U.S. AIR FORCE

BUILDING INFORMATION MODELING

MINIMUM REQUIREMENTS

VERSION 2.1

FOR: AIR FORCE CIVIL ENGINEER CENTER



18 February 2015

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SECTION A: PURPOSE AND CONTACT INFORMATION

This document represents the minimum BIM requirements for Air Force facilities projects. Additional BIM requirements may be incorporated on projects where appropriate in support of definitive objectives.

Questions pertaining to an individual solicitation shall be directed to the advertising district's contracting specialist for that solicitation.

Questions pertaining to this document should be directed to AFCEC Workflow (<u>afcec.cf.workflow@us.af.mil</u>), Paul Womble (<u>paul.womble@us.af.mil</u>), or Jose Castro-Rodriguez (jose.castro-rodriguez@us.af.mil).

SECTION B: DESIGN AND CONSTRUCTION AGENT REQUIREMENTS

Design and Construction Agents shall ensure proper synchronization of the BIM requirements with the project acquisition strategy (delivery, contracting and procurement methods). As an example: for traditional project delivery methods, requirements for data synchronization during construction may be established during the design contract execution, and must be coordinated with the construction contract.

Design and Construction Agents shall ensure contracts are coordinated to align responsibility with the chosen acquisition strategy.

Design and Construction Agents shall ensure the BIM execution plan is in support of the U.S. Air Force BIM objectives prior to approval of the BIM Execution Plan.

It is preferable to the Air Force to have bidding firms accomplish a draft implementation plan to be used as a discriminator for possible award to the firms who propose maximum BIM use throughout the facility lifecycle. Whether the BIM Project Execution Plan is accomplished before or after award, the plan shall include using the BIM data for the minimum requirements delineated in SECTION I.

Design and Construction Agents shall coordinate contract requirements to ensure appropriate contractual controls exist to ensure timely and effective implementation of the BIM Execution Plan. Such controls may include withholding of payment for design and construction for unacceptable performance in executing the Plan.

SECTION C: U.S. AIR FORCE BIM MISSION STATEMENT

U.S. Air Force Strategic BIM Goals and Objectives are aligned to directly support the Air Force Civil Engineer (CE) mission identified in the 2011 CE Strategic Plan: "...provide, operate, maintain and protect sustainable installations as weapon-system platforms through engineering and emergency response services across the full mission spectrum."

The Civil Engineer Strategic Plan identifies three Goals as the foundation of the CE Strategy:

- Build Ready Engineers,
- Build Great Leaders, and
- Build Sustainable Installations.

The project goals and BIM Uses identified in Section D have been developed to support the CE Strategic Plan. Except for some minor modifications in Section D, the BIM Uses were previously developed for the National BIM Standard. The identified BIM Uses are selected to meet the USAF goals that were developed to support the CE Strategic Plan

SECTION D: BIM GOALS, OBJECTIVES AND USES

1. MAJOR BIM GOALS / OBJECTIVES:

BIM GOAL	DESCRIPTION			
Integrate project-level BIMs with current and projected software tools.	Integrate BIM data with AF Facility Management and GeoBase geospatial tools. The current AF strategy for accomplishing this goal is to provide Construction Operations Building Information Exchange (COBie) data to populate Tririga and BUILDER databases and to geo-locate BIM models			
Support the Total Force Civil Engineer team by providing NexGen IT integrated software tools	t the Total Force Civil ser team by providing IT integrated software tools			
	Provide BIM and software tools to support lifecycle-based program management aligned with other federal government entities and universally adopted standards.			
Support sustainable installations and asset	Implement BIM-based planning, design and construction and by delivering a BIM model that integrate with approved facility management tools/software			
management	Apply BIM-enabled FM systems to optimize management of RP resources.			
	and Design phases and implement BIM-based EMCS sensor planning/monitoring			
Eliminate conflicts	Clash Detection software is used during the design and construction phases to identify conflicts by comparing 3D models of building systems. The goal of clash detection is to eliminate the major system conflicts prior to installation. The information model is then used to create detailed control points to aid in assembly layout. An example of this is layout of foundations using a total station with points preloaded and/or using GPS coordinates to determine if proper excavation depth is reached.			
Accurate 3D Record Model for FM Team	The Record Model shall, at a minimum, contain the culmination of all the BIM modeling throughout the project, including linking Operation, Maintenance, and Asset data to the asbuilt model (created from the Design, Construction, 4D Coordination Models, and Subcontractor Fabrication Models) to deliver an accurate Record Model to the Air Force asset manager. Additional information including equipment (computer racks, UPS, material handling; where applicable) and space planning system shall be included to ensure they interface properly with building systems. For D-B-B projects, the A-E will develop the Design Model and Specifications for the Construction Contractor for producing the Record Model			

