Appendix E

A/E Submission Requirements

Document Submission Requirements

The intent of these submission requirements is to ensure consistent, rational, easily understood documents to facilitate reviews by NIH staff.

These requirements are the minimum standards and the specific Scope of Work (SOW) will take precedence on each project. Additional requirements unique to each discipline may be indicated in the individual chapters of the *DRM*. Sufficient detail shall be provided to clearly indicate system parameters and requirements, and shall not be so generic as to require contractors or vendors to perform professional design tasks.

All submissions in each phase of work are required to be given to the NIH in drawing or written form and on digital format as determined by the Project Officer (PO). At the completion of the project final drawings shall be provided in CAD or BIM as specified in the SOW.

All documents provided by NIH to the A/E, including building backgrounds and previous project documents, shall be used for reference and general information only. It is incumbent on the A/E to survey and field verify dimensions, locations, sizes, elevations and other pertinent information for all existing items within the limits of a project.

At the conclusion of each design phase, or as required in the SOW, the required number and size of hard and electronic copies of the plans, specifications and Basis of Design shall be delivered to NIH, as directed by the PO. The final submission shall be signed and sealed by architects and engineers licensed by a state or territory of the United States.

Coordination, Constructability, Phasing, and Maintainability

Coordination, constructability, phasing, and maintainability are quality-related and risk-management elements inherent to a set of construction documents that will directly impact a project's short and long term success. The A/E shall include these elements in their design and documentation process from project initiation, and shall have routine processes to ensure that these elements have been addressed fully and appropriately.

Coordination: The goal of document coordination is for plans, sections, elevations, details, schedules, specifications and other documents of all disciplines to reflect the same information and agree with each other. A fully coordinated set of documents requires less field coordination during construction, and results in fewer conflicts, change orders, RFIs and delays. Examples of coordination include but are not limited to:

- Ceiling devices on mechanical and electrical drawings must be shown on and must not conflict with items on the architectural reflected ceiling plan.
- Structural columns, piping, ductwork and other vertical elements must be shown on architectural plans and must fit within enclosures.
- All equipment and items requiring service and maintenance shall be provided with adequate clearance.
- Phasing, temporary construction, assembly ratings and other conditions impacting multiple systems must be addressed uniformly on all documents and by all disciplines.
- Specifications and drawings must be coordinated to reflect the correct materials, equipment, sizes, etc.
- Documents must incorporate and coordinate with the Basis of Design (BOD), all review comments from previous submissions, and most current requirements, equipment information and other input from users.

The A/E shall use the capabilities of CADD and Building Information Modeling (BIM) where possible to use single models or files between different disciplines so that duplication is avoided and coordination and updates are automatic. BIM should be used where possible for clash detection and to automatically generate schedules and other documents. Changes during design or documentation are particularly critical. The A/E's project manager(s) or production coordinator(s) must ensure that changes are communicated between disciplines and are reflected in all appropriate locations and documents. Each discipline must have a Quality Assurance plan to review and document processes and procedure to assure coordination. A Quality Control review must be conducted by an experienced professional interdisciplinary team to sign-off that the documents have been reviewed for coordination prior to each submission.

Constructability: 'Constructability' is the ease and efficiency of the construction process. All construction documentation shall be reviewed to increase constructability by identifying and eliminating potential construction obstacles before the start of construction. Examples of constructability issues include but are not limited to:

- Existing site or building conditions that are unusual or which may require mitigation or remediation.
- Systems, materials or equipment that are incompatible or require undue coordination or customization.
- Unusual or untried techniques, materials, equipment or details.
- Unusually long lead items.
- Uncoordinated or incomplete construction documents.
- Overly complex phasing.
- Overly restrictive site access or other work restrictions.

The A/E's project manager(s) and/or Quality Control team shall review documents for constructability. Potential constructability issues shall be eliminated, or shall be highlighted in the documents and brought to the attention of the NIH Project Officer so that they can be proactively addressed in the construction schedule.

