids.
f. "Invitation to Bid" (ITB) means a Solicitation Document for the solicitation of competitive, Written, signed and sealed Bids in which Specifications, price, and delivery (or project completion) are the predominant award criteria.
g. "Responsible" means an entity that demonstrates their ability to perform satisfactorily under a Contract by meeting the applicable standards of responsibility outlined in OAR 580-061-0130.
h. "Responsive" means a Bid that has substantially complied in all material respects with the criteria outlined in the Invitation to Bid.
i. “Written or Writing” means letters, characters, and symbols inscribed on paper by hand, print, type, or other method of impression intended to represent or convey particular ideas or meanings.

2.0 INTRODUCTION AND BACKGROUND

2.01 INTRODUCTION

Oregon State University (OSU) Procurement and Contract Services (PaCS) is seeking Responsive Responsible Bidders to submit Bids for the fabrication, assembly and delivery of the High Temperature Test Experiment (HTTE) equipment as a third phase of work on the Hydro-Mechanical Fuel Test Facility (HMFTF) at the Advanced Nuclear System Engineering Laboratory (ANSEL) at OSU

2.02 BACKGROUND:

The purpose of the HTTE is the collection of experimental data that could be used for the validation of existing system safety codes and near-term multi-physics computer codes. The apparatus would provide high-temperature and simulated depressurized conduction cool-down data for thermal spectrum, and to a limited extent, fast spectrum gas-cooled, next-generation nuclear reactors.

The HTTE is a scaled model of the General Atomics Modular High Temperature Gas Reactor. It is scaled ¼ by height and ¼ by diameter. The model core will be electrically heated and there will be no radioactive material involved with the HTTE.

2.03 OREGON STATE UNIVERSITY:

Founded in 1868, Oregon State University is a comprehensive, research-extensive, public university located in Corvallis. OSU is a member of the Oregon University System and one of only two American universities to hold the Land Grant, Sea Grant, Space Grant and Sun Grant designations. OSU is also the only Oregon institution to hold the Carnegie Foundation's top ranking for research universities, a recognition of the depth and quality of OSU's graduate education and research programs.

Through its centers, institutes, Extension offices and Experiment Stations, OSU has a presence in almost every one of Oregon's 36 counties, including its main campus in Corvallis, the Hatfield Marine Sciences Center in Newport and OSU-Cascades Campus in Bend. OSU offers undergraduate, masters and doctoral degrees through 12 academic colleges enrolling more than 20,000 students from every county in Oregon, every state in the country and more than 90 nations.

3.0 SPECIFICATIONS / STATEMENT OF WORK

3.01 REQUIRED SPECIFICATIONS:

In order to qualify as a Responsive Bidder, the Bid needs to meet the required specifications per Exhibit A.

3.03 TERMS AND CONDITIONS:

OSU's terms and conditions governing the purchase resulting from this ITB are included at Exhibit B.

4.0 BIDDER QUALIFICATIONS

4.01 MINIMUM QUALIFICATIONS:

In order to qualify as a Responsive Bidder, the Bidder needs to meet the minimum qualifications below.

a. Minimum of five (5) years' demonstrated experience in fabricating similar products.

5.0 REQUIRED SUBMITTALS

5.01 QUANTITY OF BID:
Submit one (1) original Bid and one (1) duplicate copy. Mark original Bid as "ORIGINAL". Original should contain original signatures on any pages where a signature is required. Bids should contain the submittals listed in this section below:

5.02 REQUIRED SUBMITTALS:
It is the Bidder's sole responsibility to submit information in fulfillment of the requirements of this Invitation to Bid. If pertinent information or required submittals are not included within the Bid, it may cause the Bid to be rejected.

Bidders should submit the following information:

- Description of how the goods or services offered specifically meet the required specifications described in Exhibit A.
- Detailed information about how the Bidder meets the minimum qualifications detailed in section 4.
- Exhibit C, Certifications, fully completed.
- Exhibit D, References, fully completed.
- Exhibit E, Bid Price Form, fully completed.

6.0 EVALUATION AND AWARD

6.01 EVALUATION:
Bids will be evaluated to determine the lowest Responsive Responsible Bidder based upon the Invitation to Bid, Exhibits and Addenda. OSU may engage in any of the processes identified in the applicable Oregon Administrative Rules to determine Contract award.

6.02 INVESTIGATION OF REFERENCES:
OSU reserves the right to investigate and to consider the references and the past performance of any Bidder with respect to such things as its performance or provision of similar goods or services, compliance with specifications and contractual obligations, and its lawful payment of suppliers, subcontractors, and workers. OSU further reserves the right to consider past performance, historical information and facts, whether gained from the Bid, interviews, references, OSU or any other source. OSU may postpone the award or execution of the Contract after the announcement of the notice of intent to award in order to complete its investigation.

7.0 INSTRUCTIONS TO BIDDERS

7.01 APPLICABLE STATUTES AND RULES:
This ITB is subject to the applicable provisions and requirements of the Oregon Revised Statutes, Oregon Administrative Rules, and OSU Policies and Procedures.

7.02 MANUFACTURER'S NAMES AND APPROVED EQUIVALENTS:
Unless qualified by the provision "NO SUBSTITUTE" any manufacturers' names, trade name, brand names, information and/or catalogue numbers listed in a specification are for information and not intended to limit competition. Bidders may offer any brand for which they are an authorized representative, which meets or exceeds the specification for any item(s). If Bids are based on equivalent products, indicate in the Bid form the manufacturers' name and number. Bidders shall submit with their Bid, sketches, and descriptive literature, and/or complete specifications. Reference to literature submitted with a previous Bid will not satisfy this provision. Bidders shall also explain in detail the reason(s) why the proposed equivalent will meet the specifications and not be considered an exception thereto. Bids, which do not comply with these requirements,

are subject to rejection. Bids lacking any written indication of intent to provide an alternate brand will be received and considered in complete compliance with the specification as listed in the ITB.

7.03 REQUEST FOR CLARIFICATION OR CHANGE:

Requests for clarification or change of the Invitation to Bid must be in Writing and received by the Administrative Contact no later than the Deadline for Request for Clarification or Change as specified in the Schedule of Events. Such requests for clarification or change must include the reason for the Bidder's request. OSU will consider all timely requests and, if acceptable to OSU, amend the Invitation to Bid by issuing an Addendum. Envelopes, e-mails or faxes containing requests should be clearly marked as a Request for Clarification or Change and include the ITB Number and Title.

7.04 ADDENDA:

Only documents issued as Written Addenda by PaCS serve to change the Invitation to Bid in any way. No other direction received by the Bidder, written or verbal, serves to change the Invitation to Bid. PaCS will notify potential Bidders through publication of the Addenda on the OUS procurement website. If you have received an Invitation to Bid you should consult the OUS procurement website, prior to Bid submittal, to assure that you have not missed any Addenda. Bidders are not required to return Addenda with their Bid. However, Bidders are responsible for obtaining and incorporating any changes made by the Addendum into their Bid. Failure to do so may, in effect, make the Bid non-Responsive, which may cause the Bid to be rejected.

7.05 PREPARATION AND SIGNATURE:

All Required Submittals must be Written or prepared in ink and signed in ink by an authorized representative with authority to bind the Bidder. Signature certifies that the Bidder has read, fully understands, and agrees to be bound by the Invitation to Bid and all Exhibits and Addenda to the Invitation to Bid.

7.06 PUBLIC RECORD:

Upon completion of the Invitation to Bid process, information in your Bid will become subject records under the Oregon Public Records Law. Only those items considered a "trade secret" under ORS 192.501(2), may be exempt from disclosure. If a Bid contains what the Bidder considers a "trade secret" the Bidder must mark each sheet of information as such. Only bona fide trade secrets may be exempt and only if public interest does not require disclosure.

7.07 SUBMISSION:

Bids must be submitted in a sealed envelope and be delivered to the submittal location listed on the Invitation to Bid cover sheet no later than the Bid Due Date and Time. Bidder must specify on the outside of the envelope the Invitation to Bid number, the Invitation to Bid title and the Bid Due Date and Time. **E-MAIL OR FACSIMILE BIDS WILL NOT BE ACCEPTED.**

7.08 MODIFICATION:

Prior to submittal, Bidders should initial modifications or erasures in ink by the person signing the Bid. After submittal but prior to the Bid Due Date and Time, Bids may be modified by submitting a Written notice indicating the modifications and a statement that the modification amends and supersedes the prior Bid. After the Bid Due Date and Time, Bidders may not modify their Bid.

7.09 WITHDRAWALS:

A Bidder may withdraw their Bid by submitting a Written notice to the Administrative Contact identified in this Invitation to Bid prior to the Bid Due Date and Time. The Written notice must be on the Bidder's letterhead and signed by an authorized representative of the Bidder. The Bidder, or authorized representative of the Bidder, may also withdraw their Bid in person prior to the Bid Due Date and Time, upon presentation of appropriate identification and evidence of authority to withdraw the Bid satisfactory to OSU.

7.10 LATE SUBMITTALS:
Bids and Written notices of modification or withdrawal must be received no later than the Bid Due Date and Time. OSU may not accept or consider late Bids, modifications, or withdrawals except as permitted in OAR 580-061-0120.

7.11 BID OPENING:
Bids will be opened immediately following the Bid Due Date and Time at the Submittal Location. Bidder may attend the Bid opening. Only the names of the Bidders submitting Bids will be announced. No other information regarding the content of the Bids will be available.

7.12 BIDS ARE OFFERS:
The Bid is the Bidder's offer to enter into a Contract pursuant to the terms and conditions specified in the Invitation to Bid, its Exhibits, and Addenda. The offer is binding on the Bidder for one hundred twenty (120) days. OSU's award of the Contract constitutes acceptance of the offer and binds the Bidder. The Bid must be a complete offer and fully Responsive to the Invitation to Bid.

7.13 CONTINGENT BIDS:
Bidder shall not make its Bid contingent upon OSU's acceptance of specifications or contract terms that conflict with or are in addition to those in the Invitation to Bid, its Exhibits, or Addenda.

7.14 RIGHT TO REJECT:
OSU may reject, in whole or in part, any Bid not in compliance with the Invitation to Bid, Exhibits, or Addenda, if upon OSU's Written finding that it is in the public interest to do so. OSU may reject all Bids for good cause, if upon OSU's Written finding that it is in the public interest to do so. Notification of rejection of all Bids, along with the good cause justification and finding of public interest, will be sent to all who submitted a Bid.

7.15 AWARDS:
OSU reserves the right to make award(s) by individual item, group of items, all or none, or any combination thereof. OSU reserves the right to delete any item from the award when deemed to be in the best interest of OSU.

7.16 LEGAL SUFFICIENCY REVIEW:
Prior to execution of any Contract resulting from this Invitation to Bid, the Contract may be reviewed for legal sufficiency by a qualified attorney for OSU pursuant to the applicable Oregon Revised Statutes and Oregon Administrative Rules. Legal sufficiency review may result in changes to the terms and conditions specified in the Invitation to Bid, Exhibits, and Addenda.

7.17 BID RESULTS:
A notice of intent to award containing the Bid results will be issued to all Bidders. The Bid file will be available for Bidder's review during the protest period at the PaCS Department. Bidders must make an appointment with the Administrative Contact to view the Bid file. After the protest period, the file will be available by making a Public Records Request to OSU.

7.18 BID PREPARATION COST:
OSU is not liable for costs incurred by the Bidder during the Invitation to Bid process.

7.19 BID CANCELLATION:
If an Invitation to Bid is cancelled prior to the Bid Due Date and Time, all Bids that may have already been received will be returned to the Bidders. If an Invitation to Bid is cancelled after the Bid Due Date and Time or all Bids are rejected, the Bids received will be retained and become part of OSU's permanent Bid file.

7.20 PROTEST OF CONTRACTOR SELECTION, CONTRACT AWARD:

Any Bidder who feels adversely affected or aggrieved may submit a protest within seven (7) calendar days after OSU issues a notice of intent to award a Contract. The protest must be clearly identified as a protest, identify the type and nature of the protest, and include the Invitation to Bid number and title. The rules governing protests are at OAR 580-061-0145.

EXHIBIT A
REQUIRED SPECIFICATIONS

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Exhibit A

Work Proposal for the Fabrication, Assembly and Delivery of the High Temperature Test Experiment at Oregon State University

Date: November 2, 2011

Prepared by:

Brian G. Woods

Oregon State University
Department of Nuclear Engineering and Radiation Health Physics
Oregon State University
116 Radiation Center
Corvallis, OR 97331-5902

Approved: _____
Brian G. Woods
OSU HTTF Program Manager

1 PURPOSE

The purpose of this document is to solicit a bid for the procurement and fabrication of the remaining equipment and components of the High Temperature Test Experiment (HTTE); the assembly of the HTTE; the Delivery of the HTTE and its components to the Advanced Nuclear Systems Experimental Laboratory (ANSEL) at Oregon State University (OSU); the testing of components, equipment and systems as required under the applicable specifications; and, the performance of the testing and commissioning activities required to certify that the HTTE meets its intended design and operational requirements following installation.

2 PLAN

This solicitation is for the execution of Phase 3 only. A description of Phases 1, 2, 4 and 5 are included for completeness, but shall not be fully specified under this contract.

2.1 Phase 1

The purpose of the HTTE is the collection of experimental data that could be used for the validation of existing system safety codes and near-term multi-physics computer codes. The apparatus would provide high-temperature and simulated depressurized conduction cool-down data for thermal spectrum, and to a limited extent, fast spectrum gas-cooled, next-generation nuclear reactors.

The test apparatus will be operated in the Nuclear Engineering and Radiation Health Physics Department building at Oregon State University, Oregon, at an elevation of 235 ft above sea level. The test facility will be assembled in building number 98 on the Oregon State University campus (Radiation Center Building) and will operate in a non-radioactive closed loop circuit.

The HTTE is a scaled model of the General Atomics Modular High Temperature Gas Reactor. It is scaled ¼ by height and ¼ by diameter. The model core will be electrically heated and there will be no radioactive material involved with the HTTE. The HTTE will consist of several systems (1) primary, (2) secondary, (3) break simulation, and (4) RCCS. The primary system shall contain the pressure vessel and associated internal components, piping, valves, heat exchanger to secondary system and gas circulator. The secondary system shall be used to reject heat from the primary system during normal operations and consists of a the piping and valves required to reject this heat through the heat exchanger. The break simulation system shall consist of a cavity simulation tank and all of its ancillary components. Finally, the RCCS shall serve as a vessel cooling system during Depressurized Conduction Cooldown event simulations. Nominal operating conditions for the primary system are shown in Table 1.

Table 1. Nominal Operating Conditions

Description	Value
Nominal Operating Pressure	0.8 MPa
Nominal Operating Heater Inlet Temperature	235 °C
Nominal Operating Heater Outlet Temperature	670 °C
Maximum Heater Power	2.2 MW
Gas Mass Flow Rate (for helium at nominal pressure and temperature)	1.0 kg/s

Phase 1 includes the work required to complete the engineering design of the HTTE. At the completion of Phase 1, all P&IDs, arrangement drawings, detailed drawings, and technical information regarding

purchased equipment of the HTTE necessary for fabrication, assembly and erection shall be provided to the customer.

2.2 Phase 2

The major components of the HTTE shall be fabricated, delivered and tested as directed by provided engineering drawings and component specifications. The intent of Phase 2 is to initiate a procurement action on the components and equipment, listed below, with long lead times for fabrication and delivery to allow for a timely completion of the project as a whole. These components and equipment shall be installed as part of Phase 4 discussed in the following Section 2.4.

1. Primary system blowdown valves,
2. Primary system break valves,
3. Hot-cold communication break valve,
4. Primary loop circulator, motor and drive,
5. Steam generator water supply pump, motor and drive,
6. Reactor cavity cooling system water supply pump, motor and drive,
7. Primary pressure vessel (not to include vessel internals),
8. Reactor cavity simulation tank with ancillary components,
9. Reactor cavity cooling system water storage tank,
10. Steam generator, and
11. Reactor cavity cooling system heat exchanger panels.

This phase shall also include the certification and conformance testing for each component and system that is installed under this phase.

2.3 Phase 3

Phase 3 shall include the procurement, fabrication and delivery of the remaining equipment and components; the assembly and delivery of the HTTE Primary Pressure Vessel (PPV) and Reactor Cavity Simulation Tank (RCST) modules; Contractor will provide additional consulting services as reasonably requested from time to time during the installation of the HTTE during Phase 5 at no additional charge to OSU; the testing of components, equipment and systems as required under the applicable specifications; and, the performance of the testing and commissioning activities required to certify that the HTTE meets its intended design and operational requirements.

2.4 Phase 4

This phase shall include the separate procurements of the following HTTE components, systems and services:

A. Fabrication of the ceramic molds,
B. Graphite heaters and heater components,
C. Purchase of ceramic material,
D. Data Acquisition and Control System (DACS) components and software, and
E. Ceramic casting and firing services.

This phase shall also include the certification and conformance testing for each component, system and service that is procured under this phase.

2.5 Phase 5

This phase includes the installation of the High Temperature Test Experiment (HTTE) at the Advanced Nuclear Systems Experimental Laboratory (ANSEL) at Oregon State University (OSU).

3 Phase 3 Solicitation

Each bid shall include the cost of labor and material for each section. All items stated in the following sections shall meet all requirements and be fabricated, tested, and assembled in compliance with their corresponding appended specifications and drawings. All drawings appended herein are in draft form; a complete set of approved drawings will be provided to the vendor upon award of the contract. All work completed shall only be conducted via drawings, procurement specifications, and correspondences which have been reviewed, approved, and signed by OSU staff.

Prior to fabrication of all equipment and components procured under Phase 3, the final component specification shall be signed by the vendor acknowledging all engineering requirements determined by the customer. Periodic site visits may be conducted by the customer to ascertain progress to facilitate project planning.

The following requirements apply to the work conducted under this phase:

1. All items shall be certified and stamped in accordance with their specification report.
2. The vendor will provide all pressure and/or temperature testing of any and all items necessary for ASME and or ASTM certification.
3. The vendor will provide all pressure and/or temperature testing of loop assembly necessary for ASME and or ASTM certification.
4. Fabrication and subassemblies may be constructed at the vendor's site as determined suitable by the customer and vendor.
5. Any change in the facility design not included on approved drawings from Phase 1 must be approved by the customer prior to continuation.

3.1 Fabrication

Work to be performed under this section includes either (1) the purchase and performance of acceptance tests of commercially available major equipment, or (2) the fabrication and performance of acceptance tests per appropriate fabrication drawings and procurement specifications, for the following components and equipment:

1. Vessel internal components (excluding core ceramic slabs),
2. HTTE electric power distribution system,
3. Frames and structures,
4. Primary, secondary and reactor cavity cooling systems piping, fittings, hangers, miscellaneous valves and insulation,
5. Circulator cooler system piping, fittings, hangers, miscellaneous valves and insulation,
6. Primary system gas analyzer,
7. Cavity Simulation Tank vacuum pump and heat exchanger, and
8. HTTE process control and data acquisition instrumentation.

Items procured under Phase 2 (Section 2.2) are excluded from procurement under this section. The customer reserves the right to conduct periodic on-site visits; these visits are not to be construed as inspections, but rather an evaluation of the progress made by the contractor relative to the fabrication and testing schedule for all work conducted at the contractor's location. Fabrication and procurement of components and equipment procured under Phase 3 shall be completed within a period of no more than 9 weeks from the contract award date.

3.1.1 Vessel Internal Components

The vessel internal components are shown in drawings HTTF_RPV. Note that the items procured under this item do not include the Reactor Pressure Vessel (procured under phase 2) and the core ceramic slabs (procured under phase 4). Specifications for the vessel internals are outlined in the attached specification OSU-HTTF-410000-SPEC-002.

3.1.2 HTTE electric power distribution system

The HTTE electrical distribution system is shown on the following drawings:

1. E-01.0 Electrical Drawing Index
2. E-01.1 Heater Power One Line
3. E-01.2 Motor / Crane Power One Line
4. E-01.3 120V Power One Line
5. E-02.0 Panel AC-1 Wiring Diagram
6. E-02.1 Panel AC-2 Wiring Diagram
7. E-02.2 Panel AC-1 And AC-2 Arrangement
8. E-02.3 Panel to PPV Heaters Arrangement
9. E-03.0 Panel AC-3 Wiring Diagram
10. E-03.1 Panel AC-3 24V DC Wiring Diagram
11. E-03.2 Panel AC-3 Arrangement
12. E-03.3 Panel AC-4 Wiring Diagram/Arrangement

Any sections of the electrical drawings labeled "Field" will be completed as part of the installation under phase 5. Specifications for the power supply wiring are outlined in the attached specification OSU-HTTF-540001-SPEC-001.

3.1.3 Frames and Structures

Frames and structures are shown in drawings S1 through S6, which are located in the appendix. All frames and structures will be procured under this phase and assembled at the vendor's location to ensure suitability. Frames and structure will then be disassembled as required to deliver the HTTE to the ANSEL building and provided to OSU. Specifications for Frames and Structures and Cranes are outlined in the attached specifications, OSU-HTTF-700000-SPEC-001 and OSU-HTTF-911001-SPEC-001.

3.1.4 Primary, secondary and reactor cavity cooling systems

The primary, secondary and reactor cavity cooling systems components are shown in the following drawings:

1. HTTF-M1 Piping Arrangement, General Orientation Views
2. HTTF-M1 Module Piping Layout, Plan and Elevation
3. HTTF-M2 Piping Layout, Primary Coolant System
4. HTTF-M3 Piping Layout, Main Steam-Vent
5. HTTF-M3.2 Piping Layout, Reactor Cavity Cooling
6. HTTF-M3 Piping Layout, Utility Piping
7. HTTF-PID Process and Instrumentation Diagram

Note that the items procured under this item do not include the following, which were procured under phase 2:

1. Primary system blowdown valves,
2. Primary system break valves,
3. Hot-cold communication break valve,
4. Primary loop circulator, motor and drive,
5. Steam generator water supply pump, motor and drive,
6. Reactor cavity cooling system water supply pump, motor and drive,
7. Reactor cavity simulation tank with ancillary components,
8. Reactor cavity cooling system water storage tank,
9. Steam generator, and
10. Reactor cavity cooling system heat exchanger panels.

The following specifications are applicable to this section:

Document Title	**Specification Report Number**
Gas System Piping and Hangers	OSU-HTTF-211001-SPEC-001
Water System Piping and Hangers	OSU-HTTF-221001-SPEC-001
Valves-Flow Control (Liquid)	OSU-HTTF-241400-SPEC-001
Valves-Check (Liquid)	OSU-HTTF-241400-SPEC-002
Valves-Solenoid (Liquid)	OSU-HTTF-241400-SPEC-003
Valves-General Pneumatic Logic (Liquid)	OSU-HTTF-241400-SPEC-004
Valves-General Variable Position Pneumatic (Liquid)	OSU-HTTF-241400-SPEC-005
Valves-Manually Operated (Liquid)	OSU-HTTF-241400-SPEC-006
Insulation for Piping and Heat Equipment	OSU-HTTF-621000-SPEC-001

3.1.5 Circulator cooler system

The circulator has been procured under phase 2. This section pertains to the material required to install the circulator at the ANSEL building and attach it to the existing air cooler on the ANSEL roof. The circulator cooling system is shown in drawing HTTF-M3, “Piping Layout, Utility Piping”. Again this section does not include the procurement of the circulator itself. Specifications for the circulator cooling system include the applicable specifications from Section 3.1.4 and specification OSU-HTTF-661001-SPEC-001 for the Air Cooler.

3.1.6 Primary system gas analyzer

A primary system gas analyzer shall be provided in the primary to measure the content of Oxygen in the primary system. The analyzer shall be capable of operating in the expected primary system conditions outlined herein.

3.1.7 Cavity Simulation Tank vacuum pump and heat exchanger

The Cavity Simulation Tank has been procured under phase 2. This section pertains to the material required to install a pump and heat exchanger to heat and move the gas in the Cavity Simulation Tank. The Cavity Simulation Tank vacuum pump and heat exchanger is shown on drawing HTTF-PID. This section does not include the procurement of the Cavity Simulation Tank itself. Specifications for the pump and heat exchanger are included in specification OSU-HTTF-421001-SPEC-001 for the Cavity Simulation Tank.

3.1.8 HTTE process control and data acquisition instrumentation

All process and data acquisition instrumentation with the exception of the gas sensors shall be procured under this section. AN instrument list is provided as an attachment. Data acquisition and control system equipment will be provided as outlined in drawings E-05.0 through E-11.0. OSU will provide connectivity from the HTTE module Data Acquisition and Control System Panels to the modules in the control room as well as the DACS modules themselves in the control room.

3.2 Component Testing

Certification and conformance testing shall be performed on each component procured under Phase 3 as necessary to satisfy all national standards and those specifications stated in the supporting documents.

3.3 Assembly and Delivery

Work under this section includes the complete fabrication and assembly of HTTE systems and structures at the vendor's location as defined by the "Module" boundary in the appended drawings. Once complete assembly is verified, HTTE systems and structures may be disassembled to their most complete feasible state for shipping to the ANSEL at OSU. All systems assembly shall be completed per appropriate assembly drawings and procurement specifications.

HTTE systems and structures shall be delivered to the Radiation Center Parking Lot in front of the ANSEL building at OSU. The delivery of HTTE systems and structures to the ANSEL at OSU completed under Phase 3 shall be completed within a period of no more than 13 weeks from the contract award date.

3.4 Acceptance Testing

This phase shall include the testing and commissioning activities required to certify that the HTTE meets its intended design and operational requirements. Acceptance testing shall include at a minimum, the demonstration of successful operation of all installed components following installation and the demonstration that the HTTF can reach the normal operating conditions found in Table 1.

The completion on these testing and commissioning activities would not be able to be completed until the HTTE installation is complete. Following the delivery of the HTTE systems and structures to the ANSEL building, the installation of the HTTE will take place under a separate contracting action.

3.5 Deliverables

At the completion of the work solicited herein the vendor shall deliver a turnover package in electronic and hard-copy form consisting of the following:

1. A certification of conformance to include all the work scope specified herein with references to the purchase order number given to the vendor upon award and a summary of all work completed.
2. A complete set of material test reports (MTRs) of all vendor fabricated components.
3. A Complete set of electronic models developed to produce all as-built drawings in their completed form (i.e. Solidworks, Autocad, etc.).
4. A Complete set of certified As-Built drawings shall be provided to the customer upon completion of the services provided specified herein.
5. Documentation of all certification and post fabrication acceptance testing to purchased equipment, fabricated equipment, components, and assemblies.
6. All documentation and manuals for equipment, hardware, and components necessary for normal operation and maintenance of the facility.
7. Documentation of all engineering changes made during the fabrication and testing of the procured components and equipment relative to details specified in all fabrication drawings and procurement specifications (including the date of the change and customer name that approved the change) as well as NDE and test reports documenting quality.
8. Original or true copies of all shop travelers and engineering notes for all vendor manufactured items.
9. A complete set of engineering notes describing all events, observations, and outcomes resulting from all tests performed.

All work scope items and deliverables identified in this solicitation must be completed and provided to the customer 26 calendar weeks or less after contract issuance.

ELECTRICAL POWER WIRING

DRAWING NO.	DRAWING TITLE
E-01.0	ELECTRICAL DRAWING INDEX
E-01.1	HEATER POWER ONE LINE
E-01.2	MOTOR / CRANE POWER ONE LINE
E-01.3	120v POWER ONE LINE
E-02.0	PANEL AC-1 WIRING DIAGRAM
E-02.1	PANEL AC-2 WIRING DIAGRAM
E-02.2	PANEL AC-1 AND AC-2 ARRANGEMENT
E-02.3	PANEL TO PPV HEATERS ARRANGEMENT
E-03.0	PANEL AC-3 WIRING DIAGRAM
E-03.1	PANEL AC-3 24V DC WIRING DIAGRAM
E-03.2	PANEL AC-3 ARRANGEMENT
E-03.3	PANEL AC-4 WIRING DIAGRAM/ARRANGEMENT

REGISTERED PROFESSIONAL ENGINEER
10589
Istvan Papp
OREGON
JULY 10, 1998
ISTVAN PAPP

EXPIRES 12/31/12

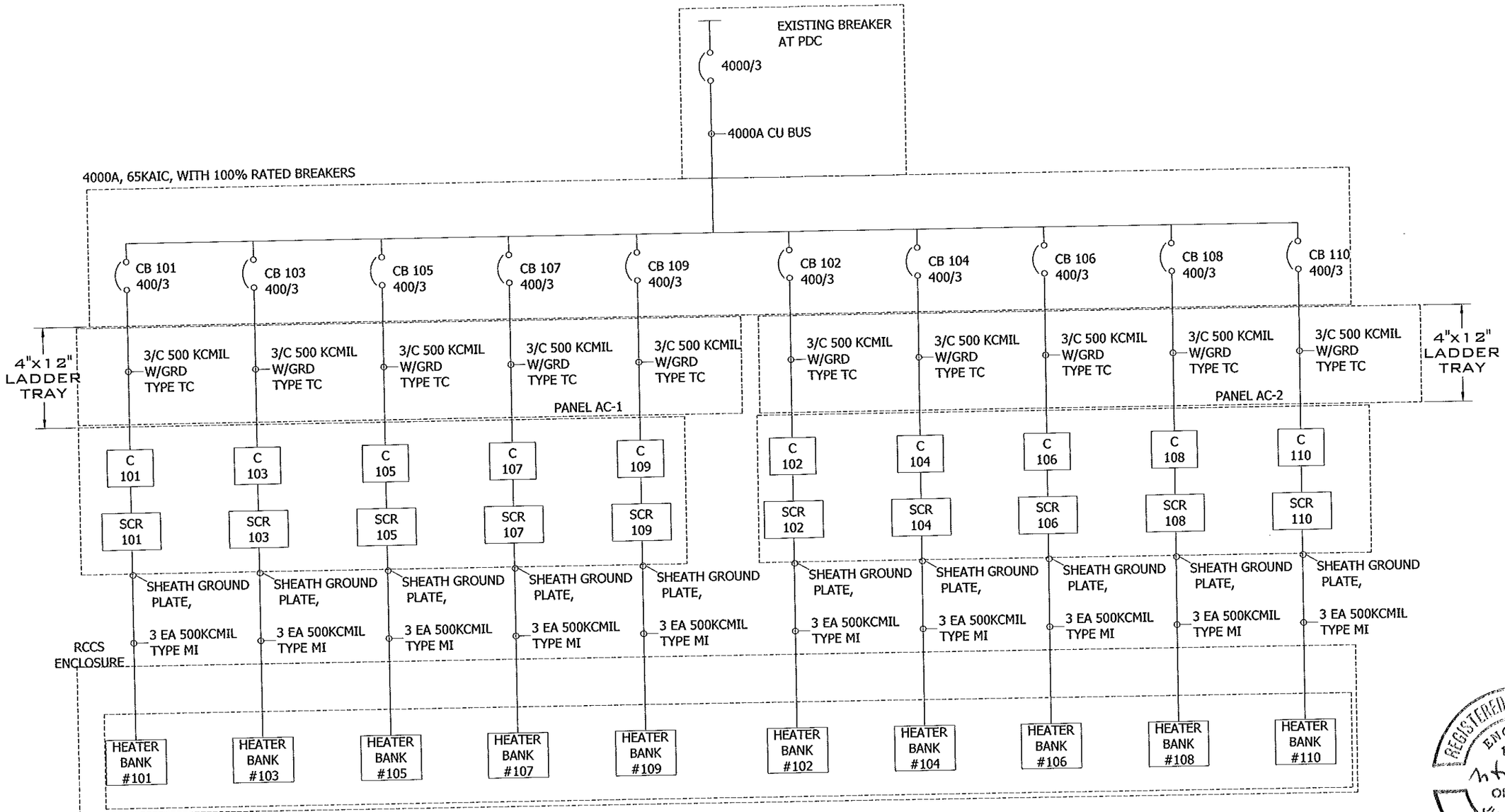
OSU Oregon State University
Department of Nuclear Engineering
Hydro-Mechanical Fuel Test Facility
Radiation Center, Corvallis, Oregon 97331
Telephone (541)-737-2341 Fax (541)-737-0480
Oregon State UNIVERSITY

REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING
ELECTRICAL DRAWING INDEX

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-01.0	REV. 0
SHEET 1 OF 4	



REGISTERED PROFESSIONAL ENGINEER
18580
OREGON
JULY 10, 1996
ISTVAN PAPP

EXPIRES 12/31/12

OSU Oregon State University
Department of Nuclear Engineering
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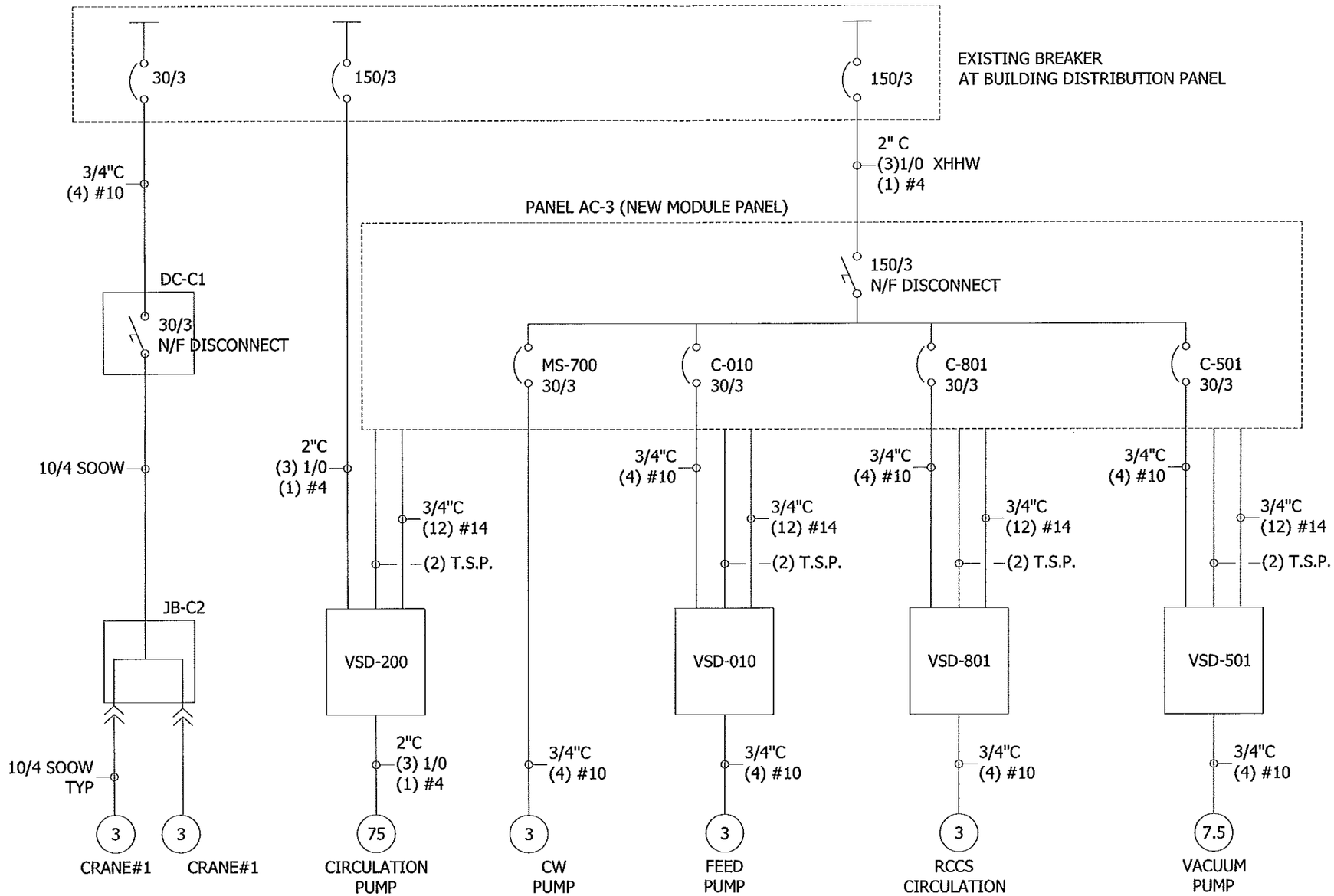
REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING
HEATER POWER ONE LINE

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-01.1	REV. 0
SHEET 2 OF 4	



REGISTERED PROFESSIONAL ENGINEER
18580
OREGON
JULY 10, 1992
ISTVAN PAPP

EXPIRES 12/31/12

OSU Oregon State University
Department of Nuclear Engineering
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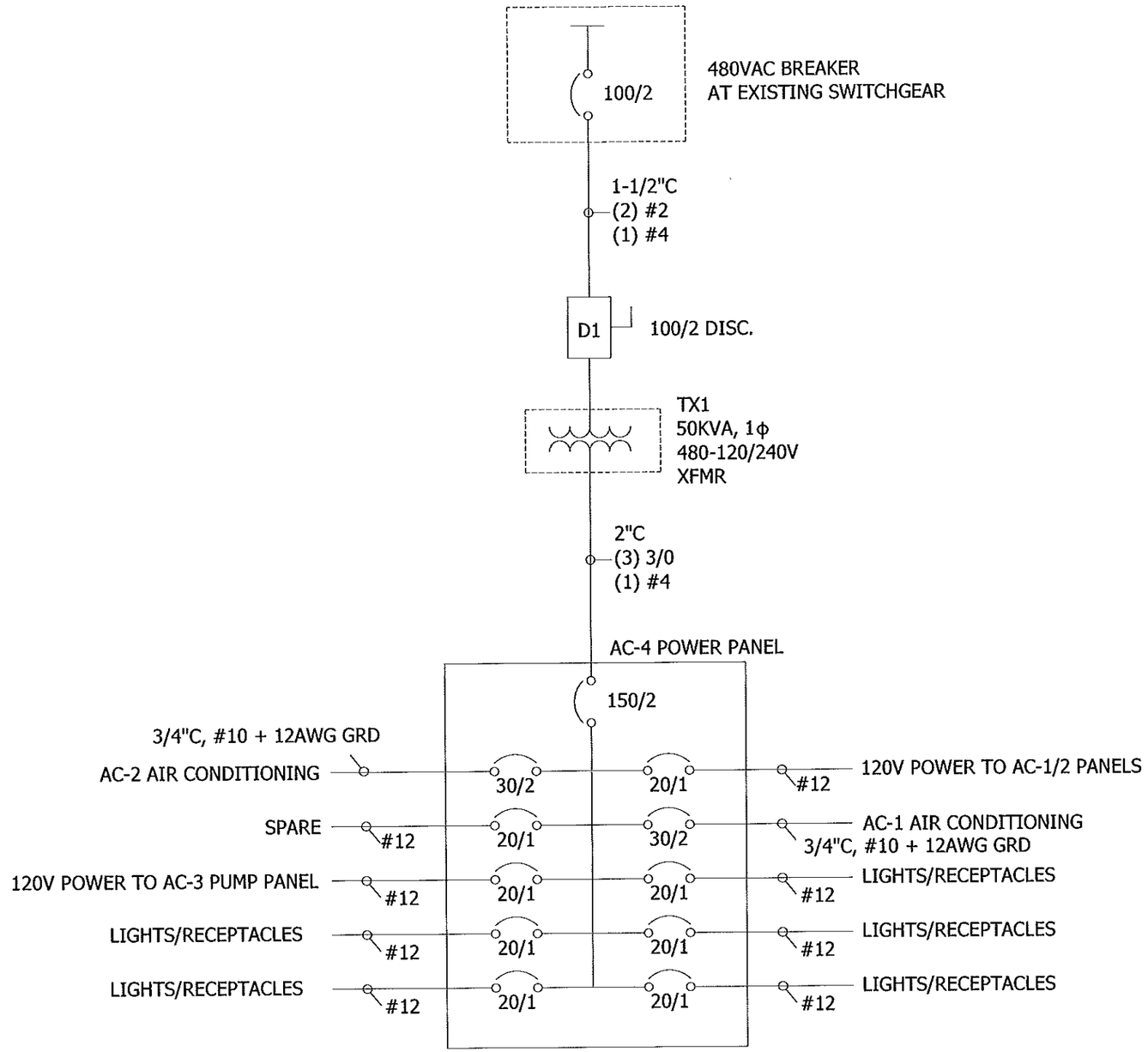
REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	0/24/11	

ELECTRICAL POWER WIRING
MOTOR/ CRANE POWER ONE LINE

OSU HTTF PACKAGE

DRAWN BY: J. NYLANDER	DATE: 10/202011
APPROVED BY:	DATE:
VENDOR DWG. NO.: HTTF-E-01	SCALE:
DRAWING NO.: E-01.2	REV.: 0
SHEET 2 OF 4	



REGISTERED PROFESSIONAL ENGINEER
18599
Istvan Papp
OREGON
JULY 10, 1996
ISTVAN PAPP

EXPIRES 12/31/12

OSU Oregon State University
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REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING
120V AC POWER ONE LINE

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/20/11
APPROVED BY	DATE
VENDOR DWG. NO. HTTF-E1	SCALE
DRAWING NO. E-01.3	REV. 0
SHEET 3 OF 4	

FIELD MODULE

NEW 4000A SWITCHGEAR

AC-4 POWER PANEL CKT. #2

AC-4 POWER PANEL CKT. #4

WIRING NOTE: SEE E-01.1 TO E-01.4 FOR WIRE SIZES

C101 C103 C105 C107 C109

FU101 1A FU103 1A FU105 1A FU107 1A FU109 1A

SCR-101 SCR-103 SCR-105 SCR-107 SCR-109

300 amps

120 VAC L1201 N120 L120

CB-3 10A L1201A ESR-002 L1201B

SEE E-3.1

CONTROL POWER

CR-101 L1201B-1 C101 LT101 CR-101

CR-103 L1201B-2 C103 LT103 CR-103

CR-105 L1201B-3 C105 LT105 CR-105

CR-107 L1201B-4 C107 LT107 CR-107

CR-109 L1201B-5 C109 LT109 CR-109

* = MTD. IN DOOR

L1AC N1AC L1AC1 CB-1 20A L1AC1-1 PC-1a CB-2 20A L1AC1-2 PC-1b

+24VDC ESR-002 CR-101 CR-103 CR-105 CR-107 CR-109 HTR-101 HTR-103 HTR-105 HTR-107 HTR-109

TB-AC1-1

DCCOM SCR-101 SCR-103 SCR-105 SCR-107 SCR-109

SEE E04.2

KW-101 KW-103 KW-105 KW-107 KW-109

TO ANALOG INPUTS SEE E11.0

SCR-101+ SCR-101- SCR-103+ SCR-103- SCR-105+ SCR-105- SCR-107+ SCR-107- SCR-109+ SCR-109-

4-20 MADC

HEATER BANK 1 220 KW 265amps

HEATER BANK 3 220 KW 265amps

HEATER BANK 5 220 KW 265amps

HEATER BANK 7 220 KW 265amps

HEATER BANK 9 220 KW 265amps

C1 300:5 C3 300:5 C5 300:5 C7 300:5 C9 300:5 kW

TYP. SEE E-11.0

HTTF PPV

HTTF RCCS

HEATER DISTRIBUTION PANEL AC-1

TYPICAL TERMINALS ON EACH SCR

SCR-1XX

TYPICAL EACH KW TRANSDUCER

T1 L2 T3 KW-211 DCCOM

HTTF BASE MODULE

REGISTERED PROFESSIONAL ENGINEER 18589 OREGON JULY 10, 1986 ISTVAN PAPP

EXPIRES 12/31/12

REV #	DESCRIPTION	DATE
0	ISSUE FOR BID	10/24/11

NOTES:

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Department of Nuclear Engineering
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Radiation Center, Corvallis, Oregon 97331
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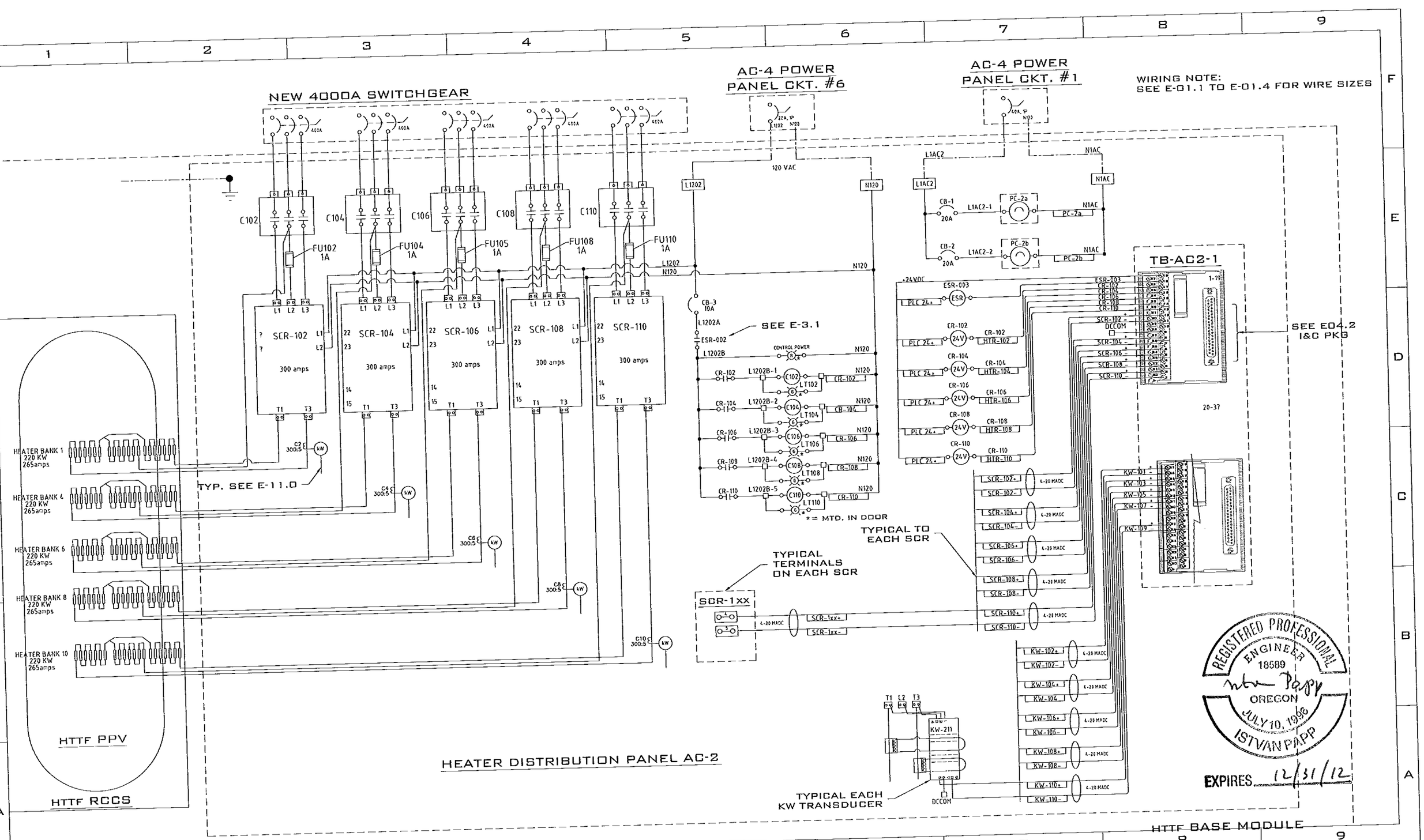
ELECTRICAL POWER WIRING PANEL AC-1 WIRING DIAGRAM

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-02.0	REV 0
SHEET 2 OF 18	



REV #	DESCRIPTION	DATE	NOTES:
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Radiation Center, Corvallis, Oregon 97331
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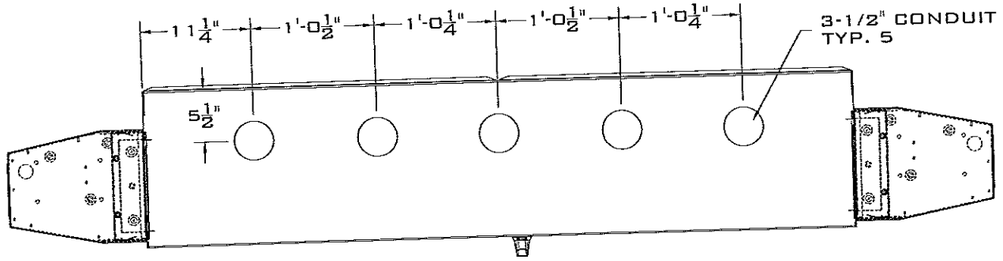
ELECTRICAL POWER WIRING PANEL AC-2 WIRING DIAGRAM

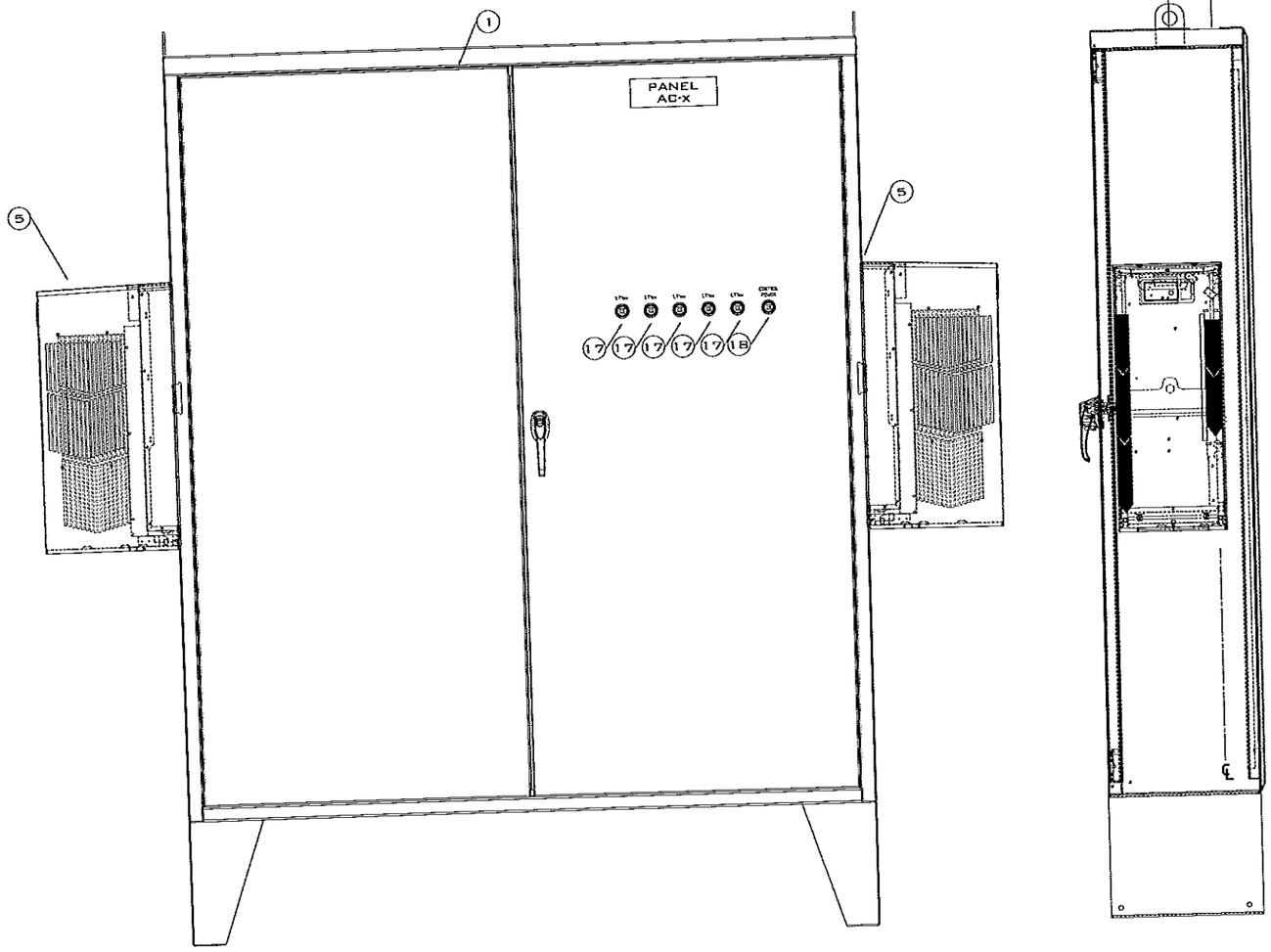
OSU HTTF PACKAGE

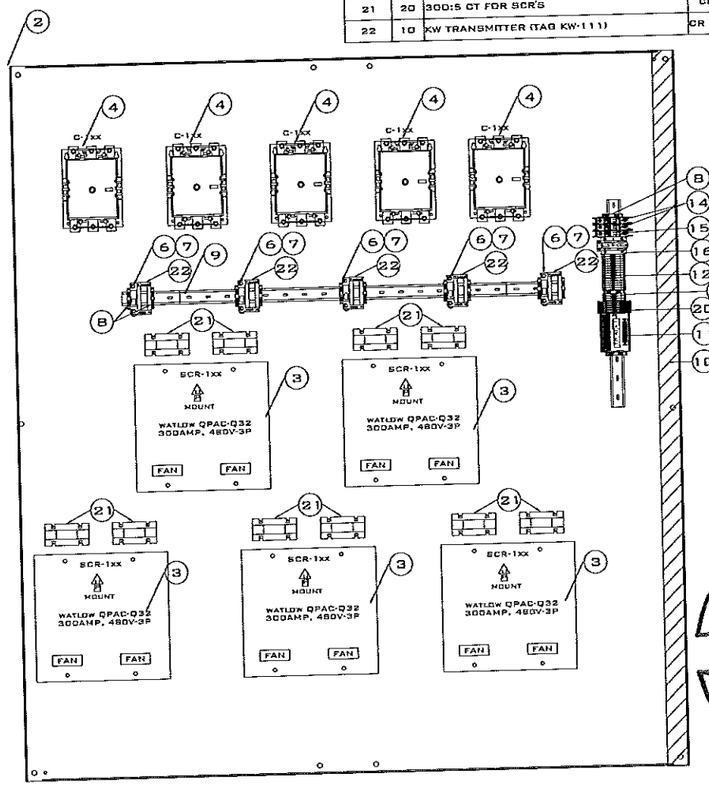
DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-02.1	REV. 0
SHEET 2 OF 4	