2. BIM USES:

The BIM Uses highlighted/shaded and checked with an (X) are required USAF BIM Requirements. Additional BIM Uses may be identified on a project as applicable. Contractors may identify additional BIM Uses for the project as Contractor Electives. Reference the BIM Project Execution Planning Guide at www.nationalbimstandard.org for BIM Use descriptions.

PLAN (NIC)		DESIGN		CONSTRUCT	OPERATE (NIC)
PROGRAMMING	Х	DESIGN AUTHORING		SITE UTILIZATION PLANNING	BUILDING SYSTEM ANALYSIS
SITE ANALYSIS	Х	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN	ASSET MANAGEMENT
	х	3D COORDINATION - INTERFERENCE MANAGEMENT	х	3D COORDINATION - INTERFERENCE MANAGEMENT	SPACE MANAGEMENT / TRACKING
		ENGINEERING ANALYSIS - STRUCTURAL		DIGITAL FABRICATION	DISASTER PLANNING
		ENGINEERING ANALYSIS - LIGHTING	Х	3D CONTROL AND PLANNING / DIGITAL LAYOUT	
		ENGINEERING ANALYSIS - ENERGY	х	RECORD MODELING	RECORD MODELING
		PROGRAM VALIDATION		FIELD / MATERIAL TRACKING	
		ENGINEERING ANALYSIS - MECHANICAL			
	x	3D CONTROL AND PLANNING (DIGITAL LAYOUT) - GEOLOCATING THE PROJECT			
		SUSTAINABILITY (LEED) EVALUATION			
		ENGINEERING ANALYSIS – OTHER (PER CONTRACT REQUIREMENTS)			
		CODE VALIDATION			
PHASE PLANNING (4D)		PRELIMINARY CONSTRUCTION SCHEDULING (4D)		CONSTRUCTION SCHEDULING (4D)	BUILDING (PREVENTIVE) MAINTENANCE SCHEDULING (4D)
COST ESTIMATION (5D)	Х	COST ESTIMATION (5D)		COST ESTIMATION (5D)	COST ESTIMATION (5D)
EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING	EXISTING CONDITIONS MODELING
CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBie)	x	CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBie)	х	CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBie) BUILDER and Omniclass as required	CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBie) BUILDER and Omniclass as required

BIM USE: CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE Description:

This is an interim process to achieve the Asset Management BIM Use by populating Record Model attributes and COBie spreadsheets to provide facility information to the USAF's NextGen IT Facilities Management system. Facility data shall include all information associated with the Design and Constructions worksheets as well as the Spares worksheet from the Operations and Maintenance worksheets.

Potential Value:

- Store operations, maintenance owner user manuals, and equipment specifications for faster access.
- Maintain up-to-date facility and equipment data including but not limited to maintenance schedules, warranties, cost data, upgrades, replacements, damages/deterioration, maintenance records, manufacturer's data, and equipment functionality

Resources Required:

- Record Model
- COBie database

COBie Data Formats: The USAF's Facility Management system is transitioning under the NextGen IT initiative to TRIRIGA and BUILDER. TRIRIGA is able to import COBie standard Omniclass formatted data via XML spreadsheets while BUILDER utilizes data formatted in Uniformat II. Facility asset data that will be maintained in BUILDER must first be uploaded into the BUILDER Remote Entry Database (BRED). Refer to the BRED Data Dictionary for data format requirements.