Phasing: Phasing is the planned sequential construction of portions of a project so that areas come on-line and/or off-line in stages for the benefit of building operations or occupancy. Phasing may be required in conditions including but not limited to:

- Funding may not be available to complete the entire project in a single phase.
- Swing space may not be available to remove all occupants from the project area.
- Critical utilities or building operations may have to be maintained.
- Access, egress or other functions may have to be maintained.
- Project outside of the A/E scope may affect the work area.

Phasing complicates construction and adds cost and time to projects. The A/E must work with Project Officers to eliminate or simplify phasing where possible. Where phasing is necessary, a plan with the fewest, least complex and most constructible phases shall be developed in an effort to reduce schedule and cost. The A/E shall develop clear, concise phasing documents for all disciplines so that the work during and at the end of all phases is complete and coordinated.

Maintainability: Ultimately all completed projects must be maintainable by facilities personnel. Maintainability means the facility is designed and constructed in a manner which promotes efficient and high quality maintenance procedures with minimal impact to facility function and operations. Maintainability may include but not be limited to:

- Appropriate clear access to valves, filters, disconnects, etc. which require routine access by maintenance personnel.
- Specifying materials and equipment which are readily available in the geographic region in which the facility is located to prevent long facility impacts due to equipment production and shipping requirements.
- Providing specifications for attic stock and spare parts for materials and equipment that may result in long facility impacts if hard to obtain material or equipment is required to be replaced per a regular maintenance schedule.
- Proper testing, commissioning, and training is included in the specifications to confirm all equipment is completely operational at the time of turn over; and the facility staff is ready to perform their duties at that time.
- Ensuring routinely accessible items such as valves, damper and disconnects are located within areas which will not impact facility functionality. This would include locating such devices in areas where maintenance personnel would not be required to gown or done special PPE to perform routine operations.

The A/E quality staff should review design concepts for maintainability with facility personnel early in the project to obtain their input. They should then perform reviews throughout the design process to make sure the maintainability requirements are carried through the design

process. For designs located within existing facilities the design team needs to be aware of the impact of maintenance requirements of the new space on existing areas within the facility. This may mean including more valves, dampers or disconnect means to isolate the new space for maintenance without impact to surrounding areas. A facility design with maintainability as part of its central planning will result in increased user satisfaction, greater equipment longevity and lower life cycle costs.

Drawings

Application: Dedicated drawing sheets (plans, details, schedules, etc.) shall be provided for each primary discipline (Civil, Structural, Architectural, Mechanical, Plumbing, Fire Protection, Electrical etc.) applicable to the project.

Size: All drawings of the same project must be a uniform standard size.

Backgrounds: Consistent backgrounds shall be provided clearly showing salient features at the specific area of work. Backgrounds shall include the immediate project area and all surrounding areas (adjacent rooms, corridors, electrical and mechanical rooms, shafts) necessary to convey the project in the context of the larger building.

Coordination: All project information shall be coordinated to avoid conflicts between drawings, between disciplines, narratives and specifications. Duplicate information should be avoided unless required for interdisciplinary coordination. An example of appropriate duplicate information is Mechanical, Electrical, and Plumbing (MEP) devices on an Architectural reflected ceiling plan. In this case devices should be referenced from their respective disciplines' documents to ensure coordination.

Primary MEP equipment rooms and similar multi discipline common spaces involving unique arrangement and access requirements associated with major equipment shall be coordinated between disciplines. Work shall be prominently identified on the respective drawings. Major equipment of other disciplines, as well as significant service access paths that must be preserved or maintained clear, shall be shown in the background through use of thin lines or patterns (such as lightly hatched, cross hatched, dashed/dotted) or otherwise clearly indicated.

Provisions for Future: Infrastructure spaces, equipment areas, utilities and other applications with an intended clear and specific need associated with planned future construction or future phasing shall be clearly noted or otherwise reserved to communicate intent and application of reserved space.