SEE E-2.0 & E-2.1 FOR TAG NUMBERS

BILL OF MATERIAL (AC-1& AC-2)				
ITEM	QTY	DESCRIPTION	MANUFACTURER	MODEL
1	2	TYPE 1, FREE-STANDING ENCLOSURE	HOFFMAN	A727216ULP
2	2	BACKPANEL	ALLEN BRADLEY	A72P72G
3	10	SCR, 300AMP, 3P (TAG = SCR-1XX)	WATLOW	QPAC-Q32-481-300-BV2
4	10	CONTACTOR, 300AMP, 3P (TAG = C-1XX)	ALLEN BRADLEY	100-D300ED11
5	4	PANEL COOLER, 6000BTU, 240V	HOFFMAN	N3606260050
6	5	IEC FUSE HOLDER, 30A, 1-POLE	ALLEN BRADLEY	1492-F1B030
7	5	1 AMP FUSE, CLASS CC	BUSSMANN	LP-CC-1
8	13	IEC TERMINAL BLOCK ANCHORS	ALLEN BRADLEY	1492-EAJ35
9	2	DIN RAIL	ALLEN BRADLEY	199-DR1
10	AR	WIREWAY,SLOTTED W COVER, 2X3	PANDUIT	F2X3LG6 W/ C2LG6 COVER
11	1	CONNECTOR BLOCK - HORIZONTAL	NATIONAL INSTRUMENTS	CB-37FH
12	20	IEC TERMINAL BLOCK GREY	ALLEN BRADLEY	1492-J4
13	1	IEC TERMINAL BLOCK END - J4	ALLEN BRADLEY	1492-EBJ3
14	2	20A, 1-POLE CIRCUIT BREAKERS	ALLEN BRADLEY	1489-A1C200
15	1	10A, 1-POLE CIRCUIT BREAKERS	ALLEN BRADLEY	1489-A1C100
16	1	IEC CONTACTOR, 9A, 24V COIL (TAG = ESR-00X)	ALLEN BRADLEY	100-C09DJ10
17	5	PILOT LIGHT, GREEN 120V LED	ALLEN-BRADLEY	800T-QH10G
18	1	PILOT LIGHT, RED 120V LED	ALLEN-BRADLEY	800T-QH10R
19	1	E-STOP SWITCH, PUSH-PULL, 63MM METAL	ALLEN-BRADLEY	800-T-FXLE6A1
20	17	SOLID STATE RELAY, 10AMP (TAG = CRX, SSR-1XX)	ALLEN BRADLEY	700-HLT1Z24
21	20	300:5 CT FOR SCR'S	CR MAGNETICS	CRS-SFT-301
22	10	KW TRANSMITTER (TAG KW-111)	CR MAGNETICS	CR5240-500-5







REGISTERED PROFESSIONAL ENGINEER
16589
Ist Papp
OREGON
JULY 10, 1993
ISTVAN PAPP

EXPIRES 12/31/12

REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10-24-11	

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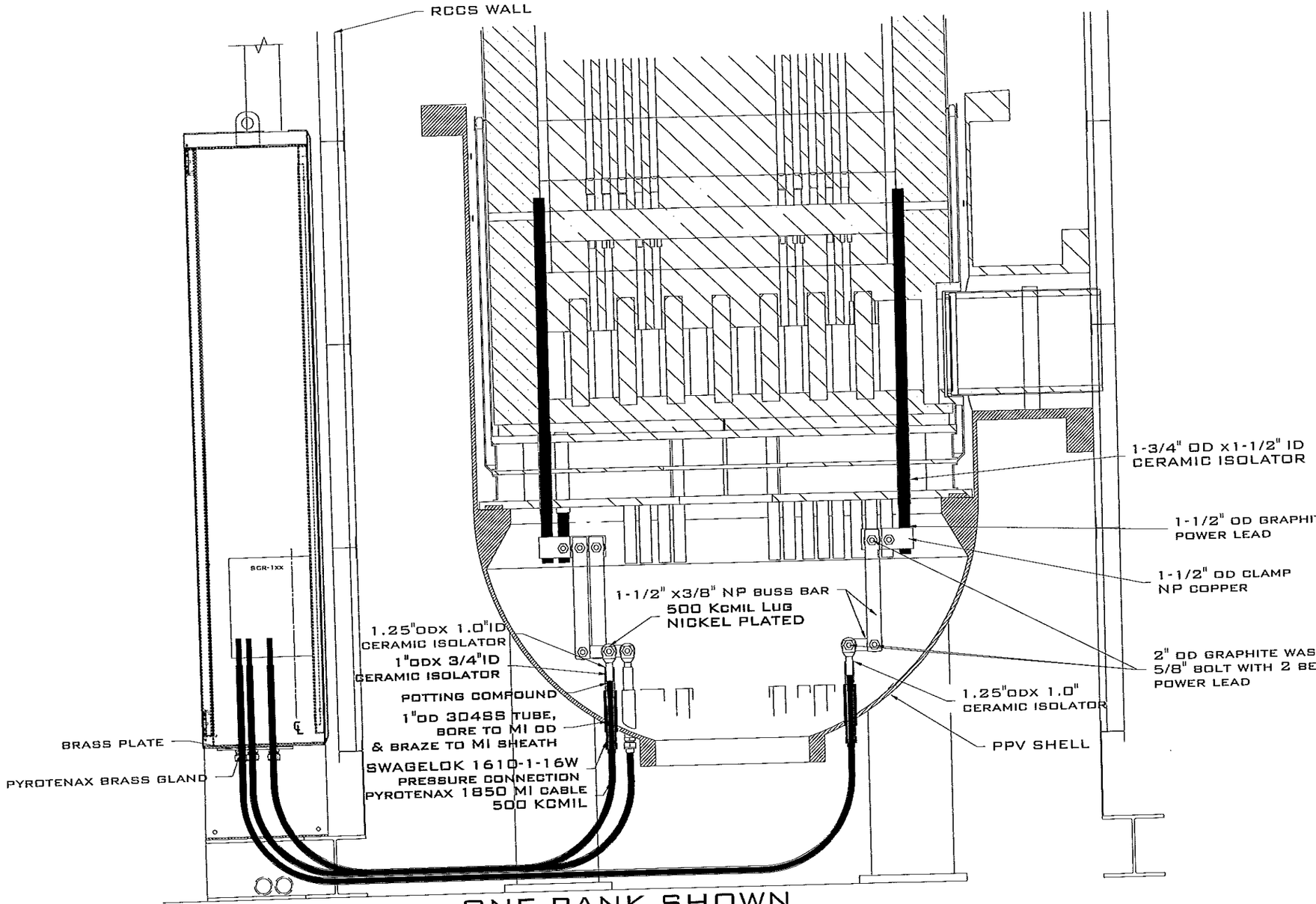
Radiation Center, Corvallis, Oregon 97331
Telephone (541)-737-2341 Fax (541)-737-0480

ELECTRICAL POWER WIRING HEATER PANEL ARRANGEMENT PANEL AC-1 AND AC-2 TYP.

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE NONE
DRAWING NO. E-02.2	REV. 0
SHEET 3 OF 4	



ONE BANK SHOWN
TYPICAL 10 BANKS

REGISTERED PROFESSIONAL ENGINEER
18589
OREGON
JULY 10, 1985
ISTVAN PAPP

EXPIRES 12/31/12

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REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING HEATER PANEL TO PPV DIAGRAM AC-1 AND AC-2 TYP.

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10-21-11
APPROVED BY B WOODS	DATE 10-24-11
VENDOR DWG. NO. HTTF-E1-E3	SCALE NONE
DRAWING NO. E-02.3	REV. 0
SHEET 4 OF 4	

BUILDING POWER DIST. PANEL

FIELD INSTALL

SUPPLY POWER
480 VAC, 30 AMP,
3 PHASE, 60 HZ.

30A NON-FUSED DISCONNECT
480 VAC, 30 AMP, 3 PHASE,60 HZ

POWER DISTRIBUTION BLOCK

480 VAC

FB701 3A
FB010 7A
FB801 7A
FB501 30A

MS 701
MC 010
MC 801
MC 501

FIELD

3ton hoists

3.0HP
3.0HP

30A NON-FUSED DISCONNECT
480 VAC, 30 AMP,
3 PHASE,60 HZ

SUPPLY POWER
480 VAC, 20 AMP,
3 PHASE, 60 HZ.

DC-C1

JB-C2

DC-C1 MOUNTED BELOW CRANE RAIL,
FESTOON CABLE TO JB-C2 ON BRIDGE

FESTOON CABLES JB-C2 TO HOIST

HTTF DRIVES

P-701
SEAL PUMP
.75HP

MS-201L1
MS-201L2
MS-201L3

2.0HP
P-010 FEED PUMP

VSD-010A
VSD-010B
VSD-010C

VSD-010
4.8 amps
ATV212HU22N4

VSD-010R
VSD-010A1

DRIVE FAULT TO PLC
SEE TB-AC3-1

ANALOG IN TO PLC
SEE TB-AC3-1

P-801PUMP
RCCS CIRCULATION PUMP
2HP

VSD-801A
VSD-801B
VSD-801C

VSD-801
4.8amps
ATV212HU22N4

VSD-801R
VSD-801A1

DRIVE FAULT TO PLC
TB-AC3-1

ANALOG IN TO PLC
SEE TB-AC3-1

SUPPLY POWER
480 VAC, 96 AMP,
3 PHASE, 60 HZ

C-200
CIRCULATOR
75HP

VSD-200A
VSD-200B
VSD-200C

VSD-200
96amps
ATV212HD55N4

VSD-200R
VSD-200A1

DRIVE FAULT TO PLC
SEE TB-AC3-1

ANALOG IN TO PLC
SEE TB-AC3-1

B501
VACUUM PUMP
7.0HP

VSD-501A
VSD-501B
VSD-501C

VSD-501
11 amps
ATV212HC55N4

VSD-501R
VSD-501A1

DRIVE FAULT TO PLC
TB-AC3-1

ANALOG IN TO PLC
SEE TB-AC3-1

HTTF MODULE

WIRING NOTE: SEE E-01.2 FOR WIRE SIZES

TB-AC3-1

SEE ?

32/C
SH37F-P-4
TO PLC PANEL
TO DISTRIBUTE
TO RESPECTIVE
TERMINAL BOARD

DCCOM
+24VDC

SEE 3.1

CR1 P-701
CR2 VSD-010
CR3 VSD-801
CR4 VSD-200
CR5 VSD-501
CR6 CW-101

* = MTD. IN DOOR

SEE 3.1

PUMP CONTROL PANEL AC-3

NOTE: SEE 3.1 FOR MORE WIRING

WIRING NOTE:
SEE E-01.1 TO E-01.4 FOR WIRE SIZES

REGISTERED PROFESSIONAL ENGINEER
18589
OREGON
JULY 10, 1986
ISTVAN PAPP

EXPIRES 12/31/12

BILL OF MATERIAL, CRANE SERVICE

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	1	WALL-MOUNT ENCLOSURE, TYPE 12	HOFFMAN	A42SA3210LP
2	1	BACKPANEL	HOFFMAN	A42P30
3	1	DISCONNECT SWITCH KIT, 30A, NON-FUSED	ALLEN-BRADLEY	1494C-DN030-A4-B-FF
4	1	POWER BLOCK	ALLEN-BRADLEY	1492-PD3263
5	1	SINGLE RECEPTACLE	HUBBELL	L16-20R
6	2	PLUG, L16-30, 600V 3P, 20 AMP	DAYTON	1EGJ1

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REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

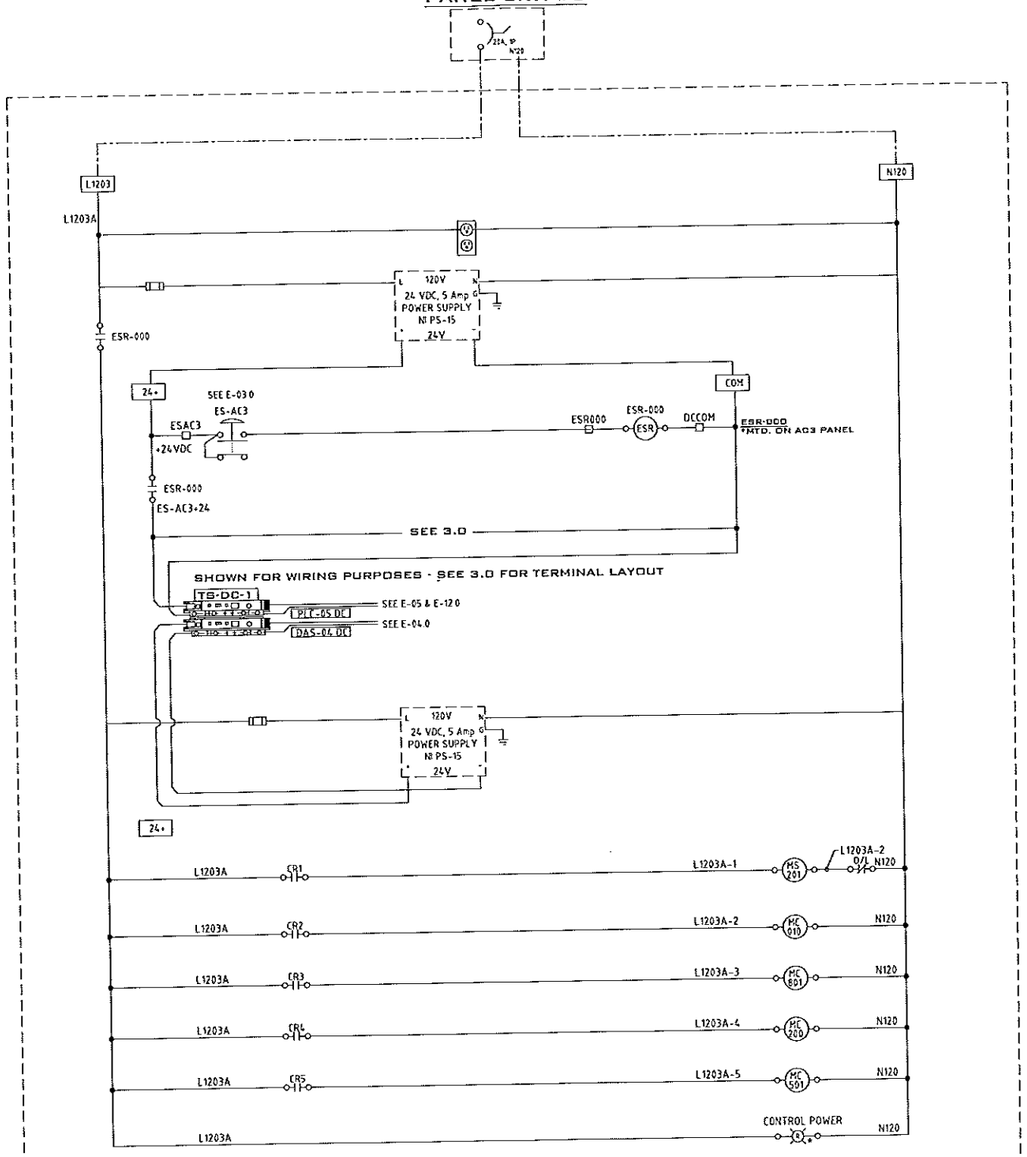
ELECTRICAL POWER WIRING
PANEL AC-3 WIRING DIAGRAM

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-03.0	REV. 0
SHEET 1 OF 4	

AC-4 POWER PANEL CKT. #5

WIRING NOTE:
SEE E-01.1 TO E-01.4 FOR WIRE SIZES



PUMP CONTROL PANEL AC-3
NOTE: SEE 3.0 FOR MORE WIRING

REGISTERED PROFESSIONAL ENGINEER
16589
Istvan Papp
OREGON
JULY 10, 1998
ISTVAN PAPP
EXPIRES 12/31/12

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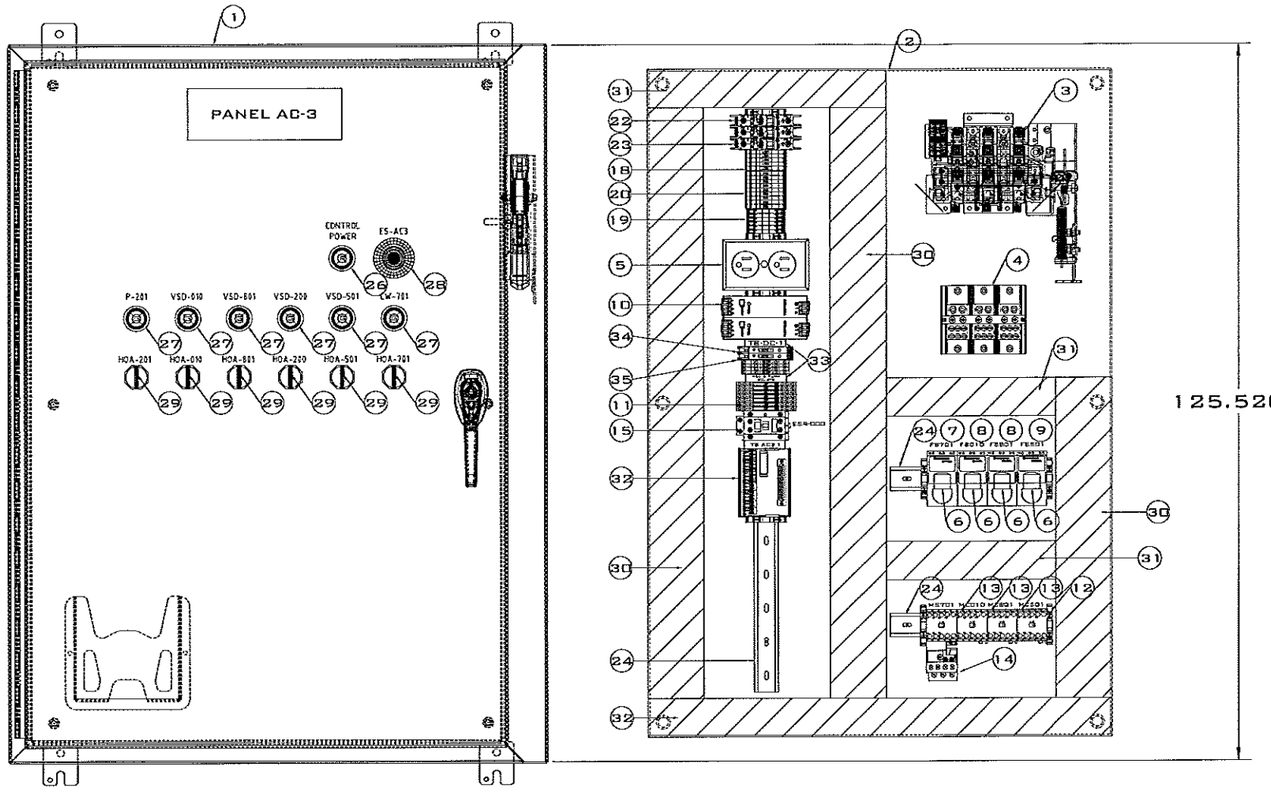
REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING
PANEL AC-3 WIRING DIAGRAM
24V DC WIRING
OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E1-E3	SCALE N/A
DRAWING NO. E-03.1	REV. 0
SHEET 5 OF 18	



* LOCATED EXTERNAL TO ENCLOSURE

Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	1	WALL-MOUNT ENCLOSURE, TYPE 12	HOFFMAN	A42SA3210LP
2	1	BACKPANEL	HOFFMAN	A42P30
3	1	DISCONNECT SWITCH KIT, 30A, NON-FUSED	ALLEN-BRADLEY	1494F-DN030-A4-B-FF
4	1	POWER BLOCK	ALLEN-BRADLEY	1492-PD3263
5	1	DUPLEX RECEPTACLE	HUBBELL	DRU815
6	4	FUSE HOLDER, 600V, 30A	BUSSMAN	DPM1038R
7	3	FUSE, TYPE FNQR, 2A	BUSSMAN	FNQR-2
8	6	FUSE, TYPE FNQR, 6A	BUSSMAN	FNQR-6
9	6	FUSE, TYPE FNQR, 15A	BUSSMAN	FNQR-15
10	1	POWER SUPPLY, 5 AMP	NATIONAL INSTRUMENTS	PS-15
11	17	SOLID STATE RELAY, 10AMP (TAG = CRX, SSR-1XX)	ALLEN BRADLEY	700-HLT1Z24
12	1	CONTACTOR, 12AMP, 3P, 120V AC COIL (TAG = MC-501)	ALLEN-BRADLEY	100-K12D10
13	4	CONTACTOR MOTOR STARTER, 120V AC COIL (TAG=MS-XXX, MC-010, MC-801)	ALLEN-BRADLEY	100-K05D10
14	1	OVERLOAD RELAY, 1/2HP	ALLEN-BRADLEY	193-K813
15	1	IEC CONTACTOR, 9A, 24V COIL (TAG = ESR-00X)	ALLEN BRADLEY	100-C09DJ10
16	2	IEC TERMINAL BLOCK END	ALLEN-BRADLEY	1492-EBJD3
17	15	IEC TERMINAL BLOCK 2-LEVEL GREY	ALLEN BRADLEY	1492-JD3C
18	34	IEC TERMINAL BLOCK GREY (24V -)	ALLEN-BRADLEY	1492-J4
19	11	IEC TERMINAL BLOCK GROUNDING	ALLEN-BRADLEY	1492-JG4
20	12	IEC TERMINAL BLOCK END	ALLEN-BRADLEY	1492-EBJ3
21	11	IEC TERMINAL BLOCK END ANCHOR	ALLEN-BRADLEY	1492-EAJ35
22	2	20A, 1-POLE CIRCUIT BREAKERS	ALLEN BRADLEY	1489-A1C200
23	1	10A, 1-POLE CIRCUIT BREAKERS	ALLEN BRADLEY	1489-A1C100
24	3	DIN RAIL	ALLEN-BRADLEY	199-DR1
25	8	10-POLE CENTER JUMPERS FOR J4	ALLEN BRADLEY	1492-CJJ6-10
26	1	PILOT LIGHT, RED 120V LED	ALLEN-BRADLEY	800T-QH10R
27	7	PILOT LIGHT, GREEN 24V LED	ALLEN-BRADLEY	800T-QH24G
28	1	E-STOP SWITCH, PUSH-PULL, 63MM METAL	ALLEN-BRADLEY	800-T-FXLE6A1
29	7	HOA, 3 POSITION SELECTOR SWITCH	ALLEN-BRADLEY	800-J2A
30	AR	WIREWAY,SLOTTED W COVER, 3X3	PANDUIT	F3X3LG6 W/ C3LG6 COVER
31	AR	WIREWAY,SLOTTED W COVER, 2X3	PANDUIT	F2X3LG6 W/ C2LG6 COVER
32	1	CONNECTOR BLOCK - HORIZONTAL	NATIONAL INSTRUMENTS	CB-37FH
33	3	GROUP MARKING TAG	ALLEN BRADLEY	1492-GM35
34	10	IEC TERMINAL BLOCK FUSED	ALLEN BRADLEY	1492-H5
35	10	IEC TERMINAL BLOCK FUSED END SECTION	ALLEN BRADLEY	1492-N37
36	1	10-POLE CENTER JUMPERS FOR JD3C	ALLEN BRADLEY	1492-CJJ5-10
37	1	10-POLE SIDE JUMPTER FOR H5	ALLEN BRADLEY	1492-N49
* 38	2	VSD, 4.8AMP, 3P (TAG = VSD-010, VSD-801)	SCHNEIDER	ATV312HU22N4
* 39	1	VSD, 11AMP, 3P (TAG = VSD-501)	SCHNEIDER	ATV212HD18N4
* 40	1	VSD, 96AMP, 3P (TAG = VSD-200)	SCHNEIDER	ATV212HD55N4

REGISTERED PROFESSIONAL ENGINEER 18589 OREGON JULY 10, 1985 ISTVAN PAPP

EXPIRES 12/31/12

PUMP PANEL AC-3

OSU Oregon State University
Department of Nuclear Engineering
Hydro-Mechanical Fuel Test Facility
Radiation Center, Corvallis, Oregon 97331
Telephone (541)-737-2341 Fax (541)-737-0480

REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

ELECTRICAL POWER WIRING PANEL AC-3 ARRANGEMENT

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10/21/11
APPROVED BY B WOODS	DATE 10/24/11
VENDOR DWG. NO. HTTF-E-1-E3	SCALE N/A
DRAWING NO. E-03.2	REV. 0
SHEET 3 OF 4	

480VAC BREAKER AT EXISTING S/G

480VAC BREAKER AT EXISTING SWITCHGEAR

100/2

1-1/2"C
(2) #2
(1) #8

FIELD INSTALL

D1 100/2 DISC.

TX1 50KVA, 1φ &80-120/240V XFMR

TX-1 TRANSFORMER

2"C
(3) 3/0
(1) #4

AC-4 POWER PANEL 240/120V 1P

100/2

AC-2 AIR CONDITIONING	40/2	20/1	120V POWER TO AC-1
SPARE	20/1	40/2	AC-1 AIR CONDITIONING
120V POWER TO AC-3 PANEL	20/1	20/1	120V POWER TO AC-2
LIGHTS/RECEPTACLES	20/1	20/1	LIGHTS/RECEPTACLES
LIGHTS/RECEPTACLES	20/1	20/1	LIGHTS/RECEPTACLES
SPARE		SPARE	
SPARE		SPARE	

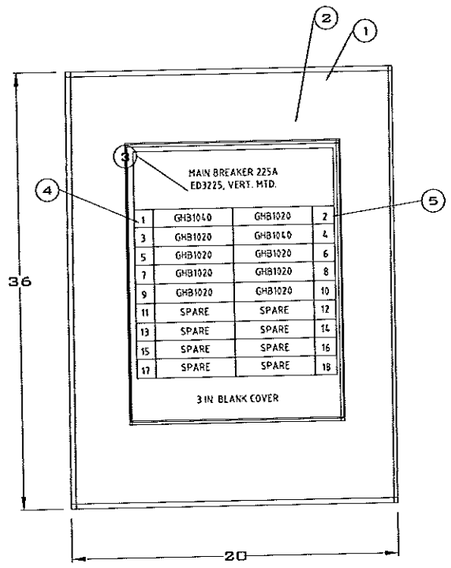
LIGHT SWITCH

HTTF MODULE LIMITS

HALOGEN 1 · HALOGEN 2 · HALOGEN 3 · HALOGEN 4

HTTF UPPER PLATFORM

WIRING NOTE: SEE E-01.3 FOR WIRE SIZES



AC-4 POWER PANEL

BILL OF MATERIAL

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	1	TYPE 1 ENCLOSURE 20X36	EATON	EZB2036R
2	1	PANELBOARD, 100 AMP, TYPE EHD	EATON	POW-R-LINE2A
3	1	MAIN CIRCUIT BREAKER, 100 AMP	EATON	EHD3100
4	2	240 V CIRCUIT BREAKER, 40 AMP	EATON	GHB1040
5	8	120 V CIRCUIT BREAKER, 20 AMP	EATON	GHB1020
6	-	120 V CIRCUIT BREAKER, 15 AMP	EATON	GHB1015
7	4	QUARTZ HALOGEN FLOODLIGHT	LITHONIA	F500QLD 120
8	6	RECEPTACLE, DUPLEX, 15A, 125V	HUBBELL	DRU815
9	1	SWITCH, SAFETY, 100 A	SQUARE D	HU363
10	1	TRANSFORMER, 120/240V OUT, 50KVA	TBD	TBD
11				
12	5	SWITCH, COMMERCIAL, 20 A	HUBBELL	1221GY
13	1	FIXTURE, WET LOCATION, FLUORESCENT, 120W	LITHONIA	XWL232 MV

REGISTERED PROFESSIONAL ENGINEER 10580 Istvan Papp OREGON JULY 10, 1996 ISTVAN PAPP

EXPIRES 12/31/12

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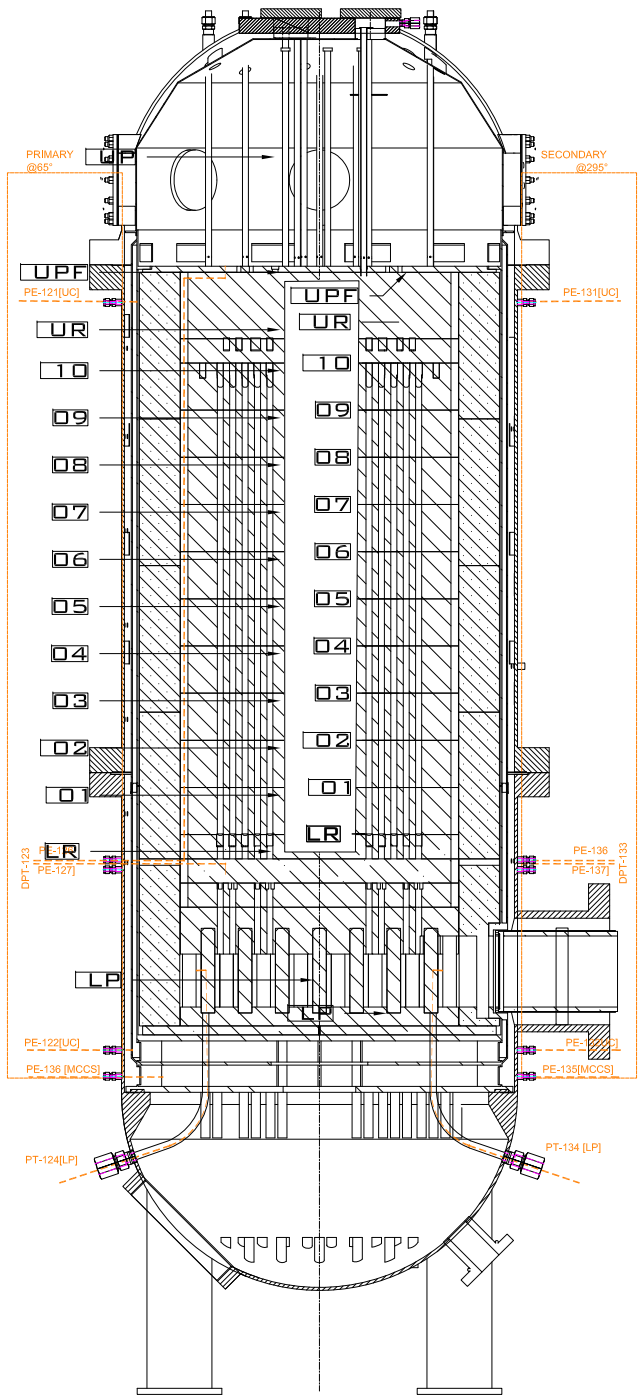
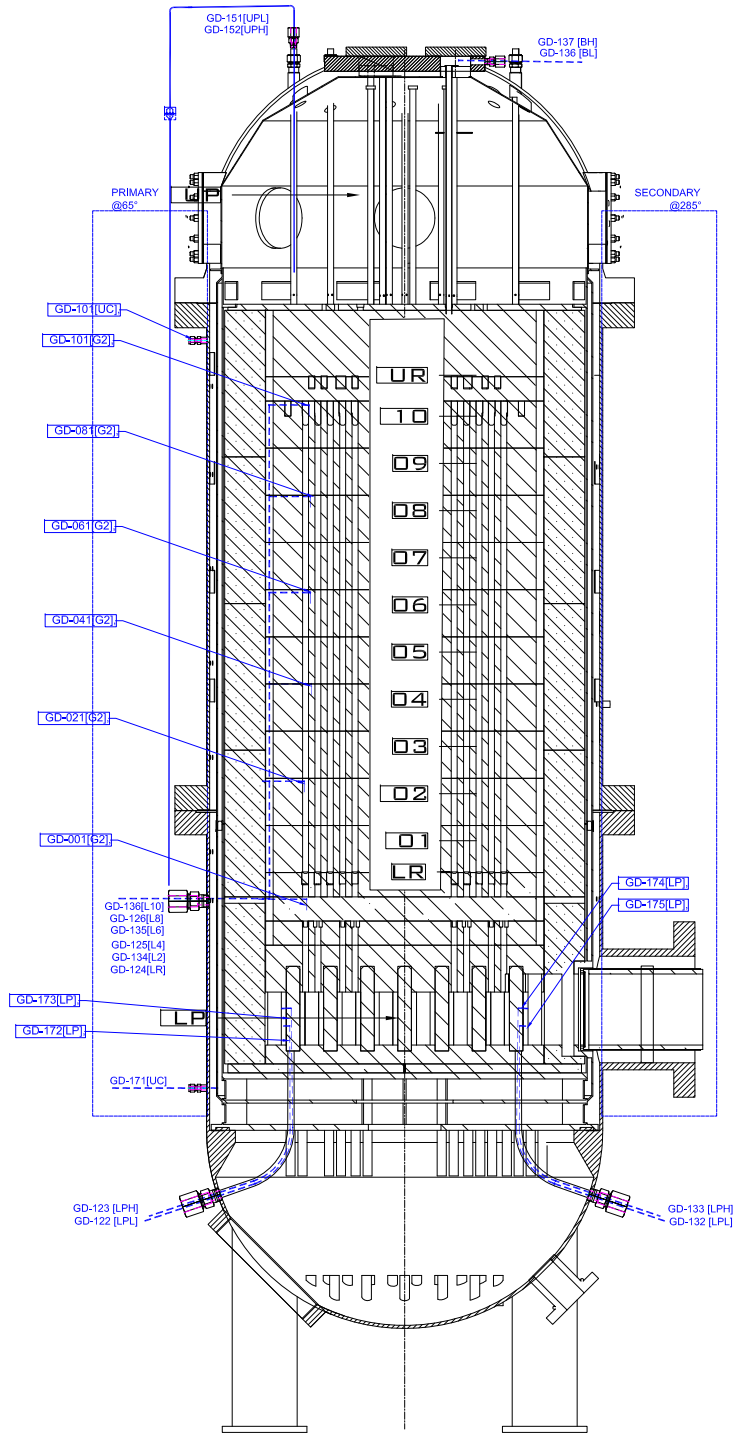
REV #	DESCRIPTION	DATE	NOTES:
0	ISSUE FOR BID	10/24/11	

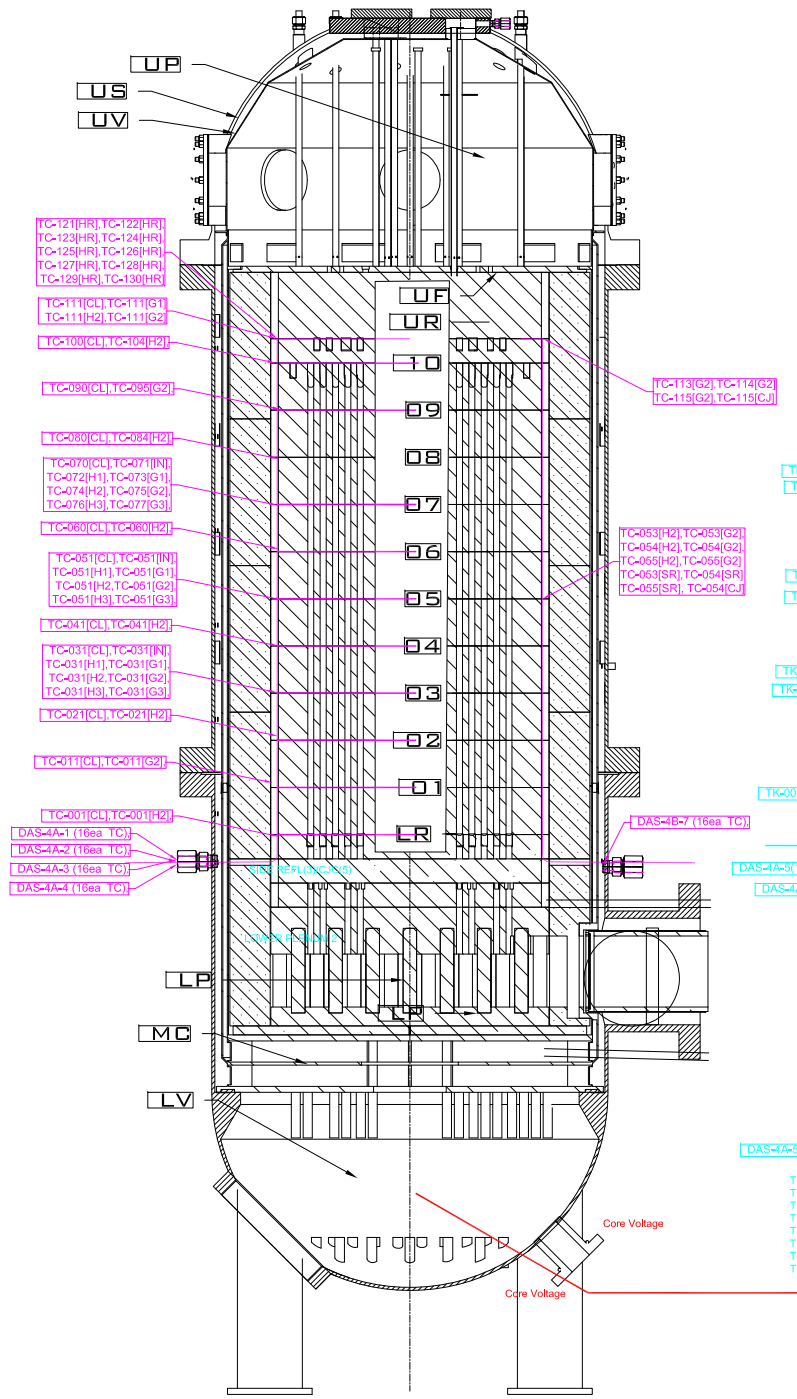
ELECTRICAL POWER WIRING PANEL AC-4 WIRING DIAGRAM & ARRANGEMENT

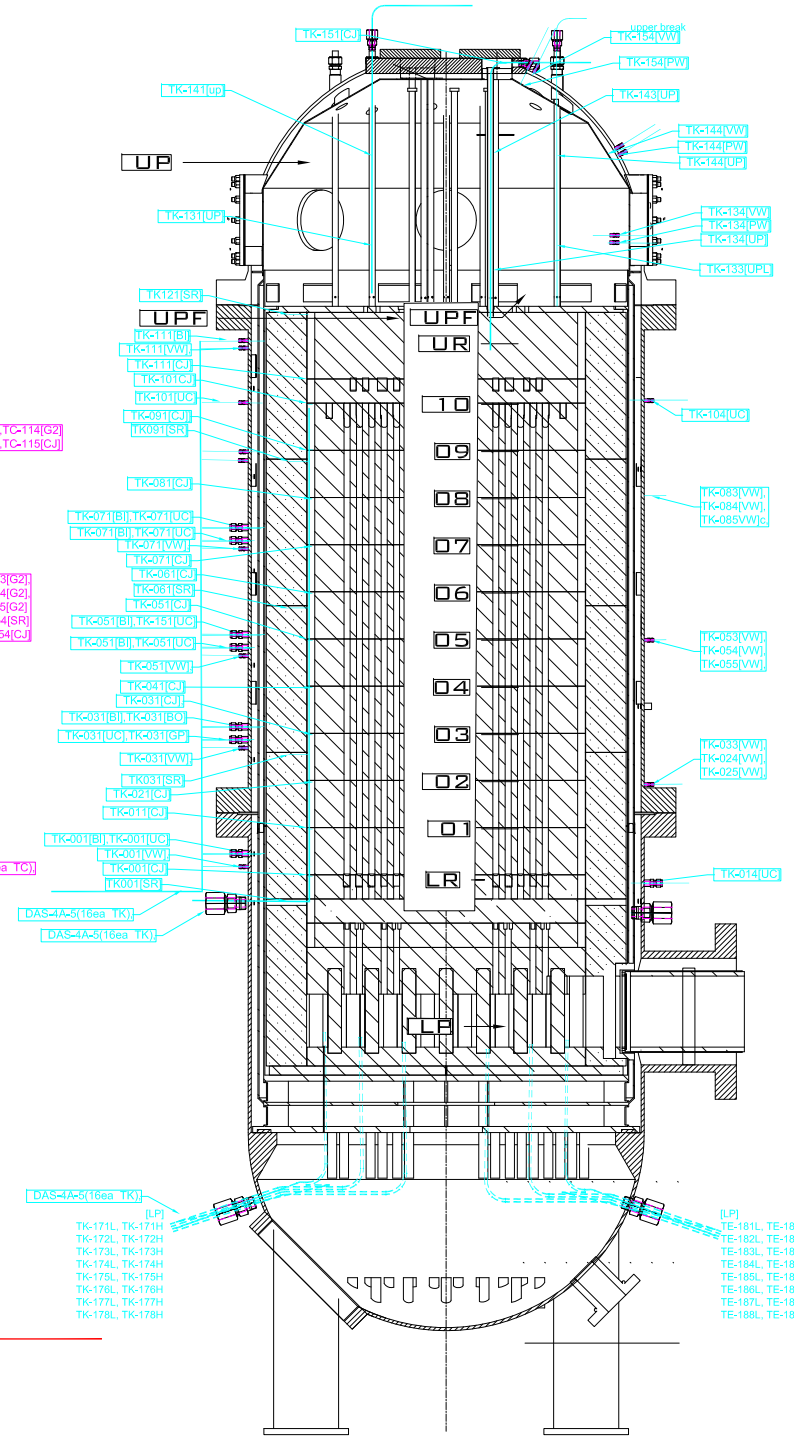
OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 10-21-11
APPROVED BY B WOODS	DATE 10-24-11
VENDOR DWG. NO. HTTF-E1-E3	SCALE
DRAWING NO. E-03.3	REV. 0
SHEET 4 OF 4	









DAS INSTRUMENT DESIGNATORS
GD - GAS DETECTOR
TC - TYPE C THERMOCOUPLE
TK - TYPE K THERMOCOUPLE
PE - PRESSURE ELEMENT
TF - FLUID TEMPERATURES
ET - EMF(VOLTAGE) ELEMENT

INSRUMENT LOCATION S
00 - LR - LOWER REFLECTOR
0x Lx - LEVEL WHERE x =1 THRU 9
10 LEVEL 10
11 UP - UPPER RELECTORR
12 UPF - UPPER PLENUM FLOOR
13 UP1 UPPER PLENUM LOWER 1/3
14 UPPER PLENUM UPPER 1/3
15 TOP OF VESSEL
16 MCSS
17 LOWER PLENUM
18 LOWER VESSEL

INSTRUMENT SEGMENT
1 PRIMARY
2
3
4 SECONDARY
5
6

RADIAL SUFFIX CORE
IN - INNER HEX
H1 - HEX 1
G1 - GAS 1
H2 - HEX2
G2 - GAS 2
H3 - HEX3
G3 - GAS 3
RG - 60% RADIAL
CJ - COLD JUNCTION
SF - SIDE REFLECTOR

RADIAL SUFFIX
CI - INNER CORE BARREL
BO - OUTER CORE BARREL
UP - UP COMER
PW - PLENUM WALL
GP - GAP BETWEEN UPCOMER AND VESSEL
VW - VESSEL WALL

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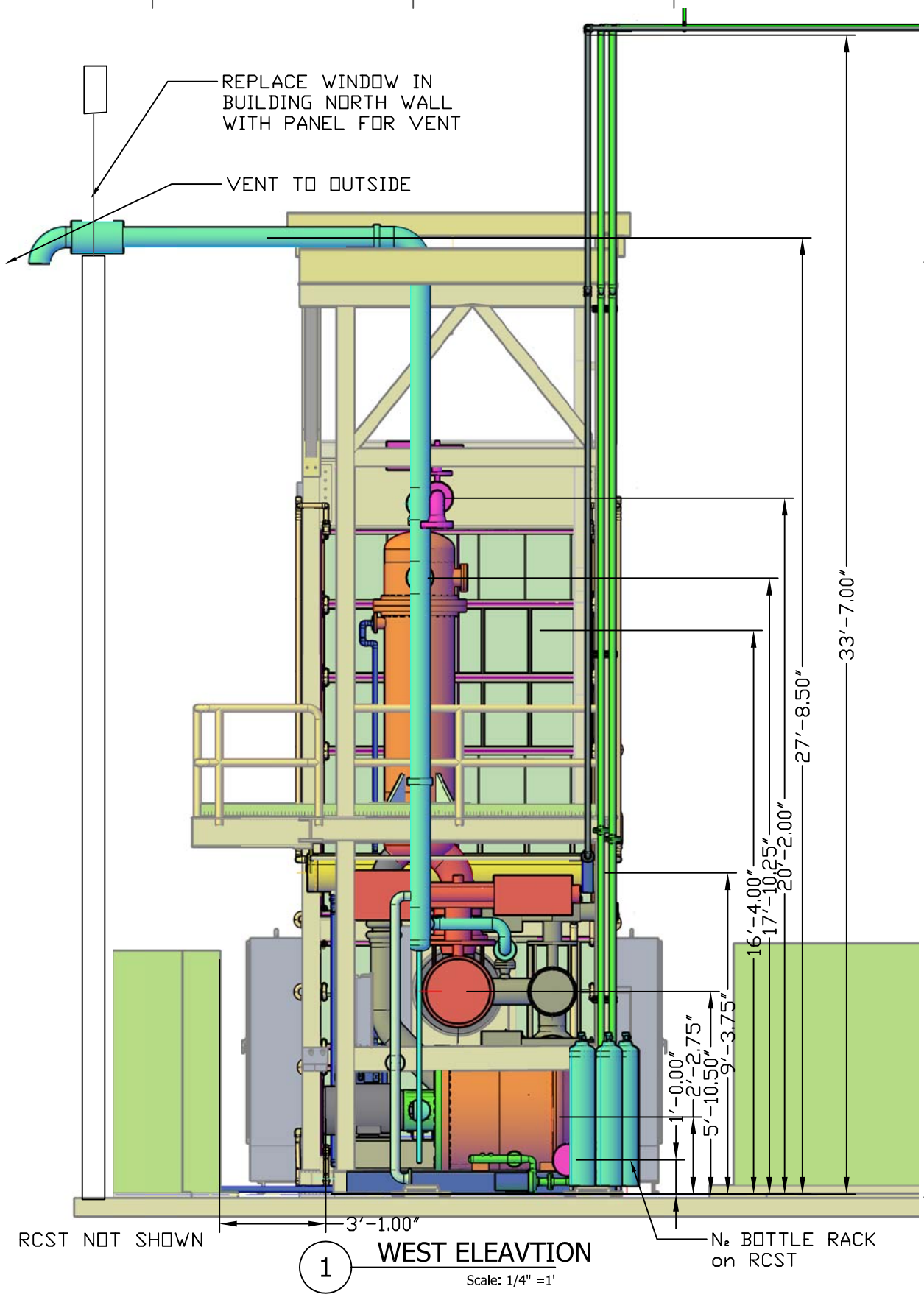
ELECTRICAL ONE-LINES
INSTRUMENTATION SCHEMATIC

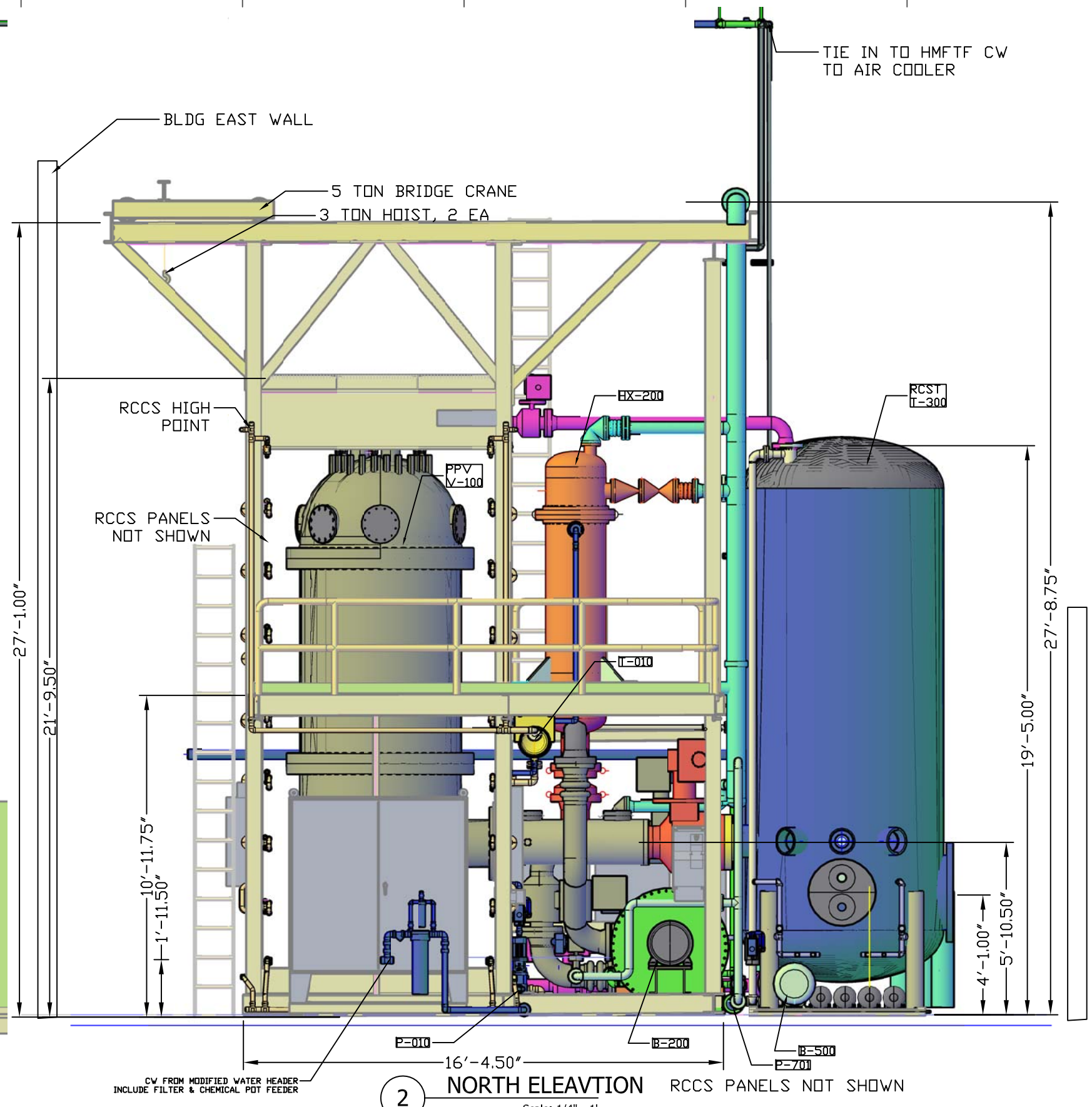
OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE
APPROVED BY 5/14/2010	DATE
VENDOR DWG. NO. 25466-E-09	SCALE
DRAWING NO. E-05.0	REV. 0
SHEET 1 OF 9	



1 WEST ELEAVTION

Scale: 1/4" =1'



2 NORTH ELEAVTION

Scale: 1/4" =1'

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0			

MODULE PIPING LAYOUT PLAN AND ELEVATION.