Team Competencies Required:

- Pre-design knowledge of which assets are worth tracking, whether the building is dynamic vs. static, and the end needs of the building to satisfy the end user
- Knowledge of the asset management system

Selected Resources:

- NIST (2007) General Buildings Information Handover Guide: Principles, Methodology, and Case Studies
- BUILDER Remote Entry Database (BRED) Data Dictionary

SECTION E: BIM FORMAT

Multiple BIM platforms will generally be used across the design specialties and trades taking advantage of the strengths of the various platforms, therefore no specific BIM platform shall be mandated. The Contractor's BIM Execution Plan shall define the BIM tools to be used in the execution of the project.

IFC Coordination View. The Contractor's selected BIM application(s) and software(s) shall be certified in the IFC (Industry Foundation Class) Coordination View (2x3 or better). Submit any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment for Government approval.

Contractors will use the Model and Facility Data to produce accurate Construction Documents. BIM associated submittals shall conform to the standards described below.

SECTION F: BIM DELIVERABLES

1. GENERAL:

Develop all designs using Building Information Modeling (BIM) and Computer Aided Design (CAD) software.

The use of BIM does not negate the need for delivery of CAD files used for the creation of the Construction Documents Drawings. Specification of a CAD file format for these drawings submitted shall not be used to limit which BIM application(s) or software(s) may be used for project development and execution.

Deliver the Model, CAD files, and Facility/Site Data, Workspace in the native format, DWF and PDF format for project manager review using viewer software or Adobe Acrobat Reader. The BIM shall be in a native file format with linked performance based specifications (via e-SPECS for Revit with SpecsIntact integration or similar), interactive for the user, and the model shall be fully compatible with the Air Force standard platform (Autodesk Revit) and in an interoperable file format like the Industry Foundation Class (IFC).

Deliver COBie data extract in Excel spreadsheet format.

Provide a list of all submitted files in Excel spreadsheet format.

Electronic submittals shall be on digital media acceptable to the Government. The electronic submittals shall be organized and structured supportive of archival and retrieval. The electronic submittals shall have a "dash-board" type feature to assist viewers navigate through the digital media and associated files. Files not using names which readily identify their content shall have appropriate Meta data attached to include searchable short descriptions of the file's content or relevance.

2. OWNERSHIP AND RIGHTS TO DATA:

The Government has ownership of rights at the date of Design Completion or Closeout Submittal (as applicable) to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27. The Government may make use of this data following any deliverable, including interim or final submittals.

3. DESIGN AND CONSTRUCTION REVIEWS:

Design submittal drawings shall be sized per contract requirements and suitable for A3 (11"x17") legible scaled reproduction.

Provide Models and CADD files for design and construction review submittals in DWG DWF & PDF format for project manager review using viewer software or Adobe Acrobat Reader.

Provide a COBie spreadsheet based on the current COBie spreadsheet template in Excel format. Refer to The COBie Guide located on the National Institute of Building Sciences (NIBS) website. Include Manufacturer's Product Data, Operations and Maintenance data, Warranty data, and spares data. Provide data formatted for BUILDER and Tririga.

Provide a list of Construction Documents (e.g., drawings, elevations, design sections and schedules, details) produced from the Facility Data and updated as necessary for each submittal.

Perform design and construction reviews at each submittal stage to test the Model. This model review shall correlate to the actual submittal provided to the Government. Minimum model reviews include:

Visual Checks: Check to ensure the design intent has been followed and that there are no unintended elements in the Model.

Interference Management Checks: Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural or mechanical vs. mechanical overlaps in the same location) and soft interferences (e.g. conflicts regarding equipment clearance, service access, fireproofing, insulation) in a written report and resolve.

IFC Coordination View: Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements. Provide IFC export configuration text file illustrating BIM to IFC assignments.

Model Standards/ CAD Standards Check Reports: Provide a written report documenting that the BIM and AEC CADD Standard have been followed (fonts, dimensions, line styles, levels/layers, etc).

Model Integrity Validation: Provide a written report documenting the QC validation process used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements and the reporting process on non-compliant elements and corrective action plans.