Room Identification: Provide room names and numbers on all plans (including demolition plans, life safety plans, reflected ceiling plans, all discipline plans). Room numbers shall be comply with NIH room numbering conventions and shall be approved by the PO.

Conventions and Symbols. Drawings shall use common industry standard conventions and symbols. Legends shall be provided to identify symbols and abbreviations.

Line Weight: Drawings shall employ multiple line weights to improve readability. Similar line weights shall be used by all disciplines. Line weights shall be sufficiently dark to permit photocopying without loss of detail.

Lettering: Letters and numbers on drawings shall be a minimum of 3/32" tall when on full sized sheets. This applies to concept and design development drawings as well as construction documents.

Reference: Column grid lines with identification shall be provided on all floor plans. Other documents (such as elevations, details, and riser diagrams) shall be provided with similar reference information as appropriate to facilitate clear and efficient document interpretation.

Scale, North Arrow, Key Plan: All plans shall have a north arrow. All drawings will be produced with metric or imperial drawing scales, as required by the *DRM* and as specified in the SOW. Scale of drawings shall be as required for legibility on half-size reduced copies. Graphic scales shall be provided on all scaled drawings. All plans showing similar work (including demolition plans, life safety plans, reflected ceiling plans, all discipline plans) shall be at the same scale and in the same orientation. Key plans shall be provided as required to show the areas of work within the context of the larger building or complex.

CAD Standards: The National CAD/CIFM Standards shall be followed for all CAD drawing formatting. All drawings shall be created with or compatible with the

latest version of the Autodesk building design suite software package. Building Information Modeling (BIM) shall be utilized for all large or complex projects, projects requiring coordination between disciplines, or as required by the SOW.

Dimensioning: All drawings will be produced with metric or imperial dimensions, as required by the *DRM* and as specified in the SOW.

- Dimensions must be legible and in continuous 'strings' where possible.
- Dimensions must be tied to column lines and other fixed points where necessary to positively locate items.
- Avoid duplicate dimensions.
- For renovation projects, use 'Minimum' or 'Verify in Field' notation for critical dimensions. Use '+/-' notation for non-critical dimensions.
- **Metric:** All dimensions shall be in millimeters, unless there is a specific reason to use another unit. On the drawings the unit symbol shall be eliminated and an explanatory note such as "All dimensions are shown in millimeters" provided. All dimensions should end in '0' or '5', unless greater tolerance is specifically required.
- **Imperial:** All dimensions shall be in feet (') and inches ("). Plan tolerance should not be less than 1", and detail tolerance should not be less than ¼", unless greater tolerance is specifically required.

Specifications

Format: All construction contract specifications shall be created and edited using the latest version of the AIA MASTERSPEC®.

AIA MASTERSPEC® shall be used as the base document for all items and systems that are adequately addressed in MASTERSPEC® sections. The A/E shall edit all MASTERSPEC® sections to ensure appropriate standards of quality for materials and systems, for conformance to the *DRM*, and to address specific project requirements. The A/E shall write new specification sections or use another standardized specification system for a section or item that MASTERSPEC® does not cover.

Each page should be numbered. Specifications should be bound and include a Table of Contents to navigate to the individual specification sections.

Editing of Specifications: Specifications shall be edited to reflect the specifics of the project. Each specification section must be carefully cross-referenced with the drawings and with other sections to ensure completeness and coordination. All items and references not pertinent to the project shall be omitted.

Basis of Design (BOD) and Calculations

BOD: Typed, bound BOD shall be produced for the initial design submission and shall be updated and resubmitted at each subsequent submission. Sections shall be provided for each design discipline.

The BOD shall fully document the parameters of the project. In conjunction with the drawings and specifications, the BOD is a permanent record of the building/project design. The BOD shall include discipline narratives, which explain and document all important requirements and decisions made during the design process. Narratives shall comply with the SOW, and shall be tailored to each project. Narratives shall be sufficiently detailed to convey the design intent (e.g., general description, areas served, significant features, provisions for future expansion/flexibility, materials/products to be used, codes, standards, design criteria) and special program requirements pertinent to the design.