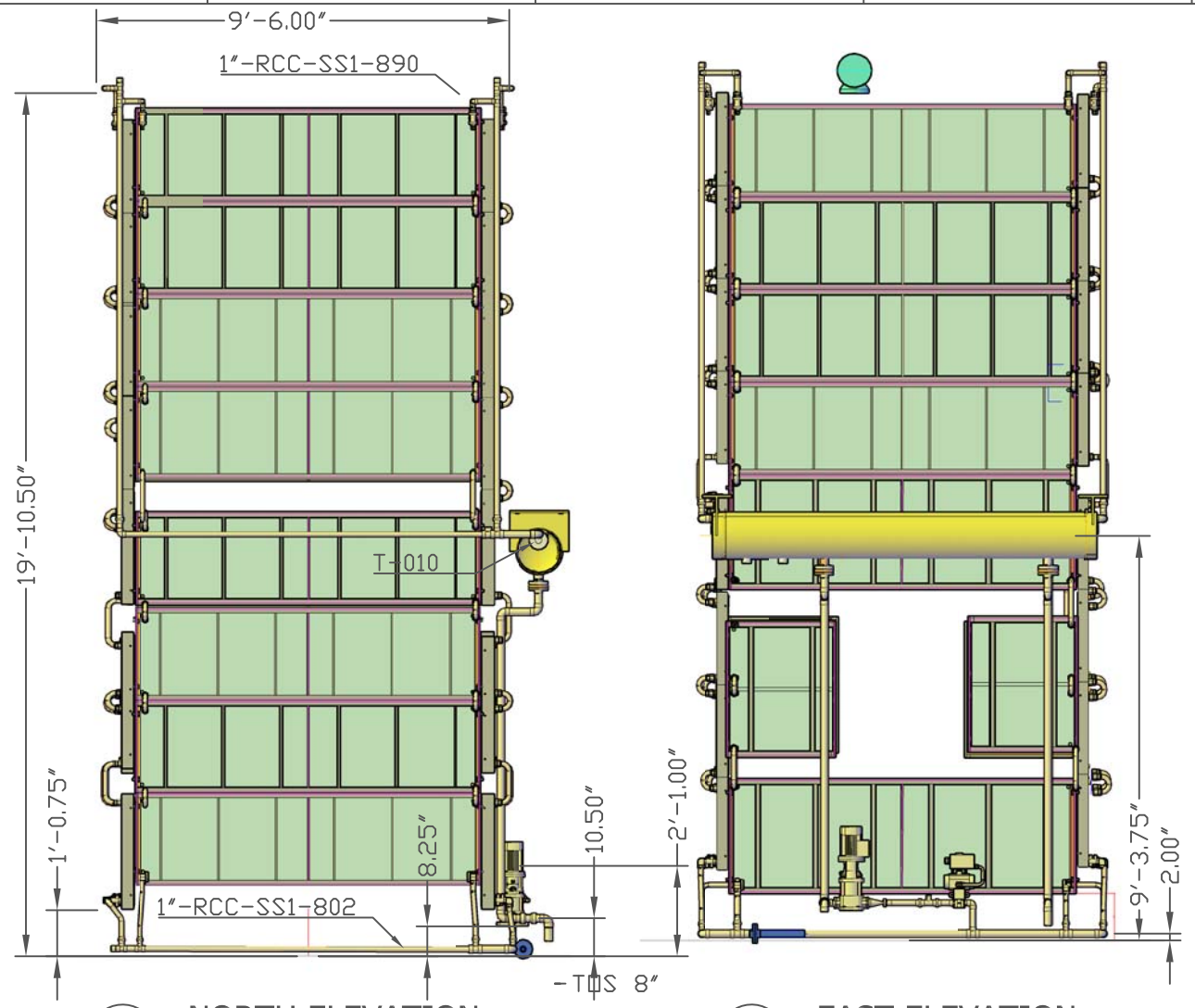
OSU HTTF PACKAGE

VENDOR DWG. NO.

CAD FILE NAME HTTF-M1.DWG

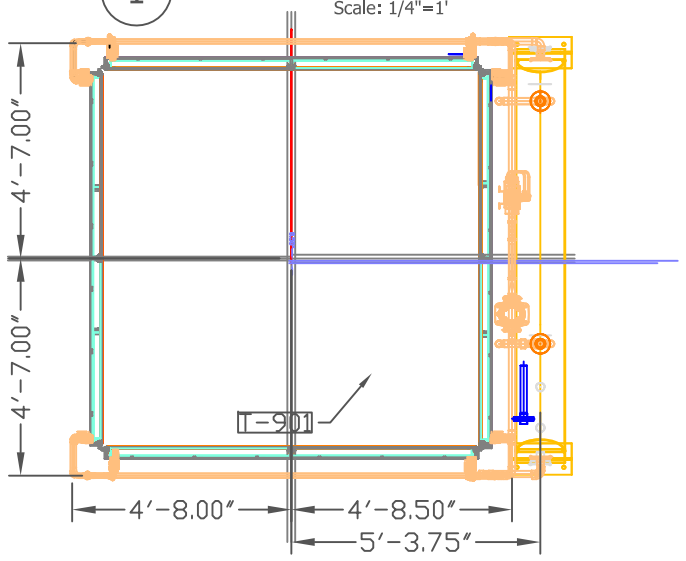
SCALE as noted

DRAWN BY J NYLANDER	DATE 06-10-11
REVIEWED BY	DATE
APPROVED BY	DATE
DRAWING NO. HTTF-M1	REVISION 0
SHEET 2 OF 2	

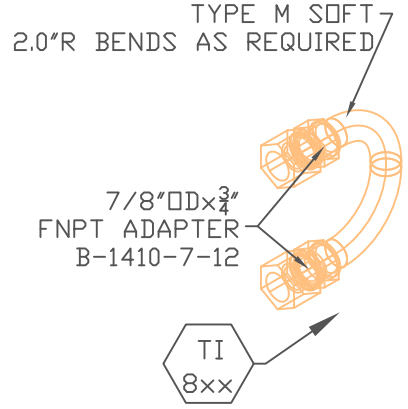


1 NORTH ELEVATION
Scale: 1/4"=1'

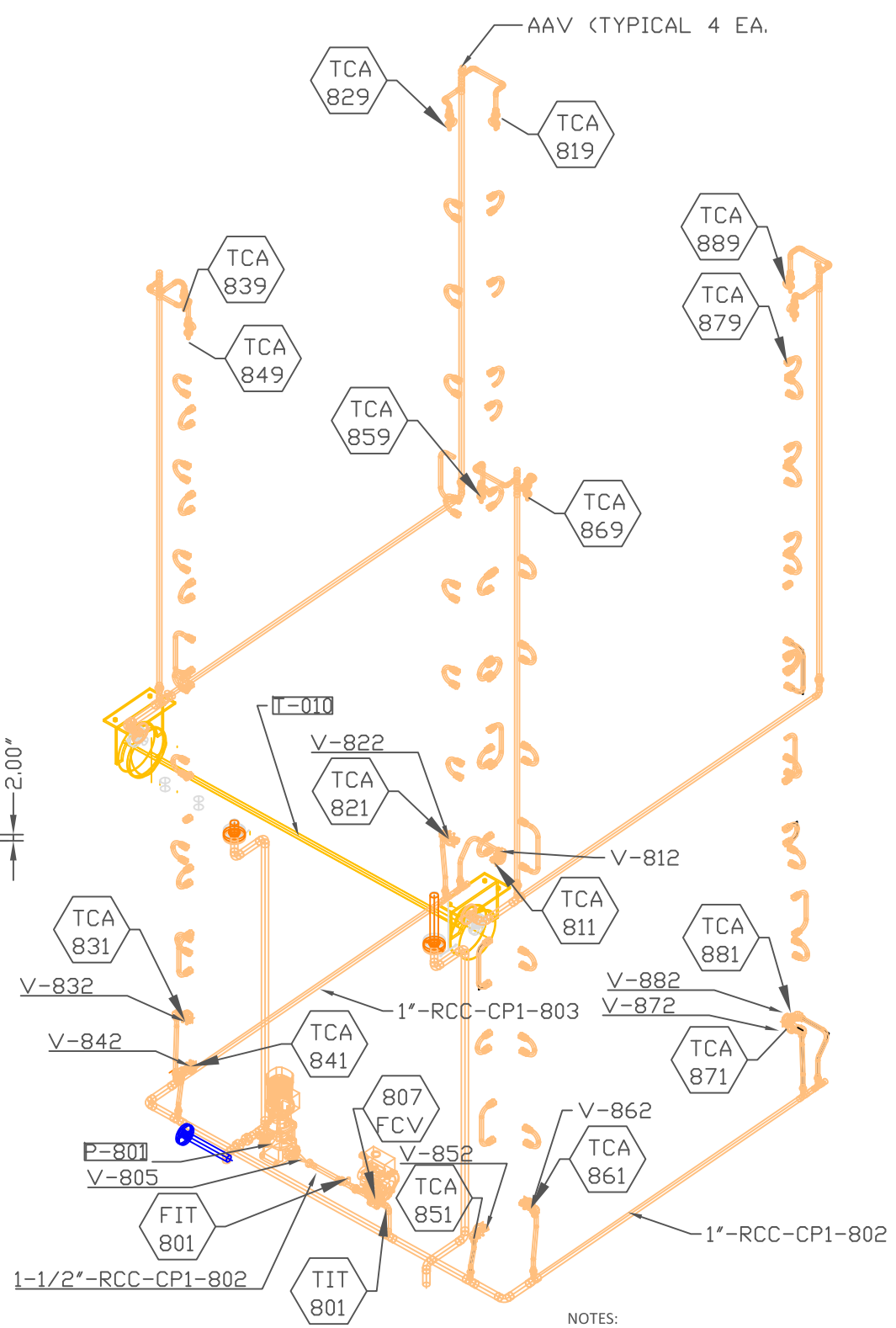
3 EAST ELEVATION
Scale: 1/4"=1'



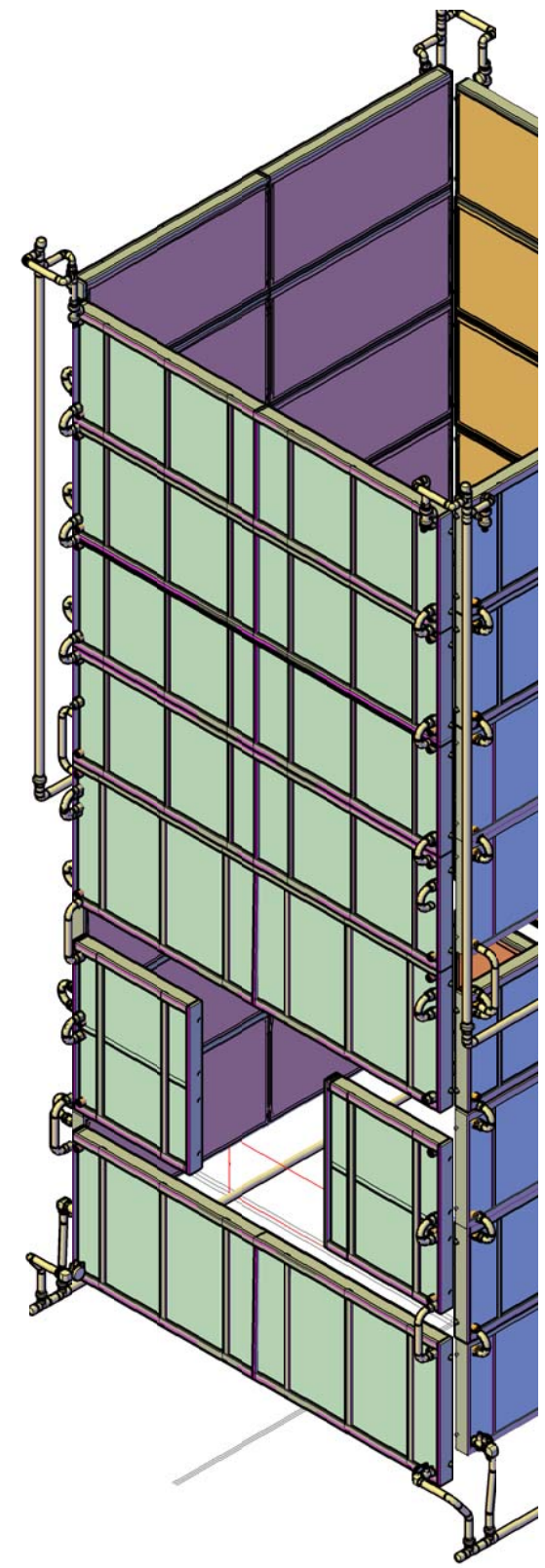
2 PLAN
Scale: 1/4"=1'



4 JUMPER DETAIL
Scale: NONE



5 SOUTHWEST ISOMETRIC
Scale: 1/4"=1'



6 NORTHEAST ISOMETRIC
Scale: 1/4"=1'

NOTES:
1. PIPING: B-88 type K COPPER
2. FITTINGS: b16.22 WROUGTH COPPER
3. FLANGES: cAST BRONZE FF 125#
4. BOLTING: SA-192 B7 STUDS + 2 SA-193 HH NUTS
5. GASKET: GARLOCK OR EQUAL TO MATCH FLANGE
6. PIPING TO BE BUILT TO ASME B31.9 bUILDING uTILITY PIPING
7. TUBING:
8. TUBE FITTINGS: SWAGELOK

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0			

PIPING LAYOUT
REACTOR CAVITY COOLING [RCC]

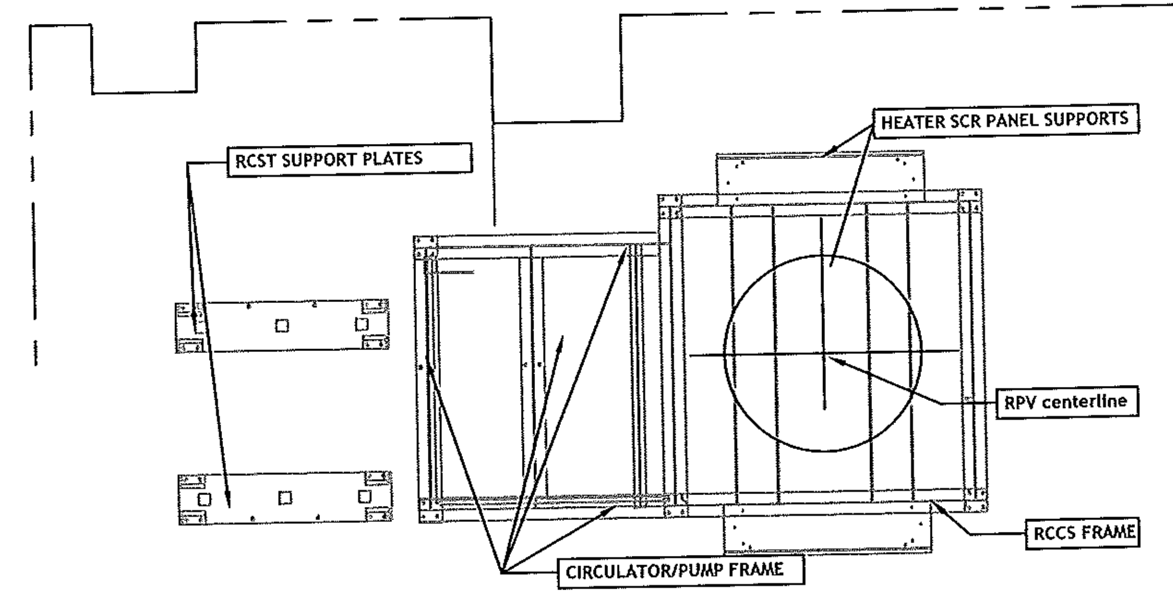
OSU HTTF PACKAGE

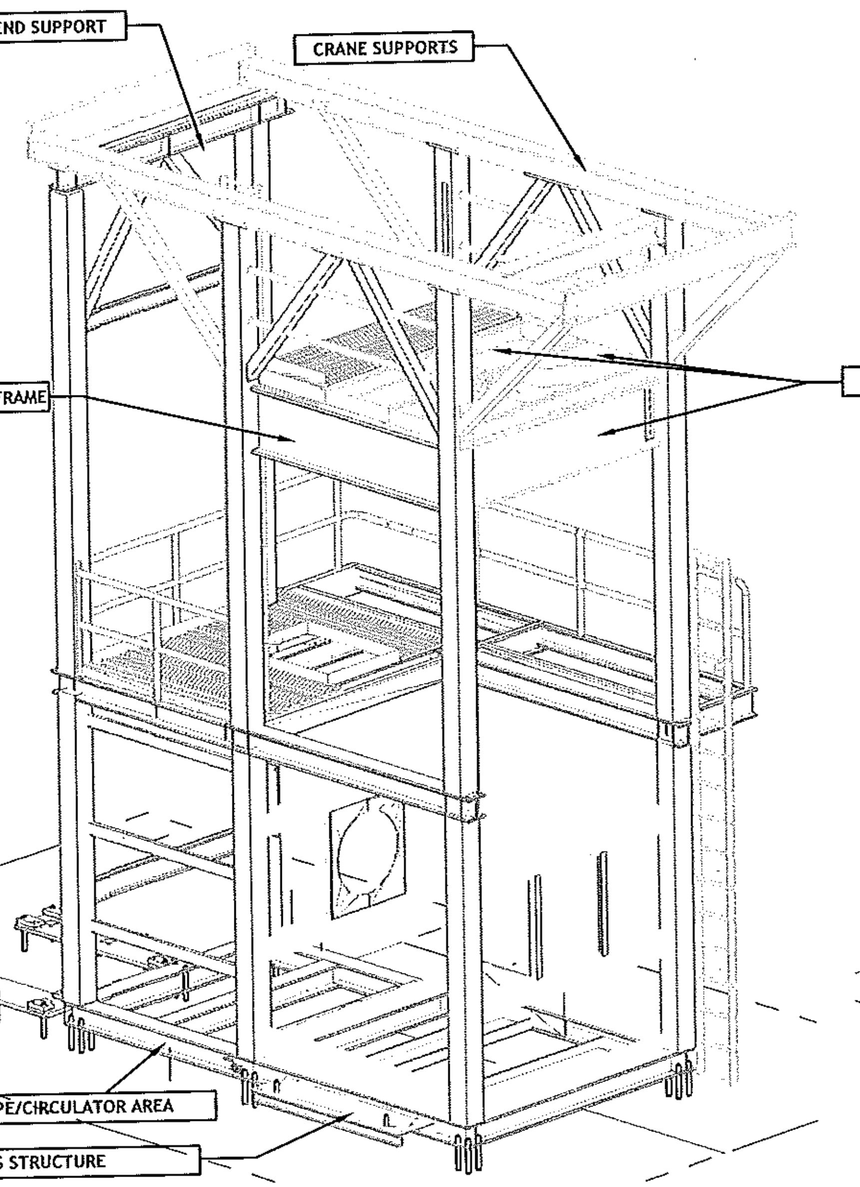
VENDOR DWG. NBINFTF-M3.2 CAD FILE NAME HTTF-M1.DWG SCALE as noted

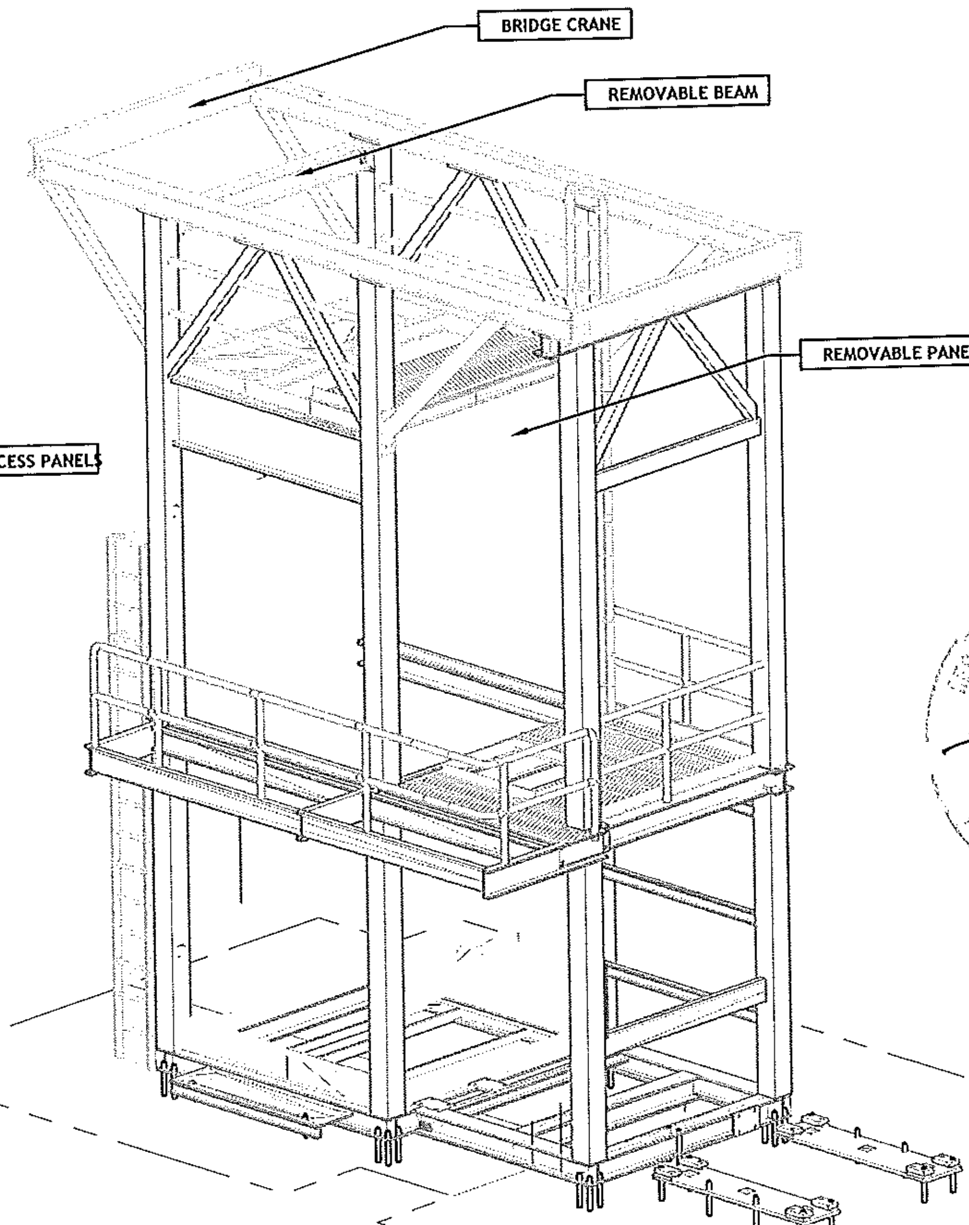
DRAWN BY J NYLANDER	DATE
REVIEWED BY	DATE
APPROVED BY	DATE
DRAWING NO. HTTF-M3.2	REVISION
SHEET 1 OF 1	

GENERAL NOTES:
STRUCTURAL ASSEMBLY CONSIST OF FOLLOWING ASSEMBLIES/SUBB ASSEMBLIES:

1. BASE FRAME AND SECOND LEVEL FRAMING CONSISTING OF LOWER RCCS STRUCTURE AND SECOND LEVEL SUPPORTS. THIS MODULE WILL BE SHIPPED WITH VESSELS, PIPING AND VALVE PRE ASSEMBLE TO THE EXTENT POSSIBLE
2. UPPER RCCS FRAME MADE UP OF TWO SIDE STRUCTURES AND MIDDLE STRUCTURE
3. THE EAST END OF THE RRCS WILL HAVE TWO FULL HEIGHT DOORS HOLDING THE EAST SIDE PANELS. THE DOORS WILL BE OPENED FOR PPV ASSEMBLY, CONFIGURATION AND MAINTENANCE.
4. RCCS PANELS WILL BE PROVIDED WITH FRAMES AND INSULATION PRE INSTALLED. THE PANNEL ARE HELD IN PLACE WITH THREADED PINS WHICH EXTEND THROUGH THE RCCS STRUCTURE .
5. 3 REMOVABLE RCCS ROOF FRAMES WHICH WILL BE REMOVED FOR ACCESS TO PPV FOR ASSEMBLY AND CONFIGURATION.
6. CRANE SUPPORT STRUCTURE WHICH WILL CONSIST OF SUPPORT BEAMS, END COLUMN ASSEMBLY AND END CAP TO SUPPORT A BRIDGE CRANE.
7. LADDERS WILL PROVIDE ACCESS TO SECOND LEVEL AND RCCS ROOF.
8. PLAFORM WILL BE PROVIDED TO SUPPORT MCC CABINETS. POWER LEADS FROM MCC WILL RUN UNDER GRATING ON THIS PLATFORM TO THE RCCS SIDE PANEL AND ON UP INTO THE PPV.
9. HANDRAILS WILL BE PROVIDED AROUND SECOND LEVEL. REMOVABLE HANDRAL SECTIONS WILL BE PROVIDED ON RCCS ROOF PLATFORM.







GENERAL STRUCTURAL NOTES

GENERAL: All materials and workmanship shall conform to the Uniform Building Code, (UBC) 1994 Edition, the local City or County building code, and the requirements of the drawings and specifications. The drawings indicate general and typical details of construction. Where conditions are not specifically indicated, but are of a similar character to details shown, similar details of construction shall be used, subject to approval by the Architect and Structural Engineer. The Contractor shall provide temporary bracing for the structural components until all final connections have been completed. All structural systems which are composed of components to be field erected shall be supervised by the supplier during manufacturing, delivery, handling, storage, and erection. Erection shall be in accordance with the instructions prepared by the supplier. Verify all existing dimensions and elevations before proceeding with the work. Verify all architectural, mechanical and electrical openings before proceeding with the work. Verify all existing utilities before proceeding with the work.

NON-SHRINK GROUT: Base plate grout shall be non-shrink type with minimum f'c=8,000 psi. All other non-shrink grout shall have f'c=5,000 psi.

STRUCTURAL STEEL: Structural steel shall be as follows:

Item	ASTM	
Plates, Shapes / Angles and Rods	A36	Fy =36 ksi
Anchor Bolts (Embedded in Mas. or Conc.)	A307	Ft =20 ksi
Structural Tubing (Square or Rect.)	A500 Gr B	Fy =46 ksi

Structural steel design, fabrication and installation shall conform to UBC Chapter 22, and shall conform to the latest edition of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. All members shall be erected with natural mill camber or induced camber up unless noted on plans. All bolts shall be 3/4" diameter unless noted otherwise. Minimum connection shall be 2 bolts unless specifically shown on drawings. Connections are to be as shown on drawings. Alternative connections require approval of Engineer. All welding shall conform to the AWS codes for arc and gas welding in building construction. All welds shall be 3/16" minimum or per section J2 of AISC (whichever is larger), unless otherwise noted. All connections shall be completely welded all around with continuous welds. 1" plates will have 1/2" fillets. Welded joints shall conform to AWS prequalified joint details for welded construction. All welding shall be performed by AWS/ASME Certified welders.

PAINT SPECIFICATION: (1) – coat of Tnemec Series 66, Hi-Build Epoxoline, self priming Polymide Epoxy

COLORS: Structural steel – light grey
Handrails and ladders – safety yellow

SURFACE PREP: SSPC-SP6/NACE 3 Commercial Blast Cleaning

Attach all pipe and electrical support steel prior to painting to avoid paint re-work.

REGISTERED PROFESSIONAL ENGINEER 9625 OREGON
6/24/2011

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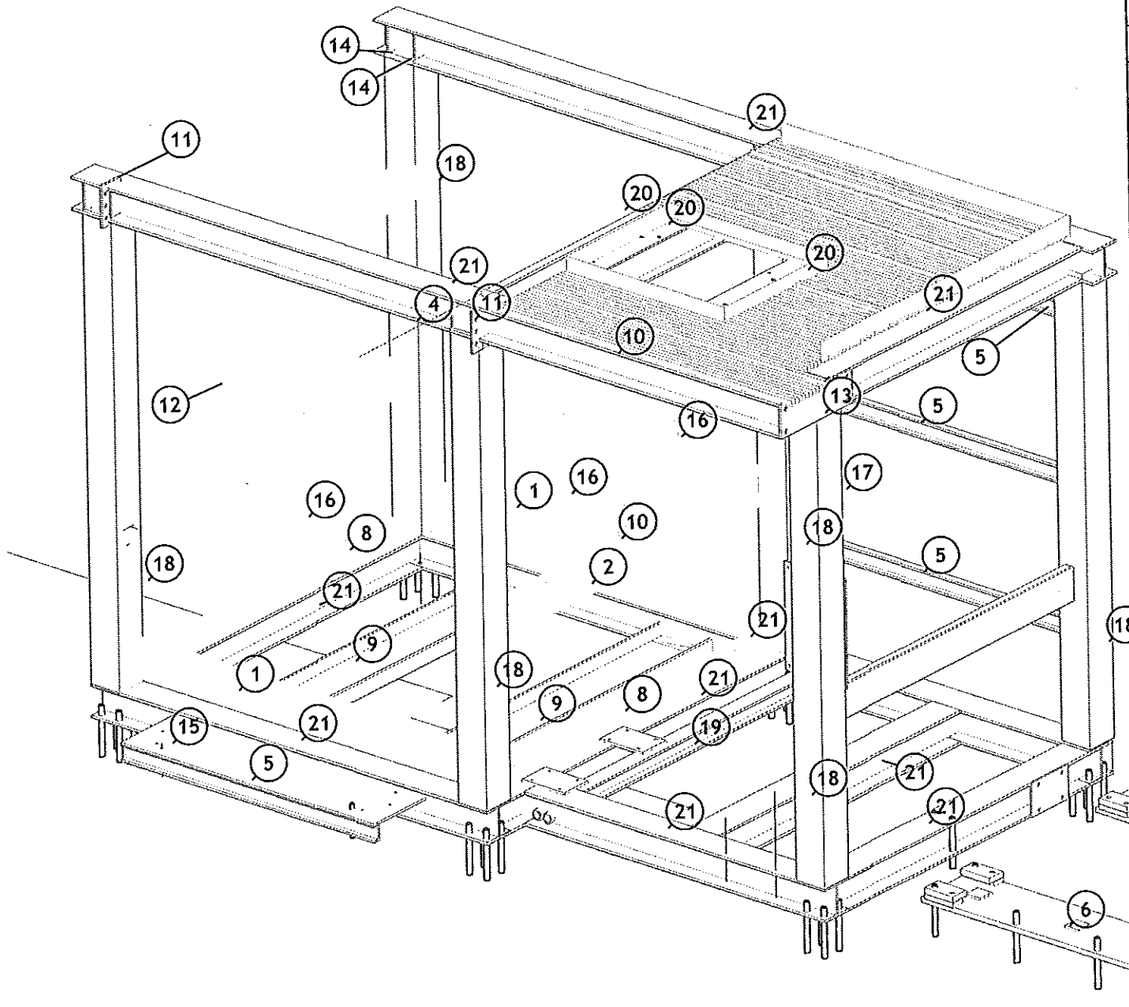
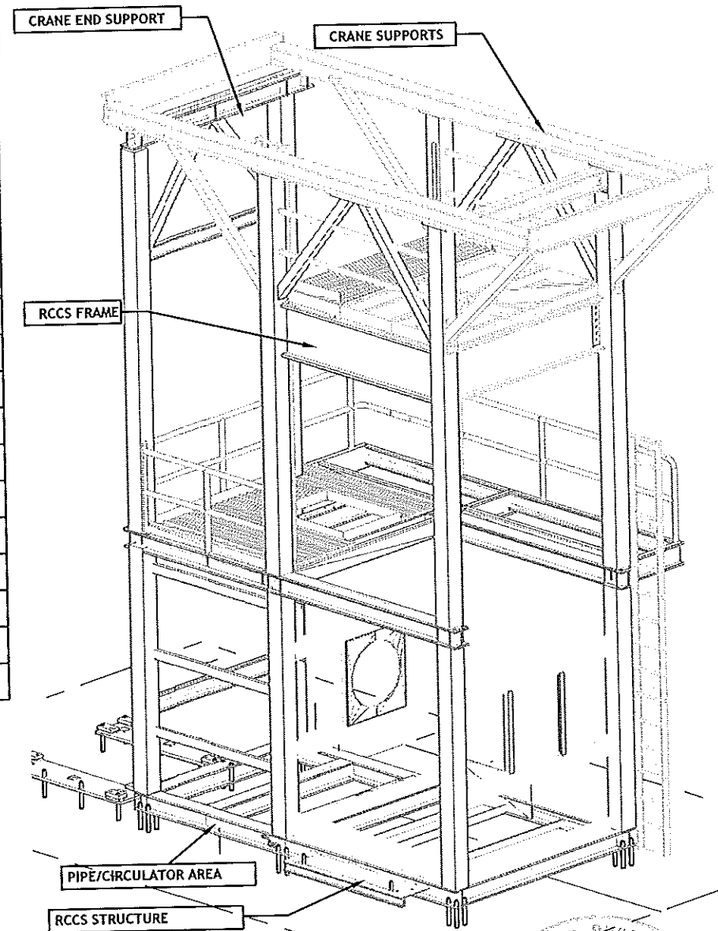
HTTF STRUCTURAL OVERVIEW

OSU HTTF PACKAGE

DRAWN BY: J. NYLANDER	DATE: 4/18/11
APPROVED BY: B. WOODS	DATE:
VENDOR DWG. NO.	SCALE: as noted
DRAWING NO.: S1	REV.: 0
SHEET 1 OF 1	



BILL OF MATERIAL		
MARK	LONG ANNOTATION	MATERIAL
1	L 10 X 4 X $\frac{1}{4}$, FORMED	SA240 304
4	C8X11.5,formed	SA240 304
3	-	-
4	C10X20	ASTM A-36
5	C4X7.25	ASTM A-36
6	FB12X 1/2	ASTM A-36
7	-	-
8	L6X3 1/2X5/16	SA240-304
9	MC12X45	ASTM A-36
10	-	-
11	PL-1/2 X 10.0000 X 6.0000	ASTM A-36
12	PL-1/4 X 3'-4" X 3'	ASTM A-36
13	PL-1/2 X 8.0000 X 18.0000	ASTM A-36
14	PL-3/8 X 7.1300 X 7.0853	ASTM A-36
15	PL-3/8 X 71.8020 X 17.8962	ASTM A-36
16	TS4X2X3/16	ASTM A-36
17	-	-
18	TS8X8X1/4	ASTM A-36
19	W4X13	ASTM A-36
20	W8X18	ASTM A-36
21	W8X31	ASTM A-36



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SAVED BY: MIX-M350N PCL6_T1, Ledger, 1:1.03808

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REV #	DESCRIPTION	DATE	NOTES
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HTTF STRUCTURAL LOWER MODULE

OSU HTTF PACKAGE

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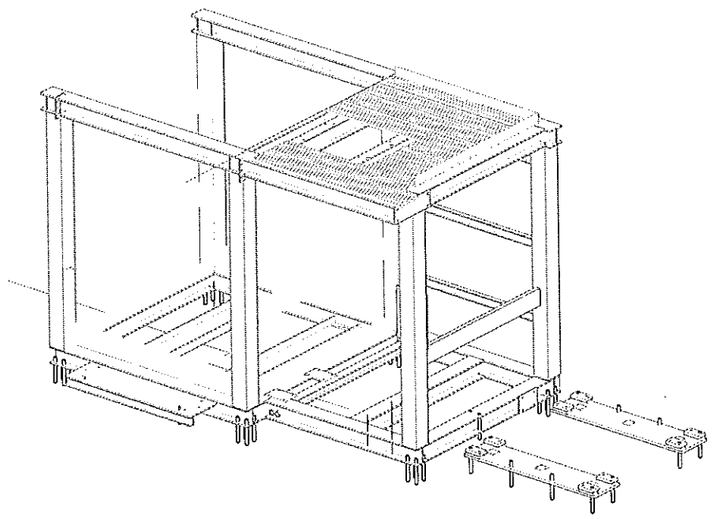
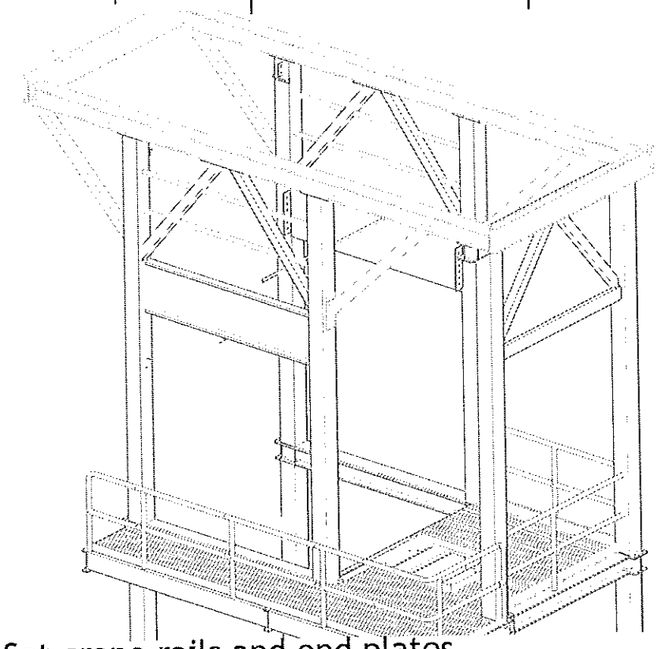
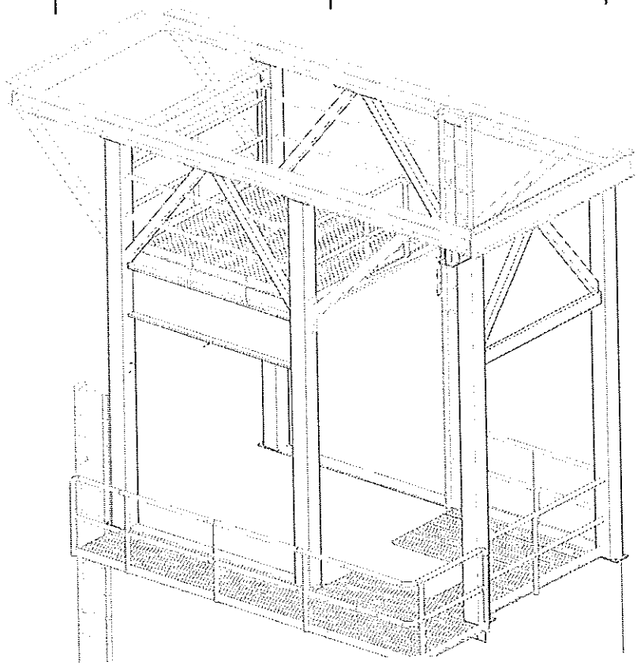
APPROVED BY: B. WOODS	DATE:
VENDOR DWG. NO.	SCALE: as noted
DRAWING NO. S1	REV. 0
SHEET 2 OF 4	



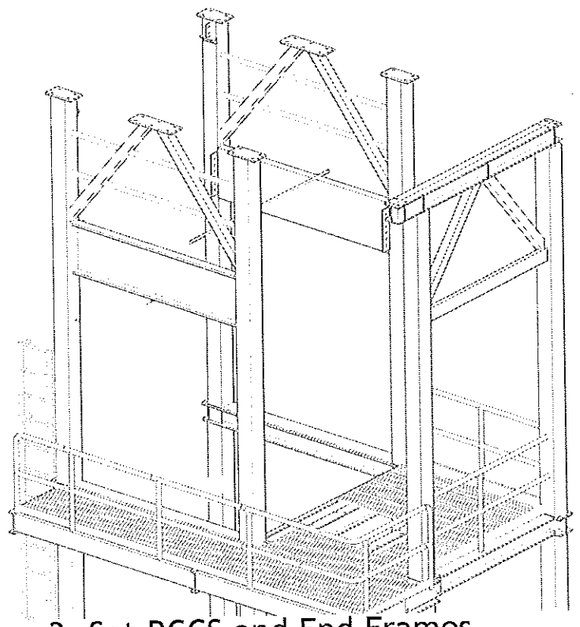
1. Set RCST base plates and install RCST
2. Set PPV module and install anchors



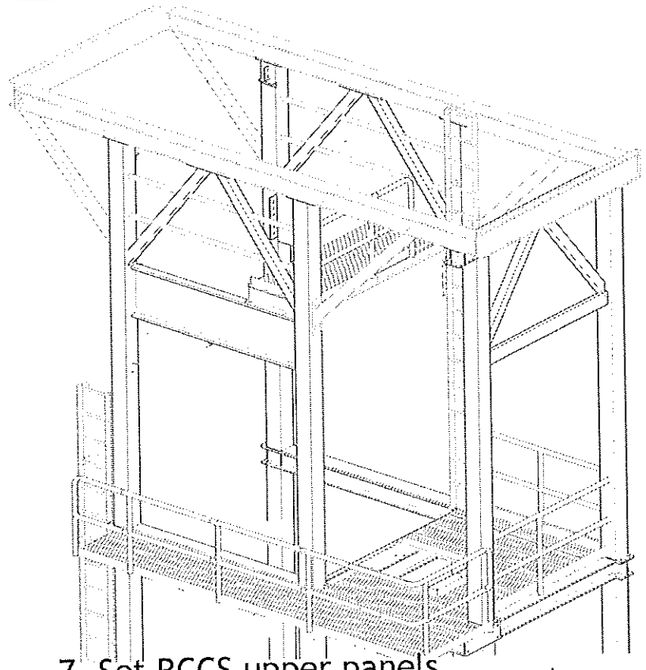
5. Set crane rails and end plates.
6. Set crane bridge and hoists



8. assemble reactor (by others)
9.Set RCCS removeable panels.



3. Set RCCS and End Frames.
4. Set 2nd level patform & handrails



7. Set RCCS upper panels

Notes:
steam generator may be set after PPV module is set or with the assistange of the bridge crane after step 6 2.