Project Scope Validation Check: Provide report of comparison of programmed scope (from the project Requirements Document) to actual design scope. The comparison shall either be done within the model platform itself or an external project review program approved by the Government. Actual NSF for the design shall be automatically generated within the model and not manually entered. The project scope validation check shall have a minimum of the following data points listed: Room Number, Department or Functional Area, Space Type, Room Name, Target NSF, Design Actual NSF, Calculated Delta between Target and Actual NSF for room, and calculated exceeds critical delta (yes or no). The project team shall establish a target "critical" delta or allowable variance for rooms at the beginning of the project (e.g. 2%). The project scope validation report will indicate rooms that fall outside of these established criteria.

Project Room Contents (PRC) Validation Check: Provide report of comparison of approved PRC list by room (from the project Requirements Document) to actual design PRC. The comparison shall either be done within the model platform itself or an external project review program approved by the Government. The report shall provide a list of rooms where the design PRC does not match the approved PRC and the specific items that do not match. The non-matching items list shall include at a minimum the PRC equipment item approved and expected, and the designed PRC item not matching.

Gross Area Tabulation Calculation: The contractor shall calculate the departmental gross square feet / meters (GSF / GSM) and the building GSF / GSM using the model's automatic calculation attributes in accordance with gross square footage calculation guidance contained in AFI 32-1084 Facility Requirements. The total building Gross Area Tabulation report shall as a minimum identify total mechanical gross, circulation gross, electrical gross and overall building gross area factor.

A 3-D interactive review format of the Model in Bentley Navigator, Navisworks, Adobe 3D PDF 9.0 (or later), Google Earth KMZ or other format per Execution Plan requirements. The file format for reviews can change between submittals.

Change Tracking Report: The contractor shall provide documentation of changes made to the Model at each stage utilizing software tools such as the Revit Compare Tool.

During the Construction Submittal stages, the Contractor shall deliver the construction schedule with information derived from the Model.

4. Final Record Model and CAD Data:

The following shall be required of the construction contractor.

Submit the final Record Model, Facility, and CAD Data files reflecting as-built conditions for Government Approval prior to project closeout.

Record Models shall contain updated and accurate parameter data at the time of submittal.

The Record Model shall update the final design Model, Facility, and CAD Data files reflecting as-built conditions for Government Approval. Update the design model assemblies with actual manufacturer BIMs (when available) as part of the Record Model. Provide Operations and Maintenance, Product, and Warranty data within the as-built model. Include updates from all Field Changes and Contract Modifications.

Provide a COBie spreadsheet based on the current COBie spreadsheet template in Excel format. Refer to The COBie Guide located on the National Institute of Building Sciences (NIBS) website. Include Manufacturer's Product Data, Operations and Maintenance data, Warranty data, and spares data. Provide data formatted for BUILDER and Tririga.

SECTION G: QUALITY CONTROL

At each stage provide a Contractor-certified written report with each design submittal, confirming that consistency checks as identified in this Section have been completed for the design submittal. This report shall be discussed as part of the design review conference and shall address cross-discipline interferences, if any.

Visual Check: Ensure there are no unintended model components and the design intent has been followed

Interference Check: Locate conflicting spatial data in the Model where two elements are occupying the same physical space. Log hard interferences (e.g., mechanical vs. structural or mechanical vs. mechanical overlaps in the same location), and soft interferences (conflicts regarding service access, fireproofing, insulation), in a written report and document disposition.

Standards Check: Ensure that the BIM and A/E/C CADD Standard have been followed (fonts, dimensions, line styles, levels/layers, and other contract document formatting issues are followed per the A/E/C CADD Standard.)

Model Integrity Checks: Conduct QC validation processes to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements and the report on non-compliant elements and corrective action. Provide justification acceptable to the Government of non-compliant elements if allowed to remain within the Model.

Version Updating Check: Ensure that all users are using the agreed upon version of the software and the method by which changing software version is completed

Revision Authority Check: Describe the method by which all users will be given access and extent of revision authority to versions of the model as updated.

Other QC Parameters: Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for concurrence.