In addition, the BOD shall include SOW, project program, a listing of all applicable codes, standards, and regulations, room data sheets, equipment schedule, equipment cut sheets with specific as-selected options identified, meeting minutes and correspondence. Depending on the scope of the project, other items may include budget and cost estimates, geotechnical and survey information, planning alternatives, questionnaires and surveys, studies, benchmarking, sustainability goals and approach, risk analysis and any other information that will provide insight and provide background on the project and its development. The BOD of each submittal may be based on the previous submittal, but must be revised and expanded at each stage to reflect the current state of the design and the basis for which each system has been engineered, constructed, and expected to operate.

Calculations: Manual and/or computer based calculations should accompany narratives where required to support technical analysis. Calculations are required for all primary equipment, infrastructure, and distribution

systems unless otherwise approved by NIH. Each set of calculations should start with a summary sheet, which shows all assumptions, references applicable codes and standards, and lists the conclusions. Calculations should include engineering sketches as an aid to understanding by reviewers. The calculations for each submittal should be cumulative, so that the final submittal contains all calculations for the project. Calculations submitted at early stages of the project must be revised later to reflect the final design. Calculations must refer to code, paragraph of code used, standards, and text books used for specific portion of calculation. Refer to drawing number where the results of the calculations have been used where applicable (e.g. number and sizes of re-bars used in reinforced concrete members). Printout of summary sheets and print-outs which indicate values but do not clearly identify data utilized, inputs and calculation methodology or otherwise do not provide a clear record of how results were obtained are unacceptable. Calculations shall be in the same unit format (metric or imperial) as other project documentation as specified in the SOW.

Metric Standards for New Construction

All final drawings and specifications for new construction shall be expressed in metric units or dual units (metric and imperial), unless other requirements are specifically provided by the contracting officer (CO). The General Services Administration (GSA) Metric Design Guide, latest edition, and the Metric Guide for Federal Construction shall be used for guidance on how drawings, specifications, and other elements of metric implementation are to be addressed.

Unit Standards for Renovations and Additions: All facility renovation and addition design projects shall be based on the unit type (i.e., metric or imperial) for which the facility was originally designed. Units in all design documentation (drawings, specifications, calculations, etc.) shall be consistent and shall not be mixed.

Unit Standards for Leases: All lease facility design projects shall use imperial units in accordance with ANSI/BOMA Z65.1.

Titleblock: All drawings larger than 11" x 17" shall be on a standard NIH titleblock. All fields, including project identification, date, project officer, and submission, shall be completed.

Project Cover Sheet: The NIH standard cover sheet shall be used, and shall include the following:

- NIH building number
- Room number(s), if applicable
- Submission
- Date
- Work request number
- Vicinity map
- Area map

Other information: The cover sheet or following sheet(s) shall contain the following:

- Complete and accurate drawing index
- Drawing Index on the Cover Sheet of each discipline (for that discipline)
- Abbreviations and symbols edited and tailored to the project
- Life safety information, including:
  - List of codes and code requirements applicable to the project
  - Life safety plan(s), including fire ratings, common paths of travel, travel distances and other pertinent information for the project area

NIH Review of Contractor's Submittals

The NIH PO reserves the right to review any contractors' construction and equipment submittals. At the PO's request, copies of contractors' submittals may be required for NIH's review and concurrence. This includes (but is not limited to) critical equipment, research equipment, or for systems where detailed piping and instrumentation drawings and associated data are deferred from initial A/E design. The A/E shall incorporate any and all NIH review comments in the contractor's submittal and the final record documentation package.

A/E Submission Requirements Matrix

The following is a list of submittal requirements to be provided with each submission. Additional submittal requirements shall be provided as required by the Statement of Work (SOW), as required in individual chapters of the *DRM*, and as required to fully convey, define and address the full scope and complexity of the project. Refer to individual sections of the *DRM* for discipline specific details. All submittals must be provided unless specifically excluded by the Project Officer (PO).