REGISTERED PROFESSIONAL ENGINEER 9625 OREGON KENNETH GREENE
10/24/2011

C:\Users\Duane\Desktop\JIM NYLANDER #2\HTTF-S1.dwg, S1-3 erection, 10/20/2011 11:15:04 AM, SAMSUNG M350N PCL6_T1, Ledger, 1:1.03808

REV #	DESCRIPTION	DATE	NOTES
0			

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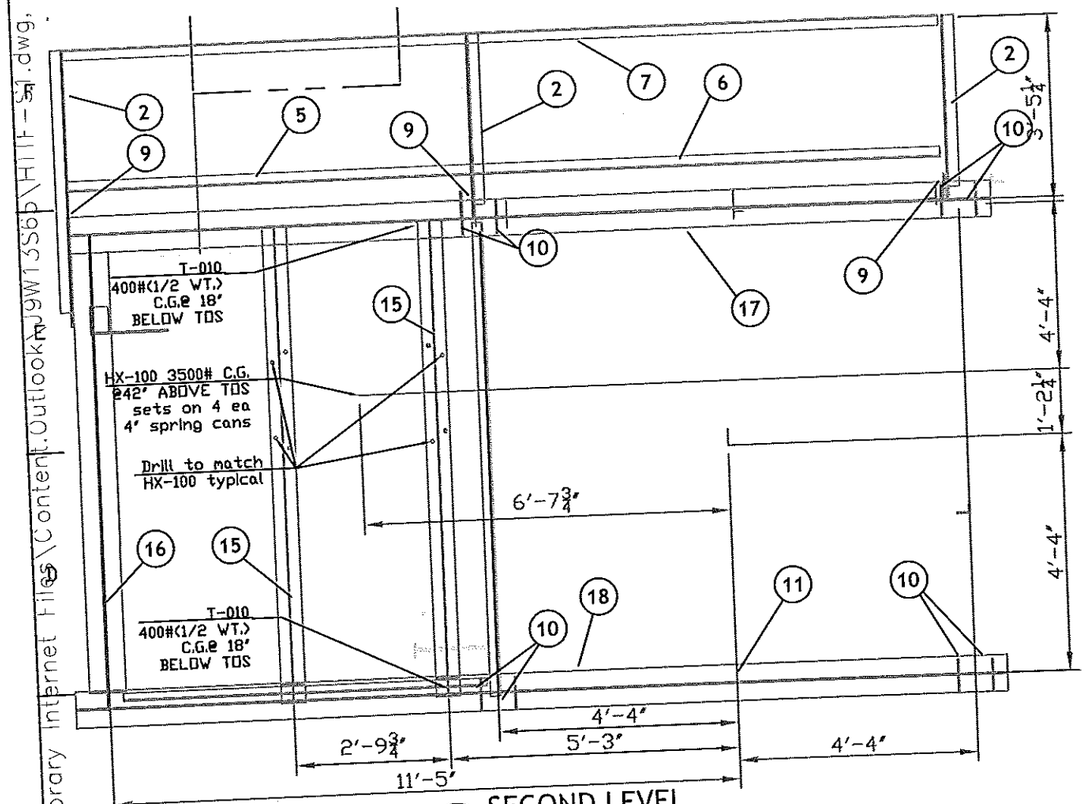
Oregon State UNIVERSITY

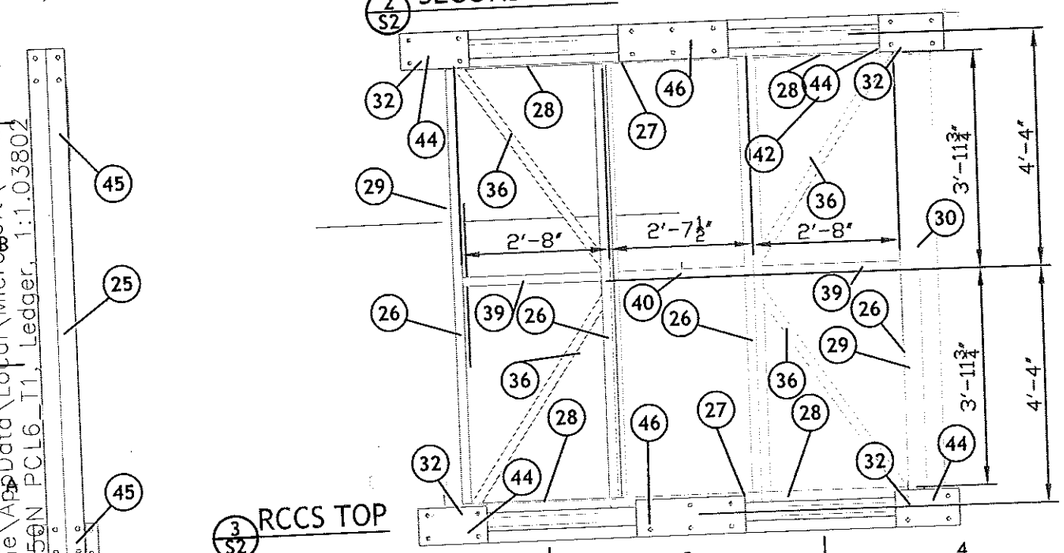
HTTF STRUCTURAL
Erection sequence

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE 4/18/11
APPROVED BY B. WOODS	DATE
VENDOR DWG. NO.	SCALE as noted
DRAWING NO. S1	REV. 0
SHEET 1 OF 1	



SECOND LEVEL



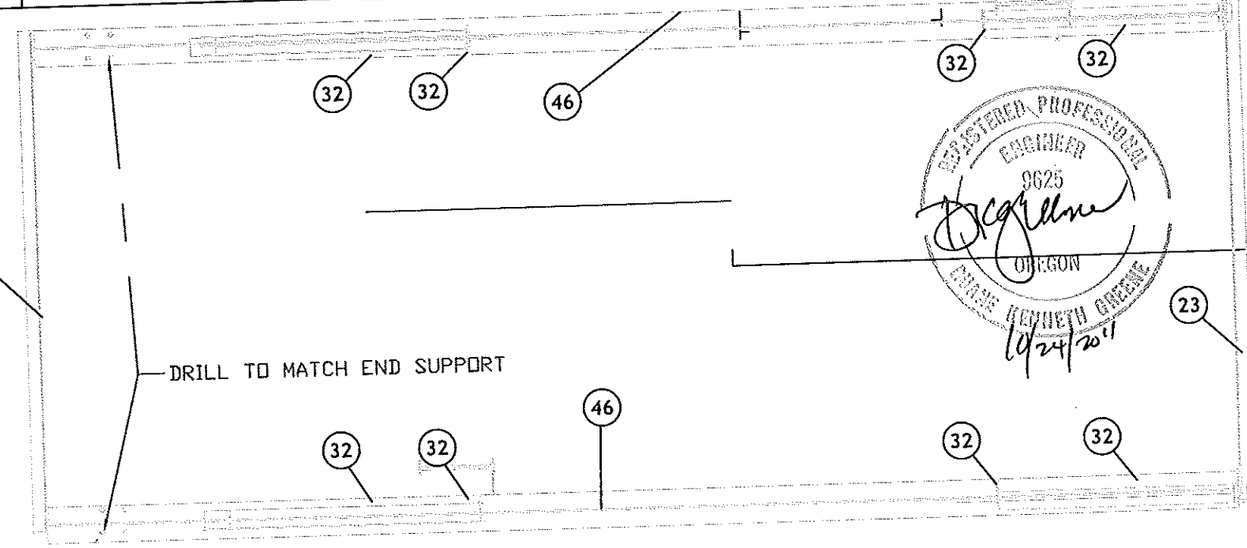
RCCS TOP

BILL OF MATERIAL

MARK	QTY	LONG ANNOTATION	MATERIAL	LENGTH	WEIGHT
1	-	-	-	-	-
2	3	C10X20	ASTM A-36	40 9/16	192.40
3	-	-	-	-	-
4	-	-	-	-	-
5	1	C8X11.5	ASTM A-36	82 1/16	78.61
6	1	C8X11.5	ASTM A-36	101 7/16	97.21
7	1	C8X11.5	ASTM A-36	184 5/16	176.64
8	-	-	-	-	-
9	3	PL-1/2 X 8.0000 X 18.0000	ASTM A-36	18	21.09
10	4	PL-3/8 X 7.1300 X 7.0853	ASTM A-36	7 1/8	21.51
11	1	TS4X2X3/16	ASTM A-36	115	65.84
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	3	W8X18	ASTM A-36	103 13/16	467.23
16	1	W8X31	ASTM A-36	102	263.48
17	1	W8X31	ASTM A-36	197 15/16	510.01
18	1	W8X31	ASTM A-36	198 5/16	510.56
19	1	W8X31	ASTM A-36	96	248
20	2	PL X96.0000 X 10.0000	SA240 304	96	54.49
21	1	PL X96.0000 X 4.0000	SA 240 304	96	66.41
22	1	PL X96.0000 X 4.0000	SA240 304	96	66.41
23	2	C12X20.7	ASTM A-36	112	379.39
24	3	C4X7.25	ASTM A-36	79 11/16	144.42
25	2	C4X7.25	ASTM A-36	96	116.00

BILL OF MATERIAL

MARK	QTY	LONG ANNOTATION	MATERIAL	LENGTH	WEIGHT
26	6	C6x8.2	ASTM A-36	95 1/2	392
27	2	L6X4X1/4	SA240-304	31 1/2	156.68
28	4	L6X4X1/4	ASTM A-36	32	56.17
29	2	C 24x4x1/4, Formed	SA240 tp304	96	960.00
30	1	W8x31	ASTM -A36	95-1/2	-
31	2	L2x2x1/4	ASTM A-36	8	-
32	4	PL-1/2 X 16.0000 X 6.0000	ASTM A-36	16	53.12
33	4	PL-1/2 X 8.0000 X 8.0000	ASTM A-36	8	34.96
34	1	PL-1/4 X 3'-4" X 3'	ASTM A-36	40	102.14
35	1	PL-1/4 X 38.2533 X 17.8637	ASTM A-36	38 1/4	48.41
36	4	C6X8.2	ASTM A-36	57 1/4	157
37	2	TS4X2X3/16	ASTM A-36	38 1/4	43.82
38	4	TS4X4X1/4	ASTM A-36	38 1/4	43.82
39	2	C6X8.2	ASTM A-36	31.25	-
40	1	C6X8.2	ASTM A-36	30.75	-
41	-	-	-	-	-
42	-	-	ASTM A-36	113 5/8	180.07
43	-	-	ASTM A-36	114 1/16	180.76
44	4	TS8X8X1/4	ASTM A-500	114 3/8	543.78
45	2	TS8X8X1/4	ASTM A-500	114 13/16	181.95
46	2	W8X31 + crane rail as req.	ASTM A-36	260	1342.96



CRANE LEVEL

REGISTERED PROFESSIONAL ENGINEER
9625
OREGON
DUANE KENNETH GREENE
10/24/2011

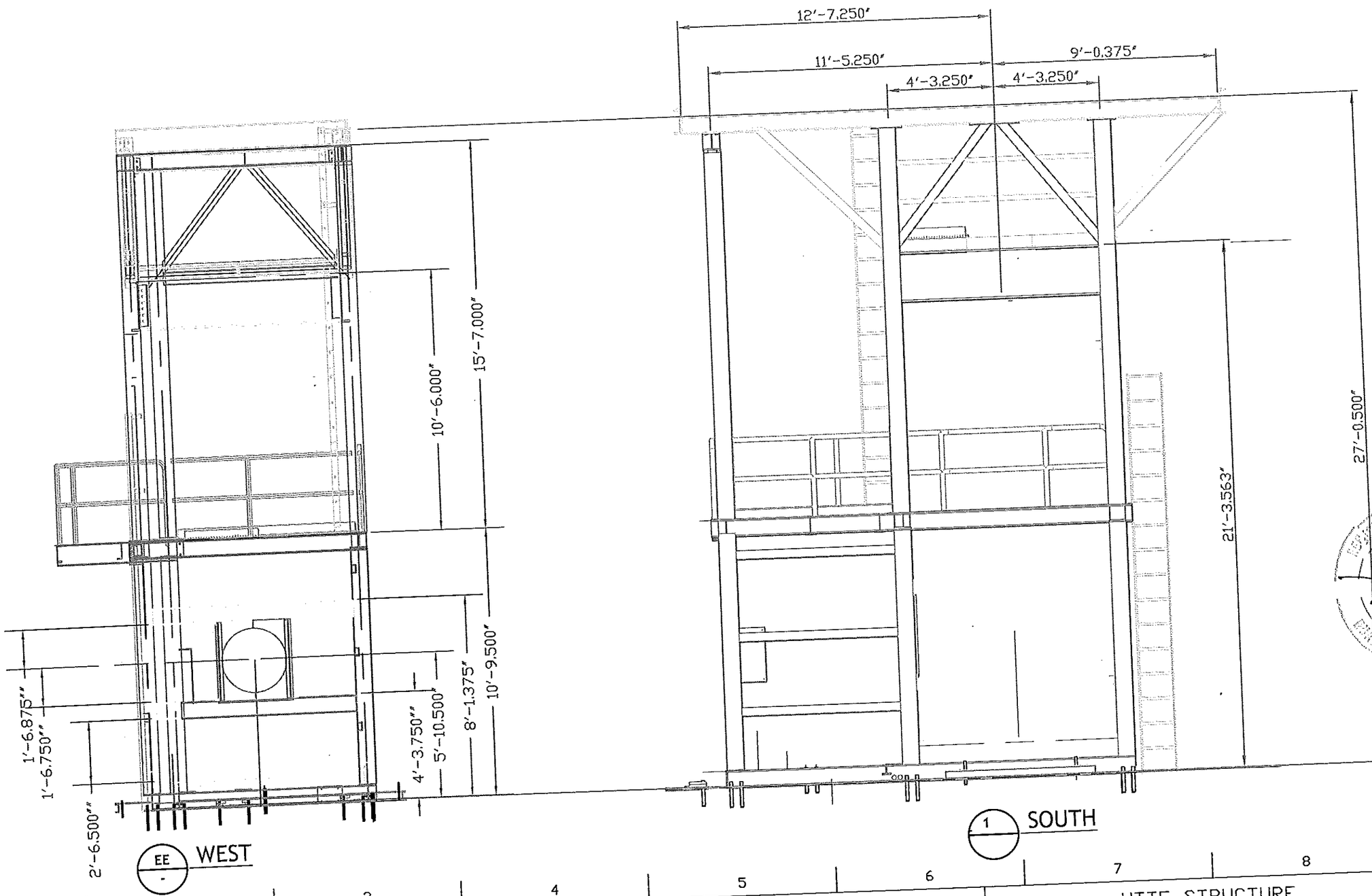
Oregon State University
Department of Nuclear Engineering
Hydro-Mechanical Fuel Test Facility
Radiation Center, Corvallis, Oregon 97331
Telephone (641)-737-2341 Fax (641)-737-0460

REV #	DESCRIPTION	DATE	NOTES:
0			

HTTF STRUCTURE
PLAN, LEVEL 2

DSU HTTF PACKAGE

DRAWN BY J NYLANDER	DATE
APPROVED BY B. WOODS	DATE
VENDOR DWG. NO.	SCALE as noted
DRAWING NO. S2	REV 0
SHEET 2 OF 2	



EE WEST

1 SOUTH

REGISTERED PROFESSIONAL ENGINEER 9625 OREGON BRIAN KENNETH QUEEN

10/24/2011

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Department of Nuclear Engineering
Hydro-Mechanical Fuel Test Facility
Radiation Center, Corvallis, Oregon 97331
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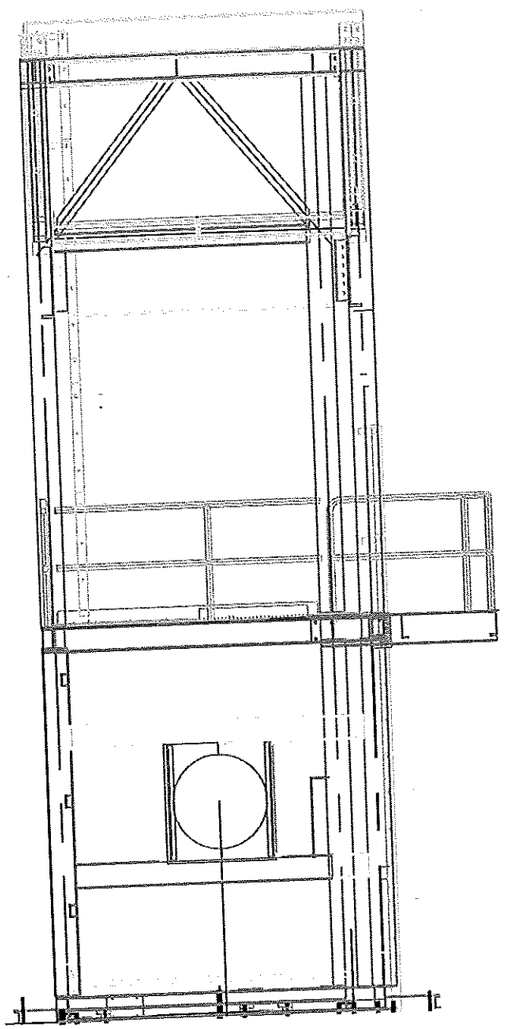
REV #	DESCRIPTION	DATE	NOTES
0			

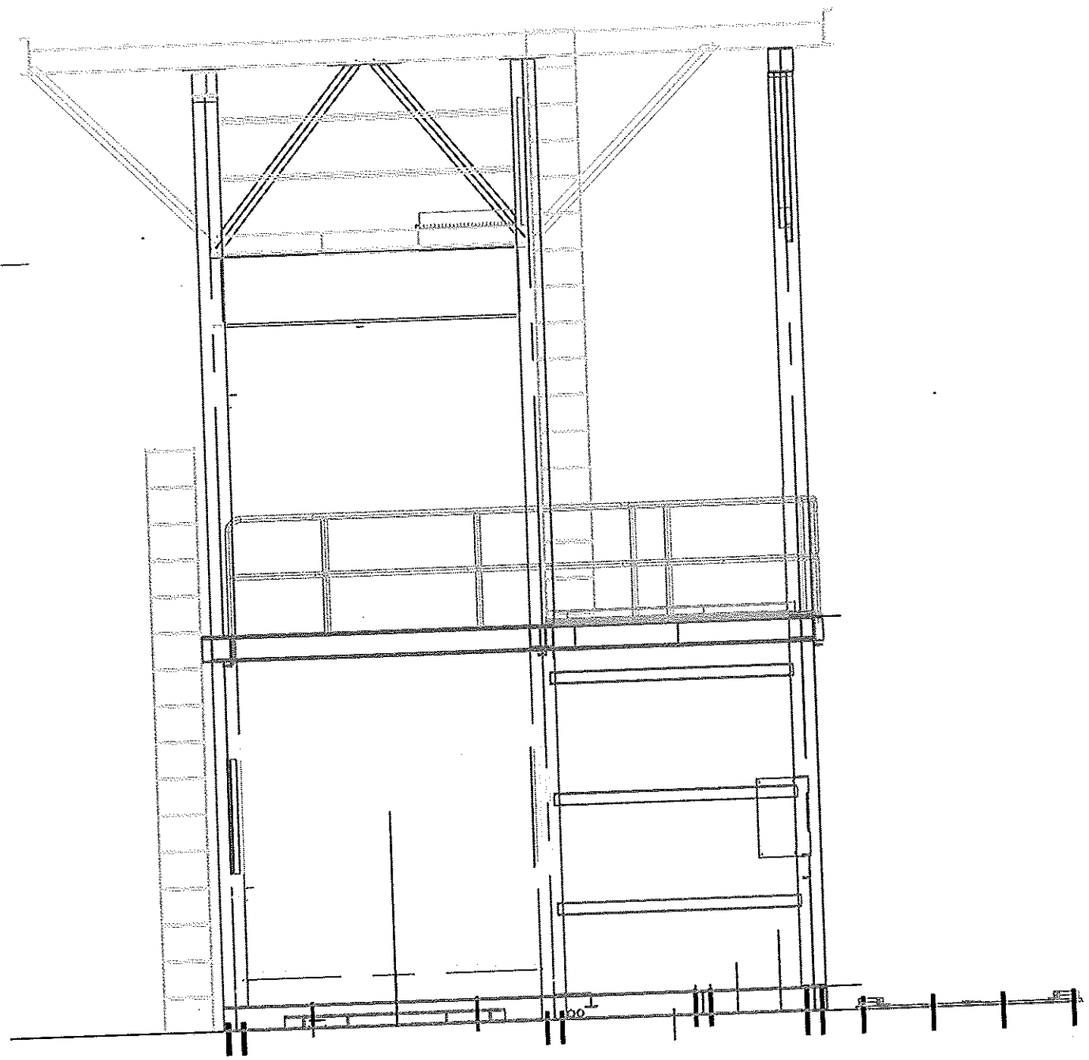
HTTF STRUCTURE ELEVATIONS

OSU HTTF PACKAGE

DRAWN BY	J NYLANDER
APPROVED BY	B. WOODS
VENDOR DWG NO.	HTTF-S1 SHT S31
DRAWING NO.	S3
SHEET	1 OF 1



3 / - EAST ELEVATION



4 / - NORTH ELEVATION

REGISTERED PROFESSIONAL ENGINEER
9625
OREGON
DUANE KENNETH GREENE
10/24/2011

REV #	DESCRIPTION	DATE	NOTES
0			

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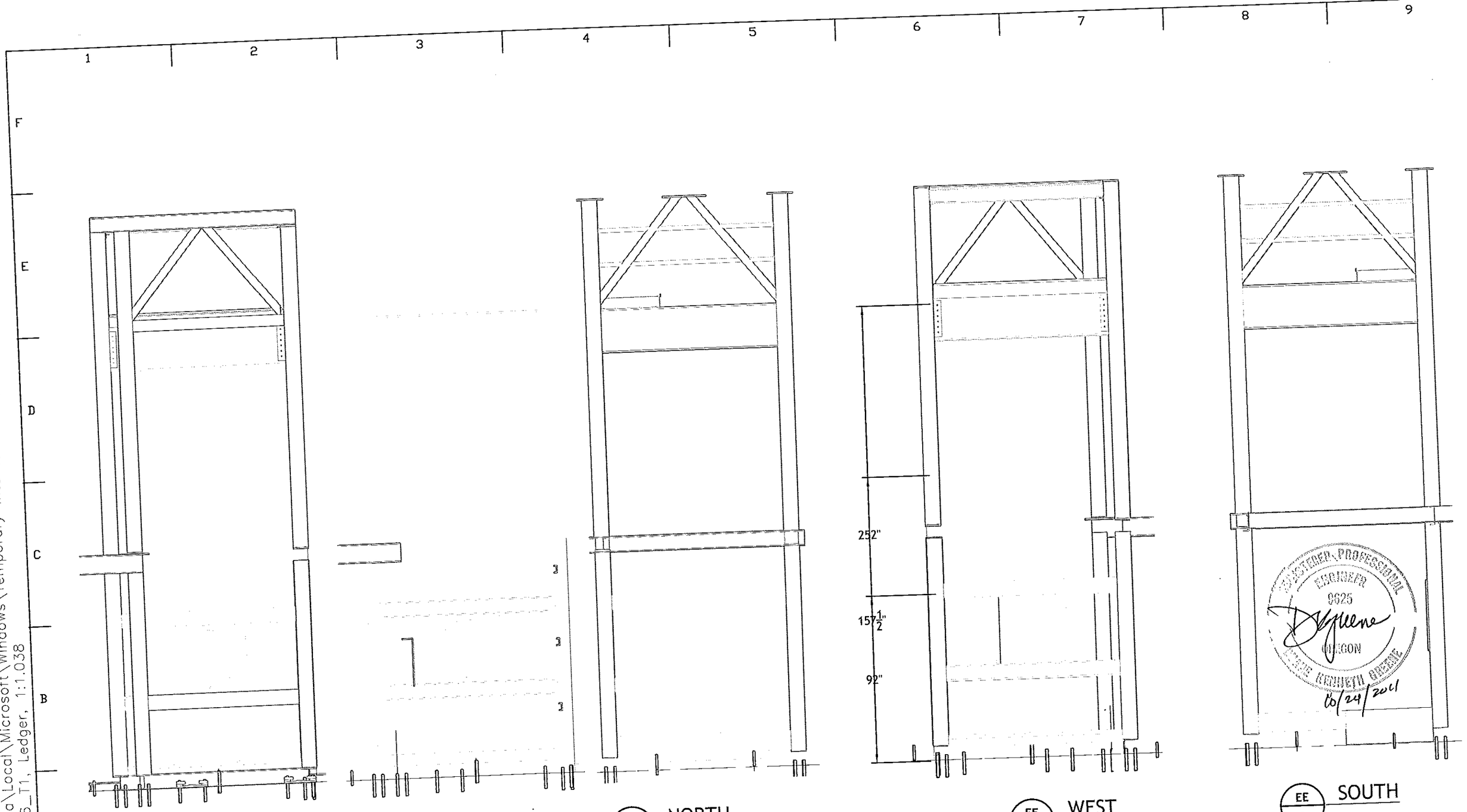
HTTF STRUCTURE
EAST & NORTH ELEVATIONS

OSU HTTF PACKAGE

		DATE
DRAWN BY	J NYLANDER	
APPROVED BY	B. WEIDS	
VENDOR DWG. NO.		SCALE 0
DRAWING NO.	S3	
SHEET 2 OF 2		



EE - EAST

EE - EAST

EE - NORTH

EE - WEST

EE - SOUTH

REGISTERED PROFESSIONAL ENGINEER
9625
OREGON
DUANE KENNETH GREENE
10/24/2011

REV #	DESCRIPTION	DATE	NOTES
0			

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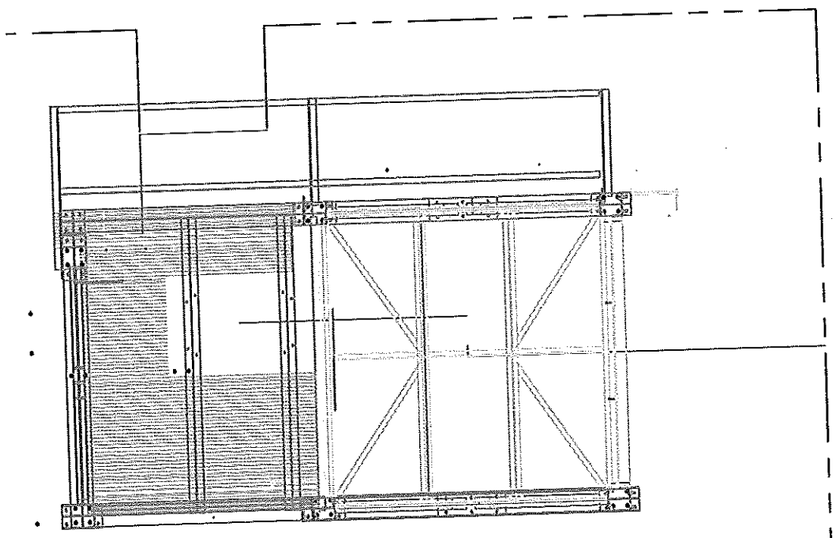
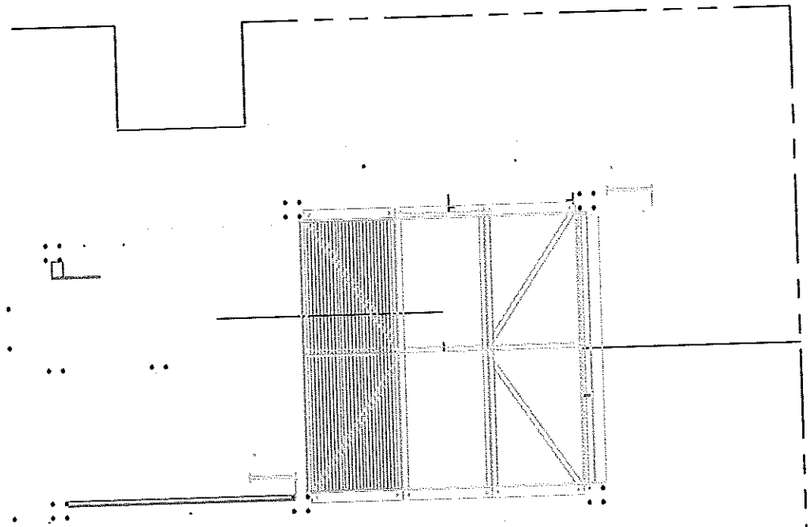
Oregon State UNIVERSITY

HTTF STRUCTURE
RCCS

OSU HTTF PACKAGE

DRAWN BY	J NYLANDER	DATE
APPROVED BY	B. WOODS	DATE
VENDOR DWG NO.		SCALE
DRAWING NO.	S4	
SHEET 1 OF 1		





CC TOP RCCS

CC SECOND LEVEL

REGISTERED PROFESSIONAL ENGINEER 9625 OREGON DUANE KENNETH GEESE

10/24/2014

REV #	DESCRIPTION	DATE	NOTES
0			

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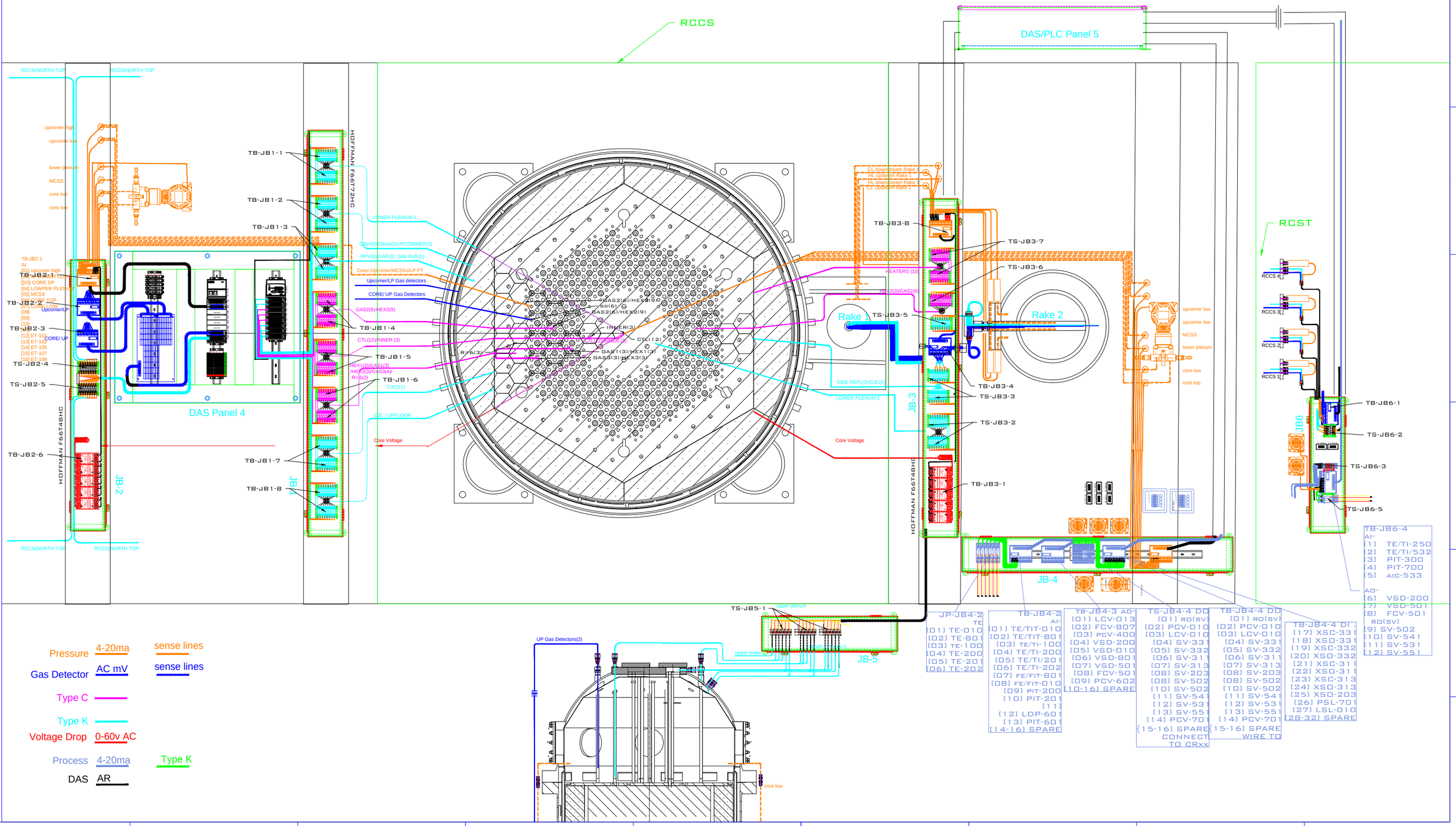
HTTF STRUCTURE
GRATING HANDRAIL

OSU HTTF PACKAGE

DRAWN BY J NYLANDER	DATE
APPROVED BY B. WOODS	DATE
VENDOR DWG NO.	SCALE as noted
DRAWING NO. S6	REV. 0
SHEET 1 OF 1	



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ELECTRICAL ONE-LINES
INSTRUMENTATION SCHEMATIC

OSU HTTF PACKAGE

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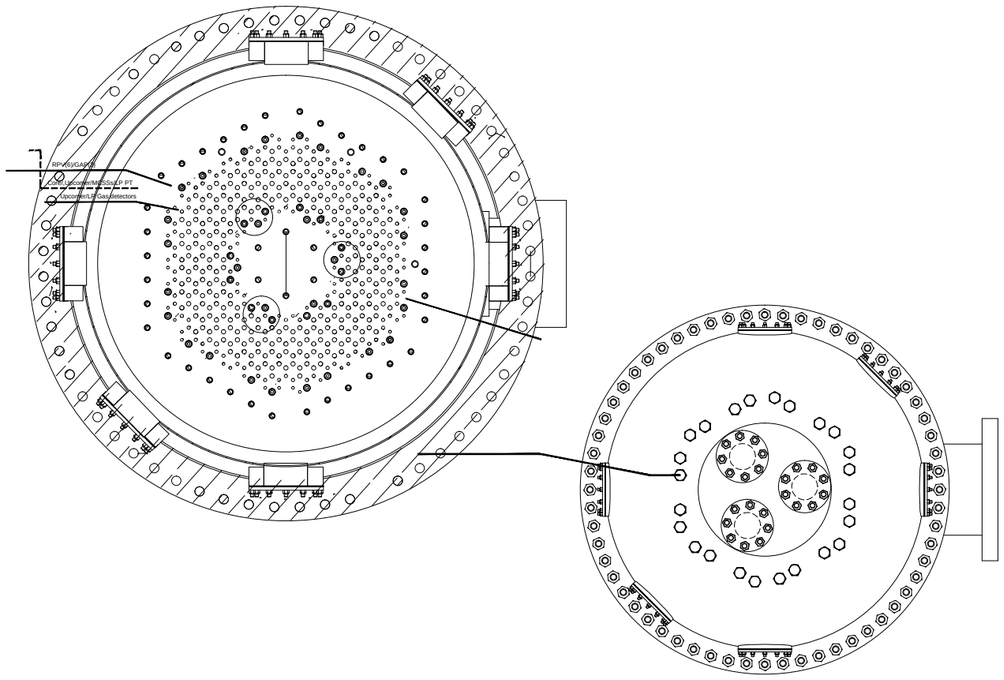
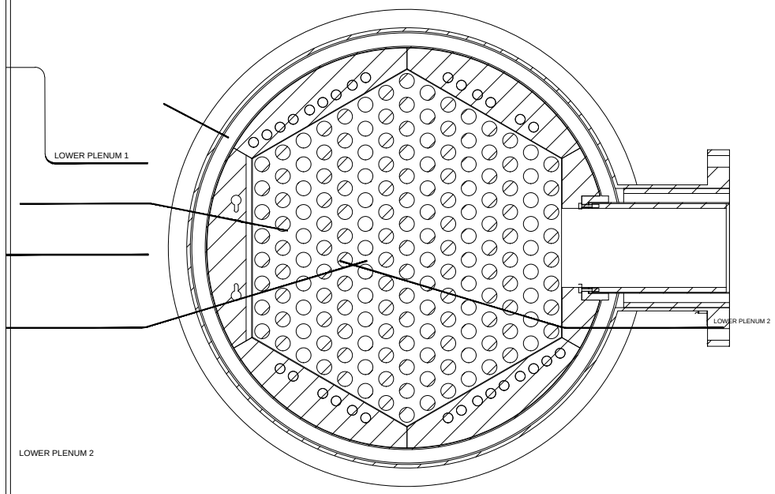
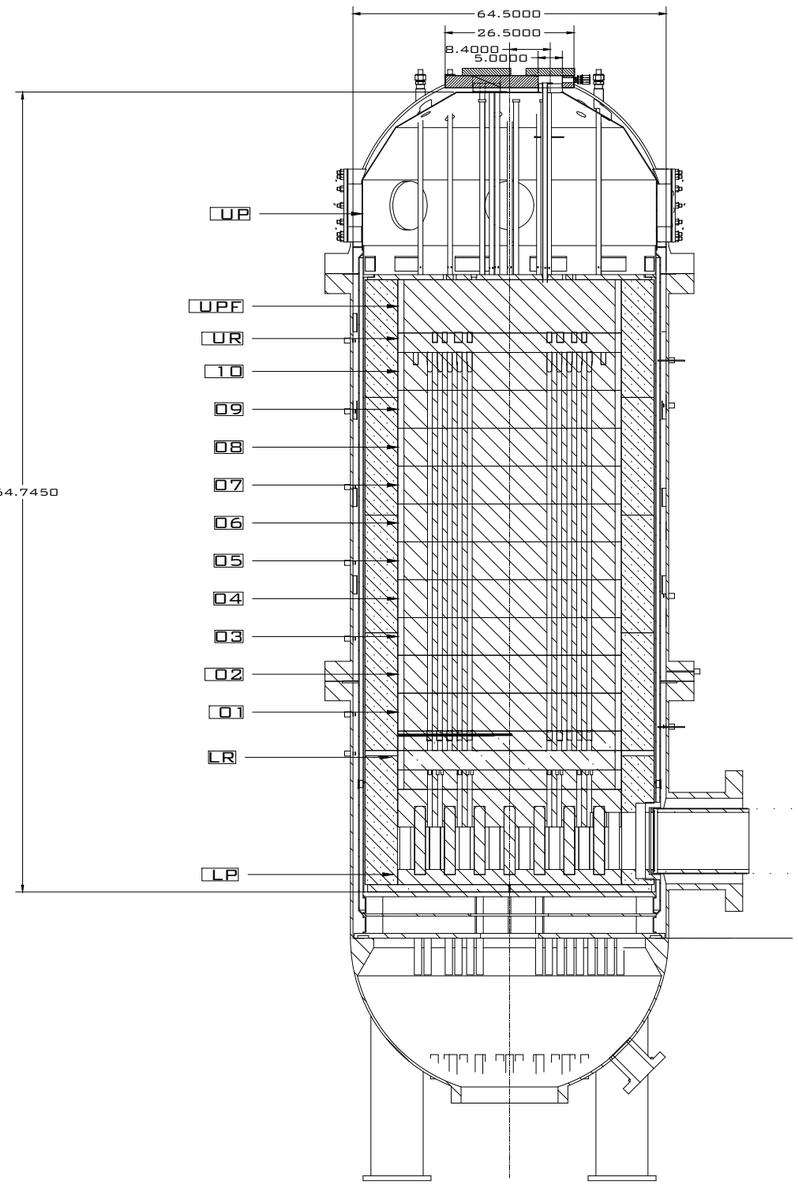
APPROVED BY 5/14/2010	DATE
VENDOR DWG. NO. 25466-E-09	SCALE
DRAWING NO. E-05.0	REV. 0

SHEET 9 OF 18







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REV #	DESCRIPTION	DATE	NOTES:

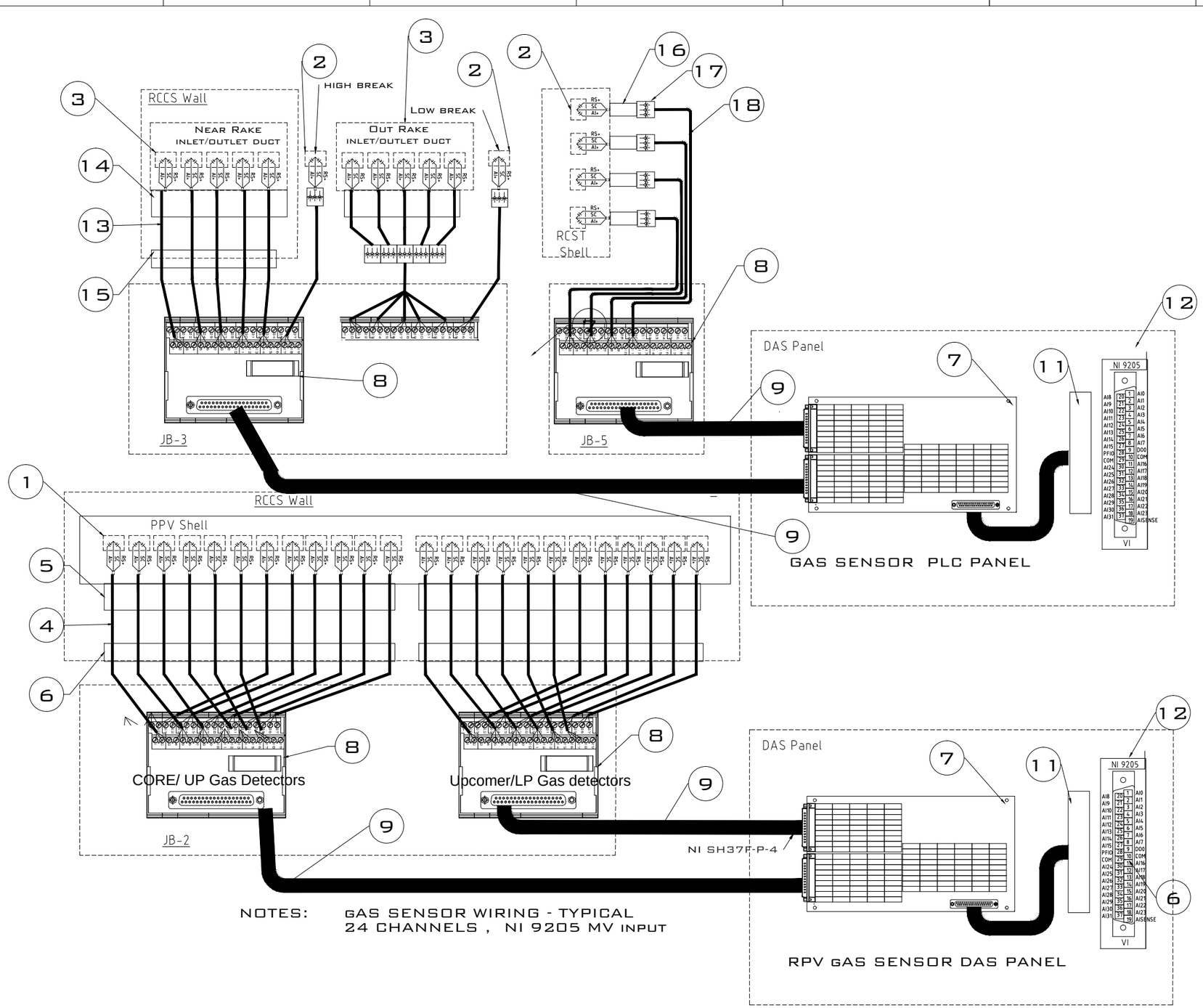
ELECTRICAL ONE-LINES
INSTRUMENTATION SCHEMATIC

OSU HTTF PACKAGE

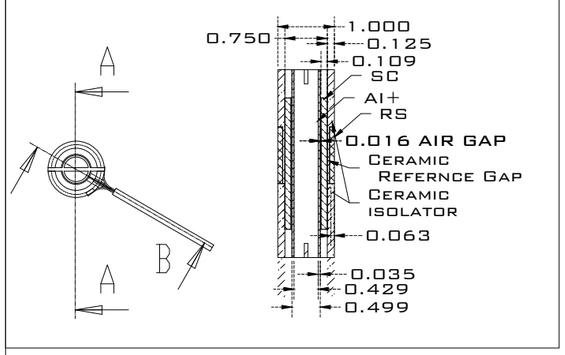
DRAWN BY: J. NYLANDER	DATE
APPROVED BY: 5/14/2010	DATE
VENDOR DWG. NO.: 25466-E-09	SCALE
DRAWING NO.: E-05.0	REV.: 0
SHEET 1 OF 9	

BILL OF MATERIAL

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	24	CORE GAS DETECTORS	DETAIL 1	TBD
2	4	TC/PT/ GAS DETECTOR PROBE	DETAIL 2	TBD
3	2	TC/GAS DETECTOR RAKE	DETAIL 3	BTP-5
4	AR	MI CABLE, 0.0625" OD, 3 CONDUCTOR	OMEGA	316-RTD-3-MO-065
5	6	MULTICONDUCTOR FEED THROUGH 8CONDUCTOR X 0.125" WIRE	CONAX	MTH-5-12-065
6	6	MULTICONDUCTOR FEEDTHROUGH, 12 CONDUCTOR	OMEGA	MFT-116-12
7	2	GAS DETECTOR TRANSMITTER BOARD	BY OTHERS	A-1210SC
8	4	37 DSUB TERMINAL BOARD	NATIONAL INSTR.	CB37FH
9	4	CABLE, 37 CONDUCTOR, DSUB ONE END	NATIONAL INSTR.	SH37F-P-4
10	4	DSUB CONNECTOR 37 PIN	NATIONAL INSTR.	NI 9933
11	2	37-PIN I/O CABLE	NATIONAL INSTR.	SH37F-37M-1
12	2	32-CHANNEL, ±200 MV TO ±10 V, 16-BIT ANALOG INPUT MODULE	NATIONAL INSTR.	NI 9205
13	AR	MI CABLE, 0.125" OD, 3 CONDUCTOR	OMEGA	316-RTD-3-MO-125
14	2	MULTICONDUCTOR FEED THROUGH 8CONDUCTOR X 0.125" WIRE	CONAX	MTH-5-8-125
15	2	MULTICONDUCTOR FEEDTHROUGH	OMEGA	MFT-18-8
16	2	1/8" TUBE ADAPTER	SWAGELOK	SS-200-1-4
17	2	MULTIPIN CONNECTOR SET, 5 PIN	OMEGA	MTC_5-MC/FC/SHL
18	AR	TRIAD CABLE, 16 AWG	OMEGA	316-RTD-3-MO-065



NOTES: GAS SENSOR WIRING - TYPICAL
24 CHANNELS , NI 9205 MV INPUT



DETAIL 1

DETAIL 3

DETAIL 2

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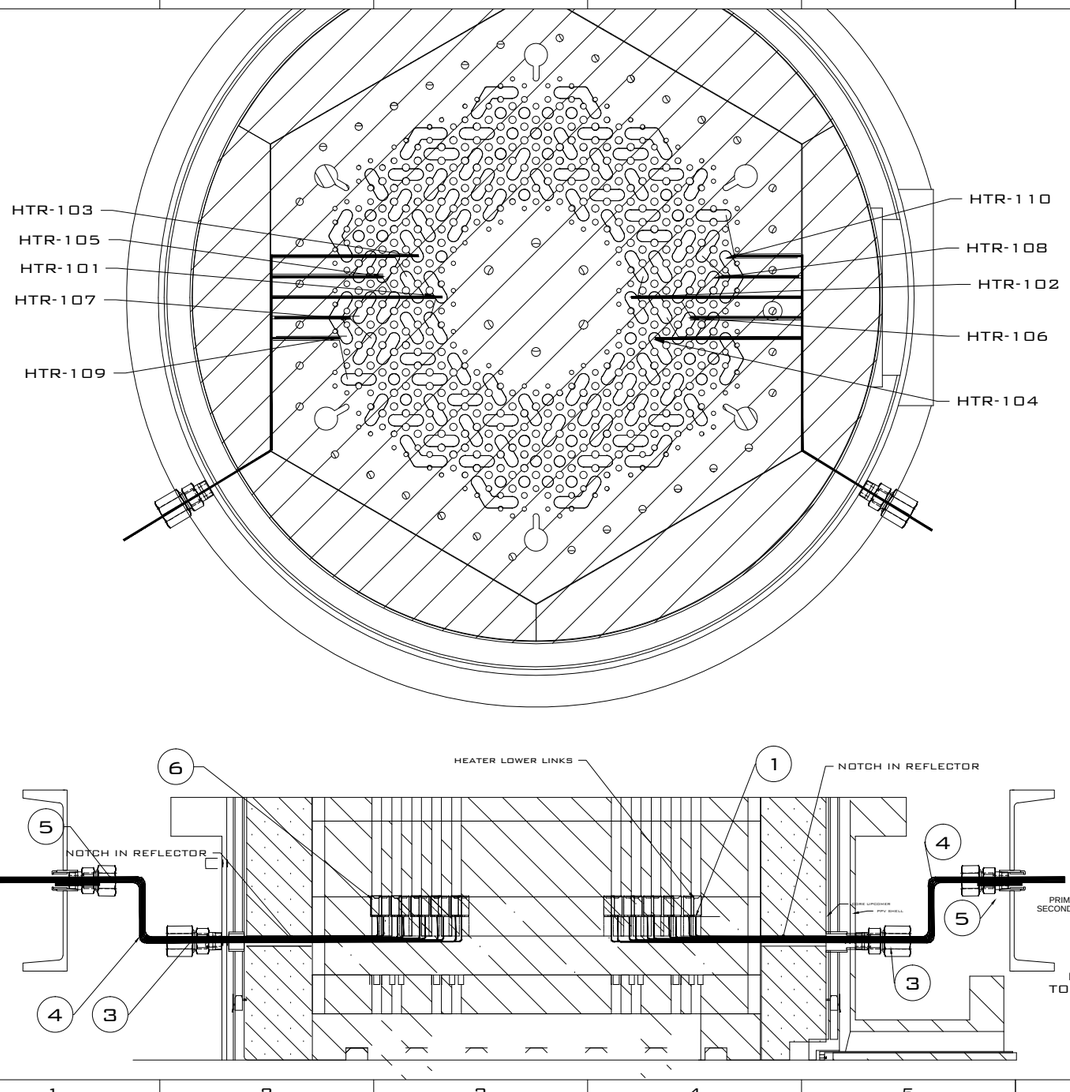
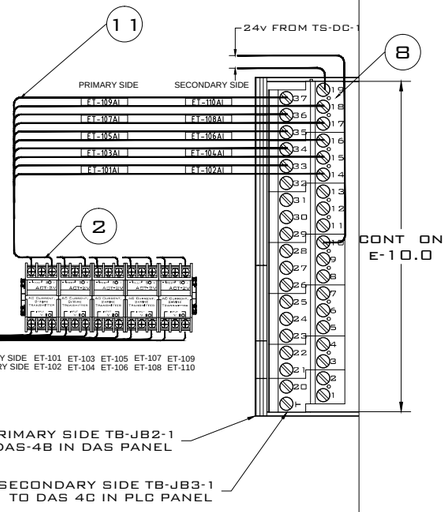
REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE
APPROVED BY 5/14/2010	DATE
VENDOR DWG. NO. 25466-E-11	SCALE
DRAWING NO. E-07.0	REV. 0
SHEET 1 OF 18	





Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	20	HEATER CONTACT PLATES,	BY OTHERS	TBD
2	10	AC VOLTAGE TRANSMITERS	OMEGA OR EQUAL	ACT-2V
5	2	MULTICONDUCTOR FEED THROUGH 8CONDUCTOR x 0.125" WIRE	CONAX	MTH-5-12-065
4	AR	MI CABLE, 0.0625" OD, 2 CONDUCTOR	OMEGA	316-RTD-2-MO-065
6	6	MULTICONDUCTOR FEEDTHROUGH, 12 CONDUCTOR	OMEGA	MFT-116-12
8	4	37 DSUB TERMINAL BOARD	NATIONAL INSTR.	C837FH
9	4	CABLE, 37 CONDUCTOR, DSUB ONE END	NATIONAL INSTR.	SH37F-P-4
10	4	DSUB CONNECTOR 37 PIN	NATIONAL INSTR.	NI 9933
11	4'	CABLE, 6 PAIR,	BELDEN.	9505
12	32	8 CONNDUCTOR 18GA UNSHEILDE CABLE 6" PRE TREMINATION	BELDEN	27601A
13	4	16-CHANNEL, ANALOG INPUT MODULE	NATION INSTRUMENTS	NI-9208

Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	24	CORE GAS DETECTORS	DETAIL 1	TBD
2	4	TC/PT/ GAS DETECTOR PROBE	DETAIL 2	TBD
3	2	TC/GAS DETECTOR RAKE	DETAIL 3	BTP-5
4	AR	MI CABLE, 0.0625" OD, 3 CONDUCTOR	OMEGA	316-RTD-3-MO-065
5	6	MULTICONDUCTOR FEED THROUGH 8CONDUCTOR x 0.125" WIRE	CONAX	MTH-5-12-065
6	6	MULTICONDUCTOR FEEDTHROUGH, 12 CONDUCTOR	OMEGA	MFT-116-12
7	2	GAS DETECTOR TRANSMITTER BOARD	BY OTHERS	A-1210SC
8	4	37 DSUB TERMINAL BOARD	NATIONAL INSTR.	C837FH
9	4	CABLE, 37 CONDUCTOR, DSUB ONE END	NATIONAL INSTR.	SH37F-P-4
10	4	DSUB CONNECTOR 37 PIN	NATIONAL INSTR.	NI 9933
11	2	37-PIN I/O CABLE	NATIONAL INSTR.	SH37F-37M-1
12	2	32-CHANNEL, ±200 MV TO ±10 V, 16-BIT ANALOG INPUT MODULE	NATIONAL INSTR.	NI 9205
13	AR	MI CABLE, 0.125" OD, 3 CONDUCTOR	OMEGA	316-RTD-3-MO-125
14	2	MULTICONDUCTOR FEED THROUGH 8CONDUCTOR x 0.125" WIRE	CONAX	MTH-5-8-125
15	2	MULTICONDUCTOR FEEDTHROUGH	OMEGA	MFT-18-8
16	2	1/8" TUBE ADAPTER	SWAGELOK	SS-200-1-4
17	2	MULTIPIN CONNECTOR SET, 5 PIN	OMEGA	MTC_5-MC/FC/SHL
18	AR	TRIAD CABLE, 16 AWG	OMEGA	316-RTD-3-MO-065

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REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES

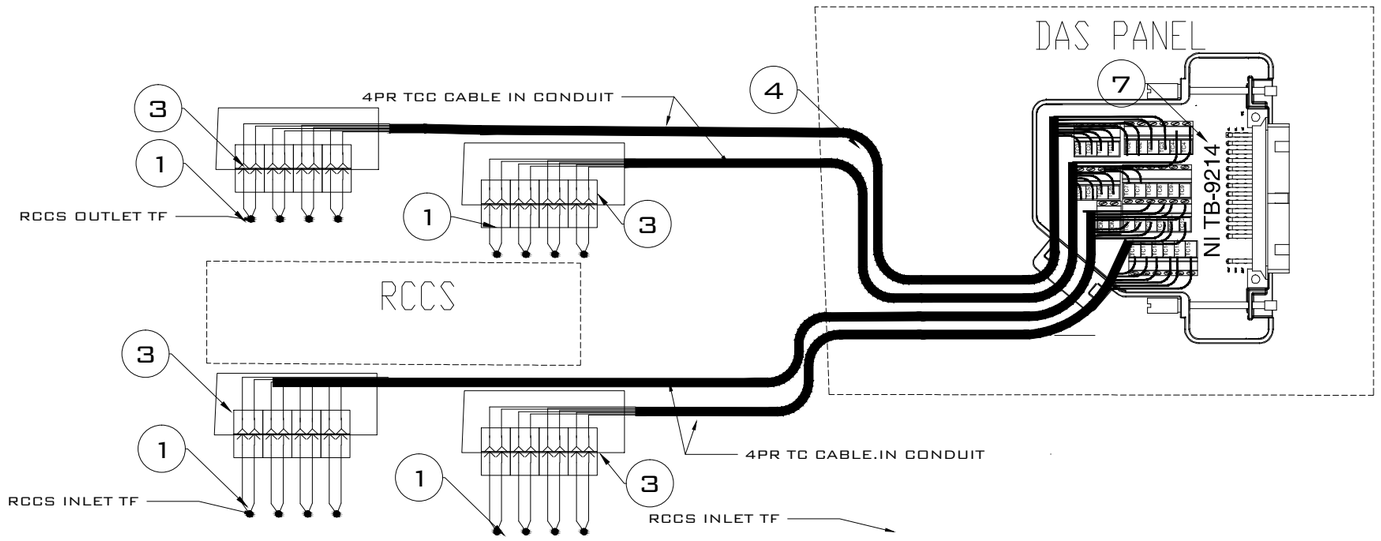
OSU HTTF PACKAGE

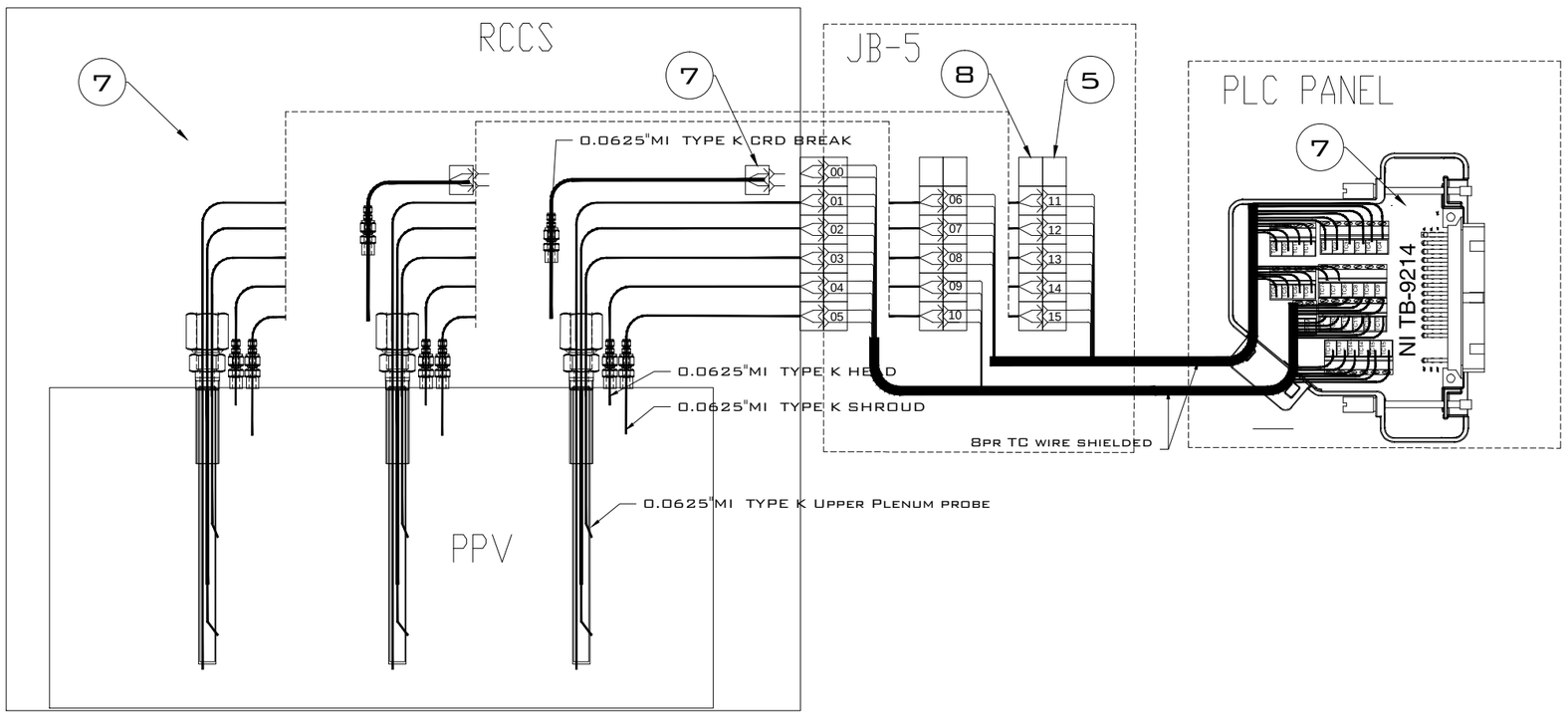
DRAWN BY: J. NYLANDER	DATE:
APPROVED BY: 5/14/2010	DATE:
VENDOR DWG. NO.: 25466-E-08	SCALE:
DRAWING NO.: E-08.0	REV.: 0
SHEET 12 OF 18	

1 Section a-a
Scale: 1:1

2 Heater Voltage Terminations
typical 2 ea

1





Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	8	Thermocouples Type K + MINIATURE MALE Plug	WATLOW	AFGK0FF030U403H
2	9	1/16"THERMOCOUPLE Type K +SPLIT LEADS	WATLOW	AFEDK07Q120U408H
3	4	THERMOCOUPLE JACK PANEL HARDWARE	OMEGA	JPJB-5-K
4	AR	MULTIPAIR EXTENSION CABLE, 4 PR	OMEGA	4KX20PP
5	3	THERMOCOUPLE CERAMIC JACK PANEL	Omega Or equal	SHXJP1-06-K
6	16	IEC TERMINAL BLOCK GROUNDING	ALLEN-BRADLEY	1492- WG4
7	2	16 CHANNEL THERMOCOUPLE INPUT CARD	NATIONAL INSTRUMENTS	9214
8	16	CERAMIC MINIATURE TYPE K THERMOCOUPLE CONNECTOR	OMEGA	SHX-K-M
9	AR	MULTIPAIR EXTENSION CABLE, 8 PR	OMEGA	8KX20PP

SEE E-9.1 FOR PROCESS CONTROL THERMOCOUPLES.