Over-The-Shoulder Progress Reviews: Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

SECTION H: BIM PROJECT EXECUTION PLAN

Prior to the Initial Design Conference / design kick off and construction kickoff meeting, the contractor shall submit a BIM Project Execution Plan (PxP), documenting the BIM design and analysis technologies selected for the Project Model from concept development through the Record Model as a design, production, coordination, construction, and documentation tool and the collaborative process by which it shall be implemented. The Government shall confirm acceptability of the PxP or advise as to additional processes or activities necessary to be incorporated into the PxP. The PxP shall include the minimums defined herein. The PxP shall be synchronized with the project acquisition strategy applied.

The PxP shall describe BIM Uses during the design and construction phases. Additionally the PxP shall describe the handoff of BIM data and model to the Government over the course of the project execution and turn over.

The PxP shall identify how the BIM data will be managed and interoperate (data storage, sharing, viewing, quality control, and updating, as necessary) among all project team members.

Within thirty (30) days after the acceptance of the PxP, conduct a demonstration at the Initial Design (and Construction, if separate contracts) Conference to review the PxP for clarification, and to verify the functionality of Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the final PxP for Government acceptance.

SECTION I: USAF BIM REQUIREMENTS

1. CONTRACT PLANNING REQUIREMENTS:

Provide a Project Execution Plan (PxP) prior to the Initial Design Kick-Off Meeting, using this document.

Provide a PxP demonstration at the Initial Design Review Conference to review the Implementation Plan for clarification, and to verify the functionality of Model technology workflow and processes. The Government shall confirm acceptability of the Plan or propose additional processes or activities necessary to be incorporated into the Plan. If modifications are required, the Contractor shall execute the modifications and resubmit the final Implementation Plan for Government acceptance prior to payments for design or construction.

Use Air Force Standard Designs and templates provided at http://www.wbdg.org/references/afbim_tools.php.

2. GENERAL BIM REQUIREMENTS:

Provide BIM files using the Air Force Blanket Purchase Agreement (BPA) for Autodesk Revit BIM software.

Use BIM application(s) and software(s) compatible with International Alliance for Interoperability (IAI) Industry Foundation Class (IFC) standards 2x3 or newer.

Provide 3D graphic model(s) (the "Model") and associated intelligent attribute data ("Facility Data") to produce accurate Construction Documents.

Provide linked, interactive specifications utilizing e-SPECS for Revit with SpecsIntact integration.

Application and software(s) must be certified in the IFC Coordination View (2x3 or newer. See www.iai-tech.org). Deviations from or additions to the IFC property sets for any new spaces, systems, and equipment must be submitted for Government approval.

Facility data shall be compliant with Construction Operations Building Information Exchange (COBie); see http://www.wbdg.org/resources/cobie.php for more information.

3. DESIGN STAGE BIM REQUIREMENTS:

Develop a Project Execution Plan PxP. Conduct a BIM Requirements Kick-Off meeting to review the PxP and provide an overview of the use of BIM in the development and support of the project construction schedule.

Conduct quality control reviews as required in Section G.

Provide Files used for the creation of Construction Documents (drawings) per the Design Agent's criteria and as noted herein. Non-BIM files used to create Conceptual, Schematic and Design Development items are excluded from this requirement.

Early-stage preliminary development of Model components and Facility Data. Review the Model with the Government for conformity to the program, massing, circulation, fire protection, and security and sustainability requirements consistent with the Project Execution Plan.

The Model shall include all disciplines and facility data, as applicable to the level of development.

Final design submissions shall include all required design elements. Secure Government acceptance of the Model from the Government before proceeding with commencement of construction.

Cost Estimating. Provide an overview of the use of BIM in the development and support of cost estimating, cost analysis, and estimate validation in the PxP.

Extracted Quantities. Use extracted quantities from the BIM for use within the cost estimate so that accurate costs can be developed. Tasks and their extracted quantities from the BIM shall be broken down by system, subsystem, or product as defined by the Level of Development in USACE's Minimum Model Matrix. Coordinate breakdown structure with the Design Agent's cost engineer. Since the BIM output will not generate all quantities necessary to develop a complete and accurate cost estimate of the project based on the design, estimators shall provide a gap cost to account for this granularity. Note that this requirement is primarily for D-B-B projects at this time.