All submissions shall fully address NIH review comments made on previous submissions. Prior to submission all appropriate updates shall be made, and all required clarification and additional information shall be provided to resolve all open issues. I: Initial Submission, U: Updated, F: Final

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Civil/Site/Landscape					
Basis of Design Report	I	U	U	U	F
Alternate Schemes	F				
Vicinity Plan	I	F			
Existing Site Plan	I	F			
Proposed Site Plans	I	U	U	U	F
Grading and drainage	I	U	U	U	F
Erosion and sediment control	I	U	U	U	F
Plantings, paving	I	U	U	U	F
Site utilities	I	U	U	U	F
Utility profiles		I	U	U	F
Excavation, waste management, etc. as required		I	U	U	F
Demolition Plan	I	U	U	U	F
Details		I	U	U	F
Specifications		I	U	U	F
Architectural					
Basis of Design Report	I	U	U	U	F
Scope of work	F				
Design narrative	I	U	U	U	F
Architectural program	I	U	U	U	F
Tabulation of net and gross areas	I	U	U	U	F
Programming questionnaires	I	F			
Alternate schemes	F				
Building envelope analysis	I	U	F		
Vertical transportation recommendations	I	F			
Sustainability strategies, score sheets	I	U	U	U	F
Major scientific equipment and specialty equipment description	I	U	U	U	F

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Architectural (continued)					
Code Analysis	I	U	U	U	F
Floor Plans	I	U	U	U	F
Building Elevations	I	U	U	U	F
Building Sections	I	U	U	U	F
Demolition Plans	I	U	U	U	F
Reflected Ceiling Plans	I	U	U	U	F
Enlarged Plans	I	U	U	U	F
Interior Elevations	I	U	U	U	F
Wall Sections	I	U	U	U	F
Details		I	U	U	F
Schedules		I	U	U	F
Specifications		I	U	U	F
Structural					
Basis of Design Report	I	U	U	U	F
Geotechnical data	F				
Calculations	I	U	U	U	F
Summary of structural systems requirements	I	F			
Alternative schemes	F				
Vibration requirements and analysis	I	U	U	U	F
Sustainability strategies, score sheets	I	U	U	U	F
Code Analysis	I	U	U	U	F
Floor Plans	I	U	U	U	F
Demolition Plans	I	U	U	U	F
Section	I	U	U	U	F
Fire-resistive Construction Requirements	I	U	U	U	F
Details		I	U	U	F
Schedules		I	U	U	F
Specifications		I	U	U	F

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Mechanical					
Basis of Design Report	I	U	U	U	F
Design criteria	I	U	U	U	F
Design conditions	I	U	U	U	F
Applicable codes, standards, regulations	I	U	U	U	F
Major scientific and specialty equipment utility requirements	I	U	U	U	F
Analysis on available utilities	I	U	U	U	F
Systems analysis and recommendations	I	U	U	U	F
Pre-design readings to determine current baseline	I	U	U	U	F
System description, existing and proposed	I	U	U	U	F
Conceptual plans/diagrams	I	U	U	U	F
Redundancy requirements	I	U	U	U	F
Energy recovery requirements	I	U	U	U	F
Calculations including room by room calculations for HVAC	I	U	U	U	F
Life cycle cost analysis	I	U	U	U	F
Numerical analysis on laboratory/animal exhaust plume discharges (where applicable)	I	U	U	U	F
Mechanical equipment cut sheets	I	U	U	U	F
Constructibility, phasing and maintainability requirements	I	U	U	U	F
Engineering monitoring and controls	I	U	U	U	F
Sustainability strategies and score sheets	I	U	U	U	F
Code Analysis	I	U	U	U	F
Floor Plans	I	U	U	U	F
Sections	I	U	U	U	F
Details		I	U	U	F
Schedules		I	U	U	F
Demolition Plans		I	U	U	F
System Diagrams		I	U	U	F
Control Diagrams		I	U	U	F