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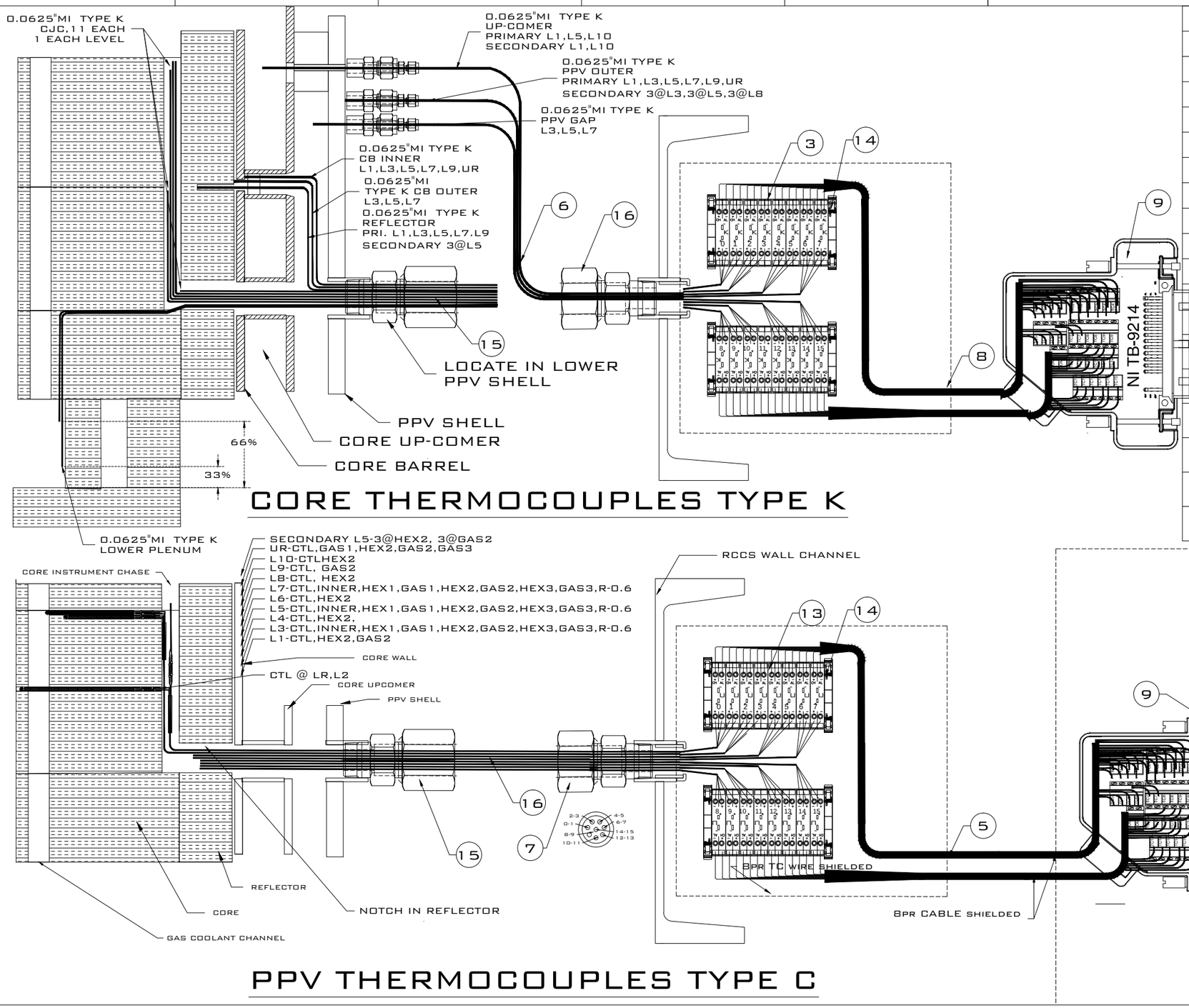
REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES
DAS THERMOCOUPLE LAYOUT

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE
APPROVED BY 5/14/2010	DATE
VENDOR DWG. NO. 25466-E-13	SCALE
DRAWING NO. E-09.0	REV. 0
SHEET 13 OF 18	



CORE THERMOCOUPLES TYPE K

PPV THERMOCOUPLES TYPE C

Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	65	THERMOCOUPLE WIRE, 0.015 TYPE C TUNGSTEN 5% RE- TUNGSTEN 26% RE 30" LG	OMEGA OR EQUAL	T5R-015-12-BW
2	180	1/8" CERAMIC INSULATOR TUBE, 2 WIRE	OMEGA OR EQUAL	CTRA-13218
3	65	THERMOCOUPLE TREMINALS 1 PR	OMEGA OR EQUAL	DRTB-K
4	10	MUTLTI CONDUCTOR FEED-THROUGH	CONAX	MHM5-125-8
5	AR	MULTI-CONDUCTOR THERMOCOUPLE WIRE, 8 PAIR TYPE K	BELDEN OR EQUAL	1013A
6	AR	1/16" MI THERMOCOUPLE WIRE, TYPE K	OMEGA OR EQUAL	INC-K-MO-062
7	12	MULTI HOLE FEEDTRHOUGH, 8 EA 1/8"	OMEGA	MFT-18-8
8	3	8 PAIR TWISTED CABLE	BELDEN	1077A
9	1	16 CHANNEL THERMOCOUPLE INPUT CARD	NATION INSTRUMENTS	NI TB-9214
10	AR	RTD MI CABLE, 4 CONDUCTOR	OMEGA OR EQUAL	316-RTD-4W-MO-125
11	65	THERMOCOUPLE PINS TYPE K	OMEGA OR EQUAL	HPC-CH-P,-S HPC-AL-P,S
12	65	THERMOCOUPLE PINS, UNCOMPENSATED	OMEGA OR EQUAL	HPC-AU-P,S
13	65	THERMOCOUPLE TERMINALS, UNCOMPENSATED	OMEGA OR EQUAL	DRTB-U
14	20	IEC TERMINAL BLOCK END - J4	ALLEN BRADLEY	1492-EBJ3
15	10	THERMOCOUPLE FEED-THROUGH 16 EA 1/16"	CONAX	MHM5-065-16
16	12	MULTI HOLE FEEDTRHOUGH, 8 EA 1/8"	OMEGA	MFT-116-8

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REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES
PPV THERMOCOUPLE SCHEMATIC

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE
APPROVED BY 5/14/2010	DATE
VENDOR DWG. NO. 25466-E-15	SCALE
DRAWING NO. E-09.1	REV. 0
SHEET 14OF 18	

Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	4	4 CHANNEL ANALOG OUTPUT CARD	NATIONAL INSTRUMENTS	9265
2	AR	SH37F-P-4 37-PIN FEMALE TO PIGTAIL SHIELDED I/O CABLE, 4 M	NATIONAL INSTRUMENTS	9389
3	15	IEC TERMINAL BLOCK, 2 LEVEL + GROUND	ALLEN-BRADLEY	1492- JD3P
4	2	IEC TERMINAL BLOCK END BARRIER	ALLEN-BRADLEY	1492- EBJD3P
5	AR	INSTRUMENT CABLE, 1PR, 22GA	BELDEN	8760
6	3	TERMINAL BLOCK, RESISTOR, 0.5W, 249OHM	ALLEN-BRADLEY	1492-JD3RC001
7	4	STRAIN RELIEF AND HIGH VOLTAGE CONNECTOR KIT, 10 POS. TERMINAL	NATIONAL INSTRUMENTS	9932

NOTES: ANALOG OUPUT WIRING - TYPICAL
16 CHANNELS, 4-20MA, 4 NI 9265

PLC-01-04 NI 9265 AO
PLC-01-05
PLC-01-06 NI 9265 AO
PLC-01-06 NI 9265 AO
PLC-01-06 NI 9265 AO

TB-AO-1
00 SCR-101AI
01 SCR-102AI
02 SCR-103AI
03 SCR-104AI
04 SCR-105AI
05 SCR-106AI
06 SCR-107AI
07 SCR-108AI
24V
08 SCR-109AI
09 SCR-110AI
10 VSD-200AI
11 FCV-532 AI
12 VSD-501AI
24V
13 VSD-010AI
14 LCV-013AI
15 VSD-801AI
16 FCV-807AI
24V
17 PCV-400AI
18 fCV-601AI
19
20
24V

24V FROM TS-DC-1
(SEE E-03.2)

TB-AC2-1
LOCATED IN AC-2
SEE E-2.2
TB-AC1-1
TB-JB6-4
LOCATED IN AC-1
SEE E-2.2
LOCATED MODULE NW CORNER
SEE E-2.0
TB-JB4-3
LOCATED WEST WALL RCCS
SEE E-5.0

TB-JB6-1
AI-
[1] TIT/TI-250
[2] PIT-300
[3] TE/TI/532
[4] PIT-700
[5] AIC-533
AO-
[6] VSD-200
[7] VSD-501
[8] FCV-501
[9] RO(SV)
[10] SV-502
[11] SV-541
[12] SV-531
[13] SV-551

TB-JB4-3 AO-
[01] LCV-013
[02] FCV-807
[03] PCV-400
[04] VSD-200
[05] VSD-010
[06] VSD-801
[07] VSD-501
[08] FCV-501
[09] PCV-602
[10-16] SPARE

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Department of Nuclear Engineering
Hydro-Mechanical Fuel Test Facility
Radiation Center, Corvallis, Oregon 97331
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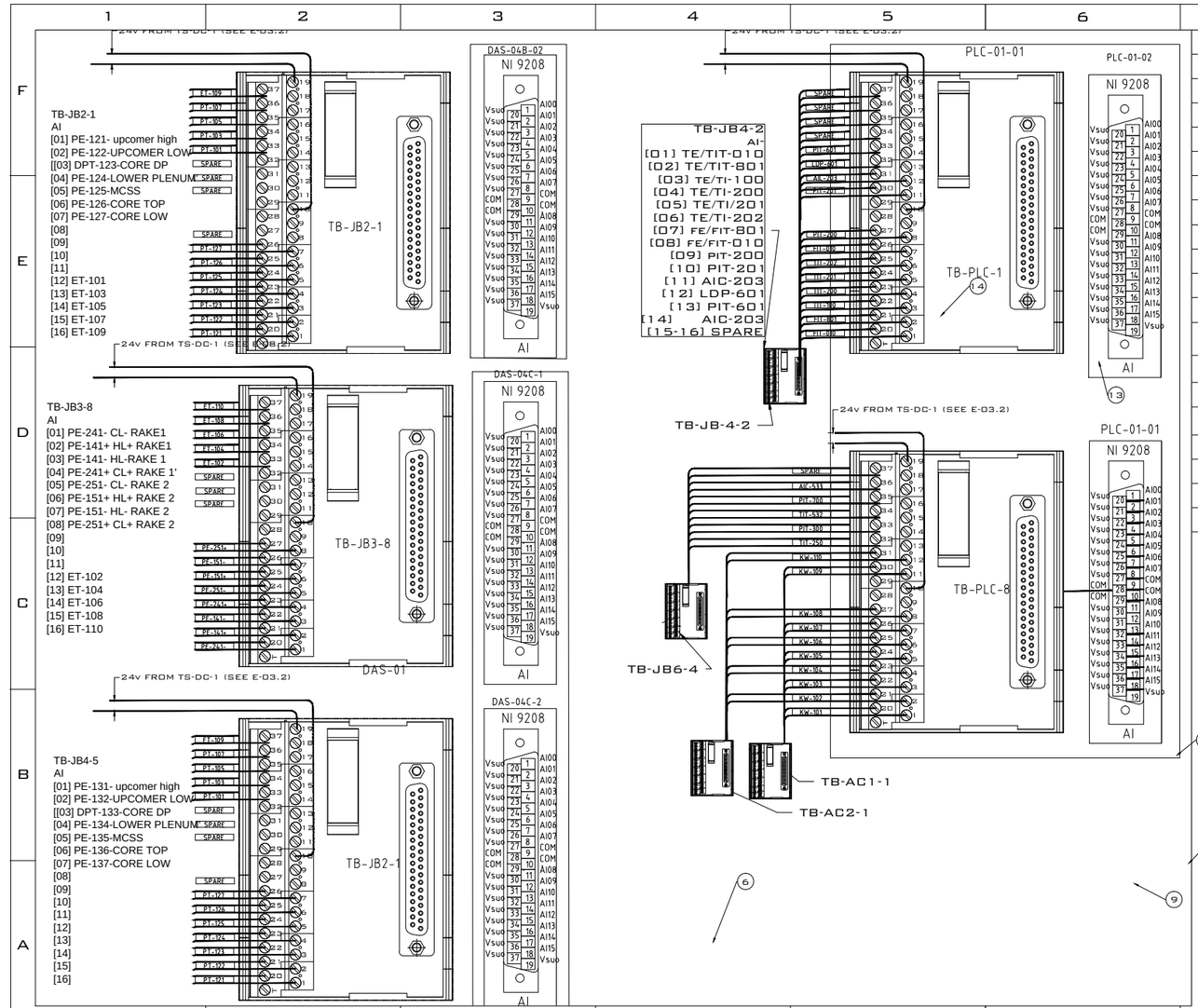
REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES
ANALOG OUTPUTS

OSU HTTF PACKAGE

DRAWN BY J. NYLANDER	DATE
APPROVED BY 9/14/2011	DATE
VENDOR DWG. NO. 25466-E-15	SCALE
DRAWING NO. E-10.0	REV. D
SHEET 19 OF 18	



Bill Of Material

ITEM	QTY	DESCIPTION	MANUFACTURER	MODEL
1	5	16 CHANNEL ANALOG INPUT CARD	NATIONAL INSTRUMENTS	9208
2	2	MULTI-CONDUCTOR INSTRUMENT CABLE 18 GA, 64 PIN D SHELL	NATIONAL INSTRUMENTS	SHC68-68-EPM
3	15	IEC TERMINAL BLOCK, 2 LEVEL + GROUND	ALLEN-BRADLEY	1492- JD3P
4	2	IEC TERMINAL BLOCK END BARRIER	ALLEN-BRADLEY	1492- EBJD3P
5	AR	INSTRUMENT CABLE, 1PR, 18GA	BELDEN	9318
6	2	37P TERMINAL BOARD	NATIONAL INSTRUMENTS	CB-37FH
7	0	RESISTOR, 0.125W, 232OHM, 5%, AXL PKG		
8	1	DIFFERENTIAL TRANSMITTER	ROSEMOUNT	1056
9	1	PRESSURE TRANDUCER	ASHCROFT	140
10	1	PRESSURE INDICATING TRANSMITTER	ASHCROFT	PH-ZR-5-TUBE-N PT500-A
	1	DIFFENTIAL PRESSURE TRANSMITTER	ASHCROFT	RE-S-1TUBE 250 C
11	9	PRESSURE INDICATING TRANSMITTER(PIT-XXX)	ROSEMOUNT	3051
12	5	TEMPERATURE INDICATING TRANSMITTER(FIT-XXX)	ROSEMOUNT	644
13	2	FLOW INDICATING TRANSMITTER(FIT-XXX) REMOTE MOUNT FROM FLOW ELEMENT +20' CABLE	ROSEMOUNT	8800
14	2	LEVEL INDICATING TRANSMITTER(FIT-XXX)	ROSEMOUNT	3301
15	2	STRAIN RELIEF AND HIGH VOLTAGE CONNECTOR KIT, 37 POS. TERMINAL	NATIONAL INSTRUMENTS	9933
16	6	CHARGE AMPLIFIER	SENSOTEC	WAC
17	6	VIBRATION ELEMENT	HONEYWELL	MAQ14

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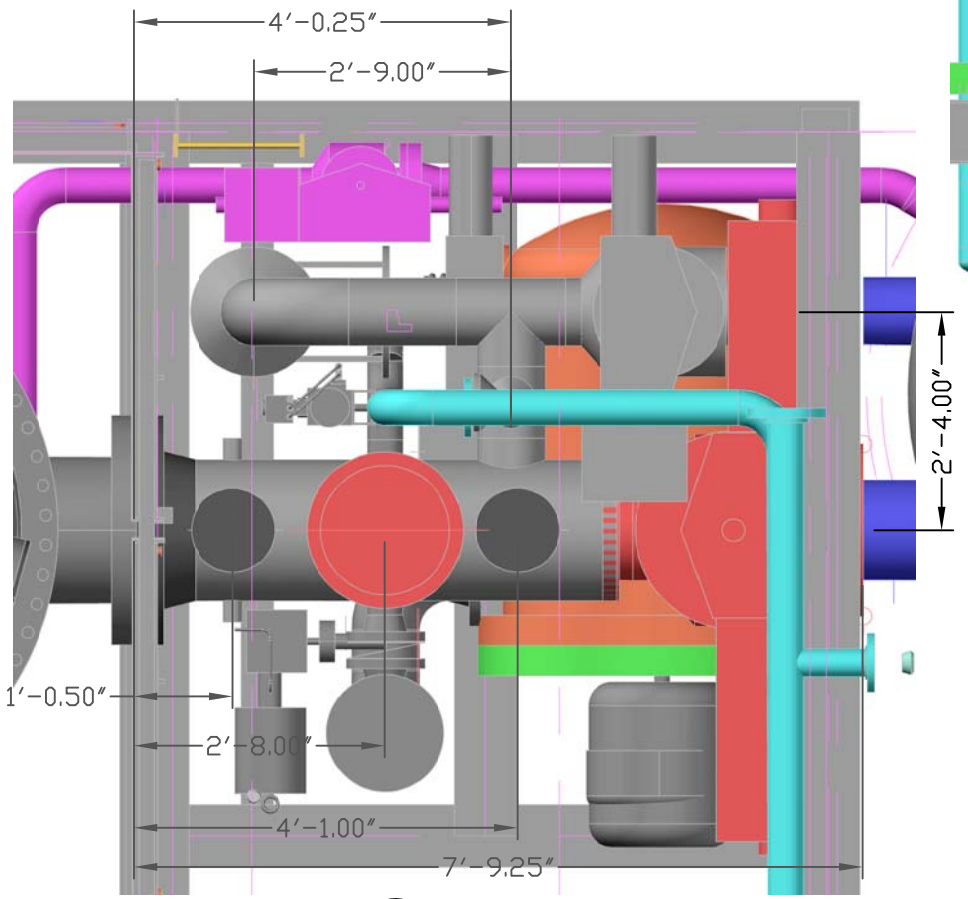
REV #	DESCRIPTION	DATE	NOTES:

ELECTRICAL ONE-LINES
ANALOG INPUT MAP

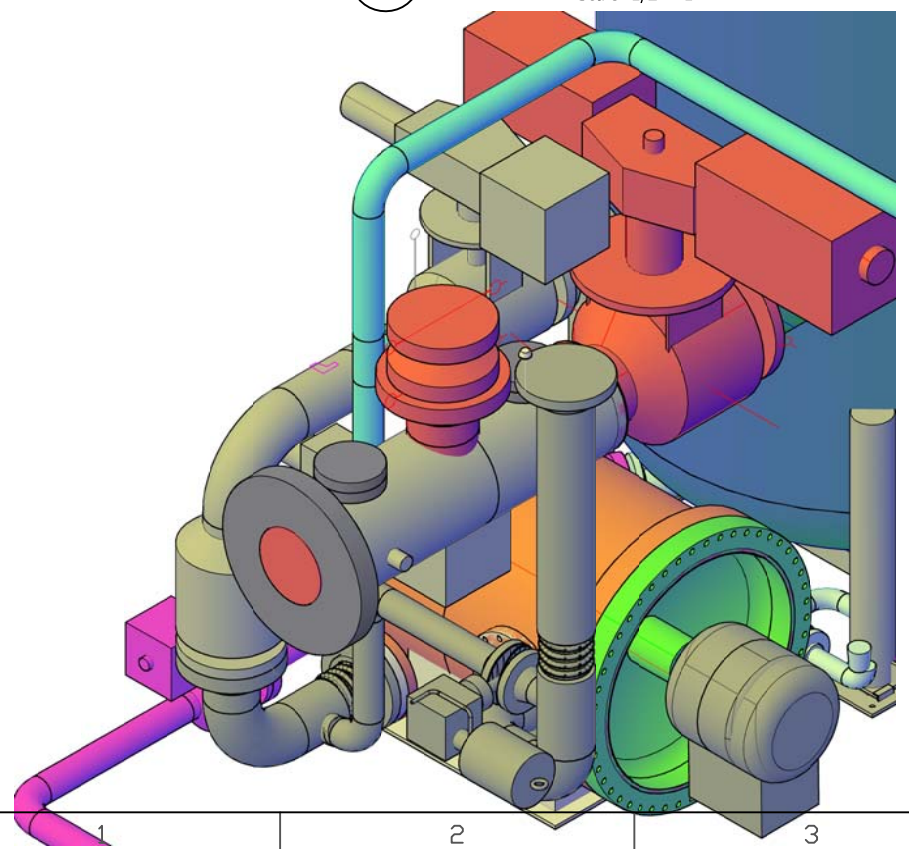
OSU HTTF PACKAGE

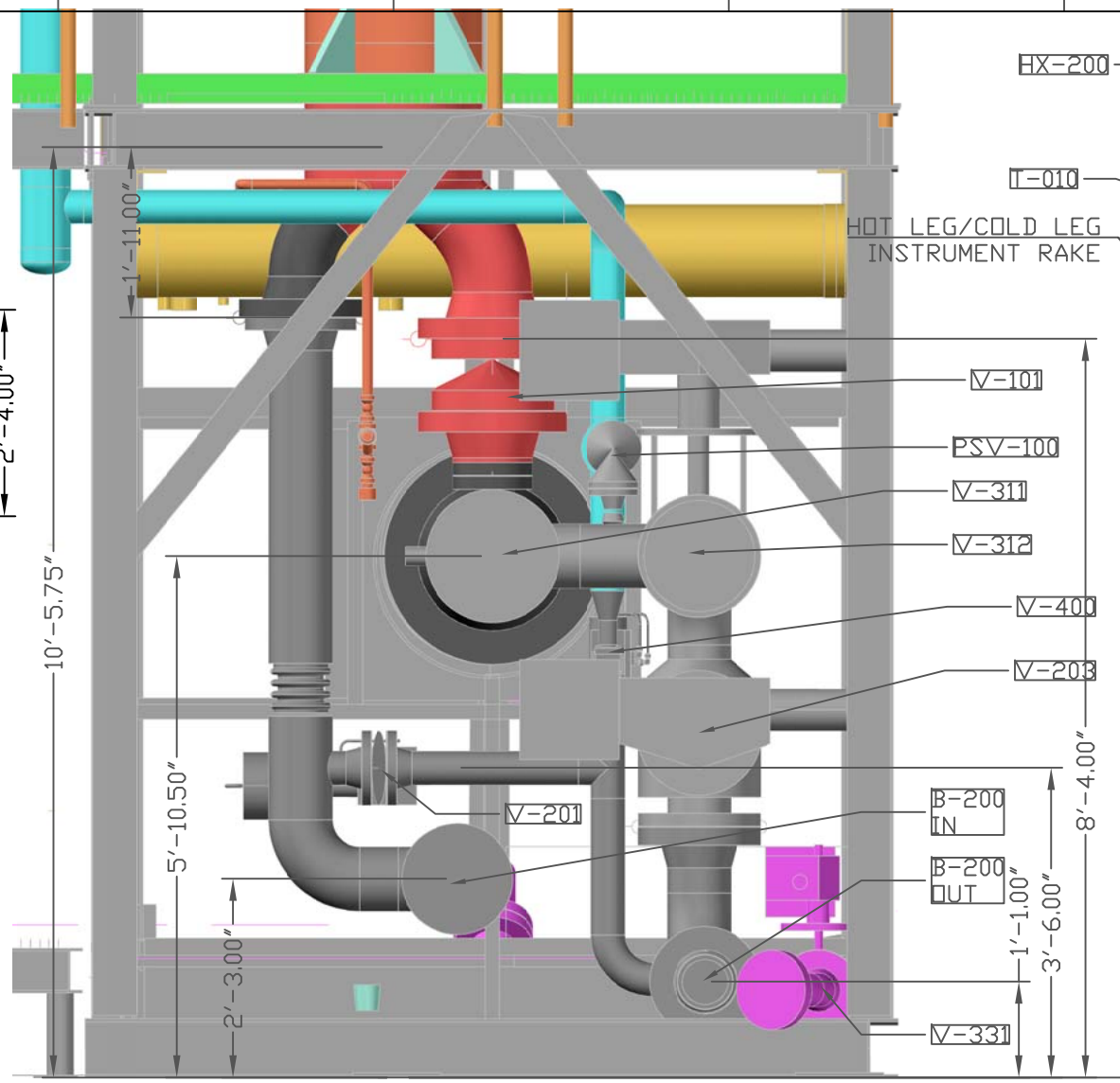
DRAWN BY	J. NYLANDER
DATE	
APPROVED BY	5/14/2010
DATE	
VENDOR DWG. NO.	25466-E-16
SCALE	
DRAWING NO.	E-11.0
REV.	0
SHEET 16 OF 18	



1 PLAN

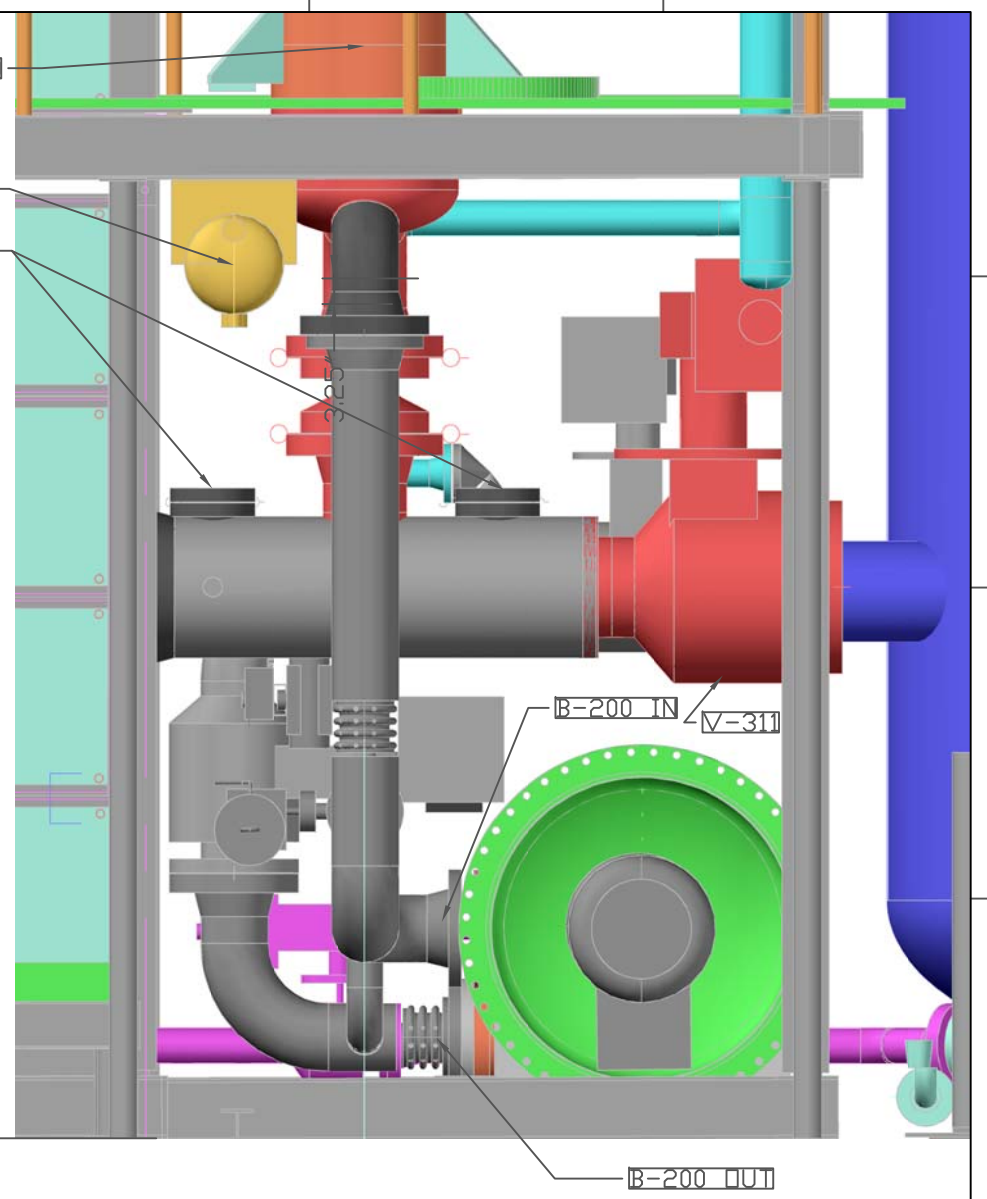
Scale: 1/2" =1'





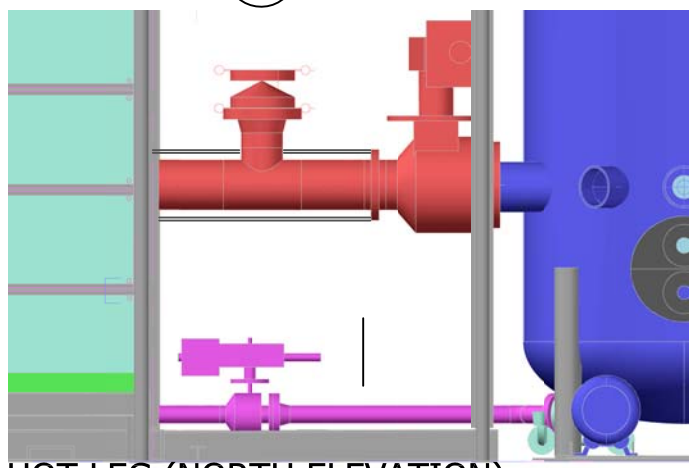
2 EAST ELEVATION

Scale: 1/4" =1'



3 NORTH ELEVATIONS

Scale: 1/4" =1'



4 HOT LEG (NORTH ELEVATION)

Scale: 1/2" =1'

NOTES:
1. PIPING: SA-312 TP304/304L SCH. 80S
2. FITTINGS: SA-403 WP304/304LSCH 80S BW
3. FLANGES: SA-182 F304/304L 600#ANSI
4. 5. BOLTING: SA-192 B7 STUDS + 2 SA-193 HH NUTS
6. SEALS FOR HOTLEG TO BE GARLOCK HELICOFLEX C-RINGS OR EQUAL.
7.COLDLEG 600# GARLOCK 9800 $\frac{1}{16}$" SPEC SS3
8. PIPING TO BE BUILT TO ASME B31.3
9 HOT LEG DESIGN 143PSIG@ 1270F., 600# ANSI, SPEC SS6
10 COLD LEG DESIGN 143 PSIG@ 560F, 300# ANSI

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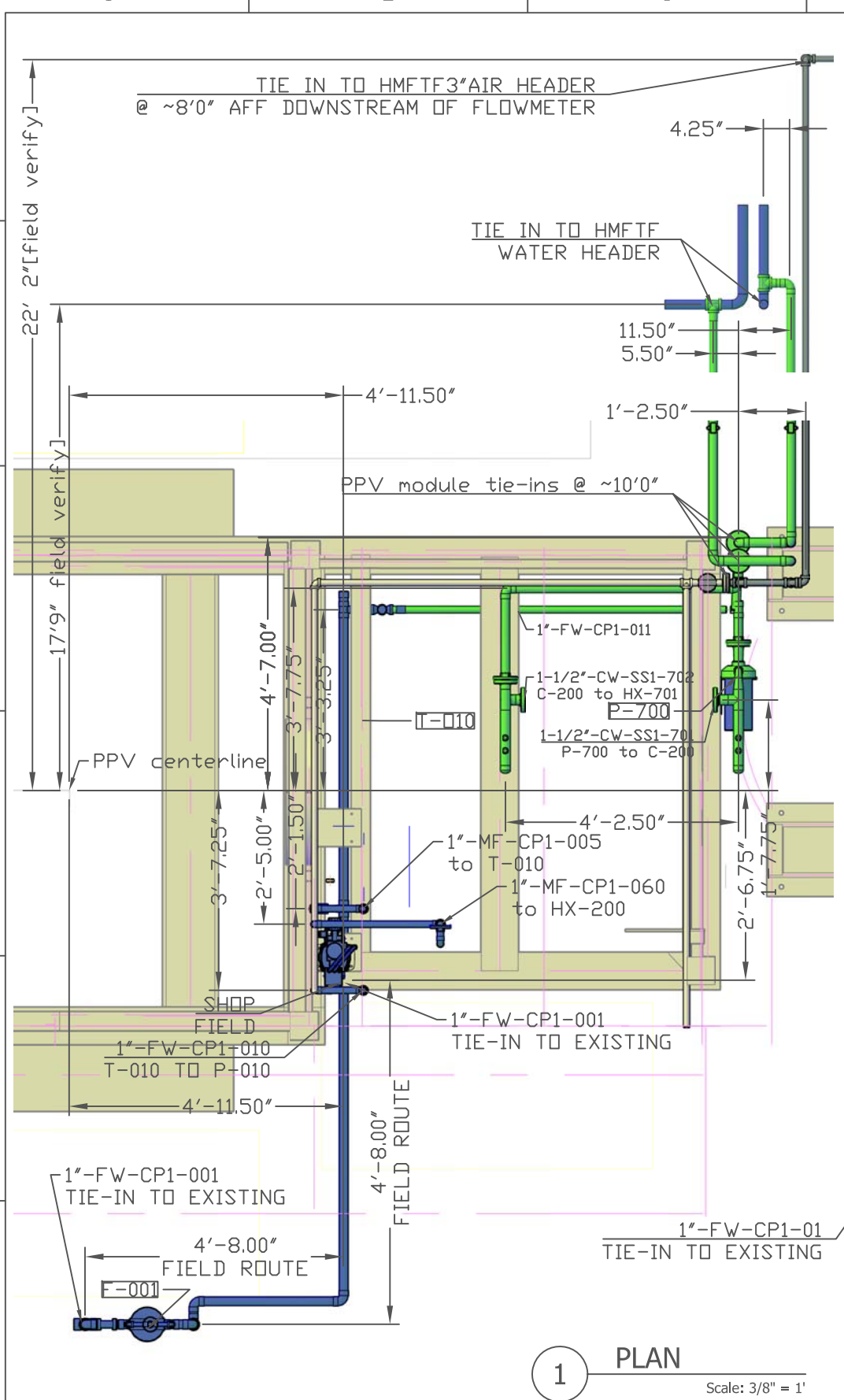
REV #	DESCRIPTION	DATE	NOTES:
0			

PIPING LAYOUT
PRIMARY COOLANT SYSTEM [PCS]

OSU HTTF PACKAGE

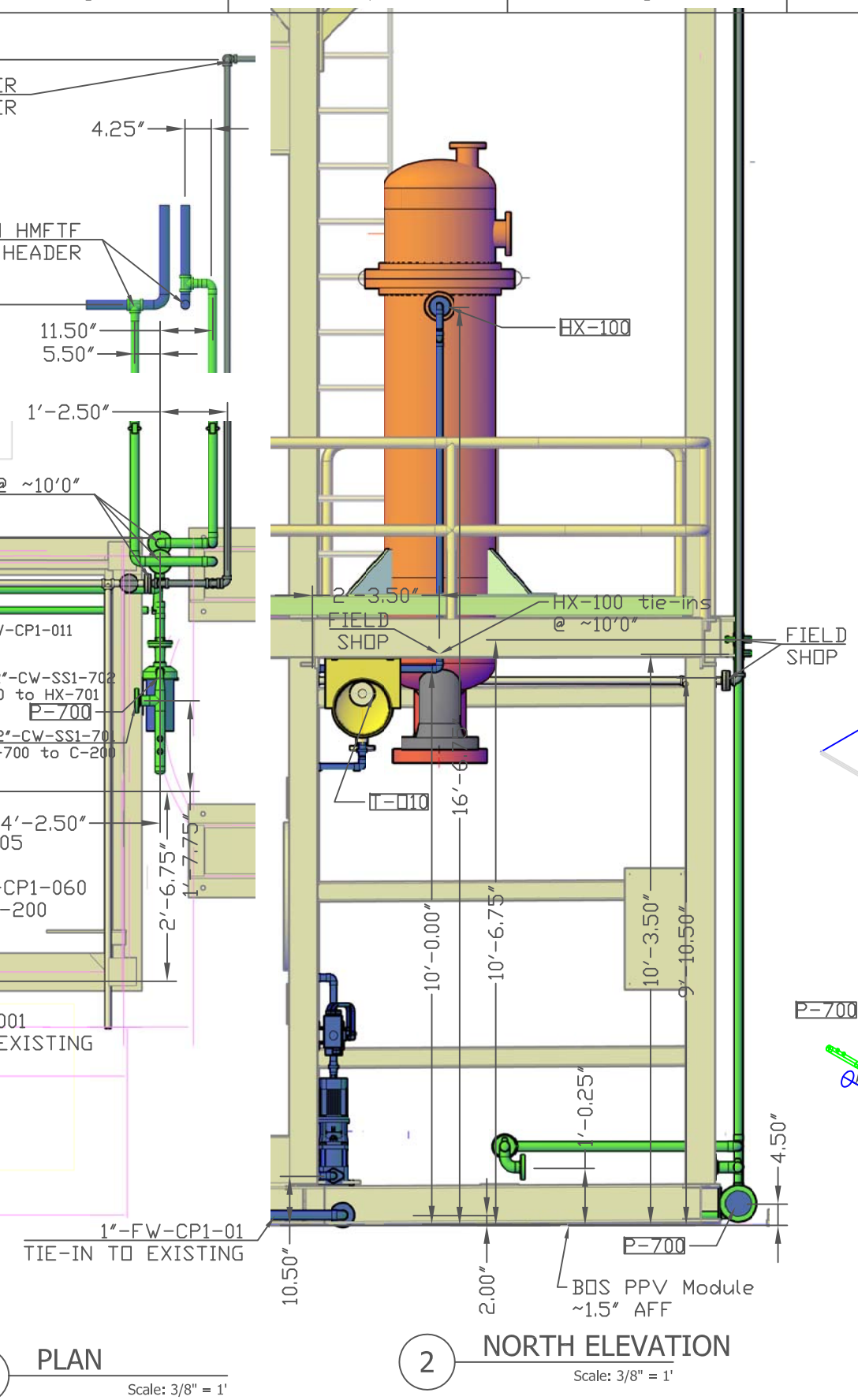
VENDOR DWG. NO 25466-M2.1 CAD FILE NAME HTTF-M1.DWG SCALE as noted

DRAWN BY J. NYLANDER	DATE 0610-11	
REVIEWED BY	DATE	
APPROVED BY	DATE	
DRAWING NO. HTTF-M2		REVISION 0
SHEET 1 OF 2		



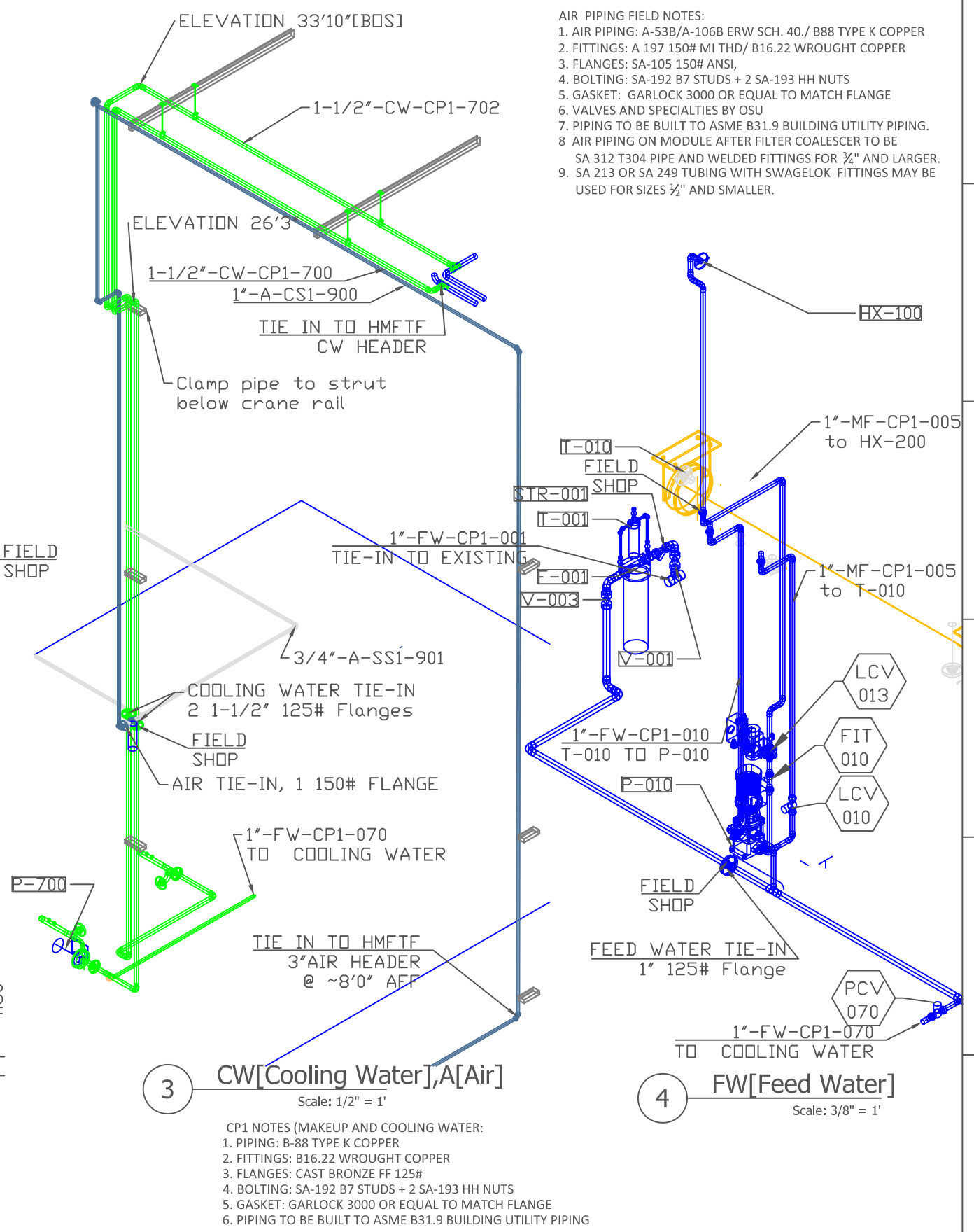
1 PLAN

Scale: 3/8" = 1'



2 NORTH ELEVATION

Scale: 3/8" = 1'



3 CW[Cooling Water],A[Air]

Scale: 1/2" = 1'

4 FW[Feed Water]

Scale: 3/8" = 1'

AIR PIPING FIELD NOTES:
1. AIR PIPING: A-53B/A-106B ERW SCH. 40,/ B88 TYPE K COPPER
2. FITTINGS: A 197 150# MI THD/ B16.22 WROUGHT COPPER
3. FLANGES: SA-105 150# ANSI,
4. BOLTING: SA-192 B7 STUDS + 2 SA-193 HH NUTS
5. GASKET: GARLOCK 3000 OR EQUAL TO MATCH FLANGE
6. VALVES AND SPECIALTIES BY OSU
7. PIPING TO BE BUILT TO ASME B31.9 BUILDING UTILITY PIPING.
8 AIR PIPING ON MODULE AFTER FILTER COALESCER TO BE SA 312 T304 PIPE AND WELDED FITTINGS FOR ¾" AND LARGER.
9. SA 213 OR SA 249 TUBING WITH SWAGELOK FITTINGS MAY BE USED FOR SIZES ½" AND SMALLER.