4. CONSTRUCTION STAGE BIM REQUIREMENTS:

Note that for D-B-B projects, the A-E will produce the Design Model and provide specifications for the Construction Contractor to fulfill the requirements indicated below.

Develop a Project Execution Plan PxP. Conduct a BIM Requirements Kick-Off meeting to review the PxP and provide an overview of the use of BIM in the development and support of the project construction schedule.

Conduct periodic quality control reviews as required in Section G.

During the construction submittal stage, the Contractor shall deliver the construction schedule with information derived from the Model.

Model Driven RFIs and/or Change Orders. [Include in a future demonstration project]

Project Billing and cost loaded schedule developed from the Model. [Include in a future demonstration project]

5. GENERAL MODEL AUTHORING REQUIREMENTS:

Provide Project Specific BIM Facility Data consisting of a set of intelligent elements for the Model (e.g., doors, air handlers, electrical panels). This Facility Data shall include all material definitions, qualities, and attributes that are necessary for the project facility design. Data format must be compatible with the Facility Management software (BUILDER and Tririga) for subsequent database searches.

Model Granularity. Models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a quarter inch (1/4" = 1"0") scaled drawing (e.g. at least 1/16th, 1/8th and 1/4th), or appropriately scaled civil drawings.

6. SPECIFIC BIM MODEL AUTHORING REQUIREMENTS:

The BIM Model Authoring Requirements described below generally conform to USACE's Minimum Modeling Matrix (M3). Contract language detailing the minimum BIM requirements, including the completed M3, should be reviewed to ensure that these Air Force requirements are included.

Architecture & Interior Design. The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

- Space Measurements. The Model shall include spaces defining accurate net square footage and net volume, and holding data for the room finish schedule for including room names and numbers. Include Programmatic Information provided by the Government or validated program to verify design space against programmed space, using this information to validate area quantities. The model shall provide accurate gross area tabulations for use in validating DD Form 1391 programmatic requirements and for use in generating the DD Form 1354.
- Walls and Curtain Walls. Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements
- Doors, Windows, Clearstories and Louvers. Doors, windows and louvers shall be depicted to represent their actual size, rating, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules.

- Roof. The Model shall include the roof configuration, drainage system, major penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted.
- Floors. The floor slab shall be developed in the structural Model and then referenced by the architectural Model for each floor of the Project building.
- Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and generic wall sections where ceiling design elements are depicted.
- Vertical Circulation. All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.
- Architectural Specialties and Woodwork. All architectural specialties (i.e., toilet room accessories, toilet
 partitions, grab bars, lockers, and display cases) and woodwork (i.e., cabinetry and counters) shall be
 accurately depicted with the necessary intelligence to produce accurate plans, elevations and sections in
 which such design elements are referenced.
- Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.
- Schedules. Provide door, window, hardware, sets using BHMA designations, flooring, and wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.
- Furniture/Fixtures/Equipment (FFE). 3D representation of FFE elements is preferred. For projects with an extensive systems furniture layout that may impact BIM system performance the Contractor will consult with the Government for consideration of 2D representation. The FFE systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:
 - Furniture (INCLUDE AS REQUIRED) The furniture systems Model may vary in level of detail for individual elements within a Model, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing, and shall include all relevant office equipment and furniture system layouts, with necessary intelligence to produce accurate plans, sections, perspectives and elevations necessary to completely depict furniture systems locations and sizes.
 - Systems Coordination. Furniture that makes use of electrical, data, plumbing or other features shall include the necessary intelligence to produce coordinated documents and data.
 - Fixtures and Equipment Fixtures and equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans, elevations, sections and schedules depicting their configuration.
 - Schedules Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements.

Structural. The structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

- Foundations. All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations.
- Floor Slabs. Structural floor slabs shall be depicted, including all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.
- Structural Steel. All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans and related building/wall sections.
- Cast-in-Place Concrete. All walls, columns, and beams, including necessary intelligence to produce accurate plans and building/wall sections depicting cast-in-place concrete elements.
- Expansion/Contraction Joints. Joints shall be accurately depicted.