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Mechanical (continued)					
Ductwork sizing in plenums and shafts		I	U	U	F
Specifications		I	U	U	F
Commissioning Specifications				I	F
Plumbing					
Basis of Design Report	I	U	U	U	F
Design criteria including general sizing	I	U	U	U	F
Design conditions	I	U	U	U	F
Applicable codes, standards, regulations	I	U	U	U	F
Major scientific and specialty equipment utility requirements	I	U	U	U	F
Analysis on incoming utilities and environmental conditions	I	U	U	U	F
Hydraulic analysis, flow, pressure, water quality	I	U	U	U	F
Systems analysis, material selection	I	U	U	U	F
System description, existing and proposed	I	U	U	U	F
Conceptual plans/diagrams	I	U	U	U	F
Redundancy requirements	I	U	U	U	F
Energy saving requirements	I	U	U	U	F
Calculations	I	U	U	U	F
Life cycle cost analysis	I	U	U	U	F
Plumbing cut sheets	I	U	U	U	F
Constructibility, phasing and maintainability requirements	I	U	U	U	F
Engineering monitoring and controls	I	U	U	U	F
Sustainability strategies and score sheets	I	U	U	U	F
Code Analysis	I	U	U	U	F
Floor Plans	I	U	U	U	F
Plot Plan for Outside of Building Underground Distribution	I	U	U	U	F
Plumbing Riser Diagrams	I	U	U	U	F

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Plumbing (continued)					
Details	I	U	U	U	F
Demolition Plans	I	U	U	U	F
One Line Flow and Control Diagram	I	U	U	U	F
Schedules		I	U	U	F
Specifications		I	U	U	F
Fire Protection					
Basis of Design Report	I	U	U	U	F
Hydrostatic flow test and water supply analysis	I	F			
Calculation of required water supply	I	U	U	U	F
Requirements for fire protection	I	U	U	U	F
Requirement for fire pump	I	U	U	U	F
Overall system concepts	I	U	U	U	F
Analysis of conceptual design solutions	I	F			
Alternative materials/systems/ equipment	F				
Protection analysis report for each alternative	F				
Sizes and capacities of major components	I	U	U	U	F
Code Analysis	I	U	U	U	F
Present Conditions	I	F			
Floor Plans	I	U	U	U	F
Special Fire Suppression Systems	I	U	U	U	F
Integrated Fire Alarm		I	U	U	F
Specifications		I	U	U	F
Electrical/Communications					
Basis of Design Report	I	U	U	U	F
Energy budget	I	U	U	U	F
Overall building connected load requirements	I	U	U	U	F
Electrical service sizing calculations	I	U	U	U	F
Sizing of transformers, generator, UPS etc.	I	U	U	U	F

Submission Requirements	Schematic Design 15%	Design Development 35%	Construction Document 65%	Construction Document 95%	Construction Document Phase 100%
Electrical/Communications (continued)					
Basis of Design Report (continued)					
Equipment cut sheets	I	U	U	U	F
Sustainability strategies, score sheets	I	U	U	U	F
Code Analysis	I	U	U	U	F
Present Conditions	I	U	U	U	F
Floor Plans	I	U	U	U	F
Layouts of Components Where Space is Critical		I	U	U	F
Lighting Plans		I	U	U	F
Riser Diagram for Normal & Emergency Power Distribution	I	U	U	U	F
Details		I	U	U	F
Demolition plans	I	U	U	U	F
Schedules		I	U	U	F
Specifications		I	U	U	F
Telecommunications					
Basis of Design Report	I	U	U	U	F
Site Plans	I	U	U	U	F
Floor Plans		I	U	U	F
Layouts of Components Where Space is Critical		I	U	U	F
Riser Diagram for Telecommunication Distribution	I	U	U	U	F
Specifications		I	U	U	F