CP1 NOTES (MAKEUP AND COOLING WATER:
1. PIPING: B-88 TYPE K COPPER
2. FITTINGS: B16.22 WROUGHT COPPER
3. FLANGES: CAST BRONZE FF 125#
4. BOLTING: SA-192 B7 STUDS + 2 SA-193 HH NUTS
5. GASKET: GARLOCK 3000 OR EQUAL TO MATCH FLANGE
6. PIPING TO BE BUILT TO ASME B31.9 BUILDING UTILITY PIPING

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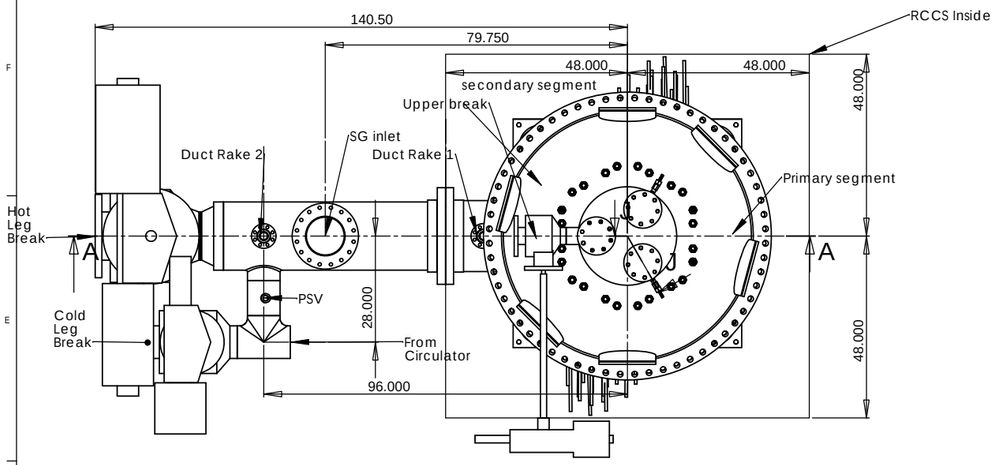
REV #	DESCRIPTION	DATE	NOTES:
0			

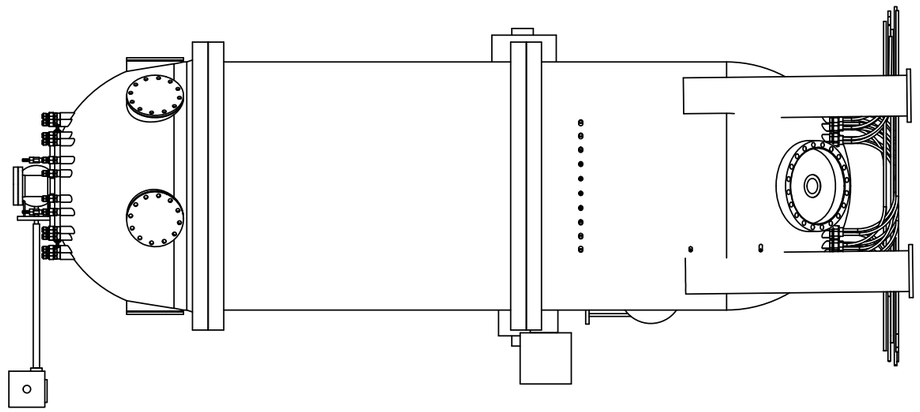
PIPING LAYOUT
UTILITY PIPING [FW,CW,A]

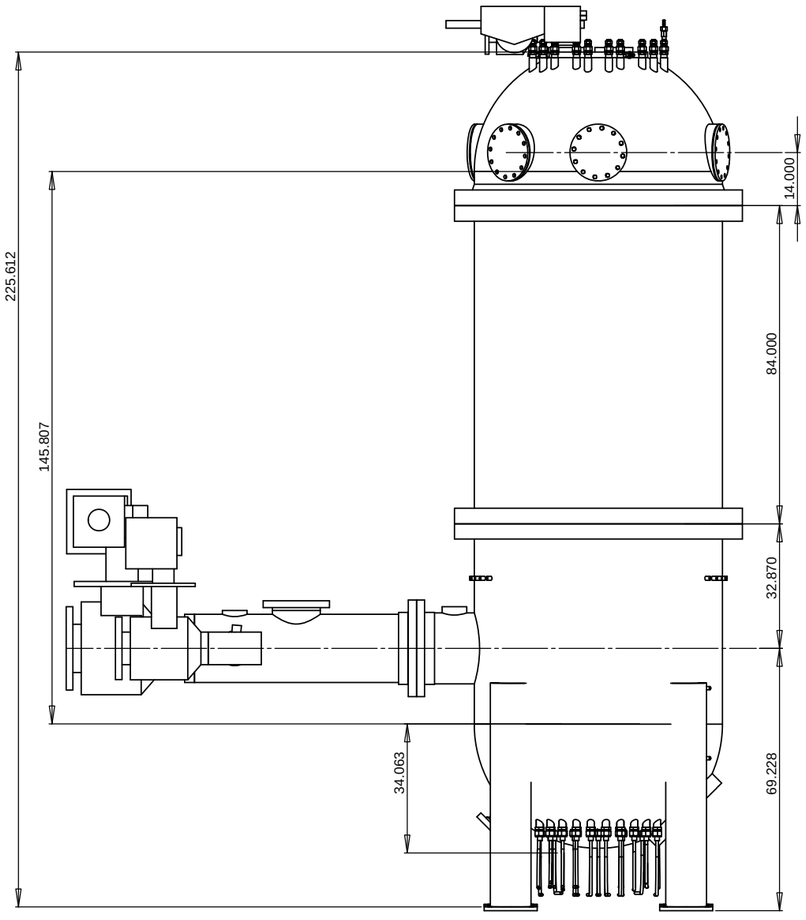
OSU HTTF PACKAGE

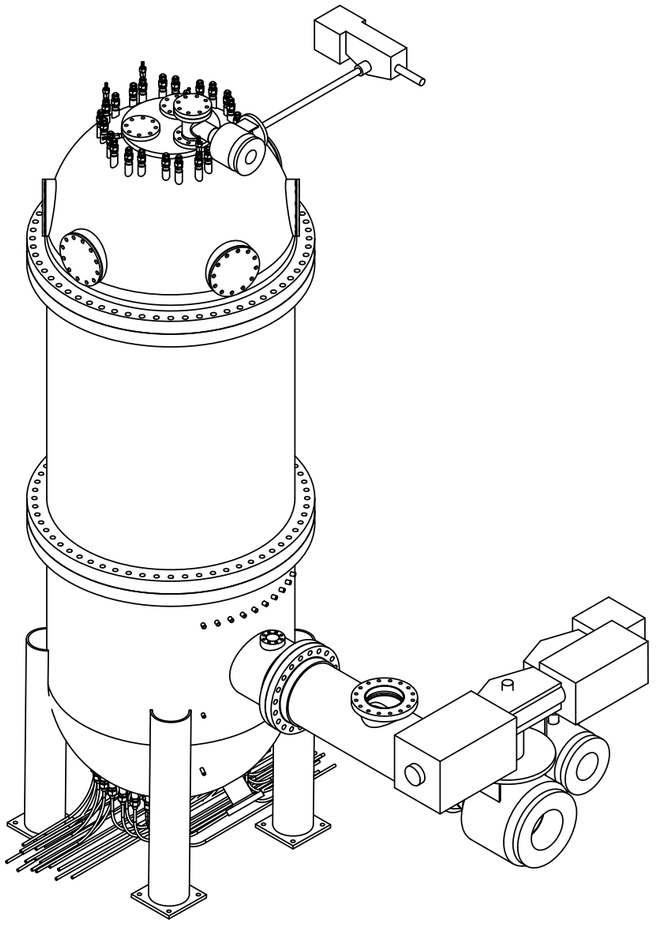
VENDOR DWG. NO.	HTTF-M3.1	CAD FILE NAME	HTTF-M1.DWG	SCALE	as noted

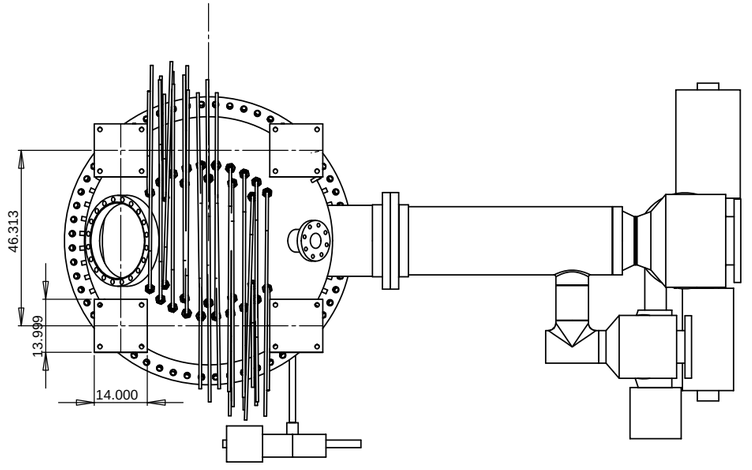
DRAWN BY J NYLANDER	DATE	
REVIEWED BY	DATE	
APPROVED BY	DATE	08-02-10
DRAWING NO. HTTF-M3		REVISION 0
SHEET 1 OF 2		









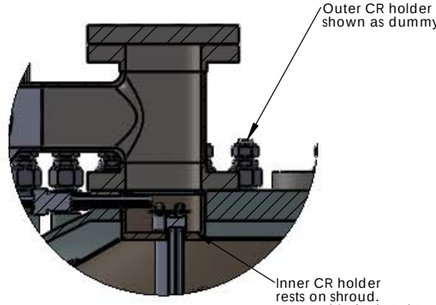


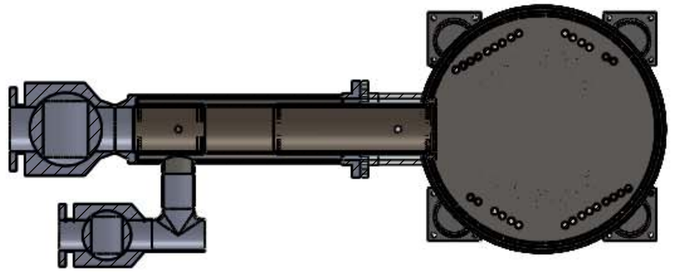
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
		FINISH			
NEXT ASSY	USED ON				
APPLICATION					

TITLE:

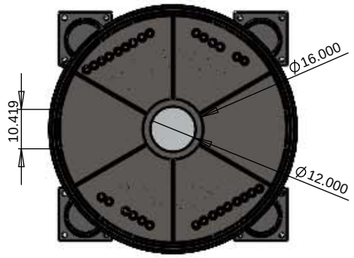
SIZE	DWG. NO.	REV
D	HTTF_RPV	
SCALE: 1:50	WEIGHT:	SHEET 1 OF 2

REV
D
HTTF_RPV

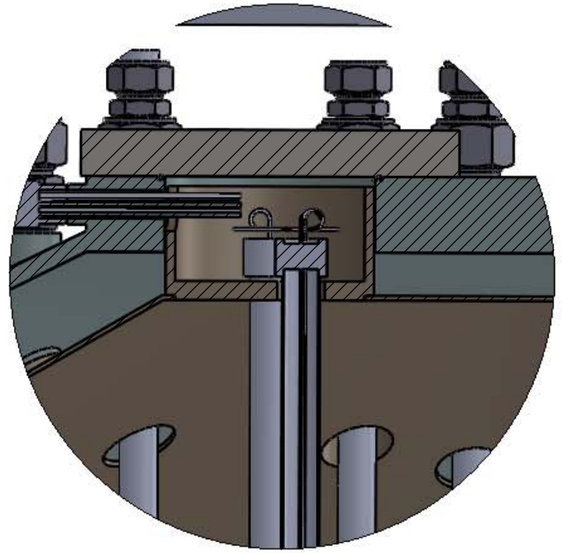




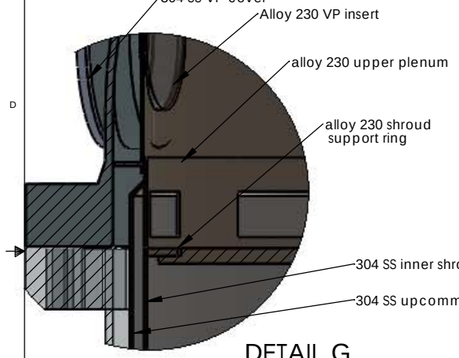
SECTION C-C
SCALE 1 : 20



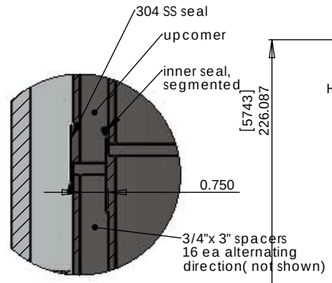
SECTION D-D
SCALE 1 : 20



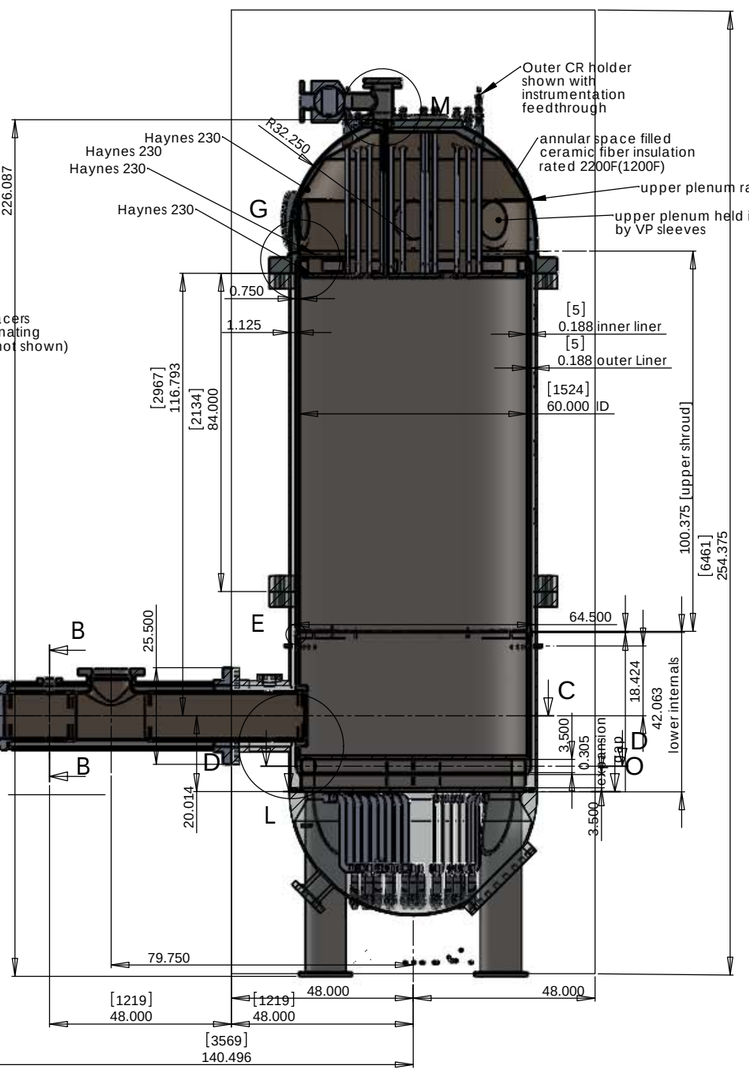
DETAIL M
SCALE 1 : 5



DETAIL G
SCALE 1 : 5



DETAIL E
SCALE 1 : 2



SECTION A-A
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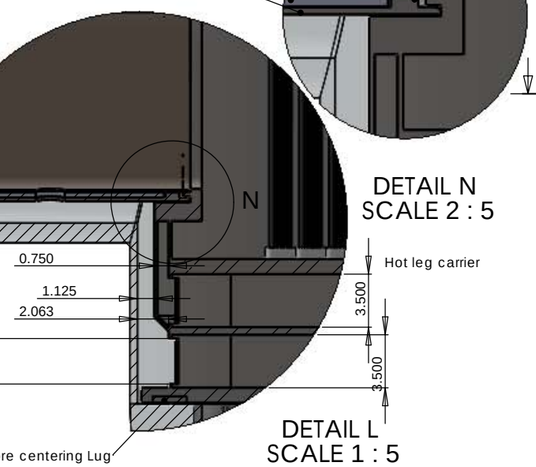
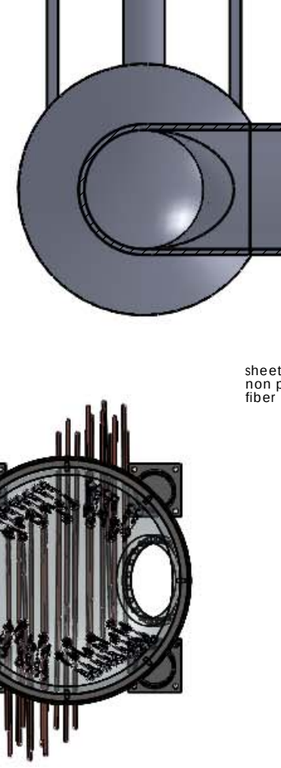
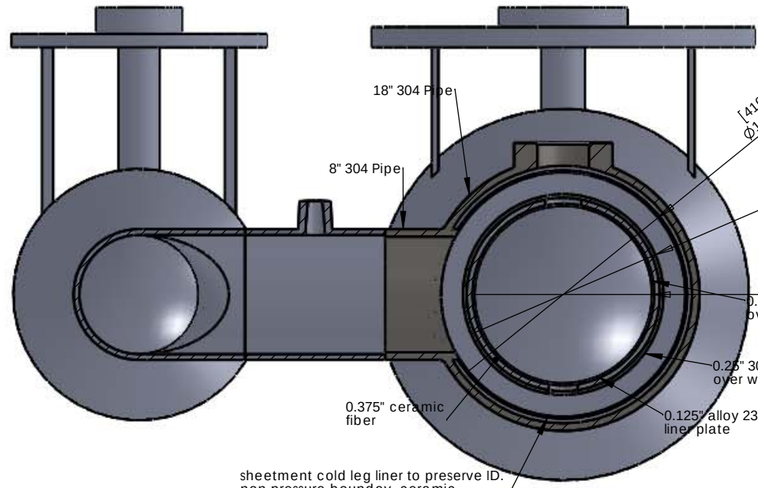


DETAIL N
SCALE 2 : 5

DETAIL L
SCALE 1 : 5



SECTION O-O
SCALE 1 : 20



DETAIL K
SCALE 1 : 2

sheetment cold leg liner to preserve ID.
non pressure bounday, ceramic
fiber for insulation

SECTION B-B
SCALE 1 : 5

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION

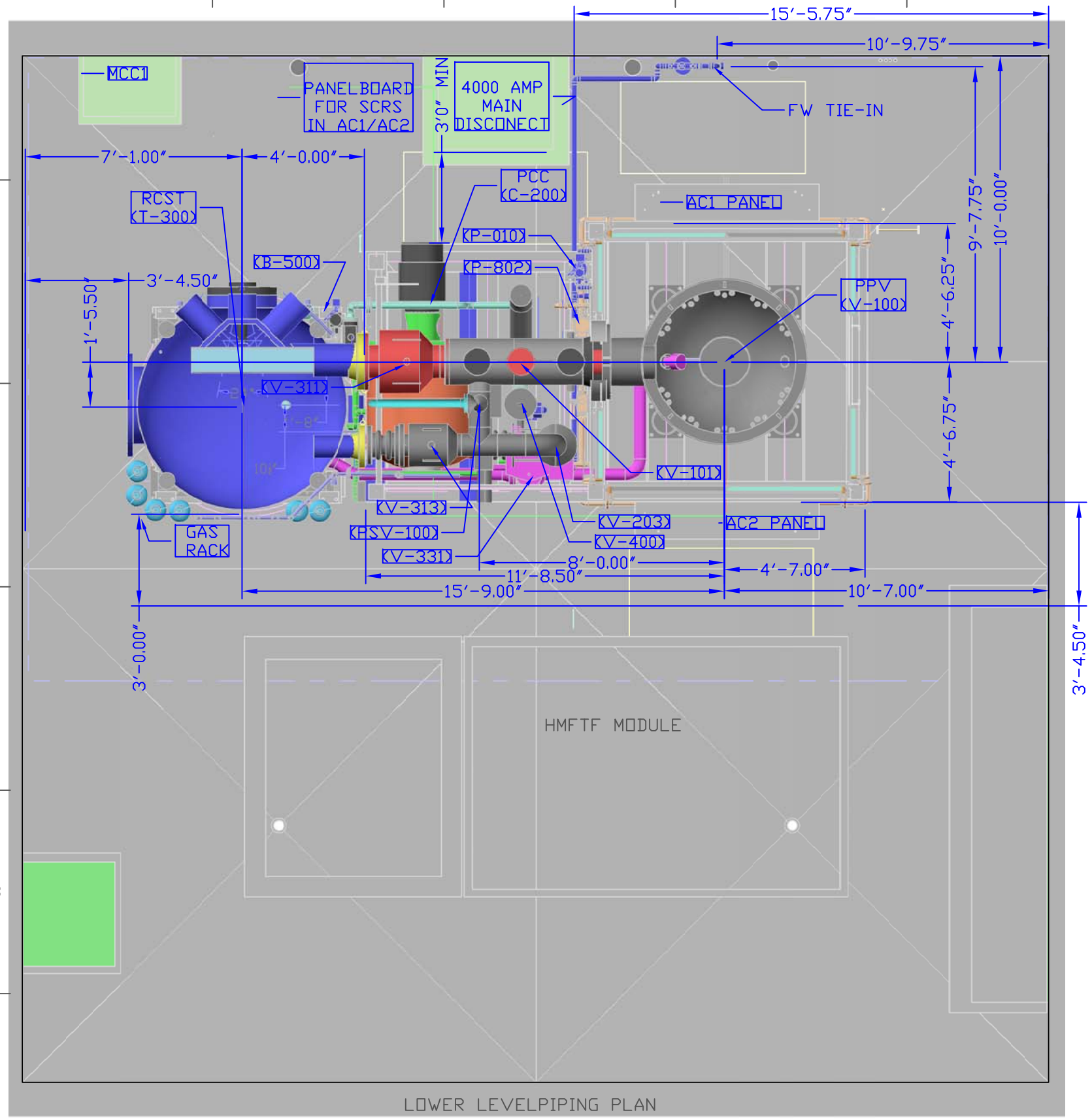
	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

TITLE:

SIZE D | DWG. NO. HTTF_RPV | REV

SCALE: 1:50 WEIGHT: | SHEET 2 OF 2

REV	HTTF_RPV
D	



FEEDWATER P000 | PCS(HOT) P100 | PCS(COLD)P200 | BREAK P300 | VENT P400 | GAS P500 | STM/COND P600 | CW P700 | RCC P800 | AIR P900

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Radiation Center, Corvallis, Oregon 97331
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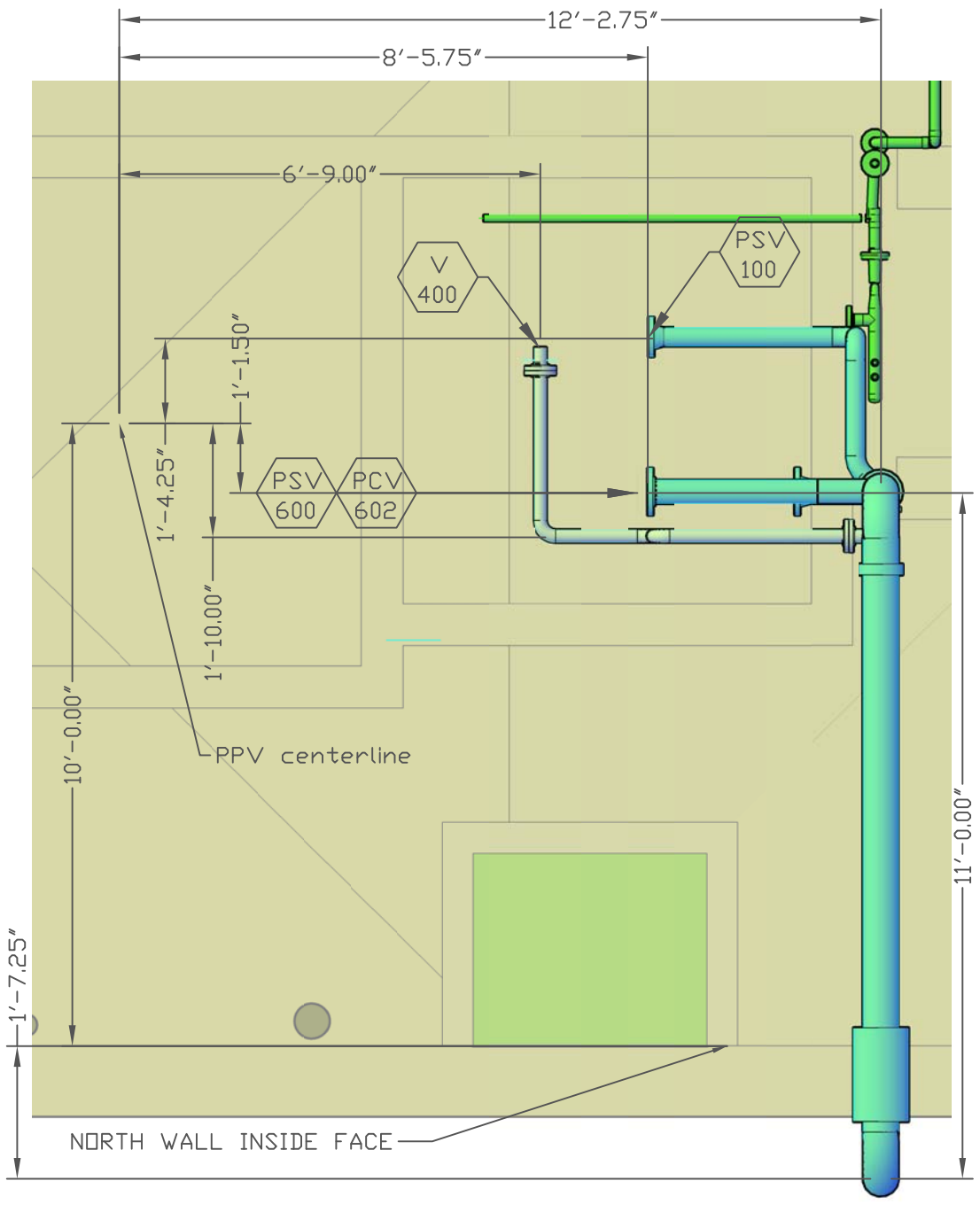
REV #	DESCRIPTION	DATE	NOTES:
0			

PIPING ARRANGEMENT GENERAL ORIENTATION VIEWS

OSU HTTF PACKAGE

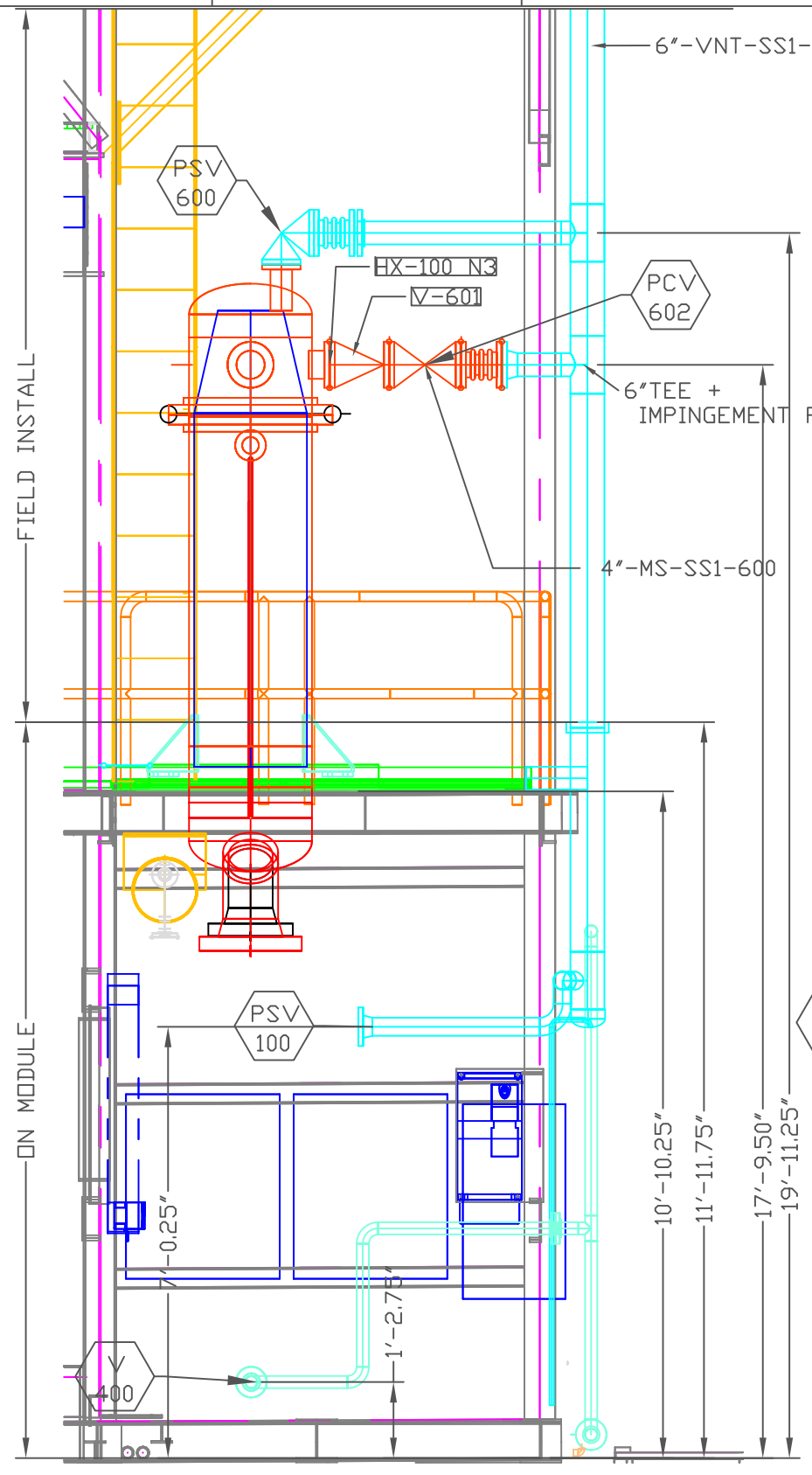
VENDOR DWG. NO. | CAD FILE NAME HTTF-M1.DWG | SCALE as noted

DRAWN BY J NYLANDER	DATE 08-01-10
REVIEWED BY	DATE
APPROVED BY	DATE
DRAWING NO. HTTF-M1	REVISION 0
SHEET 1 OF 2	



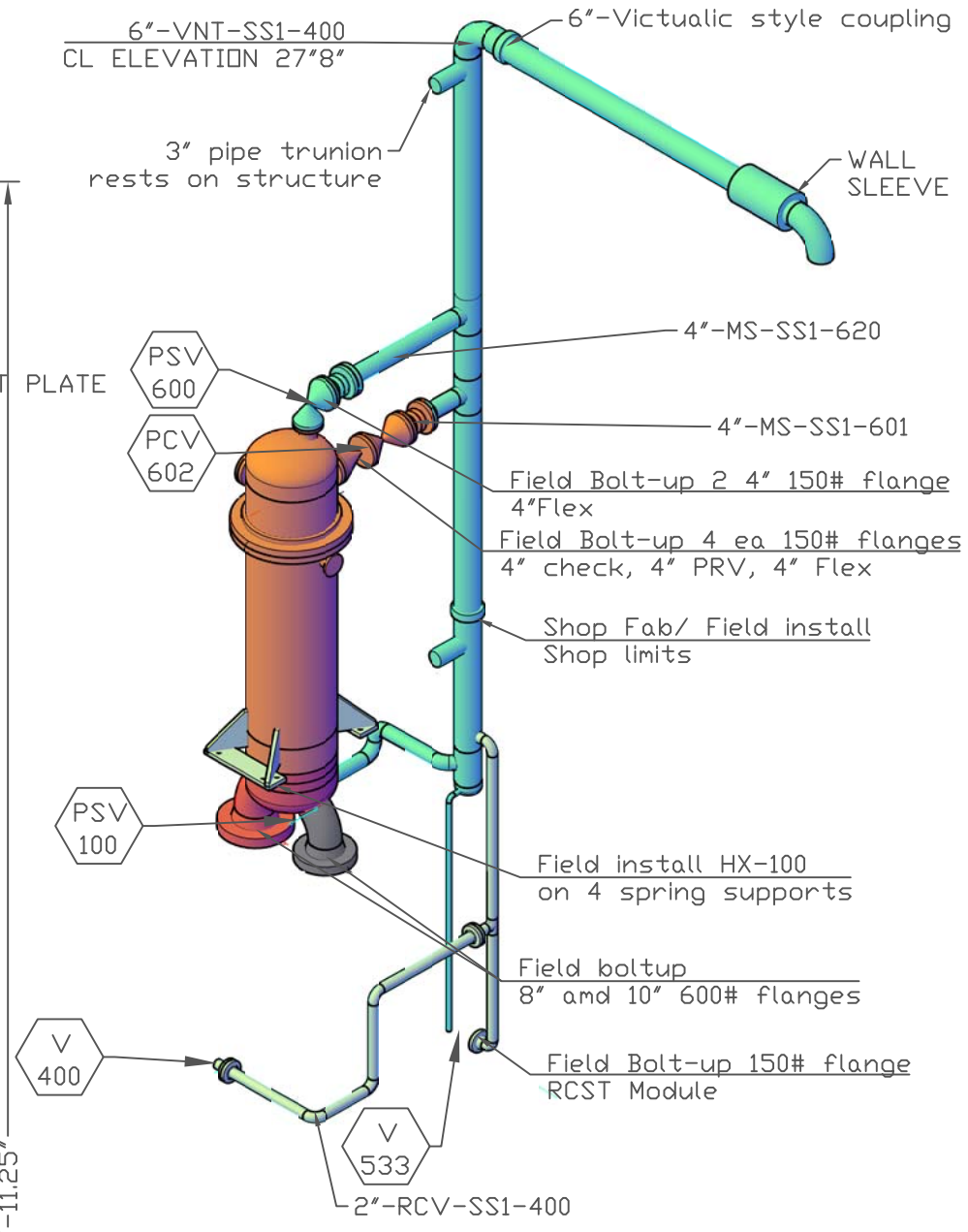
1 PLAN

Scale: 3/8" = 1'



2 NORTH ELEVATION

Scale: 3/8" = 1'



8 6"-VNT-SS1-400

Scale: 1/2" = 1'

NOTES:
1. PIPING: SA-312 TP304/304L SCH. 10.
2. FITTINGS: SA-403 WP304/304L SCH. 10 BW
3. FLANGES: SA-182 F304/304L , SS1 -150# ANSI, SS3 300# ANSI ANSI,SS6 - 600#ANSI (
4. BOLTING: SA-192 B7 STUDS + 2 SA-193 HH NUTS
5. GASKET: Garlock 9800 OR EQUAL TO MATCH FLANGE
6. PIPING TO BE BUILT TO ASME B31.9 Building services piping

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REV #	DESCRIPTION	DATE	NOTES:
0			

PIPING LAYOUT
MAIN STEAM-VENT

OSU HTTF PACKAGE

VENDOR DWG. NO.	HTTF-M3.1	CAD FILE NAME	HTTF-M1.DWG	SCALE	as noted

DRAWN BY J NYLANDER	DATE	
REVIEWED BY	DATE	
APPROVED BY	DATE	08-02-10
DRAWING NO. HTTF-M3		REVISION 0
SHEET 1 OF 2		

RCCS
INSULATED STRUCTURE, 96'x96' x 240'HIGH
REACTOR CAVITY COOLANT SYSTEM
400 KW @ ATM & 250F

HX-8xx
Heat collection panel
Temp-plate 6SCx-EP
5F dT @ 10 GPM & 0.08PSID

P-801
RCCS Circulation Pump
Centrifugal Pump
30 GPM @ 75' TDH, 2HP-480/3P,

PPV-100
VESSEL, 68"ID x 120" T-T
PRIMARY PRESSURE VESSEL
143PSIG @ 1063F, FV

HX-701
CIRCULATOR HEAT REJECTION
AIR COOLED HEAT EXCHANGER
100PSIG @230F, FV

P-700
CIRCULATOR COOLING PUMP
CENTRIFUGAL PUMP
20GPM @ 50tdh, 100 PSIG CASE

HTFC
CIRCULATOR CONTAINMENT VESSEL
VESSEL, 48"ID x 72" T-F
155 PSIG @ 550F

HX-200
CIRCULATOR COOLING JACKET
AIR-WATER HEATING COIL
50kw@ 200F

C-200
PRIMARY COOLANT CIRCULATOR
CENTRIFUGAL BLOWER
5PSIG @ 2500 ACFM

HX-200
PCS STEAM GENERATOR
HEAT EXCHANGER, 22"ID x 72" T-T
SHELL SIDE 100PSIG @450F, FV
TUBE SIDE, 143 PSIG @1300F/FV

P-100
FEEDWATER PUMP
CENTRIFUGAL PUMP
20GPM @ 60PSIG, 2HP 480V 3PH

T-010
VESSEL, 12"ID x 60" T-T
RCCS\COOLANT DAY TANK
ATM @ 220F, FV

T-300
VESSEL, 68"ID x 282" T-T (640 CF)
REACTOR CAVITY SIMULATION TANK
15PSIG @ 1050F, FV

HX-500
CST PREHEATER
HEAT EXCHANGER,
SHELL SIDE 15PSIG @1072F, FV
TUBE SIDE, 100 PSIG @ 300F/FV

B-500
RCST EVACUATION/RECIRULATION BLOWER
REGENERATIVE BLOWER
64"H20 @ 210 CFM\370CFM max flow)

EXISTING HMFTF CW SYSTEM
EXISTING 3" AIR HEADER
1"-A-CS1-900
4"-RCV-SS6-400
PHASE 3 ERECTION
PPV MODULE LIMITS
PPV MODULE LOOSE SHIP
LINTERNAL SPOOL FABRICATED TO MATCH BREAK SCENARIO
HTTF STAFF INSTALL
1-1/2"-RCC-CP1-890
1-1/2"-RCC-CP1-891
3/4"-RCC-CP1-810
3/4"-RCC-CP1-820
3/4"-RCC-CP1-830
3/4"-RCC-CP1-840
3/4"-RCC-CP1-850
3/4"-RCC-CP1-860
3/4"-RCC-SS1-880
3/4"-RCC-CP1-870
3/4"-RCC-CP1-880
TCA 819
TCA 829
TCA 839
TCA 849
TCA 859
TCA 869
TCA 879
TCA 889
TCA 811
TCA 821
TCA 831
TCA 841
TCA 851
TCA 861
TCA 871
TCA 881
V-812
V-822
V-832
V-842
V-852
V-862
V-872
V-882
1-1/2"-RCC-CP1-803
1-1/2"-RCC-CP1-802
1-1/2"-RCC-CP1-801
1-1/2"-RCC-CP1-800
V-809
V-808
V-807
V-805
V-804
V-803
FIC 801
FIT-801
TIT 801
HDA 801
3HP 480 3ph
VSD 801
SV-332
V-332
4"-RCB-SS6-332
V-100
A-901
F-901
IP-013
IP-207
IP-311
IP-313
IP-331
IP-332
IP-400
IP-531
IP-533
IP-602
SPARE
1-1/2"-CV-CP1-700
1-1/2"-CV-CP1-702
PSL 701
PCV-701
V-701
V-702
V-703
V-704
PSV-100
153 PSIG
3" 150#
1-1/2" 600#
HDA 200
75HP
480 3 PH
VSD 200
TIC 003
TIT 202
PIT 201
PIC 201
IP-400
SV-203
V-203
V-400
2"
8"-PCC-SS3-201
8"-PCC-SS3-200
C-200
PIT 200
PI 312
PCV-503
MS 702
3HP, 480 3 PH
SD-720
SD-730
SD-721
SD-731
V-705
V-706
V-707
V-708
TIC 250
TIT 250
TIC 602
TIT 201
PIT 700
PIT 601
LDP 601
LIC 601
PCV-601HP
PCV-601LP
V-601
HX-100
100 PSIG
PSV-600
4"-MS-SS1-601
T/P-602
set 60psig
PCV-602
FUTURE 4" STEAM BREAK
to LCV-603
AIC 200
10"-RCH-SS6-101
12"-PCH-SS6-101
18"-PCC-SS3-200
SV-313
V-313
SV-311
V-311
12" HOT LEG BREAK SPOOL
HOT LEG BREAK VISUALIZATION DUCT
4" COMMUNICATION BREAK SPOOL
PPV-RCST
RCST MODULE
T-300
RCST
TIT 532
PIT 300
2"-PCS-SS1-532
DRAIN
PSV-300
set 15 psig
TIC 532
SV-551
PCV-550
2"-PCS-SS1-550
IP-532
V-532
SV-533
V-533
2"-PCS-SS1-531
AIC 533
PDT 500
B-500
HDA 701
7.5HP
480 3 PH
SV-531
V-531
2"-PCS-SS1-530
PI 540
PCV-540
1/2"-PCS-SS1-540
PI 501
SV-502
PCV-501
0-160psig
TIT 100
TIT 200
SV-331
V-331
4"-RCB-SS6-331
SCR 101
SCR 102
SCR 103
SCR 104
SCR 105
SCR 106
SCR 107
SCR 108
SCR 109
SCR 110
TIC 003
10ea @ 265amps
2650 amps = 2.2MW
480 3 PH
480 3 PH
TIC 010
TIT 010
T-010
LSL 010
LCV-010
1"-FW-CP1-060
PCV-010
V-005
1"-FW-CP1-001
V-012
V-011
FIT-010
IP-013
LCV-013
V-010
P-010
HDA 801
VSD 010
3HP 480 3ph
T-001
V-022
V-024
V-021
V-023
V-003
F-001
PW-002
V-001
1/4"-FW-CP1-020
EXISTING 2" POTABLE WATER HEADER
PHASE 3 ERECTION
PPV MODULE LIMITS
VTA
DRAIN

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REV #	DESCRIPTION	DATE	NOTES:
0			
A	PIPING & EQUIPMENTL REVISIONS	5-15-11	
B	PRE BID REVISIONS	8-22-11	

PROCESS & INSTRUMENT DIAGRAM
PROCESS CONTROL

OSU HTTF PACKAGE

VENDOR DWG. NO. 25651- | CAD FILE NAME HTTF-PIDB.DWG | SCALE as noted

DRAWN BY J. NYLANDER	DATE 07-06-11
REVIEWED BY	DATE
APPROVED BY	DATE
DRAWING NO. HTTF-PID	REVISION B
SHEET 1 OF 1	

OSU HTTF Gas System Piping and Hangers Specification, Revision NC

OSU-HTTF-211001-SPEC-001-R0

Date Published: February 3, 2011

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OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	03FEB11	OSU-HTTF-211001-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification covers general technical requirements and details for the selection, fabrication, testing, cleaning, marking, shipping, and inspecting of all gas system piping and hangers. Gas system piping includes all pipes through which the gas coolant flows including primary loop, depressurization venting pipes, and pipes in communication with the Cavity Simulation Tank. Systems consist of necessary straight lengths of pipe, elbows, reducers, fittings, auxiliary pipe connections, instrumentation taps and specialties called for by the applicable drawings.

2. GENERAL

(A) Purpose

The purpose of the piping for the HTTF is to provide a controlled fluid path through each component as laid out in the piping drawings. The hangers are arranged to provide appropriate support for piping to allow for thermal expansion and prevent buckling.

(B) Location

The primary gas system will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

(C) Welding shall be used throughout for joining large pipe except where flanged joints are specified or shown on drawings. Screwed or socket connections shall be used for small pipe, except where flanged joints are specified or shown on drawings. No seal welding will be permitted unless indicated in specifications or drawings. The number of welded joints shall be kept to a minimum and 3 pipe diameter minimum length is required if added pieces of pipe are used. All piping shall be erected true to lines and elevations as indicated on the piping drawings.

(D) Piping shall be shop or field fabricated and of the sizes noted on the drawings. Fittings shall be used for changes in directions, except as herein modified. Field hot or cold bending, except for low pressure instrumentation and control copper tubing will not be permitted.

(E) Piping shall be fabricated and erected in accordance with the piping drawings and as described herein.

(1) Each pipe bend shall be made with at least five (5) pipe diameters, unless noted otherwise on the drawings.

(2) All elbows shall be long radius unless noted otherwise on the drawings.

(3) Vendor shall make allowance for gaskets.

(F) It shall be the responsibility of the Construction Contractor to furnish piping vendor with prints of all special valves.

3. STANDARDS

Piping and fittings shall be designed, fabricated and tested in accordance with ASME B31.1-2001 Power Piping as well as ASME 16.5-1996 Pipe Flanges and Flanged Fittings.

4. DESIGN CONDITIONS

Primary Piping Conditions

(A)	Design Pressure	0.986 MPa (143 psig)
(B)	Design Temperature (Gas)	1100 °C (2012 ^{o}F)
(C)	Normal Operating Pressures	0 to 0.81 MPa (0 to 118 psig)
(D)	Normal Operating Temperatures (Gas)	Room Temp (RT) to 1000 °C (RT to 1832 ^{o}F)
(E)	Fluid (Gas)	
	(1) Type	Helium, Nitrogen, Air, Argon, Carbon Dioxide

5. OPERATING CONDITIONS

(A) <u>Depressurizing</u>

Depressurization during normal operation of the primary system shall occur indirectly through depressurization valves connected to the primary loop. The primary piping shall be constructed such that significant vessel mechanical degradation is not expected following a pressure reduction from the system operating pressure to atmospheric pressure over a 30 second period while the primary system is at room temperature.

(B) Cycling
The primary system shall be capable of 1000 cycles from atmospheric pressure and room temperature to its operating pressure and temperature and back to atmospheric pressure and room temperature over its lifetime.

(C) Leakage
The primary piping shall have a maximum helium leakage at its allowable operating pressure and temperature such that the helium leakage from the entire HTTF primary system does not exceed 1% of total helium mass inventory over 1 hour.

6. GENERAL CONSTRUCTION

(A) Quality Control – The Vendor shall maintain a quality control system. The Vendor shall submit complete outlines of his inspection processes and procedures.

7. CODE STAMPED VESSELS

No welding or penetrations shall be made in the field on the shells of ASME code stamped vessels.

8. PIPE AND FITTING WALL THICKNESS

(A) Pipe – The minimum acceptable pipe wall thicknesses are shown in ASME B31.1

(B) Fittings – The nominal pipe wall thickness shown in ASME standard B31.1 shall be increased in accordance with Vendor's standards to account for the manufacturing process used for bends and fittings. Such standards shall include allowance for a) thinning of the pipe wall due to any bending and forming operations and b) shop fabrication tolerances. In no case shall the furnished wall thickness be less than the minimum required by ASME standard B31.1

(C) Alignment – The ends of pipe-to-pipe, pipe-to-fittings, and pipe-to-valve joints shall be aligned as accurately as is practical within the existing commercial tolerances on pipe diameters, pipe wall thicknesses and out-of-roundness. Alignment shall provide the most favorable condition for the deposition of the root bead. This alignment shall be preserved during welding. In cases where ends of unequal internal diameters are abutted, and the internal misalignment exceeds 1/16 inch, the pipe with the smaller internal diameter shall be internally trimmed so that the adjoining internal diameters will result in approximately the same thickness.

9. WELDING

All welding shall be done in accordance with the manufacturer's procedures. Approved ASME or qualified procedures as submitted by manufacturer or fabricator are also acceptable.

10. WELDERS: QUALIFYING TESTS AND INDICATION

All welders engaged in work performed both on pipe and hanger welding shall have been qualified in accordance with the test requirements of approved ASME qualifications as submitted by manufacturer or fabricator.

11. TOLERANCES

Dimensional tolerances of fabricated sections shall be at least equivalent to those found in ASME B31.1 and ASME B16.5.

12. FINISHED PIPE

The finished piping shall be free from injurious defects. Surface defects such as scabs, laps, tears, seams, or slivers, shall be removed by machining or grinding as shown in the applicable ASTM specification. Repair by welding shall be permitted as required in the applicable ASTM specification.

13. HEAT TREATMENT

Any general heating operation in the shop such as is required for hot bending or forming where the stainless steel material is heated above 800°F, (not including welding) shall be followed by a solution heat treatment.

14. FLANGES

Contractor shall install flanged connections, blind flanges, and other non-welded joints as shown on the drawings and in compliance with all applicable piping standards. Flange gaskets shall be carefully installed to ensure proper sealing without wrinkles or tears. Bolts shall be tightened evenly to ensure that all bolts are stressed equally.

15. GASKETS

Gaskets shall be supplied and assembled by vendor in all applicable locations. Gaskets shall conform to ASME 16.20 or 16.21, whichever is applicable. Gaskets shall be made of stainless steel 304 or better.

16. FITTINGS

Fittings shall be installed as shown on the drawings. In general, pipe fittings 2-1/2 inches and larger shall be butt welded type. Pipe fittings 2 inches and smaller shall be either socket or butt welding type, or threaded. All fittings shall have the same pressure and temperature rating as their mating pipe at a minimum.

17. PIPE ATTACHMENTS

(A) All welded hanger attachments and instrument pads shall be supplied in the same material and be subject to the same fabricating procedures as the main piping.

(B) No nozzles shall be installed in any circumferential pipe welds. Thermocouple wells shall be tapped according to their specified details on drawings.

(C) The fabrication and use of weld connections shall be in accordance with ASME B31.1-2001 Power Piping. Welded connections or saddled connections shall be used if the branch line pipe size is 75 percent or less of the main run pipe size as shown in the drawings. Fittings shall be used for branch lines greater than 75 percent of the main run as shown on the drawings.

(D) Welded caps shall be used for all welded enclosures and headers.

(E) Unions shall be installed where shown on drawings to facilitate removal of equipment.

18. SWAGE NIPPLES

Reduction in piping shall be made with reducing fittings or commercial pipe swages.

19. SLEEVES

Where pipe lines pass through floors, gratings, walls and partitions, standard steel pipe sleeves, when practicable, shall be set before walls and floors are constructed. Sleeves through gratings shall be welded. All sleeves shall have sufficient internal diameter to allow for the thickness of piping insulation and to permit free expansion movement of the piping plus clearance of 1 inch all around. Sleeves shall project approximately 4 inches above floors, gratings, or floor plates, unless otherwise noted. All openings through checkered plated, grating or concrete floors shall be properly reinforced. Details of typical installations are provided in the drawings.

20. TESTS AND INSPECTION

(A) Hydrostatic Tests

Hydrostatic testing prior to flushing of the fabricated assemblies shall be done after erection in accordance with ASME B31.1-2001, and the pressures used shall conform to the pressures designated in corresponding pipe codes.

Precautions shall be taken to protect the mechanical parts of valves from excessive unbalanced pressure either by raising the pressure on the side of the valve not under test, or by the use of blanked-off flanges, or blocking the disc open in the case of check valves. Precautions shall be taken to protect all equipment from excessive pressure. Details of testing shall be in accordance with the following paragraphs:

(1) All lines which have successfully completed testing shall be tagged and a record shall be kept of all testing operations and the results.

(2) The assembled pipe systems shall be visually inspected while under test pressure. Where hydrostatic testing is impractical, piping shall be similarly tested with steam, gas or air to a pressure at least equal to the pressure designated in the applicable piping code.

(3) Test of gas piping shall be made after installation with air at test pressures designated in the piping codes.

(4) All dirt and foreign matter shall be removed by a thorough flushing with water, or air corresponding to fluid used for hydrostatic test. Each valved section of installed pipe shall be flushed independently. Tests on lines concealed by structural work must be tested and proved tight before the pipes are concealed. Care should be taken to properly brace all caps and plugs before the test pressure is applied, and that all piers, masonry supports, and anchors at bends are in place. The test pressure shall be maintained until a thorough inspection can be made of all joints. All leaks shall be repaired and the test repeated until the test section is proved tight to the satisfaction of all applicable ASME codes.

(B) Radiography and Fluid Penetrant Tests

Radiography, fluid penetrant tests and inspection of all socket, fillet, and groove welds shall be in accordance with all applicable ASME specifications

(C) Inspection

The contractor shall provide for and perform the inspection of all straight pipe, shop fabricators assemblies, and fittings furnished by them for the project. Contractor shall maintain a receiving and inspection area. A separate storage area for materials released for field fabrication or installation shall also be maintained.

The procedure for inspection of pipe material furnished for the project shall include the following:

(1) Thorough visual examination in accordance with the applicable ASME specification of outside and inside surfaces for injurious defects such as checks, seams, slivers, pits, mechanical abrasions and dents.

(2) For carbon steel and stainless steel pipes determine and record the following:

a. The fabrication identification mark.

b. The concentricity and straightness of each piece.

c. The end preparation to ensure it is as specified.

d. The heat number of heat pipe, excluding carbon steel.

e. Material certification for stainless steel piping.

(3) Piping material having defects considered by the contracting officer to be unacceptable shall be removed from the job site by the contractor immediately.

21. FIELD RUN PIPING

Routing of small piping and tubing not dimensioned on the drawings shall be routed and erected in a neat and convenient manner, supported properly, and installed in accordance with the requirements of flow and instrument diagrams.

22. INSTRUMENT PIPING

(A) Instrument piping shall conform to the requirements found in ASME B31.1-2001. Special tools shall be used for forming tubing ends and for bending. Care shall be taken to avoid flattening or damaging of tubing. All tubing and instrument piping shall be thoroughly cleaned by blowing with compressed air after erection and before connections to instruments or controls.

(B) All temperature, flow, pressure, level instrumentation wells shall be installed in accordance with the drawings.

(C) Tubing runs in exposed locations subject to accidental crushing or damaging shall be protected with lightweight structural channels.

(D) Shut-off valves shall be located as close to each main line tap location as possible.

23. FIELD ERECTION

(A) General

(1) All piping shall be installed in accordance with ASME B31.1-2001, except where specified herein.

(2) The male end of all pipe having threaded joints shall be reamed to remove burrs, the threads of both parts cleaned and a leaded thread lubricant applied

to the male threads only before making up the joint. Changes in direction shall be made by standard fittings of the same material as the run of pipe. Branches of threaded and coupled pipe shall be made from standard fittings.

(3) Grinding wheels, wire brushed, and cutting tools used on carbon steel materials shall not be used on stainless steel pipe. Stainless steel wire brushes shall be used for cleaning.

(4) When attaching piping to pumps and equipment, special care shall be taken to avoid excessive stresses.

24. CLEANING, MARKING, SHIPPING AND PROTECTION

(A) Cleaning

(1) General

Prior to installation, all piping and fittings shall be clean and free from blisters, loose mill scale, sand, dirt, rust, oil grease and other foreign material.

During installation care shall be taken by means of plugs and caps to prevent introduction of foreign materials into the completed systems.

Control valves and flanged systems shall not be removed during flushing. Control valves in welded systems shall not be disassembled and capped. The contractor shall not install strainers ahead of control valves.

All flushing shall be continuous using water or air. Temporary strainer elements shall be periodically removed, cleaned of debris, and placed back in service. When the strainer elements have remained clean for a period of not less than 1/2 hours, flushing shall be discontinued and the temporary piping shall be removed. Permanent strainers shall be cleaned. All equipment removed during flushing shall be individually cleaned and replaced, and the systems shall be placed in full operating condition.

(2) Stainless Steel Materials

Prior to installation, stainless steel shall be kept as clean as reasonably achievable and shall be periodically checked to ensure no entrance of foreign material. After installation, all stainless steel piping shall be flushed initially in the same manner as carbon steel previously described, followed by a second flush with deminerilized water.

(3) Other Pipe Systems

After installation, all water lines shall be flushed in the same manner as stainless steel previously described.

(B) Marking

Piping, tubing, flanges, welding fittings, nozzles, and welding caps, shall be marked in accordance with ASME A13.1-2007

(C) Shipping and Protection

During shipment internal surfaces of stainless steel pipe and fittings shall be protected by plugging or covering the pipe ends. Molded polyethylene caps adequately taped in place is an acceptable method for protecting pipe ends and precautions shall be taken to ensure the pipe arrives in good conditions.