- Stairs. The structural Model shall include all necessary openings and framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.
- Shafts and Pits. The structural Model shall include all necessary shafts, pits, and openings, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

Mechanical. The mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

- HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, registers, diffusers, grills and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules. All piping larger than 1.5" diameter shall be modeled.
- Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules. All piping larger than 1.5" diameter shall be modeled.
- Plumbing. All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All piping larger than ½" diameter shall be modeled.
- Equipment Clearances. All HVAC and Plumbing equipment clearances shall be modeled for use in interference management and maintenance access requirements.
- Elevator Equipment. The Model shall include the necessary equipment and control system, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.
- Schedules. The construction drawings shall include equipment schedules that are of the BIM native schedules. Equipment shall not be generated in third party software and inserted on the drawings as raster images, detail lines and text, AutoCAD line work and text, or other non -BIM format for aesthetic reasons. The data in the schedules as printed on the contract drawings shall be the exact same data as in the model.

Electrical/Telecommunications. The electrical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

- Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panel boards and control systems), including necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents. Lighting and power built into furniture/equipment shall be modeled.
- Special Electrical Systems. All necessary special electrical components (i.e., security, Mass Notification, Public Address, nurse call and other special occupancies, and control systems), including necessary intelligence to produce accurate plans, details and schedules.
- Grounding Systems. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications, grounding systems and bonding), including necessary intelligence to produce accurate plans, details and schedules.
- Communications. All existing and new communications service controls and connections, both above ground and underground with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents. Communications conduit larger than 1.5" shall be modeled.
- Exterior Building Lighting. All necessary exterior lighting with necessary intelligence to produce accurate plans, elevations and schedules. The exterior building lighting Model shall include all necessary lighting, relevant existing and proposed support utility lines and equipment required with necessary intelligence to produce accurate plans, details and schedules.

- Equipment Clearances. All lighting and communications equipment clearances and no-fly zones shall be modeled for use in interference management and maintenance access requirements. Include Original Model Based Schedules for all equipment. No fabricated or extraneously produced Schedules will be accepted.
- Schedules. The construction drawings shall include equipment schedules that are of the BIM native schedules. Equipment shall not be generated in third party software and inserted on the drawings as raster images, detail lines and text, AutoCAD line work and text, or other non -BIM format for aesthetic reasons. The data in the schedules as printed on the contract drawings shall be the exact same data as in the model.

Fire Protection. The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

- Fire Protection System. All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) shall be indicated with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled. In a D-B-B project where the suppression system is specified through a performance specification and designed by the Construction Contractor, the A-E will provide the Design Model with associated FPS components appropriate to the level of design, and provide specifications for the Construction Contractor to the final installed FPS in the Record Model.
- Fire Alarms. Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

Civil. The civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

- Digital Terrain Model (DTM). Model all relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.
- Drainage. Model all existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.
- Storm Water and Sanitary Sewers. Model all existing and new sewer structures and piping, including upgrades thereto, on the Project site with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles for the Project site.
- Utilities. Model all necessary new utilities connections from the Project building(s) to the existing or newlycreated utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.
- Roads and Parking. Model all necessary roadways and parking lots or parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

SECTION J: REFERENCES

- 1. USACE A/E/C CADD Standard: https://cadbim.usace.army.mil/default.aspx?p=a&t=1&i=7
- 2. USACE REVIT Template Guides: <u>https://cadbim.usace.army.mil/default.aspx?p=a&t=1&i=12</u>
- Autodesk Revit BIM Template for US Air Force projects Version
 2010: <u>http://www.wbdg.org/references/afbim_tools.php</u>
- USACE Construction Operations Building Information Exchange (COBie): <u>http://www.wbdg.org/pdfs/erdc_cerl_tr0730.pdf</u>
- 5. BIM Project Execution Planning Guide: http://www.bim.psu.edu/Project/resources/default.aspx
- 6. BUILDER Remote Entry Database (BRED) Data Dictionary: <u>http://sms.cecer.army.mil/Support/SiteAssets/BUILDER%20Downloads/Forms/AllItems/BRED%20D</u> <u>ata%20Dictionary%203.1%20v3.1.pdf</u>