25. HANGERS, SUPPORTS AND ANCHORS

(A) Standards

Unless otherwise specified herein, all hangers, supports, and anchors shall conform to the following specifications:

(1) ANSI/MSS SP-69-2003 Pipe Hangers and Supports - Selection and Application Manufacturers Standardization Society

(2) MSS SP-58-2002 Pipe Hangers and Supports - Materials, Design and Manufacture

(3) MSS SP-89-2003 Pipe Hangers and Supports - Fabrication and Installation Practices

(4) MSS SP-127-2001 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

(5) Unistrut General engineering catalog No 16

(B) Pipe Sizes 2-1/2 inches and larger

All pipe hangers and supports including structural members for supporting pipe hangers between floor beams, turnbuckle rod hangers, anchors, rollers and guides for the piping system shall be installed as shown on the drawings.

(C) Pipe Sizes 2 inches and Smaller

Contractor shall select and furnish hangers and supports for all pipe lines and tubing, 2 in. and smaller, unless detailed on the drawings, in accordance with the following specifications:

(1) Hangers and Support Spacing

The maximum permissible unsupported pipe and tubing spans for selected hangers shall be as follows:

Pipe Size (inches)	Span Length (feet)
1 and smaller	10
1-1/2	12
2	15

(2) Type of Pipe Attachment

Pipe lines shall be attached to hangers with adjustable clevises or equally approved. Tubing shall be supported with Unistrut or equally approved type members. Tubing may not be placed inside or attached to electrical cable trays.

(3) Pipe Hanger Connection Details

The selection of pipe hanger attachments to steel shall be governed by considerations of safety and minimum field work and shall be one of the following types:

a. Beam Clamps or approved equal. Scissor-type clamps are acceptable for use on 8WF17 beams or larger WF, or on other beams with flanges 3/8 inches or more in thickness.

b. For beams where the scissor-type clamp cannot be used, a weld type connection consisting of U-shaped bars or approved equal shall be used and secured by welds parallel to the longitudinal axis of the beam.

c. Supplementary steel shall be framed into webs of steel. Supplementary steel may rest on and be welded to top of bottom flange of a beam. Sub-framing consisting of channels or angles back-to-back shall be tied with battens, fillers, diaphragms or stitch rivets.

(4) Miscellaneous Details

Plain steel lugs may be welded to build structural members for hanger support.

Wall brackets shall be bolted to wall using concrete inserts or anchored with bolts extending through wall with steel backing plates of sufficient size to properly distribute the load over the wall. On steel construction, brackets may be welded to structural steel.

Riser clamps may rest directly on floor sleeves or can be hung from above using hangers. To hold pipe tightly in place, offset pipe clamps or longer arm riser clamps shall be used.

Pipe supports shall be spaced to permit proper drainage of pipe by limiting pipe sag.

OSU HTTF Water System Piping and Hangers, Revision NC

OSU-HTTF-221001-SPEC-001-R0

Date Published: December 16, 2010

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Approved: _____

Brian G. Woods
OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	16DEC10	OSU-HTTF-211001-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification covers general technical requirements and details for the selection, fabrication, testing, cleaning, marking, shipping, inspecting and installation of all water system piping and hangers. Water system piping includes all piping of the steam generator water supply system, and piping used in the Reactor Cavity Cooling System (RCCS). The RCCS heat exchanger panels are not part of this specification, only piping needed for water delivery to, from and between the panels. Systems consist of necessary straight lengths of pipe, elbows, reducers, fittings, auxiliary pipe connections, instrumentation taps and specialties called for by the applicable drawings.

2. GENERAL

(A) Purpose

The purpose of the piping for the HTTF is to provide a controlled fluid path through each component as laid out in the piping drawings. The hangers are arranged to provide appropriate support for piping to allow for thermal expansion and prevent buckling.

(B) Location

The primary water system will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

(C) Welding shall be used throughout for joining large pipe except where flanged joints are specified or shown on drawings. Screwed or socket connections shall be used for small pipe, except where flanged joints are specified or shown on drawings. No seal welding will be permitted unless indicated in specifications or drawings. The number of welded joints shall be kept to a minimum and 3 pipe diameter minimum length is required if added pieces of pipe are used. All piping shall be erected true to lines and elevations as indicated on the piping drawings.

(D) Piping shall be shop or field fabricated and of the sizes noted on the drawings. Fittings shall be used for changes in directions, except as herein modified. Field hot or cold bending, except for low pressure instrumentation and control copper tubing will not be permitted.

(E) Piping shall be fabricated and erected in accordance with the piping drawings and as described herein.

(1) Each pipe bend shall be made with at least five (5) pipe diameters, unless noted otherwise on the drawings.

(2) All elbows shall be long radius unless noted otherwise on the drawings.

(3) Vendor shall make allowance for gaskets.

(F) It shall be the responsibility of the Construction Contractor to furnish piping vendor with prints of all special valves.

3. STANDARDS

Piping and fittings shall be designed, fabricated and tested in accordance with ASME B31.1-2001 Power Piping as well as ASME 16.5-1996 Pipe Flanges and Flanged Fittings.

4. DESIGN CONDITIONS

Steam Generator Water Supply System

(A)	Design Pressure	0.54 MPa (78 psig)
(B)	Design Temperature	360 °F (182.2 ^{o}F)
(C)	Normal Operating Pressures	0.43 MPa (62 psig)
(D)	Normal Operating Temperatures	60 to 300 F (15 to 149 C)
(E)	Fluid	
	(1) Type	City water, steam

Reactor Cavity Cooling System

(A)	Design Pressure	0.43 MPa (62.5 psig)
(B)	Design Temperature	188 F (87 C)
(C)	Normal Operating Pressures	0.344 MPa (50 psig)
(D)	Normal Operating Temperatures (Gas)	Room Temp (RT) to 150 F (RT to 66 C)

(E) Fluid

(1) Type City water

5. GENERAL CONSTRUCTION

(A) Quality Control – The Vendor shall maintain a quality control system. The Vendor shall submit complete outlines of his inspection processes and procedures.

6. CODE STAMPED VESSELS

No welding or penetrations shall be made in the field on the shells of ASME code stamped vessels.

7. PIPE AND FITTING WALL THICKNESS

(A) Pipe – The minimum acceptable pipe wall thicknesses are shown in ASME B31.1

(B) Fittings – The nominal pipe wall thickness shown in ASME standard B31.1 shall be increased in accordance with Vendor's standards to account for the manufacturing process used for bends and fittings. Such standards shall include allowance for a) thinning of the pipe wall due to any bending and forming operations and b) shop fabrication tolerances. In no case shall the furnished wall thickness be less than the minimum required by ASME standard B31.1

(C) Alignment – The ends of pipe-to-pipe, pipe-to-fittings, and pipe-to-valve joints shall be aligned as accurately as is practical within the existing commercial tolerances on pipe diameters, pipe wall thicknesses and out-of-roundness. Alignment shall provide the most favorable condition for the deposition of the root bead. This alignment shall be preserved during welding. In cases where ends of unequal internal diameters are abutted, and the internal misalignment exceeds 1/16 inch, the pipe with the smaller internal diameter shall be internally trimmed so that the adjoining internal diameters will result in approximately the same thickness.

8. WELDING

All welding shall be done in accordance with the manufacturer's procedures. Approved ASME or qualified procedures as submitted by manufacturer or fabricator are also acceptable.

9. WELDERS: QUALIFYING TESTS AND INDICATION

All welders engaged in work performed both on pipe and hanger welding shall have been qualified in accordance with the test requirements of approved ASME qualifications as submitted by manufacturer or fabricator.

10. TOLERANCES

Dimensional tolerances of fabricated sections shall be at least equivalent to those found in ASME B31.1 and ASME B16.5.

11. FINISHED PIPE

The finished piping shall be free from injurious defects. Surface defects such as scabs, laps, tears, seams, or slivers, shall be removed by machining or grinding as shown in the applicable ASTM specification. Repair by welding shall be permitted as required in the applicable ASTM specification.

12. HEAT TREATMENT

Any general heating operation in the shop such as is required for hot bending or forming where the stainless steel material is heated above 800°F, (not including welding) shall be followed by a solution heat treatment.

13. FLANGES

Contractor shall install flanged connections, blind flanges, and other non-welded joints as shown on the drawings and in compliance with all applicable piping standards. Flange gaskets shall be carefully installed to ensure proper sealing without wrinkles or tears. Bolts shall be tightened evenly to ensure that all bolts are stressed equally.

14. GASKETS

Gaskets shall be supplied and assembled by vendor in all applicable locations. Gaskets shall conform to ASME 16.20 or 16.21, whichever is applicable. Gaskets shall be made of stainless steel 304 or better.

15. FITTINGS

Fittings shall be installed as shown on the drawings. In general, pipe fittings 2-1/2 inches and larger shall be butt welded type. Pipe fittings 2 inches and smaller shall be either socket or butt welding type, or threaded. All fittings shall have the same pressure and temperature rating as their mating pipe at a minimum.

16. PIPE ATTACHMENTS

(A) All welded hanger attachments and instrument pads shall be supplied in the same material and be subject to the same fabricating procedures as the main piping.

(B) No nozzles shall be installed in any circumferential pipe welds. Thermocouple wells shall be tapped according to their specified details on drawings.

(C) The fabrication and use of weld connections shall be in accordance with ASME B31.1-2001 Power Piping. Welded connections or saddled connections shall be used

if the branch line pipe size is 75 percent or less of the main run pipe size as shown in the drawings. Fittings shall be used for branch lines greater than 75 percent of the main run as shown on the drawings.

(D) Welded caps shall be used for all welded enclosures and headers.

(E) Unions shall be installed where shown on drawings to facilitate removal of equipment.

17. SWAGE NIPPLES

Reduction in piping shall be made with reducing fittings or commercial pipe swages.

18. SLEEVES

Where pipe lines pass through floors, gratings, walls and partitions, standard steel pipe sleeves, when practicable, shall be set before walls and floors are constructed. Sleeves through gratings shall be welded. All sleeves shall have sufficient internal diameter to allow for the thickness of piping insulation and to permit free expansion movement of the piping plus clearance of 1 inch all around. Sleeves shall project approximately 4 inches above floors, gratings, or floor plates, unless otherwise noted. All openings through checkered plated, grating or concrete floors shall be properly reinforced. Details of typical installations are provided in the drawings.

19. TESTS AND INSPECTION

(A) Hydrostatic Tests

Hydrostatic testing prior to flushing of the fabricated assemblies shall be done after erection in accordance with ASME B31.1-2001, and the pressures used shall conform to the pressures designated in corresponding pipe codes.

Precautions shall be taken to protect the mechanical parts of valves from excessive unbalanced pressure either by raising the pressure on the side of the valve not under test, or by the use of blanked-off flanges, or blocking the disc open in the case of check valves. Precautions shall be taken to protect all equipment from excessive pressure. Details of testing shall be in accordance with the following paragraphs:

(1) All lines which have successfully completed testing shall be tagged and a record shall be kept of all testing operations and the results.

(2) The assembled pipe systems shall be visually inspected while under test pressure. Where hydrostatic testing is impractical, piping shall be similarly tested with steam, gas or air to a pressure at least equal to the pressure designated in the applicable piping code.

(3) Test of gas piping shall be made after installation with air at test pressures designated in the piping codes.

(4) All dirt and foreign matter shall be removed by a thorough flushing with water. Each valved section of installed pipe shall be flushed independently. Tests on lines concealed by structural work must be tested and proved tight before the pipes are concealed. Care should be taken to properly brace all caps and plugs before the test pressure is applied, and that all piers, masonry supports, and anchors at bends are in place. The test pressure shall be maintained until a thorough inspection can be made of all joints. All leaks shall be repaired and the test repeated until the test section is proved tight to the satisfaction of all applicable ASME codes.

(B) Radiography and Fluid Penetrant Tests

Radiography, fluid penetrant tests and inspection of all socket, fillet, and groove welds shall be in accordance with all applicable ASME specifications

(C) Inspection

The contractor shall provide for and perform the inspection of all straight pipe, shop fabricators assemblies, and fittings furnished by them for the project. Contractor shall maintain a receiving and inspection area. A separate storage area for materials released for field fabrication or installation shall also be maintained.

The procedure for inspection of pipe material furnished for the project shall include the following:

(1) Thorough visual examination in accordance with the applicable ASME specification of outside and inside surfaces for injurious defects such as checks, seams, slivers, pits, mechanical abrasions and dents.

(2) For carbon steel and stainless steel pipes determine and record the following:

a. The fabrication identification mark.

b. The concentricity and straightness of each piece.

c. The end preparation to ensure it is as specified.

d. The heat number of heat pipe, excluding carbon steel.

e. Material certification for stainless steel piping.

(3) Piping material having defects considered by the contracting officer to be unacceptable shall be removed from the job site by the contractor immediately.

20. FIELD RUN PIPING

Routing of small piping and tubing not dimensioned on the drawings shall be routed and erected in a neat and convenient manner, supported properly, and installed in accordance with the requirements of flow and instrument diagrams.

21. INSTRUMENT PIPING

(A) Instrument piping shall conform to the requirements found in ASME B31.1-2001. Special tools shall be used for forming tubing ends and for bending. Care shall be taken to avoid flattening or damaging of tubing. All tubing and instrument piping shall be thoroughly cleaned by blowing with compressed air after erection and before connections to instruments or controls.

(B) All temperature, flow, pressure, level instrumentation wells shall be installed in accordance with the drawings.

(C) Tubing runs in exposed locations subject to accidental crushing or damaging shall be protected with lightweight structural channels.

(D) Shut-off valves shall be located as close to each main line tap location as possible.

22. FIELD ERECTION

(A) General

(1) All piping shall be installed in accordance with ASME B31.1-2001, except where specified herein.

(2) The male end of all pipe having threaded joints shall be reamed to remove burrs, the threads of both parts cleaned and a leaded thread lubricant applied to the male threads only before making up the joint. Changes in direction shall be made by standard fittings of the same material as the run of pipe. Branches of threaded and coupled pipe shall be made from standard fittings.

(3) Grinding wheels, wire brushed, and cutting tools used on carbon steel materials shall not be used on stainless steel pipe. Stainless steel wire brushes shall be used for cleaning.

(4) When attaching piping to pumps and equipment, special care shall be taken to avoid excessive stresses.

23. CLEANING, MARKING, SHIPPING AND PROTECTION

(A) Cleaning

(1) General

Prior to installation, all piping and fittings shall be clean and free from blisters, loose mill scale, sand, dirt, rust, oil grease and other foreign material.

During installation care shall be taken by means of plugs and caps to prevent introduction of foreign materials into the completed systems.

Control valves and flanged systems shall not be removed during flushing. Control valves in welded systems shall not be disassembled and capped. The contractor shall not install strainers ahead of control valves.

All flushing shall be continuous using water. Temporary strainer elements shall be periodically removed, cleaned of debris, and placed back in service. When the strainer elements have remained clean for a period of not less than 1/2 hours, flushing shall be discontinued and the temporary piping shall be removed. Permanent strainers shall be cleaned. All equipment removed during flushing shall be individually cleaned and replaced, and the systems shall be placed in full operating condition.

(2) Stainless Steel Materials

Prior to installation, stainless steel shall be kept as clean as reasonably achievable and shall be periodically checked to ensure no entrance of foreign material. After installation, all stainless steel piping shall be flushed initially in the same manner as carbon steel previously described, followed by a second flush with deminerilized water.

(3) Other Pipe Systems

After installation, all water lines shall be flushed in the same manner as stainless steel previously described.

(B) Marking

Piping, tubing, flanges, welding fittings, nozzles, and welding caps, shall be marked in accordance with ASME A13.1-2007

(C) Shipping and Protection

During shipment internal surfaces of stainless steel pipe and fittings shall be protected by plugging or covering the pipe ends. Molded polyethylene caps adequately taped in place is an acceptable method for protecting pipe ends and precautions shall be taken to ensure the pipe arrives in good conditions.

24. HANGERS, SUPPORTS AND ANCHORS

(A) Standards

Unless otherwise specified herein, all hangers, supports, and anchors shall conform to the following specifications:

(1) ANSI/MSS SP-69-2003 Pipe Hangers and Supports - Selection and Application Manufacturers Standardization Society

(2) MSS SP-58-2002 Pipe Hangers and Supports - Materials, Design and Manufacture

(3) MSS SP-89-2003 Pipe Hangers and Supports - Fabrication and Installation Practices

(4) MSS SP-127-2001 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

(5) Unistrut General engineering catalog No 16

(B) Pipe Sizes 2-1/2 inches and larger

All pipe hangers and supports including structural members for supporting pipe hangers between floor beams, turnbuckle rod hangers, anchors, rollers and guides for the piping system shall be installed as shown on the drawings.

(C) Pipe Sizes 2 inches and Smaller

Contractor shall select and furnish hangers and supports for all pipe lines and tubing, 2 in. and smaller, unless detailed on the drawings, in accordance with the following specifications:

(1) Hangers and Support Spacing

The maximum permissible unsupported pipe and tubing spans for selected hangers shall be as follows:

Pipe Size (inches)	Span Length (feet)
1 and smaller	10
1-1/2	12
2	15

(2) Type of Pipe Attachment

Pipe lines shall be attached to hangers with adjustable clevises or equally approved. Tubing shall be supported with Unistrut or equally approved type members. Tubing may not be placed inside or attached to electrical cable trays.

(3) Pipe Hanger Connection Details

The selection of pipe hanger attachments to steel shall be governed by considerations of safety and minimum field work and shall be one of the following types:

a. Beam Clamps or approved equal. Scissor-type clamps are acceptable for use on 8WF17 beams or larger WF, or on other beams with flanges 3/8 inches or more in thickness.

b. For beams where the scissor-type clamp cannot be used, a weld type connection consisting of U-shaped bars or approved equal shall be used and secured by welds parallel to the longitudinal axis of the beam.

c. Supplementary steel shall be framed into webs of steel. Supplementary steel may rest on and be welded to top of bottom flange of a beam. Sub-framing consisting of channels or angles back-to-back shall be tied with battens, fillers, diaphragms or stitch rivets.

(4) Miscellaneous Details

Plain steel lugs may be welded to build structural members for hanger support.

Wall brackets shall be bolted to wall using concrete inserts or anchored with bolts extending through wall with steel backing plates of sufficient size to

properly distribute the load over the wall. On steel construction, brackets may be welded to structural steel.

Riser clamps may rest directly on floor sleeves or can be hung from above using hangers. To hold pipe tightly in place, offset pipe clamps or longer arm riser clamps shall be used.

Pipe supports shall be spaced to permit proper drainage of pipe by limiting pipe sag.

OSU HTTF Valves-Flow Control (Liquid) Specification, Revision NC

OSU-HTTF-241400-SPEC-001-R0

Date Published: December 20, 2010

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Approved: _____

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Record of Revisions

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Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of the Flow Control Valves and positioners, respectively, for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. GENERAL

(A) Purpose

The Flow Control Valves provide sustained, controlled flow rates as determined by the facility operator.

(A) Location

The primary pressure vessel and other systems will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. STANDARDS

All work furnished under this specification shall conform to:

(A) Industry Standard Architecture

(1) All applicable ISA standards necessary for the compliance of interfacing with standard pipe sizes and pressure temperature ratings at a minimum equivalent to pressure temperature ratings of schedule 40 stainless steel 316 piping of similar size.

4. MATERIALS OF CONSTRUCTION

All materials in direct contact with primary loop coolant shall be stainless steel Type 304, ASTM A-312-61T, or better. Materials used in other loops (secondary steam generator supply system, RCCS, Cavity Simulation Mixing piping system) shall be temperature and pressure rated in accordance with applicable industry standards to the temperatures and pressures of the neighboring piping.

5. GENERAL CONSTRUCTION

(B) Topworks

(1) The topworks shall be of the “spring opposed” type to obtain positive action on air failure (e.g. Air-to-close operating).

(2) The topworks shall be capable of handling the following control signals.

a. Pneumatic 90 psig

(3) Valve springs shall be fully enclosed in a metal housing and stamped or color coded for identification of characteristics. Maximum spring tolerance shall not exceed ±5% of the spring rate. Spring shall be ground flat on each end to minimize canting. (90° ± 1° angle to axis).

(4) Top works shall be sized so that valve will operate properly when the differential pressure is 10% greater than the design differential pressure limit.

(5) The spring shall not go solid under any conditions of operation.

(6) Topworks shall be removable without releasing pressure on bolted stuffing box.

(C) Bodies

(1) The body casting shall be provided with fillets on corners where a concentration of stress may be expected.

(2) Steel and stainless steel flanges shall be spot faced or back faced parallel to the flange face. Metal removed in spot facing or back facing shall not reduce the thickness of the flange below the minimum required for the ASME body rating.

(3) Valve bodies with flanged ends shall have pressure temperature rating at least equal to ASME standard applicable to end flanges specified.

(4) Bodies for service above 450 °F shall be equipped with thermal insulating bonnets.

(5) Valves shall consist of Sureguard XT Live Loaded Packing.

(D) Valve Positioners

(1) When an external valve positioner is specified it shall be mounted on or as near as possible to the valve body. The positioner shall be furnished with three two inch gasketed pressure gauges for air supply, input pressure, and output pressure.

(2) The positioned shall communicate through a HART communication via a 4 to 20 mA signal.

(3) If the electrical supply fails, the positioner shall have a spring return, or fail-safe-open position.

(4) Positioners shall be equipped with a digital display that presents the valve position between 0 and 100% of its available rotational range, or a malfunction, alarm or message based on the most important process available.

(5) The following states shall be available for the positioned, (1) 4-20 mA setpoint signal out of range, (2) position our of the adjusted range, (3) positioning time-out, (4) position controller inactive, (5) counter limits exceeded.

(E) Inner Valves

(1) If inner valve is specified to have equal-percent characteristic, port openings shall be shaped so that with constant pressure drop across the valve the percent change in flow per unit change in opening is a constant.

(2) If inner valve is specified to have linear characteristic, port openings shall be shaped so that with constant pressure drop across the valve the rate of flow through the valve is directly proportional to the opening.

(3) If inner valve is specified to have quick-opening characteristic, port openings shall be shaped so that maximum capacity is reached at a relatively small proportion of the total available maximum opening.

(4) The valve flow coefficient, CV, is defined by the following formula:

$$CV = \frac{Q\sqrt{G}}{\sqrt{\Delta P}}$$

where

Q = capacity in gpm
G = specific gravity at flowing temperature
ΔP = pressure drop in psi

(5) The valve rangability shall be 30:1 minimum. Rangeability is defined as maximum to minimum controllable flow at constant pressure drop.

6. PERFORMANCE & TESTING

(A) Hydrostatic Body Test

(1) Valve bodies shall be tested in accordance with ASME B31.1, 2001. The test procedure shall be maintained for a period of not less than 30 minutes. Any weeping or leakage through the valve body shall be considered cause for rejection.

(2) At 150% of operation pressure, there shall be no visible stem packing leakage.

(B) Travel

(1) Valves having "3 to 15 psi" range shall be factory adjusted so that air-to-close valves are fully open at 3 psig (±0.25 psig) and are fully closed at 15 psig, and air-to-open valves are fully closed at 3.0 psig, are fully open at 15 psig (±0.25 psig).

(2) Valves having "6 to 30 psi" range shall be factory adjusted so that air-to-close valves are fully open at 6.0 psig(±0.5 psig) and are fully closed at 30.0 psig and air-to-open valves are fully closed at 6.0 psig and are fully open at 30 psig (±0.5 psig) at normal operation conditions.

(C) Hysteresis

(1) Hysteresis tests shall be run on completely assembled valves. The stuffing box shall be fully packed and made up hand tight.

(2) All diaphragm motor valves shall be guaranteed to have a maximum hysteresis of 2% of spring range (unloaded body).

(D) Topworks Leakage

(1) Soap and water shall be brushed over the chamber and its flanges. No leakage is permitted.

(2) Assembled topworks shall be loaded to 150% of spring range with pressure gauge in circuit. A valve located at inlet to diaphragm shall then be shut. Capacity of pipe between valve and diaphragm shall not exceed 25% of maximum diaphragm casing volume. Pressure shall not decrease by more than 6% per hour.

7. MISCELLANEOUS

(A) Marking

(1) Valves shall have rustproof tag attached with rust-proof wire and stamped with their designated tag number.

(2) Body, bonnet, bottom plate, seating rings and inner valve shall be permanently marked with materials identification.

(3) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:
   a. Serial number
   b. Model number
   c. Valve tag number.

(B) Protective Coating and Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(2) Machined surfaces which will be exposed to the atmosphere in transit and subsequent storage shall be properly protected with an easily removable rust preventative coating of the proper consistency applied by the manufacturer, such as Rust-Ban 347, but not until inspection has been completed.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with cardboard, plastic, wooden, or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

(2) Desiccant must be applied to valve for moisture protection.

(3) Air connection openings on diaphragm; positioner or pneumatic accessories shall be plugged with plastic or metal seals.

(D) Packing

Valves must be packed so as to prevent damage during shipment. Special attention should be given to protection of pilots, positioners, and tubing.

8. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following control valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification in the form of one (1) electronic and one (1) hard copy.

(A) Control Valve Data

(1) Control valve CV at maximum opening
(2) Control valve capacity at sizing pressure drop

(3) Positioner air supply required
(4) Control valve rotation time, (from closed to full-open, and from full-open to closed).

(B) Operation and Maintenance Manuals

These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

(C) Certified Performance & Test Data

All test results produced as a result of the completion of requirements stated in section 6 must be presented to the customer in certified format including the date each test was conducted and the procedures used to perform these tests.

OSU HTTF Valves-Check (Liquid) Specification, Revision NC

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External Bid Solicitation

Approved: _____

Brian G. Woods
OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	20DEC10	OSU-HTTF-241400-SPEC-002 initial release.	B. Woods

Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of the Check Valves for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. STANDARDS

All check valves shall meet or exceed compliance of the following specifications:

API 594	Valve Design
API 598	Valve Pressure Testing and Inspection
ASME B16.5 & B16.47	Flanges
ASME B16.34	Pressure/Temperature Ratings
API 6D	Pipeline Valves
API 6A	Production Valves

3. GENERAL

(A) Location – The check valves will be located in the Nuclear Engineering and Radiation Health Physics Department building at Oregon State University, Oregon, at an elevation of 235 ft above sea level.

(B) Bodies-General

(1) The body casting shall be provided with fillets on corners where a concentration of stress may be expected.

(2) Valves shall be wafer style to fit between standard ASME 600# flanges.

(3) Bodies for service that are not weld-in above 450 °F shall be equipped with thermally insulating bonnets.

(4) The valve shall be of the “spring opposed” type to obtain positive action.

(C) Bolting – Steel and alloy steel bodies shall be bolted together with studs and nuts. Cast iron and bronze bodies may be bolted together with bolts or studs and nuts.

4. MATERIALS OF CONSTRUCTION

(A) Bolting

(1) Stainless steel valves shall have alloy steel bonnet and gland studs conforming appropriate ASTM standards. Similarly, all nuts shall conform to appropriate ASTM standards.

(B) Trim – Trim shall be of material stainless steel type 316.

(C) Seat – Valve seats shall be made of Reinforces PTFE

(D) Seals – Seals shall be made of Fluorocarbon FKM.

(E) Spring – Spring shall be made of tempered alloy steel or stainless steel.

5. MISCELLANEOUS

(A) Marking

(1) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:

a. Serial number
b. Model number
c. Valve tag number.

(B) Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with cardboard, plastic, wooden, or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

(2) Desiccant must be applied to valve for moisture protection.

(D) Packing – Valves must be packed so as to prevent damage during shipment.

6. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following check valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification.

(A) Check Valve Data
Check valve capacity at sizing pressure drop

(B) Operation and Maintenance Manuals
These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

OSU HTTF Valves-General Pneumatic Logic (Liquid) Specification, Revision NC

OSU-HTTF-241400-SPEC-004-R0

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NC	20DEC10	OSU-HTTF-241400-SPEC-004 initial release.	B. Woods

Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of the General Pneumatic Logic Valves for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. GENERAL

(A) Purpose

The General Pneumatic Logic Valves provide sustained, controlled flow rates as determined by the facility operator.

(B) Location

The HTTF will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. STANDARDS

All work furnished under this specification shall conform to:

(A) American Society of Mechanical Engineers

(1) ASME A961 Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, valves, and Parts for Piping Applications

(2) ASME B16.10 Face to Face and End-to-End Dimensions of Valves

(3) ASME B16.34 Valves – Flanged, Threaded, and Welded End

(4) ASME B16.5 Standards of Piping and Fittings

4. MATERIALS OF CONSTRUCTION

All materials in direct contact with primary loop coolant shall be stainless steel Type 304, ASTM A-312-61T, or better. Materials used in other loops (secondary steam generator supply system, RCCS, Cavity Simulation Mixing piping system) shall be temperature and pressure rated in accordance with applicable industry standards to the temperatures and pressures of the neighboring piping.

5. GENERAL CONSTRUCTION

(A) Topworks

(1) All pneumatic logic valves shall be solenoid drive.

(2) Active limit switches for all pneumatic logic valves shall be installed including the active identification of both 0% open and 100% open.

(B) Bodies

(1) The body casting shall be provided with fillets on corners where a concentration of stress may be expected.

(2) Valve body shall be wafer type to fit against standard ASME 600# flanges or include ASME 600# flanges as appropriate.

(3) Bodies for service above 450 °F shall be equipped with heat insulation bonnets.

(4) Valves shall consist of Sureguard XT Live Loaded Packing.

(C) Inner Valves

(1) If inner valve is specified to have equal-percent characteristic, port openings shall be shaped so that with constant pressure drop across the valve the percent change in flow per unit change in opening is a constant.

(2) If inner valve is specified to have linear characteristic, port openings shall be shaped so that with constant pressure drop across the valve the rate of flow through the valve is directly proportional to the opening.

(3) If inner valve is specified to have quick-opening characteristic, port openings shall be shaped so that maximum capacity is reached at a relatively small proportion of the total available maximum opening.

(4) The valve flow coefficient, CV, is defined by the following formula:

$$CV = \frac{Q\sqrt{G}}{\sqrt{\Delta P}}$$

where

Q = capacity in gpm
G = specific gravity at flowing temperature
ΔP = pressure drop in psi

(5) The valve rangability shall be 30:1 minimum. Rangeability is defined as maximum to minimum controllable flow at constant pressure drop.

6. PERFORMANCE & TESTING

(A) Hydrostatic Body Test

(1) Valve bodies shall be tested in accordance with ASME B31.1, 2001. The test procedure shall be maintained for a period of not less than 30 minutes. Any weeping or leakage through the valve body shall be considered cause for rejection.

(2) At 150% of operation pressure, there shall be no visible stem packing leakage.

(B) Travel

(1) Valves shall be tested on 90 psi of supply air in both the open and closed state.

(C) Topworks Leakage

(1) Soap and water shall be brushed over the chamber and its flanges. No leakage is permitted.

7. MISCELLANEOUS

(A) Marking

(1) Valves shall have rustproof tag attached with rust-proof wire and stamped with their designated tag number.

(2) Body, bonnet, bottom plate, seating rings and inner valve shall be permanently marked with materials identification.

(3) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:

a. Serial number
b. Model number
c. Valve tag number.

(B) Protective Coating and Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(2) Machined surfaces which will be exposed to the atmosphere in transit and subsequent storage shall be properly protected with an easily removable rust preventative coating of the proper consistency applied by the manufacturer, such as Rust-Ban 347, but not until inspection has been completed.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with cardboard, plastic, wooden, or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

(2) Desiccant must be applied to valve for moisture protection.

(D) Packing

Valves must be packed so as to prevent damage during shipment.

8. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following control valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification in the form of one (1) electronic and one (1) hard copy.

(A) Operation and Maintenance Manuals

These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

(B) Certified Performance & Test Data

All test results produced as a result of the completion of requirements stated in section 6 must be presented to the customer in certified format including the date each test was conducted and the procedures used to perform these tests.

OSU HTTF Valves-Solenoid (Liquid) Specification, Revision NC

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Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of the Solenoid Valves for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. GENERAL

(A) Location

The HTTF will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

(B) Bodies-General

(1) The body casting shall be provided with fillets on corners where a concentration of stress may be expected.

(2) Steel and stainless steel flanges shall be spot faced or back faced parallel to the flange face. Metal removed in spot facing or back facing shall not reduce the thickness of the flange below the minimum required for the ASME body rating.

(3) Valve bodies with flanged ends shall have pressure temperature rating at least equal to ASME standards applicable to end flanges specified.

(4) Bodies for service above 450 °F shall be equipped with heat insulation bonnets.

(5) The 24V DC coils shall be of the “spring opposed” type to obtain positive action on air failure.

(C) Bolting – Steel and alloy steel bodies shall be bolted together with studs and nuts. Cast iron and bronze bodies may be bolted together with bolts or studs and nuts.

3. PERFORMANCE & TESTING

(A) Hydrostatic Body Test

(1) Valve bodies shall be tested in accordance with ASME B31.1, 2001. The test procedure shall be maintained for a period of not less than 30 minutes. Any weeping or leakage through the valve body shall be considered cause for rejection.

(2) At 150% of operation pressure, there shall be no visible stem packing leakage.

(B) Seat Leakage Test

(1) Single and double seated valves shall pass seat leakage test. Valves that close on air failure shall be seat tested with 0 psig on diaphragm. Valves that close with pressure shall be seat tested with 18 psig on their diaphragm of 3-15 psig operator or with specified supply pressure on diaphragm of other range operators.

(2) Double seated valve testing apparatus shall be manufacturer's standard. Leakage shall not exceed 0.5% of the flow which valve will pass when full open at maximum pressure drop specified by purchaser.

(3) Single seated valve testing apparatus may be manufacturer's standard. Leakage shall not exceed 0.01% of the flow which valve will pass when full open at maximum pressure drop.

(4) If single seat valves are specified as bubble-tight shut off, the following test procedure shall be used: The valve shall be tested with compressed air at a pressure equal to the maximum inlet pressure. The valve seat and plug shall be clean of grease and oil. The outlet flange of the valve shall be blanked off, and tubing shall be run from the outlet flange to a beaker of water. Any bubbling through the water shall be considered cause for rejection.

4. MISCELLANEOUS

(A) Marking

(1) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:

a. Serial number
b. Model number
c. Valve tag number

(B) Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with wooden or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

5. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following solenoid valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification.

(A) Solenoid Valve Data

Solenoid valve capacity at sizing pressure drop

(B) Operation and Maintenance Manuals

These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

OSU HTTF Valves-General Variable Position Pneumatic (Liquid) Specification, Revision NC

OSU-HTTF-241400-SPEC-005-R0

Date Published: December 20, 2010

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Brian G. Woods
OSU Program Manager

Record of Revisions

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Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of the general variable position valves and positioners, respectively, for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. GENERAL

(A) Purpose

The general variable position pneumatic valves provide various functions throughout the HTTF, but are similar in that they variably control the state of fluid in the piping system as determined by the facility operator.

(B) Location

The HTTF will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. STANDARDS

All work furnished under this specification shall conform to:

(A) American Society of Mechanical Engineers

(1) ASME A961 Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, valves, and Parts for Piping Applications

(2) ASME B16.10 Face to Face and End-to-End Dimensions of Valves

(3) ASME B16.34 Valves – Flanged, Threaded, and Welded End

(4) ASME B16.5 Standards of Piping and Fittings

4. MATERIALS OF CONSTRUCTION

All materials in direct contact with primary loop coolant shall be stainless steel Type 304, ASTM A-312-61T, or better. Materials used in other loops (secondary steam generator supply system, RCCS, Cavity Simulation Mixing piping system) shall be temperature and pressure rated in accordance with applicable industry standards to the temperatures and pressures of the neighboring piping.

5. GENERAL CONSTRUCTION

(A) Topworks

(1) The topworks shall be capable of handling the following control signals.

i. Pneumatic 90 psig

(2) Top works shall be sized so that valve will operate properly when the differential pressure is 10% greater than the design differential pressure limit.

(3) The spring shall not go solid under any conditions of operation.

(4) Topworks shall be removable without releasing pressure on bolted stuffing box.

(B) Bodies

(1) The body casting shall be provided with fillets on corners where a concentration of stress may be expected.

(2) Valve body shall be wafer type to fit against standard ASME 600# flanges.

(3) Bodies for service above 450 °F shall be equipped with heat insulation bonnets.

(4) Valves shall consist of Sureguard XT Live Loaded Packing.

(C) Valve Positioners

(1) When an external valve positioner is specified it shall be mounted on or as near as possible to the valve body. The positioner shall be furnished with three two inch gasketed pressure gauges for air supply, input pressure, and output pressure.

(2) The positioned shall communicate through a HART communication via a 4 to 20 mA signal.

(3) Positioners shall be equipped with a digital display that presents the valve position between 0 and 100% of its available rotational range, or a malfunction, alarm or message based on the most important process available.

(4) The following states shall be available for the positioned, (1) 4-20 mA setpoint signal out of range, (2) position our of the adjusted range, (3) positioning time-out, (4) position controller inactive, (5) counter limits exceeded.

(D) Inner Valves

(1) If inner valve is specified to have equal-percent characteristic, port openings shall be shaped so that with constant pressure drop across the valve the percent change in flow per unit change in opening is a constant.

(2) If inner valve is specified to have linear characteristic, port openings shall be shaped so that with constant pressure drop across the valve the rate of flow through the valve is directly proportional to the opening.

(3) If inner valve is specified to have quick-opening characteristic, port openings shall be shaped so that maximum capacity is reached at a relatively small proportion of the total available maximum opening.

(4) The valve flow coefficient, CV, is defined by the following formula:

$$CV = \frac{Q\sqrt{G}}{\sqrt{\Delta P}}$$

where

Q = capacity in gpm
G = specific gravity at flowing temperature
ΔP = pressure drop in psi

(5) The valve rangability shall be 30:1 minimum. Rangeability is defined as maximum to minimum controllable flow at constant pressure drop.

6. PERFORMANCE & TESTING

(A) Hydrostatic Body Test

(1) Valve bodies shall be tested in accordance with ASME B31.1, 2001. The test procedure shall be maintained for a period of not less than 30 minutes. Any weeping or leakage through the valve body shall be considered cause for rejection.

(2) At 150% of operation pressure, there shall be no visible stem packing leakage.

(B) Travel

(1) Valves shall be tested on 90 psi of supply air in both the open and closed state.

(C) Topworks Leakage

(1) Soap and water shall be brushed over the chamber and its flanges. No leakage is permitted.

7. MISCELLANEOUS

(A) Marking

(1) Valves shall have rustproof tag attached with rust-proof wire and stamped with their designated tag number.

(2) Body, bonnet, bottom plate, seating rings and inner valve shall be permanently marked with materials identification.

(3) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:

a. Serial number
b. Model number
c. Valve tag number.

(B) Protective Coating and Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(2) Machined surfaces which will be exposed to the atmosphere in transit and subsequent storage shall be properly protected with an easily removable rust preventative coating of the proper consistency applied by the manufacturer, such as Rust-Ban 347, but not until inspection has been completed.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with cardboard, plastic, wooden, or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

(2) Desiccant must be applied to valve for moisture protection.

(D) Packing

Valves must be packed so as to prevent damage during shipment.

8. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following variable position pneumatic valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification in the form of one (1) electronic and one (1) hard copy.

(A) Operation and Maintenance Manuals

These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

(B) Certified Performance & Test Data

All test results produced as a result of the completion of requirements stated in section 6 must be presented to the customer in certified format including the date each test was conducted and the procedures used to perform these tests.

OSU HTTF Valves-Manually Operated (Liquid) Specification, Revision NC

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Contents

1. SCOPE

This specification covers the required design, construction, materials, performance and testing of manually operated valves for service in the High Temperature Test Facility (HTTF). The equipment furnished to this specification shall conform to the requirements herein, unless approved by the purchaser. It is not the intent to completely specify all details of design and construction; however, equipment shall in all respects conform to highest standards of design and workmanship.

2. GENERAL

(A) Purpose

The manually operated valves provide various functions for the HTTF including flow balancing, flow isolation, or a pressure boundary.

(B) Location

The HTTF will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

(C) Bodies-General

(1) Valve bodies shall either be 3-piece socket weld or screwed or butterfly valves.

(2) Steel and stainless steel flanges shall be spot faced or back faced parallel to the flange face. Metal removed in spot facing or back facing shall not reduce the thickness of the flange below the minimum required for the ASME body rating.

(3) Valve bodies with flanged ends shall have pressure temperature rating at least equal to ASME standards applicable to end flanges specified.

(4) Bodies for service above 450 °F shall be equipped with radiation bonnets.

3. REFERENCE STANDARDS

If not specified in this document, all valves shall conform to the appropriate listed standards below:

(A)	MSS SP-68-1997	High Pressure Butterfly Valves with Offset Design
(B)	MSS SP-67-2002a	Butterfly Valves
(C)	MSS SP-84	Steel Valves Socket Welding and Threaded Ends

4. MATERIALS OF CONSTRUCTION

(A) Bolting

(1) Stainless steel valves shall have alloy steel bonnet and gland studs conforming appropriate ASTM standards. Similarly, all nuts shall conform to appropriate ASTM standards.

(B) Trim – Trim shall be of material stainless steel type 316.

(C) Gland – Gland shall be made of PTFE-coated stainless steel 316.

(D) Seat – Valve seats shall be made of Reinforces PTFE at a minimum, or an equivalent pressure temperature rated seat material that is suitable for demineralized water applications.

(E) Seals – Seals shall be made of Fluorocarbon FKM.

(F) Packing - Packing shall be spring loaded, molded Teflon V-Ring, PEEK, or molded Teflon impregnated packing unless otherwise specified by the purchaser.

5. PERFORMANCE & TESTING

(A) Hydrostatic Body Test

(1) Valve bodies shall be tested in accordance with ASME B31.1, 2001. The test procedure shall be maintained for a period of not less than 30 minutes. Any weeping or leakage through the valve body shall be considered cause for rejection.

(2) At 150% of operation pressure, there shall be no visible stem packing leakage.

6. MISCELLANEOUS

(A) Marking

(1) Valves must be furnished with rustproof metal nameplate permanently attached to valve. Nameplate data shall include:

a. Serial number
b. Model number
c. Valve tag number.

(B) Cleaning

(1) All equipment shall be commercially clean and free of all dirt, debris, grease and oil before shipment.

(C) Protection of Valve Interior

(1) Pipe line connections shall be covered with wooden or metal friction plugs or flanges which will exclude foreign materials from the interior of the valve and will fully protect the faces of flanged valves from damage during shipment.

(D) Packing – Valves must be packed so as to prevent damage during shipment. Special attention should be given to protection of pilots, and tubing.

7. INFORMATION REQUIRED FROM VENDOR AFTER AWARD

The following manually operated valve data and information are to be furnished by the vendor upon delivery of all items outlined in this specification.

(A) Operation and Maintenance Manuals

These manuals shall be complete and shall include sufficient data to provide instructions for installation, start-up sequence, operation instructions, maintenance procedures, special test procedures and/or other instructions pertinent to this equipment.

OSU HTTF Cavity Simulation Tank Specification, Revision NC

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Contents

1. SCOPE

This specification covers the performance and fabrication features of the cavity simulation tank (CST) of the High Temperature Test Facility (HTTF). This procurement specification addresses components ancillary to the CST including the fill gas tank piping, heaters, mixing circulator and injection nozzles. It is not the intent to completely specify all details of design and fabrication; however, equipment shall conform in all respects to high standards of engineering design and workmanship.

2. GENERAL

(A) Purpose

The CST of the HTTF simulates the confinement of the MHTGR which the primary reactor vessel communicates with following depressurization transients. For the purposes of the HTTF it serves as the fluid boundary condition for simulation of the Depressurized Conduction Cooldown event.

(B) Location

The CST will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. STANDARDS

The CST shall conform to the following standards to the extent specified herein:

(A) American Society of Mechanical Engineers

(1)	BPVC - Section VIII 2007, 2009 addenda	Unfired Pressure Vessel Code
(2)	BPVC - Section IX 2007, 2009 addenda	Welding and Brazing Qualifications

4. DESCRIPTION OF WORK

This describes labor, materials, and equipment to completely design, fabricate, test, and deliver the CST under discussion. In general, this specification covers, but is not limited to the CST, gas fill tank piping, mixing circulator, injection nozzles, external flanges and penetrations.

5. DESIGN CONDITIONS

Cavity Simulation Tank Conditions

(A)	Design Pressure	0.1 MPa (15 psig)
(B)	Design Temperature (Gas)	578 °C (1072 ^{o}F)

(C)	Normal Operating Pressures	0 to 0.034 MPa (0 to 5 psig)
(D)	Normal Operating Temperatures (Gas)	Room Temp (RT) to 500 °C (RT to 932 ^{o}F)
(E)	Fluid (Gas)	
	(1) Type	Helium, Nitrogen, Air, Argon, Carbon Dioxide

6. OPERATING CONDITIONS

(A) Pressure Regulation

Following BPVC Section VIII 2007, the CST will contain pressure relief devices.

(B) Cycling

The CST shall be capable of 1000 cycles from atmospheric pressure and room temperature to its operating pressure and temperature and back to atmospheric pressure and room temperature over its lifetime.

(C) Leakage

The CST, including gas circulator and associated piping, shall have a maximum helium leakage at its allowable operating pressure and temperature that does not exceed 1% of total helium mass inventory over 24 hours.

(D) Layup

The CST shall be constructed of a material that shall not experience significant degradation or corrosion during extended idle periods, even without layup preparation, while residing in the Advanced Nuclear System Engineering Laboratory with expected atmospheric conditions between 20°F-110°F and 0%-100% humidity.

(E) Gas Injection

The CST shall have a two gas injection nozzles with associated piping. One nozzle will be located in the upper ¼ of the CST volume while the second nozzle will be located in the lower ¼ of the CST volume. Piping for both nozzles will allow for connection to commercially available compressed gas cylinders. Remotely operated regulating valves will be installed for both nozzles and piping systems that shall allow for control of the gas injection flow rates. The gas injection nozzles and associated piping shall be capable of operating in the CST design conditions from item 5 of this

specification as well as conditions expected to be encountered using commercially available compressed gas cylinders.

(F) Gas Mixing

The CST shall have a gas circulator and associated piping installed external to the tank. The gas circulator will be capable of drawing suction from either the upper or the lower nozzle discussed in item 6 (E) of this specification and discharging to the other nozzle not used for suction. The maximum operating flow rate for the gas circulator shall be the flow rate which moves a volume of gas equal to the CST volume in ten minutes. Remotely operated regulating valves will be installed to allow for control of the gas flow rates. The gas circulator and associated piping shall be capable of operating in the CST design conditions from item 5 of this specification.

(G) Gas Heating

The CST shall have a gas heater and associated power distribution connections installed. The heaters will be capable of raising the average CST gas temperature at a rate of 20° C per hour with an ambient temperature of 10° C. Electrical power at nominal 460 volts, 3 phase, 60 hertz, effectively grounded will be provided.

(H) Internal Insulation

Hot gas at atmospheric pressure from the primary system will be gravity driven into the CST. High temperature insulation will be placed on the internal surface of the CST at a location opposite the projection of the hot and cold legs. This insulation shall be of size equal to the pipe projection area and at least one foot in all directions around the projection area. High temperature insulation shall also be used on the internal surface of the upper head.

7. CIRCULATOR

(A) Flow Characteristics

The gas flow and thrust characteristics of the unit shall be such as to ensure stable operation over the entire range of the Head-Flow Characteristic Curve.

(B) Electrical Supply System

Electrical power at nominal 460 volts, 3 phase, 60 hertz, effectively grounded will be provided.

(C) Vibration
The circulator shall conform to all applicable industrial standards for vibration severity.

(D) Remote Operation
The circulator shall be capable of remote stop, start and adjustable speed control to allow for continuous flow control from zero flow to circulator design flow rates.

8. FABRICATION OF VESSEL AND INTERNALS

(A) Code Fabrication – Pressure vessels shall be of all welded construction in accordance with ASME Pressure Vessel Code, Section VIII - 2007, 2009 addenda, Unfired Pressure Vessels and Section IX - 2007, 2009 addenda Welding Qualifications. Pressure vessels shall bear the ASME Code Stamp.

(B) Ports – The CST is designed containing a number of ports (instrumentation ports, ports for future visualization capability, etc.). Design specifications of these ports with their respective flanges, connections and any plugs are contained in the schematic drawings. Ports and their associated flanges shall be constructed in accordance with ASME Pressure Vessel Code, Section VIII - 2007, 2009 addenda and be equipped with applicable ANSI B 16.5 standard flanges.

(C) Quality Control – The Vendor shall maintain a quality control system. The Vendor shall submit complete outlines of his inspection processes and procedures.

(D) Insulation – The CST shall be enclosed in sufficient insulation to limit the average CST gas temperature change to 20° C over 1 hour at operating temperatures and pressures and an ambient temperature of 10° C. This specification shall assume that the CST gas circulator is not operating.

9. MATERIALS OF FABRICATION

All materials in this specification shall be made of SS304 or better.

10. GENERAL FABRICATION

(A) Connections – All connections shall be Vendor's standard size equipped with 600 lb standard ANSI B 16.5 raised face flanges, 3000 pound rated fittings and couplings, or as specified on drawings.

11. TESTS

(A) Hydrostatic Testing – The pressure vessel shall be hydrostatically tested in accordance with requirements of the ASME Unfired Pressure Vessel Code, Section VIII - 2007, 2009 addenda.

(B) Liquid Penetrant Testing – The root pass of every weld shall be inspected for 100 percent of their length with a liquid penetrant.

(C) Helium Testing – The pressure vessel test shall be subjected to a helium leak test.

12. MISCELLANEOUS REQUIREMENTS

(A) Cleaning

(1) Each vessel shall have exterior and interior surfaces thoroughly cleaned using a two step process. First, Oil, grease and salts shall be removed by use of suitable solvents; no detrimental residue shall be left on the surfaces. Second, all accessible surfaces shall be thoroughly cleaned by power wire brushing to remove all dirt, welding flux and slag, paint and other detrimental foreign matter. Power wire brushes shall be stainless steel and not previously used on materials other than stainless steel.

(2) After cleaning interior surfaces all openings shall be closed with pipe plugs, plastic covered flanges, or other adequate means to prevent damage, corrosion or entrance of foreign matter during shipment and erection.

(B) Operation and Maintenance Manual – The vendor shall furnish two (2) copies of a single document prepared by the Manufacturer. This document should include all data sheets, certified material test reports and non-destructive evaluation records.

(C) Repair – Means shall be provided for lifting and handling separable parts of each vessel from its prescribed support structures (if applicable) and are to be lifted using straps.

(D) Nameplates – Unique nameplates shall be provided for each mechanically unique component. The nameplate shall be made of the same material as the material to which it is attached. The nameplates shall be attached by welding to components. Nameplates for the pressure vessel parts shall include the following data or space therefore.

(1) Title of Equipment
(2) Vendor's Name and Serial Number
(3) Date of Manufacture
(4) Mechanical Equipment Number
(5) Design Pressure and Temperature

For internal components, only the part number is needed for identification. This number shall be applied by etching at a location consistent with the part drawing.

(E) Mechanical Equipment Number – The following unique Mechanical Equipment Number assignment:

(1) Cavity Simulation Tank: HTTF-421001

(F) Painting – Stainless steel surfaces shall not be painted.

OSU HTTF Primary Pressure Vessel Internal Component Specification, Revision NC

OSU-HTTF-410001-SPEC-002-R0

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Contents

1. SCOPE

This specification covers the performance and fabrication features of the primary pressure vessel metal internal components of the High Temperature Test Facility (HTTF) including, but not limited to core barrel, Metallic Cores Support Structure (MCSS), upcomers, upper plenum shroud, control rod guide tubes, and core support plates. This specification does not include the core ceramic, the core heaters, the vessel internal instrumentation or the heater power distribution system internal to the vessel. It is not the intent to completely specify all details of design and fabrication; however, equipment shall conform in all respects to high standards of engineering design and workmanship.

2. GENERAL

(A) Purpose

The primary pressure vessel internal components of the HTTF provide the flow path for the gas flow during both normal and transient operation. These internal components also provide structural support for all of the mechanical and electrical components inside of the pressure vessel including but not limited to the core ceramic, core heaters, power distribution system and vessel internal instrumentation.

(B) Location

The primary pressure vessel will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. STANDARDS

All pressure vessel internal components shall conform to all generally accepted applicable codes and standards.

4. DESCRIPTION OF WORK

This describes labor, materials, and equipment to completely design, fabricate, test, and deliver the primary pressure vessel internal components under discussion.

5. DESIGN CONDITIONS

Pressure Vessel Internal Component Conditions

(A)	Design Pressure	0.986 MPa (143 psig)
(B)	Design Temperature	Location dependent. For components in the upper and lower plenum or in contact with the bottom of the core, 1200 °C (2192 °F). Upper plenum plate 1420 ^{o}C (2590 ^{o}F) For all other components 1000 °C (1832 °F).
(C)	Normal Operating Pressures	0 to 0.81 MPa (0 to 118 psig)
(D)	Normal Operating Temperatures	Location Dependent Upper, lower plenum, and core contact components: Room Temp (RT) to 1000 °C (RT to 1832 ^{o}F). Upper plenum plate RT to 1200 ^{o}C (2200 ^{o}F). For all other components: Room Temp (RT) to 850 ^{o}C.
(E)	Fluid (Gas)	
	(1) Type	Helium, Nitrogen, Air, Argon, Carbon Dioxide
(F)	Load	Consult vessel internals drawings for calculation of applicable component load.

6. OPERATING CONDITIONS

(A) <u>Depressurizing</u>

Depressurization during normal operation of the primary pressure vessel shall occur indirectly through depressurization valves connected to the primary loop. The pressure vessel internal components shall be constructed such that significant vessel mechanical degradation is not expected following a pressure reduction from the vessel operating pressure to atmospheric pressure over a 30 second period while the vessel is at room temperature.

(B) Cycling

The pressure vessel internal components shall be capable of 1000 cycles from atmospheric pressure and room temperature to its operating pressure and temperature and back to atmospheric pressure and room temperature over its lifetime.

(C) Thermal Cycling

The pressure vessel internal components shall be constructed such that significant vessel internal component mechanical degradation is not expected when heating up from room temperature to normal operating temperatures at less than a rate of 300 °C/hour. Significant degradation shall be defined as the movement of primary vessel internal components due to expected thermal expansion or contraction of a magnitude that will not degraded the ability of the primary vessel internal components to perform their functions.

(D) Thermal Gradients

The pressure vessel internal components shall be constructed such that significant vessel mechanical degradation is not expected when exposed to temperature gradients less than 50°C/1 meter length in any direction. Significant degradation shall be defined as component deflection due to expected thermal gradients of a magnitude that degrades the ability of the primary vessel internal components to perform their functions.

7. FABRICATION

(A) Quality Control – The Vendor shall maintain a quality control system. The Vendor shall submit complete outlines of his inspection processes and procedures.

OSU HTTF Power Supply Wiring Specification, Revision NC

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Contents

1. SCOPE

This specification includes electrical wiring requirements pertaining to any and all wiring used for the purpose of supplying power for the High Temperature Test Facility (HTTF).

2. GENERAL

(A) Purpose

Power supply wiring shall be installed to provide electrical power to all components needing appropriate voltage and current to conduct their functional purpose for the HTTF.

(B) Location

The primary pressure vessel will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

3. POWER SUPPLY WIRES

(A) Materials

a. All power supply wires shall be twisted, sheathed, and bundled.

b. All power supply wires shall have appropriate shielding to reduce as much electrical noise as feasibly possible.

(B) Color

All power supply wires shall be colored in accordance with applicable IEEE and NEC specifications.

4. INSTALLATION

(A) AC Power supply wiring of differing voltages shall be installed in independent raceways (conduit, troughs, or trays)

(B) All power supply wiring shall be run in independent raceways from all signal wiring, unless power supply wiring is DC and in appropriately shielded cabling.

(C) Wiring which is installed directly to electrical components shall be installed via the prescribed component’s manufacturer installation procedures and shall comply with all manufacturer specifications.

(D) All bundles shall be labeled with their appropriate identification tag. All tags shall be installed at each termination location and shall be located no farther than 4 inches from the termination location.

(E) Power wiring shall be THHN unless otherwise required by code for specific applications.

(F) Heater leads to be PFAH (perfluorolkoxy) or SA (silicone) or otherwise approved.

(G) Wire lengths shall be kept as short as possible while preventing any tension stresses caused by cable length at termination locations.

(H) All wires shall be supported by cable trays or troughs, wire ways, or conduit and shall have no continuous unsupported length of more than 12 inches.

(I) Wires that penetrate through walls shall be run through conduit.

(J) Care shall be taken when routing power supply wires in cable trays or troughs, wire ways, or conduit, to reduce bundle to bundle cross over as much as feasibly possible.

(K) Care shall be taken when routing power supply wire in electrical panels to reduce the length of wires in panel as much as feasibly possible, while meeting all functional and identification requirements.

(L) As needed, care and means shall be provided to provide adequate cooling of power providing wiring for the HTTF.

OSU HTTF Insulation for Piping and Heat Equipment Specification, Revision NC

OSU-HTTF-621000-SPEC-001

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Record of Revisions

Revision	Date	Changes	Approval
NC	20DEC10	OSU-HTTF-621000-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification covers the requirements for the insulation of piping and equipment in the High Temperature Test Facility (HTTF). Included in this specification is the insulation to be used on the outside of the reactor cavity doors. It is not the intent to completely specify all details of design and construction; however the material and workmanship shall conform in all respects to the highest engineering standards.

2. GENERAL

(A) Purpose – The purpose of the insulation is to limit heat losses from piping and equipment.

(B) Location – The insulation covered by this specification shall be installed in the Nuclear Engineering and Radiation Health Physics Department building at Oregon State University, Oregon, at an elevation of 235 ft above sea level.

(C) Materials

(1) The piping and equipment in the HTTF which is applicable to all insulation consists of stainless steel 304 or better.

(2) The insulation for all materials shall be as herein-after specified.

3. DESCRIPTION OF WORK

(A) The contractor shall furnish all materials, labor, supervision, tools, and equipment to insulate the piping and equipment as specified herein. The work shall include but is not limited to the following:

(1) Insulation on all primary loop piping.

(2) Insulation of equipment as herein specified.

(3) Insulation of reactor cavity doors.

4. GENERAL REQUIREMENTS

(A) Where piping insulation is called for it shall include all valves, fittings and bends forming a part of such piping. Flanges and inline components shall be insulated with removable blankets.

(B) Before insulation is applied all surfaces shall be dry and thoroughly cleaned. All scale, dirt, rust or other foreign material shall be removed by appropriate means.

(C) No insulation shall be installed or surfaces cleaned until all hydrostatic testing has been completed and all leaks have been repaired.

(D) All piping shall be covered with sectional insulation made up in 36 inch section have two longitudinal joints. All cracks and joints shall be filled solid with insulation cement. Where flanged valves and pipe fittings occur, a clear space between end of insulating materials and flange shall be left of sufficient length to permit withdrawing flange bolts without interference. Ends of insulating materials at these joints are to be tapered from the outside surface of the insulation to the pipe and sealed as herein-after specified. All valves, fittings and other piping appurtenances, except screwed unions shall be covered with the same thickness and type of insulating material as used on pipes in the form of molded blocks. Blocks shall be wired in place and all joints filled with insulating cement. Blocks shall be applied so that they can be removed and replaced without damage to adjacent insulating materials or its protective covering.

(E) Equipment nameplates, or identification plates and code inspection marking shall not be covered or obscured by insulation. The insulation shall be arranged to leave them visible for inspection.

(F) Valve stems shall not be in contact with insulation and hand-wheels or other valve operating devices shall not be insulated.

(G) All insulation shall be single layer construction of the thicknesses specified herein.

(H) Bends or elbows shall be insulated with segments cut from pipe insulating material. The first and last segments shall extend over the welded beads.

(I) Insulation cement shall be used only where formed or block insulations cannot be used. It shall be used to fill crevices in formed insulation and, if necessary, to insulate irregularly shaped components.

(J) All insulation shall be sealed aluminum metal jacketing, as specified herein, immediately after installation.

5. SPECIFIC REQUIREMENTS

(A) Insulating Materials

For 500 °F service insulation shall be formed or block insulation made for high temperature application.

(B) Insulating Tape

If cement is applied to insulation for irregular shaped components, they shall be wrapped with tape to not over 3/32 inches total thickness to act as a foundation for holding the cement.

(C) Lacing Wire

Formed pipe and block insulation shall be held in place with No. 16 gage stainless steel wire on approximately 9 inch centers.

(D) Protective Finish

(1) Where insulation ends at flanges or fittings and is tapered, a tack coat of heat resistant aluminum sealer shall be applied extending for at least 2 inches on bare pipe surface and at least 2 inches on full insulation thickness. The end section (or taper) shall be finished with another coat of the aluminum sealer.

(2) No water or moisture shall be permitted to come in contact with any insulation until the entire assembly is completely cured. To this end and to prevent damage to the sealer while it is still soft, the work on each loop should be completed as quickly as possible before proceeding with the next loop.

(3) All piping shall be lastly covered with a stainless steel rolled insulation jacket. The jacket shall be 0.019 inch or greater thickness with one side a smooth finish. A vapor barrier paper shall be used between the stainless steel and insulation. The jacket shall be designed for removal and reuse.

(E) Piping and Equipment to Be Insulated and Insulation Thickness

(1) All gas systems piping.

(2) The equipment to be insulated and the thickness of the insulation to be applied is given in the following table:

Equipment Name	Insulation Thickness [in]
Reactor cavity doors	2
Primary Loop Gas Circulator (1)	
Casing	2

OSU HTTF Air Cooler Specification, Revision NC

OSU-HTTF-661001-SPEC-001-R0

Date Published: April 11, 2011

Prepared by:

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Prepared for:

External Bid Solicitation

Approved: _____
Brian G. Woods
OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	11APR11	OSU-HTTF-661001-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification covers performance and construction features of the air cooler in the High Temperature Test Facility (HTTF). It is not the intent to completely specify all details of design and construction; however the material and workmanship shall conform in all respects to the highest engineering standards.

2. GENERAL

(A) Purpose

The purpose of the air cooler is to provide sufficient cooling to allow for operation of the primary system gas circulator.

(B) Location

The primary pressure vessel will be operated in the Advanced Nuclear Systems Engineering Laboratory (ANSEL) building of the Radiation Center Building of the Nuclear Engineering and Radiation Health Physics Department at Oregon State University, Corvallis, Oregon, at an elevation of 235 ft above sea level.

(C) Equipment Number

(1) Equipment numbers – Mechanical equipment number or tag number shall appear on an identification plate or tag.

(2) The cooling fan motors shall be assigned the same mechanical equipment number as mechanical unit.

3. STANDARDS

Air cooler shall conform to all generally accepted applicable codes and standards.

4. DESCRIPTION OF WORK

This describes labor, materials, and equipment to completely design, fabricate, test, and deliver the air cooler under discussion.

5. DESIGN CONDITIONS

(A) Vendor Responsibility – The vendor shall have full and complete design responsibility and shall ensure full compliance with the provision of this specification.

(B) Electrical Supply System – Electrical power at nominally 460 volts, 3 phase, 60 cycle, effectively grounded will be provided by the purchaser in the building. Means shall be provided by the vendor for sufficient power from the building ground level to the rooftop air cooler location to meet all specifications herein.

(C) Water Supply System – Potable water supply shall be provided by the purchaser in the building. Means shall be provided by the vendor for sufficient water from the building ground level to the rooftop air cooler location to meet all specifications herein.

(D) Control system – All electrical leads necessary for providing normal operational functions to the air cooler from the ground level of the building shall be furnished by the vendor.

(E) Air Cooler

(1) Potable liquid water will be circulated through the air cooler and not used when ambient temperatures drop below 32 °F.

(2) The air cooler shall have the capacity to sufficiently handle a total flow of 3-45 gpm and have a pressure drop of no more than 9 psi at a flow rate of 30 gpm.

(3) The air cooler shall be designed to sufficiently withstand system pressures up to 120 psi.

(4) The air cooler shall be designed to sufficiently withstand liquid temperatures ranging from 30 to 212 °F.

(5) Capacity shall be sufficient to remove at least 400,000 Btu/hr heat load at 30 gpm, given an inlet water temperature of 130 °F.

6. GENERAL CONSTRUCTION

(A) Weight – The air cooler, including manifold connections and motors shall not exceed 450 lbs in weight.

(B) Dimensions – The air cooler, including manifold, connections, and motors shall not have a foot print larger than 5 feet wide by 10 feet in length, and shall not be more than 5 feet in total height.

(C) Mounting – The air cooler shall have means for mechanically fastening to its floor surface. This may be done through the use of roof curbs.

(D) Repair – Means shall be provided for lifting and handling separable parts such as the manifold and fan motors.

7. MISCELLANEOUS REQUIREMENTS

(A) Cleaning – All equipment shall be commercially clean and free from dirt, grease, oil or other contaminants when packed for shipment, except that relief valves shall be commercially clean in accordance with manufacturer's standards when packed for shipment, and all relief valve surfaces exposed to the fluid, both before and after relieving, shall be free from dirt, grease, oil or other contaminants and shall also show no visible stain when wiped with a clean white cloth.

(B) Protection – All equipment shall be adequately protected against damage during shipment or storage and all nozzles, or other openings, shall be adequately sealed to prevent corrosion or the entrance of moisture or any foreign matter.

(C) Instruction Manuals – Vendor shall furnish copies of instruction manuals which shall include sufficient information for installation, start-up, operation and maintenance of equipment furnished.

(D) Identification – All equipment shall have an identification plate or tag which shall bear the following applicable information or space therefore:

(1) Vendor's name and serial number

(2) Size or capacity of equipment

(3) Design pressure and temperature rating

(4) Mechanical equipment or tag number which shall be HTTF-661001.

OSU HTTF Frames and Structures Specification, Revision NC

OSU-HTTF-700000-SPEC-001-R0

Date Published: December 20, 2010

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Prepared for:

External Bid Solicitation

Approved: _____

Brian G. Woods
OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	20DEC10	OSU-HTTF-700000-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required for the High Temperature Test Facility (HTTF). This includes structures, platforms, reactor cavity doors, and other supporting structures as shown on facility drawings. It is not the intent to completely specify all details of design and construction; however, the material and workmanship shall conform in all respects to the highest engineering standards.

Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges" and as otherwise shown on drawings.

2. GENERAL

(A) Purpose – All frames and structures are to provide support and/or alignment of components continuously through the life of the HTTF.

(B) Location

All frames and structures will be located at the Nuclear Engineering and Radiation Health Physics Department building at Oregon State University, Oregon, at an elevation of 235 ft above sea level.

(C) Equipment Number

Equipment number – Mechanical equipment number or tag number shall appear on an identification plate or tag connected to each frame or structure.

(D) Ambient Environment

1. All structural components shall not experience significant material degradation when exposed to intermediate term operation (less than 24 hour) in an environment of helium, air, carbon dioxide, argon or nitrogen at atmospheric pressure and an elevated temperature. Elevated temperature for frames and structures associated with the reactor cavity doors support system shall be 450 F. The elevated temperature of other frames and supports of system piping and components shall be 300 F.

2. All structural components shall not experience significant material degradation when exposed to very short term operation (less than 15 minutes) in an environment of (1) high temperature (greater than 1000° C) helium, air, carbon dioxide, argon or nitrogen at atmospheric pressure, or (2) saturated steam at atmospheric pressure.

3. DELIVERY

(A) The vendor shall deliver materials to site at such intervals to ensure uninterrupted progress of work.

(B) The vendor shall deliver anchor bolts and anchorage devices, which are to be embedded in cast–in-place concrete or masonry, in ample time so that work will not be delayed.

(C) Field Measurements – the vendor shall check actual locations of walls and other construction to which steel framing must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings.

4. MATERIALS

(A) Metal surfaces, general – For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Removal of such blemishes shall be done by grinding, or by welding and grinding, prior to cleaning, treating and applying surface finishes.

(B) Structural Steel Shapes, Plates, and Bars – American Society of Testing and Materials (ASTM) A36

(C) Cold-Formed Steel Tubing – ASTM A500, Grade B.

(D) Hot-Formed Steel Tubing – ASTM A501.

(E) Steel Pipe – ASTM A53, Type E or S, Grade B: or ASTM A501.
Finish – Black, except where indicated to be galvanized.

(F) Steel Castings – ASTM A27, Grade 65-35, medium-strength carbon steel.

(G) Headed Stud-Type Shear Connectors – ASTM A108, Grade 1015 or 1020, cold-finished carbon steel with dimensions complying with AISC Specifications.

(H) Anchor Bolts – ASTM A307, nonheaded type unless otherwise indicated.

(I) Unfinished Threaded Fasteners – ASTM A307, Grade A, regular low-carbon steel bolts and nuts; provide hexagonal heads and nuts for all connections.

(J) High-Strength Threaded Fasteners – Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

(1) Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325.

(2) Where indicated as galvanized, provide units that are zinc-coated, either mechanically deposited complying with ASTM B695, Class 50, or hot-dip galvanized complying with ASTM A153.

(K) Direct Tension Indicators – ASTM F959, type as required; use at Contractor's option.

(L) Electrodes for Welding – Comply with American Welding Society (AWS) Code.

(M) Structural Steel Primer Paint – Red oxide, lead- and cadmium-free, corrosion-inhibiting primer complying with performance requirements of Federal Specification (FS) TT-P-664. (refer to section 6 for paint specifications)

(N) Nonmetallic Shrinkage-Resistant Grout – Premixed, nonmetallic, non-corrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

(1) 100 Non-Shrink Grout (Non-Metallic) - Conspec, Inc.
(2) Crystex - L & M Construction Chemicals, Inc.
(3) Euco N-S Grout - Euclid Chemical Co.
(4) Kemset - Chem-Masters Corp.
(5) Sonogrout - Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
(6) Supreme Grout - Cormix, Inc.
(7) Sure-Grip High Performance Grout - Dayton Superior
(8) Vibropruf #11 - Lambert Corp.

5. FABRICATION

(A) Shop Fabrication and Assembly – The vendor shall fabricate and assemble structural assemblies in shop to the greatest extent possible: Items of structural steel shall be fabricated in accordance with AISC specifications and as indicated on all appropriate drawings. The vendor shall provide camber in structural members where indicated.

(1) The vendor shall properly mark and math-mark materials for field assembly. The vendor shall fabricate all frames and structures for delivery sequence that will expedite erection and minimize field handling of materials.

(2) Where finishing is required, the vendor shall complete the prescribed assembly, including welding of units, before the start of finishing operation(s) and provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

(B) Connections – Weld or bolt shop connections as indicated on appropriate drawings.

(1) Bolt field connections, except where welded connections or other connections are indicated.

(2) Provide high strength threaded fasteners, unless otherwise specified.

(C) High-Strength Bolted Connections – Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts".

(D) Welded Construction – Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welded work.

(E) Shear Connections – Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

(F) Holes for Other Work – Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown in appropriate drawings.

(1) Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

(2) Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

6. SHOP PAINTING

Paint shall be applied to applicable surfaces as prescribed below only after completing primary adhesion specified in section 4M.

(A) General – Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initially 2 inches of embedded areas only.

(1) Paint shall be blue and chosen by matching finish and color to MFP pump frame colors of the HMFTF as best as reasonable that is commercially available.

(2) Do not paint surfaces to be welded or bolted (high-strength) with friction-type connections.

(3) Apply 2 coats of primer and paint to surfaces that are inaccessible after assembly or erection.

(B) Surface Preparation – After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Society of Protective Coatings (SSPC) as follows:

SP-1 "Solvent Cleaning"
SP-2 "Hand-Tool Cleaning"
SP-3 "Power-Tool Cleaning"

(C) Painting – Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 3 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surface.

7. ERECTION

(A) Temporary Shoring and Bracing – Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

(B) Anchor Bolts – Furnish anchor bolts and other connectors required for securing structural steel to foundation and other in-place work.

(C) Setting Bases and Bearing Plates – Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

(1) Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

(2) Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

(3) Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

(4) For proprietary grout materials, comply with manufacturer's instructions.

(D) Field Assembly – Set structural frames accurately to lines and elevations indicated on appropriate drawings and in accordance with AISC Specifications. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

(1) Level and plumb individual members of structures within specified AISC tolerances.

(2) Establish required leveling and plumbing measurements on mean operating temperature of structure. Making allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

(3) Splice members only where indicated and accepted on drawings.

(4) Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

(5) Do not enlarge unfair holds in members by burning or by using drift pints, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

(E) Gas Cutting – Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members

that are not under stress. Finish gas-cut sections equal to a sheared appearance when permitted.

(F) Touch-Up Painting – Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 3 mils.

8. MISCELLANEOUS REQUIREMENTS

(A) Cleaning – All equipment shall be commercially clean and free from dirt, grease, oil or other contaminants when installed.

(B) Protection – All equipment shall be adequately protected against damage during shipment or storage and all flanges, or other exposed openings shall be adequately guarded to prevent entry of foreign material.

(C) Identification – All equipment shall have an identification plate or tag which shall bear the mechanical equipment or tag number.

(D) Submittal – Vendor shall submit the product data or manufacturer's specifications for the following products.

(1) Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

(2) Anchor bolt.

(3) Unfinished threaded fasteners

(4) High-strength bolts (each type), including nuts and washers, include direct tension indicators if used.

(5) Structural Steel primer paint.

(6) Nonmetallic shrinkage-resistant grout.

(7) Material Safety Data Sheets (MSDS) – Submit MSDS for structural steel (each type), anchor bolts, unfinished threaded fasteners, high-strength bolts (each type) including nuts and washers, structural steel primer paint and nonmetallic shrinkage-resistant grout.

(8) Test Reports – submit test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

OSU HTTF Crane Specification, Revision NC

OSU-HTTF-911001-SPEC-001-R0

Date Published: December 20, 2010

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Approved: _____
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OSU Program Manager

Record of Revisions

Revision	Date	Changes	Approval
NC	20DEC10	OSU-HTTF-911001-SPEC-001 initial release.	B. Woods

Contents

1. SCOPE

This specification includes fabrication, assembly, and performance requirements of the crane for the High Temperature Test Facility (HTTF). It is not the intent to completely specify all details of design and construction; however the material and workmanship shall conform in all respects to the highest engineering standards.

2. GENERAL

(A) Purpose – The crane provide lifting capability for the HTTF necessary for assembly and disassembly of the HTTF primary system and RCCS.

(B) Location

The crane will be located at the Nuclear Engineering and Radiation Health Physics Department building at Oregon State University, Oregon, at an elevation of 235 ft above sea level.

(C) Equipment Number

Equipment number – Mechanical equipment number or tag number shall appear on an identification plate or tag connected to the crane.

3. DESCRIPTION OF WORK

Labor, materials, and equipment to completely design, fabricate, and deliver the crane under discussion. In general, this specification covers, but is not limited to one overhead crane structures, trolley, winch and controls.

4. OPERATING CONDITIONS

(A) Reach – The crane shall have a reach of 2 feet beyond the outside of the RCCS panels. Reach in this case is measured from the center of the pivot location to the center of the winch grapple in its most extended position.

(B) Weight Capacity – The crane and winch shall be rated to at least 10,000 pounds of sustained load.

(C) Ambient Environment

1. All structural components shall not experience significant material degradation when exposed to intermediate term operation (less than 24 hour) in an environment of helium, air, carbon dioxide, argon or nitrogen at atmospheric pressure and an elevated temperature of 300 F.

2. All structural components shall not experience significant material degradation when exposed to very short term operation (less than 15 minutes) in an environment of (1) high temperature (greater than 1000° C) helium, air, carbon dioxide, argon or nitrogen at atmospheric pressure, or (2) saturated steam at atmospheric pressure.

5. WINCH – SPECIFIC REQUIREMENTS

(A) Power Required – Each winch shall have a 230/460 V, 3 phase line provided.

(B) Power Supply – Power to each winch shall be provided with 230 V, 3 phase plug to receptacle on tower structure. Circuit breakers in AC power panel on tower module shall control primary power to receptacle.

(C) Control – Each winch shall be remotely controlled by its own controller. Function shall be provided in each controller for fast extension, slow extension, fast retraction, and slow retraction of the winch cable.

6. MATERIALS

(A) Metal surfaces, general – For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Removal of such blemishes shall be done by grinding, or by welding and grinding prior to cleaning, treating and applying surface finishes.

(B) Structural Steel Shapes, Plates, and Bars – American Society of Testing and Materials (ASTM) A36.

(C) Cold-Formed Steel Tubing – ASTM A500, Grade B.

(D) Hot-Formed Steel Tubing – ASTM A501.

(E) Steel Pipe – ASTM A53, Type E or S, Grade B: or ASTM A501.
Finish – Black, except where indicated to be galvanized.

(F) Steel Castings – ASTM A27, Grade 65-35, medium-strength carbon steel.

(G) Headed Stud-Type Shear Connectors – ASTM A108, Grade 1015 or 1020, cold-finished carbon steel with dimensions complying with AISC Specifications.

(H) Anchor Bolts – ASTM A307, nonheaded type unless otherwise indicated.

(I) Unfinished Threaded Fasteners – ASTM A307, Grade A, regular low-carbon steel bolts and nuts; provide hexagonal heads and nuts for all connections.

(J) High-Strength Threaded Fasteners – Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

(1) Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325.

(2) Where indicated as galvanized, provide units that are zinc-coated, either mechanically deposited complying with ASTM B695, Class 50, or hot-dip galvanized complying with ASTM A153.

(K) Direct Tension Indicators – ASTM F959, type as required; use at contractor's option.

(L) Electrodes for Welding – Comply with American Welding Society (AWS) Code.

(M) Structural Steel Primer Paint – Red oxide, lead- and cadmium-free, corrosion-inhibiting primer complying with performance requirements of Federal Specification (FS) TT-P-664.

7. FABRICATION

(A) Shop Fabrication and Assembly – The vendor shall fabricate and assemble structural assemblies in shop to the greatest extent possible. Items of structural steel shall be fabricated in accordance with AISC specifications and as indicated on all appropriate drawings. The vendor shall provide camber in structural members were indicated.

(1) The vendor shall properly mark and math-mark materials for field assembly. The vendor shall fabricate all frames and structures for delivery sequence that will expedite erection and minimize filed handling of materials.

(2) Where finishing is required, the vendor shall complete the prescribed assembly, including welding of units, before the start of finishing operation(s) and provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

(B) Connections – Weld or bolt shop connections as indicated on appropriate drawings.

(1) Bolt field connections, except where welded connections or other connections are indicated.

(2) Provide high strength threaded fasteners, unless otherwise specified.

(C) High-Strength Bolted Connections – Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts".

(D) Welded Construction – Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welded work.

(E) Shear Connections – Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

(F) Installation – The crane shall be mounted on top of the tower.

(G) Holes for Other Work – Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown in appropriate drawings.

(1) Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

(2) Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

8. SHOP PAINTING

(A) General – Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initially 2 inches of embedded areas only. Paint color of crane frame shall be the same as that chosen for general structures.

(1) Do not paint surfaces to be welded or high-strength bolted with friction-type connections.

(2) Apply 2 coats of primer and paint to surfaces that are inaccessible after assembly or erection.

(B) Surface Preparation – After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Society of Protective Coatings (SSPC) as follows:

SP-1 "Solvent Cleaning"
SP-2 "Hand-Tool Cleaning"
SP-3 "Power-Tool Cleaning"

(C) Painting – Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 3 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surface.

9. MISCELLANEOUS REQUIREMENTS

(A) Cleaning – All equipment shall be commercially clean and free from dirt, grease, oil or other contaminants when installed.

(B) Protection – All equipment shall be adequately protected against damage during shipment or storage and all flanges, or other exposed openings shall be adequately guarded to prevent entry of foreign material.

(C) Identification – All equipment shall have an identification plate or tag which shall bear the mechanical equipment or tag number.

(D) Submittal – Vendor shall submit the product data or manufacturer's specifications for the following products.

(1) Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

(2) Anchor bolt.

(3) Unfinished threaded fasteners.

(4) High-strength bolts (each type), including nuts and washers, include direct tension indicators if used.

(5) Structural Steel primer paint.

(6) Nonmetallic shrinkage-resistant grout.

(7) Material Safety Data Sheets (MSDS) – Submit MSDS for structural steel (each type), anchor bolts, unfinished threaded fasteners, high-strength bolts (each type) including nuts and washers, structural steel primer paint and nonmetallic shrinkage-resistant grout.

(8) Test Reports – submit test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

(9) Vendor shall provide operation and maintenance manuals for each winch.

EXHIBIT B
TERMS AND CONDITIONS FOR GOODS

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OREGON STATE UNIVERSITY
STANDARD TERMS AND CONDITIONS FOR GOODS
Revised November 2010
MODIFIED FOR RFP TB157697B (Modifications in italics)

These Standard Terms and Conditions for Goods shall govern the purchase by OSU from the Contractor and shall replace and supersede any terms and conditions presented by Contractor or any sales quotations, order acknowledgements, or similar forms unless otherwise specified in the Solicitation Documents or on the face of the Purchase Order issued by OSU.

1. DEFINITIONS:

As used in this Contract, the terms set forth below are defined as follows:

a. "Contract" means only the documents listed below, which, in the event of any conflicts among them, must be interpreted in the following order of precedence:
   i. The Solicitation Document and its Attachments and Addenda, if any; and
   ii. The Purchase Order Issued by OSU
b. "Contractor" means a person or organization with whom OSU has contracted for the provision of goods pursuant to this Contract;
c. "Contractor Intellectual Property" means any intellectual property owned by Contractor and developed independently from Contractor's performance of this Contract;
d. "OAR" means the Oregon Administrative Rules;
e. "ORS" means the Oregon Revised Statutes;
f. "OSU" means the State of Oregon, acting by and through the State Board of Higher Education, on behalf of Oregon State University.
g. "Solicitation Document" means the Request for Quotes, Invitation to Bid, Request for Proposals, or any other written document issued by OSU that outlines the required specifications necessary to submit a responsive quote, bid, proposal, or any other response;

2. ACCESS TO RECORDS:

Contractor shall maintain books, records, documents, and other evidence and accounting procedures and practices sufficient to reflect properly all costs of whatever nature claimed to have been incurred and anticipated to be incurred in the performance of this Contract. OSU, the Oregon State Board of Higher Education, Oregon Secretary of State, federal government, and their duly authorized representatives shall have access to the books, documents, papers, and records of Contractor which are directly pertinent to this Contract for the purpose of making audit, examination, excerpts, and transcripts. Contractor shall maintain such books and records for OSU's review for at least six years beyond the Term of the Contract unless OSU authorizes a shorter period in writing. Contractor shall promptly remedy any discrepancies involving deviation from the terms of this Contract and shall promptly reimburse OSU for any commitments or expenditures found by OSU to have been in excess of amounts authorized by OSU.

3. AFFIRMATIVE ACTION:

Pursuant to OAR 580-061-0030, Contractor certifies that Contractor has not discriminated against Minority, Women or Emerging Small Business Enterprises in obtaining any required subcontracts.

4. APPLICABLE LAW; JURISDICTION AND VENUE.

a. This Contract is governed and shall be construed in accordance with the laws of the State of Oregon, without resort to any other jurisdiction's conflict of law rules or doctrines. Any claim, action, or suit between OSU and Contractor that arises out of or relates to performance of this Contract must be brought and conducted solely and exclusively within the Circuit Court for Marion County, for the State of Oregon.
b. Notwithstanding the foregoing paragraph, if a claim must be brought in federal forum, it must be brought and adjudicated solely and exclusively in the United States District Court for the District of Oregon. This paragraph applies to a claim brought against OSU only to the extent Congress has validly abrogated OSU's sovereign immunity and is not consent by OSU to be sued in federal court. This paragraph is also not a waiver by OSU of any form of immunity, including without limitation sovereign immunity and immunity based on the Eleventh Amendment to the United States Constitution.
c. Except as set forth in the paragraph above, the parties consent to in personam jurisdiction in the above courts and waive any objection to venue and any objection that the forum is inconvenient.

5. ASSIGNMENT/SUBCONTRACT/SUCCESSORS:

Contractor shall not assign, sell, transfer, or subcontract rights, or delegate responsibilities under this Contract, in whole or in part, without the prior written approval of the OSU Procurement and Contract Services Department, and any attempt by Contractor to assign, sell, transfer, or subcontract rights or delegate responsibilities under this Contract, without first acquiring written approval of the OSU Procurement and Contract Services Department, is void. No such written approval

from OSU relieves Contractor of any obligations of this Contract, however, and any assignee, new owner, transferee or subcontractor will be considered an agent of Contractor. Contractor shall remain liable to OSU under the Contract as if no such assignment, sale, transfer, or subcontract had occurred. The provisions of this Contract are binding upon and will inure to the benefit of the parties to the Contract and their respective permitted successors and assigns.

6. COMPLIANCE WITH APPLICABLE LAW:
Contractor shall comply with all federal, state and local laws, regulations, executive orders and ordinances applicable to the Contract. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following laws, regulations and executive orders to the extent they are applicable to the Contract: (i) Titles VI and VII of the Civil Rights Act of 1964, as amended; (ii) Sections 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Americans with Disabilities Act of 1990, as amended; (iv) Executive Order 11246, as amended; (v) the Health Insurance Portability and Accountability Act of 1996; (vi) the Age Discrimination in Employment Act of 1967, as amended, and the Age Discrimination Act of 1975, as amended; (vii) the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended; (viii) ORS Chapter 659, as amended; (ix) all regulations and administrative rules established pursuant to the foregoing laws; and (x) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations. These laws, regulations and executive orders are incorporated by reference herein to the extent that they are applicable to the Contract and required by law to be so incorporated.

7. CONFIDENTIALITY:
This Contract is subject to the limitations and conditions of the Oregon Public Records Law, ORS 192.410-192.505.

8. DELIVERY:
All deliveries are F.O.B. destination with all transportation and handling charges paid by the Contractor, unless specified otherwise in the Solicitation Documents or on the face of the Purchase Order issued by OSU. Responsibility and liability for loss or damage remain with the Contractor until final inspection and acceptance, when responsibility passes to OSU except as to latent defects, fraud and Contractor's warranty obligations.

9. EXPORT CONTROL:
Contractor acknowledges that OSU has students and faculty who are foreign nationals who may work with the services, product or technology received from Contractor pursuant to this Contract. Contractor represents that it has informed OSU in writing, prior to executing this Contract if it is providing OSU any product or technology subject to the U.S. Export Administration Act of 1979, the Export Administration Regulations and the International Traffic in Arms Regulations, and if so, under what Commerce Control List number(s) or U.S. Munitions List number(s) it is controlled.

10. FORCE MAJEURE:
Neither OSU nor Contractor shall be held responsible for delay or default caused by fire, riot, act of nature, terrorist acts, or other acts of political sabotage, or war where such cause was beyond, respectively, OSU's or Contractor's reasonable control. Contractor shall make all reasonable efforts to remove or eliminate such a cause of delay or default and shall, upon cessation of the cause, diligently pursue performance of its obligations under this Contract. However, if a default or delay due to a force majeure event continues for an unreasonable time, as determined by OSU, then OSU is entitled to terminate the Contract. *No later than two working days after becoming aware of the occurrence of a force majeure event, Contractor shall furnish OSU with a written report describing the particulars of the occurrence, including an estimate of its expected duration and probable impact on the performance of the nonperforming party's obligations under this Contract. During the continuation of the force majeure event, Contractor shall furnish timely, regular written reports, updating the information required by this paragraph and providing any other information that OSU reasonably requests.*

11. GOVERNMENT EMPLOYMENT STATUS:
Contractor certifies that it is not currently employed by the federal government and not an employee of OSU.

12. INDEMNITY, RESPONSIBILITY FOR DAMAGES:

a. Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay which may be caused by, or result from, any willful or negligent act or omission of Contractor, its subcontractors, or employees under this Contract. Contractor shall save, defend, indemnify, and hold harmless OSU, the Oregon State Board of Higher Education, the State of Oregon and their agencies, subdivisions, officers, directors, agents, members, and employees from all claims, suits, and actions resulting from or arising out of the willful or negligent acts or omissions of Contractor or its subcontractors, officers, agents, or employees acting under this Contract.
b. Without limiting the generality of this section a., Contractor expressly agrees to defend, indemnify, and hold OSU, the Oregon State Board of Higher Education, the State of Oregon and their agencies, subdivisions, officers, directors, agents, members, and employees harmless from any and all claims, suits, actions, losses, liabilities,

costs, expenses and damages arising out of or related to any claims that the services or any other tangible or intangible goods delivered to OSU by Contractor that may be the subject of protection under any state or federal intellectual property law or doctrine, or OSU's use thereof infringes any patent, copyright, trade secret, trademark, trade dress, mask work, utility design, or other proprietary right of any third party; provided, that OSU shall provide Contractor with prompt written notice of any infringement claim.

c. Contractor shall have control of the defense and settlement of any claim that is subject to a. or b.; however, neither Contractor nor any attorney engaged by Contractor shall defend the claim in the name of the State of Oregon or any agency of the State of Oregon, nor purport to act as legal representative of the State of Oregon or any of its agencies, without first receiving from the Oregon Attorney General, in a form and manner determined appropriate by the Attorney General, authority to act as legal counsel for the State of Oregon, nor shall Contractor settle any claim on behalf of the State of Oregon without the approval of the Attorney General. The State of Oregon may, at its election and expense, assume its own defense and settlement in the event that the State of Oregon determines that Contractor is prohibited from defending the State of Oregon, or is not adequately defending the State of Oregon's interests, or that an important governmental principle is at issue and the State of Oregon desires to assume its own defense.

13. INSPECTIONS:

Goods furnished under this Contract are subject to inspection and test by OSU at times and places determined by OSU. If OSU finds goods furnished to be incomplete or not in compliance with the Contract, OSU, at its sole discretion, may either reject the goods, require Contractor to correct any defects without charge, or negotiate with Contractor to sell the goods to OSU at a reduced price, whichever OSU deems appropriate under the circumstances. If Contractor is unable or refuses to cure any defects within a time deemed reasonable by OSU, OSU may reject the goods and cancel the Contract in whole or in part. Nothing in this paragraph is to in any way affect or limit OSU's rights as a Buyer, including the rights and remedies relating to rejection under ORS 72.6020 and revocation of acceptance under ORS 72.6080.

14. INSURANCE:

Contractor shall secure at its own expense and keep in effect during the term of this Contract general liability or professional liability insurance as deemed applicable by OSU with limits of not less than four million dollars ($4,000,000) aggregate, unless otherwise specified in writing by OSU. Insurance policies are to be issued by an insurance company authorized to do business in the State of Oregon with a rating of A or better, or as deemed acceptable by OSU. If requested, Contractor shall provide proof of insurance of said insurance policy. If any of the liability insurance is arranged on "claims made basis, tail" coverage will be required at the completion of this Contract for a duration commiserate with the statute of limitations for tort claims in Oregon.

15. INVOICES:

Contractor shall send invoices to OSU for goods and services accepted by OSU to OSU's Department at the address specified in the Purchase Order. Contractor shall include in each invoice:

a. The Purchase Order number;
b. The quantity of goods ordered, the quantity of goods delivered, the date goods were delivered, the price per unit;
c. A detailed description of any services performed, the dates services were performed, the rate or rates for services performed, and the total cost of services; and
d. The total amount due and the payment address.

OSU shall pay Contractor for services performed at the prices and rates specified herein. Contractor shall look solely to OSU for payment of all amounts OSU owes to Contractor. Payment of OSU contracts is normally made within 30-45 days following the date the invoice is received. After 45 days, Contractor may assess overdue account charges up to a maximum of two-thirds of one percent (2/3 of 1%) per month or eight percent (8%) per annum on the outstanding balance (ORS 293.462).

16. NECESSARY COMPONENTS:

Unless specified otherwise, Contractor shall include all components, hardware and parts necessary for complete and proper assembly, installation and operation of goods.

17. NON-COMPLIANCE:

If any goods or component parts are recalled by a regulatory body or the manufacturer, or discovered by Contractor not to comply with applicable regulatory standards or the Specifications, Contractor shall immediately notify OSU of the recall or non-compliance, and shall provide copies of the recall notice or notice of non-compliance, as applicable, and all other supporting documentation for the recall or non-compliance determination. OSU may elect to (a) reject goods in whole or in part, or (b) revoke its acceptance of goods in whole or in part. If OSU rejects goods or revokes its acceptance of goods, Contractor shall remove the particular goods from OSU's possession at no cost to OSU and shall reimburse OSU for all payments made for those goods.

18. NOTICE:
Unless otherwise specified, any notice pursuant to this Contract shall be validly given if in writing and delivered to the other party via e-mail, fax, or by registered or certified mail, postage prepaid, to the respective addressees of Contractor and OSU.

19. OSU NAME AND TRADEMARK:
Contractor's shall not use names, marks or trademarks identifying OSU, or any department or office of OSU, or in any other way identify OSU without prior written approval from OSU's Office of University Advancement.

20. PARKING:
Contractors doing business on the OSU campus may be required to have a permit to park, if utilizing restricted street parking or parking lots. Contractor parking permits may be picked up from OSU's Office of Transit & Parking Services.

21. RECYCLABLE PRODUCTS:
Contractors will use recyclable products to the maximum extent economically feasible in the performance of the Contract. *Contractor shall not use recyclable products when using the recyclable products reasonably conflicts with the provisions of Exhibit A or any other provisions of the Contract.*

22. RETIREMENT SYSTEM STATUS:
Contractor is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment under this Contract. Contractor will not, by virtue of this Contract, be eligible for federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual.

23. SAFETY AND HEALTH REQUIREMENTS/HAZARD COMMUNICATION:
Goods supplied under this Contract shall comply with all federal Occupational Safety and Health Administration (OSHA) requirements and with all Oregon safety and health requirements, including those of the State of Oregon Workers' Compensation Division. Contractor shall notify OSU prior to using products containing hazardous chemicals to which OSU employees may be exposed. Products containing hazardous chemicals are those products defined by Oregon Administrative Rules, Chapter 437. Upon OSU's request, Contractor shall immediately provide Material Safety Data Sheets, as required by OAR 437-155-025, for the products subject to this provision.

24. SEVERABILITY:
The invalidity, illegality or enforceability of any provision of this Contract shall not affect the validity, legality or enforceability of any other provision of this Contract, which shall remain in full force and effect and shall be liberally construed in order to effectuate the purpose and intent of this Contract.

25. SEXUAL HARASSMENT:
The State Board of Higher Education has adopted polices applicable to Contractors that prohibit sexual harassment, and Contractor's company and employees are required to adhere to OSU's policy prohibiting sexual harassment in their interactions with members of the OSU community.

26. STANDARD COMPONENTS:
Unless specified, Contractor shall provide goods with all components and accessories that the manufacturer lists as "standard" for goods.

27. SURVIVAL:
The terms and conditions of this Contract that by their sense and context are intended to survive termination or expiration hereof shall so survive.

28. TAX COMPLIANCE CERTIFICATION:
Contractor certifies under penalty of perjury that Contractor is, to the best of the undersigned's knowledge, not in violation of any Oregon Tax Laws. For purposes of this certification, "Oregon Tax Laws" means a state tax imposed by ORS 320.005 to 320.150 and 403.200 to 403.250 and ORS chapters 118, 314, 316, 317, 318, 321 and 323 and 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.

29. TERMINATION:
This Contract may be terminated at any time by mutual consent of both parties or by OSU upon thirty (30) days' notice in

writing and delivered by certified mail or in person to the other party. In addition, OSU may terminate this Contract at any time by written notice to Contractor if (a) Federal or state statutes, regulations or guidelines are modified or interpreted in such a way that the services are no longer allowable or appropriate for purchase under this Contract; (b) any license or certificate required by law or regulation to be held by the Contractor to provide the services required by this Contract is for any reason denied, revoked, or not renewed; or (c) OSU fails to receive sufficient legislative appropriations (or from applicable federal, state, or other sources) to permit OSU, in the exercise of its reasonable administrative discretion, to fulfill its obligations under this Contract, or if the OSU program for which this Contract was executed is abolished. This Contract may also be terminated by OSU for default (including breach of contract) if (a) Contractor fails to timely provide services or materials called for by this Contract; or (b) Contractor fails to perform any of the other provisions of this Contract, or so fails to pursue the work as to endanger performance of this Contract in accordance with its terms and conditions, and after receipt of written notice from OSU, fails to correct such failures within ten (10) days. The rights and remedies of OSU provided in the above clause related to defaults (including breach of contract) by Contractor shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

30. THIRD PARTY BENEFICIARY:
OSU 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 parties.

31. TIME IS OF THE ESSENCE:
Time is of the essence for the completion of the work described in this Contract. It is anticipated by the parties that all work described herein will be completed by the dates specified, and that any delay in the completion of the work described herein shall constitute a material breach of this contract.

32. WAIVER:
Failure of OSU to enforce any provision of this Contract will not constitute a waiver or relinquishment by OSU of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

33. WARRANTIES:
Unless specified, Contractor shall deliver goods that are new, unused and produced from current production inventory. Contractor shall provide goods manufactured from only those components that the manufacturer offers in the manufacturer's current parts catalogue for goods and carry full manufacturer warranties. Contractor warrants all goods delivered to be free from defects in labor, material, and manufacture and to be in compliance with specifications in the Solicitation Document. All implied or expressed warranty provisions of the Uniform Commercial Code, at ORS Chapter 72, are incorporated into this Contract. All warranties run to OSU.

34. WARRANTIES ON FABRICATED EQUIPMENT:
Contractor warrants to OSU that:

i) Deliverables furnished and their production, conform to the Specifications.
ii) Deliverables furnished are free from defects in material and workmanship under normal use and operation for a period of 36 months from the date of installation. This warranty does not apply to defects which are the result of the Specifications, normal wear and tear, mishandling, misuse, neglect or improper testing or repair by other than Contractor or its authorized representative.
iii) As used in this section, "Specifications" means the requirements stated in Exhibit A and any modifications to those requirements that have been approved in writing by OSU in accordance with the process specified in Exhibit A.

35. WORKERS' COMPENSATION:
The Contractor, its subcontractors, if any, and all employers providing work, labor or materials under this Contract are subject employers under the Oregon Workers' Compensation law and shall comply with ORS 656.017, which requires them to provide workers' compensation coverage that satisfies Oregon law for all their subject workers, unless such employees are exempt under ORS 656.126.

36. MERGER:
THIS CONTRACT CONSTITUTES THE ENTIRE CONTRACT BETWEEN THE PARTIES. THERE ARE NO UNDERSTANDINGS, ORAL OR WRITTEN, NOT SPECIFIED HEREIN REGARDING THIS CONTRACT. NO AMENDMENT, CONSENT, OR WAIVER OF TERMS OF THIS CONTRACT SHALL BIND EITHER PARTY UNLESS IN WRITING AND SIGNED BY ALL PARTIES. ANY SUCH AMENDMENT, CONSENT, OR WAIVER IS EFFECTIVE ONLY IN THE SPECIFIC INSTANCE AND FOR THE SPECIFIC PURPOSE GIVEN.

EXHIBIT C
CERTIFICATIONS

By signature on this certification the undersigned certifies that they are authorized to act on behalf of the Bidder and that under penalty of perjury the undersigned will comply with the following:

SECTION I. OREGON TAX LAWS

The undersigned hereby certifies under penalty of perjury that the undersigned is authorized to act on behalf of Bidder and that Bidder is, to the best of the undersigned's knowledge, not in violation of any Oregon Tax Laws. For purposes of this certification, "Oregon Tax Laws" means a state tax imposed by ORS 320.005 to 320.150 and 403.200 to 403.250 and ORS chapters 118, 314, 316, 317, 318, 321 and 323 and 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.

SECTION II. AFFIRMATIVE ACTION

The undersigned hereby certifies that they have not discriminated against Minority, Women or Emerging Small Business Enterprises in obtaining any required subcontracts, pursuant to OAR 580-061-0030 (3).

SECTION III. COMPLIANCE WITH SOLICITATION

The undersigned agrees and certifies that they:

1. Have read, fully understands and agrees to be bound by the Invitation to Bid and all Exhibits and Addenda to the Invitation to Bid; and
2. Are an authorized representative of the Bidder, that the information provided is true and accurate, and that providing incorrect or incomplete information may be cause for rejection of the Bid or Contract termination; and
3. Will furnish the designated item(s) and/or service(s) in accordance with the Invitation to Bid and the Contract; and
4. Has provided a correct Federal Employer Identification Number or Social Security Number with the Bid.

SECTION IV. PERMISSIVE COOPERATIVE PROCUREMENTS

If Bidder is awarded a contract from this Invitation to Bid, Bidder hereby (check one)

☐ agrees
☐ disagrees

to offer the resulting contractual terms and prices to other public institutions.

Authorized Signature:_____ Date:_____

Name (Type or Print):_____ Telephone:(_____)_____

Title:_____ Fax:(_____)_____

FEIN ID# or SSN# (required):_____ Email:_____

Company:_____

Address, City, State, Zip:_____

Construction Contractors Board (CCB) License Number (if applicable):_____

Business Designation (check one):
☐ Corporation ☐ Partnership ☐ LLC ☐ Sole Proprietorship ☐ Non-Profit
Minority, Women & Emerging Small Business (MWESB) Certified Firm: ☐Yes ☐No
If yes, Minority, Women & Emerging Small Business (MWESB) Certification Number:_____

EXHIBIT D
REFERENCES

REFERENCE 1

COMPANY: _____ CONTACT NAME: _____

ADDRESS: _____ PHONE NUMBER: _____

CITY, STATE ZIP: _____ FAX NUMBER: _____

WEBSITE: _____ E-MAIL: _____

GOODS OR SERVICES PROVIDED: _____

REFERENCE 2

COMPANY: _____ CONTACT NAME: _____

ADDRESS: _____ PHONE NUMBER: _____

CITY, STATE ZIP: _____ FAX NUMBER: _____

WEBSITE: _____ E-MAIL: _____

GOODS OR SERVICES PROVIDED: _____

REFERENCE 3

COMPANY: _____ CONTACT NAME: _____

ADDRESS: _____ PHONE NUMBER: _____

CITY, STATE ZIP: _____ FAX NUMBER: _____

WEBSITE: _____ E-MAIL: _____

GOODS OR SERVICES PROVIDED: _____

EXHIBIT E
BID PRICE FORM

Bid pricing response must be FOB: Corvallis, OR and include all taxes, tariffs, and delivery costs

BID: JOB TB157697B FOR THE LUMP SUM TOTAL: $_____

Delivery Time after Receipt of Purchase Order:_____ Prices Good through:_____

Company:_____

Address, City, State, Zip:_____

Contact Name:_____ Telephone:(_____)_____

Contact Title:_____ Email:_____

By:_____ Title:_____

(Authorized Signature)