State of Tennessee Office of the State Architect (TN OSA)

Building Information Modeling (BIM) Requirements

Version 1.0

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1. Introduction

1.1. Mission of the TN OSA BIM Requirements

The mission of the State of Tennessee Office of the State Architect (TN OSA) BIM Requirements is to utilize building information modeling (BIM) technology to create building projects with greater long term owner value through an enhanced design, construction and operations process.

1.2. Purpose and Application of the TN OSA BIM Requirements

The State of Tennessee Office of the State Architect (TN OSA) has established these BIM Requirements for the consistent development and management of BIM on state building projects. These BIM Requirements apply to Designers and their Consultants, and/or to Contractors and their Subcontractors, selected by the State of Tennessee Real Estate Asset Management (STREAM), the University of Tennessee (UT), and the Tennessee Board of Regents (TBR) for projects designated to use BIM. These BIM Requirements may be voluntarily used by Designers, and/or may be voluntarily used by Contractors, working on State projects who choose on their own to use BIM and agree to do so according to the State's standards.

Additional BIM requirements, deliverables, and exchanges may be identified for project delivery by the Owner.

1.3. Incremental BIM Adoption

BIM requires process change and every firm and owner implements that change in a series of steps.

First is typically the use of BIM to provide immediate three-dimensional visualization of the evolving design. This improves communication both within the Project Team and with the Owner. It has been shown to speed design decision-making, as owners are more confident they understand the options presented. 3D visualization also speeds issue resolution during both design and construction, because everyone can "see" the problem.

Another early step is the use of BIM to assist with drawing coordination, by extracting plan, sections and elevations from the model. This is followed by BIM-based spatial coordination, using interference checking software to ensure that building systems are coordinated. This technique can be used by both Designers and Contractors. Benefits include more accurate and constructible designs, fewer field coordination issues and change orders, enhanced productivity during both design and construction, and reduced schedule overruns.

As Project Teams gain expertise with BIM techniques, they step up to eliminating redundant and diverging versions of project information by using the BIMs as the basis of calculations and analyses. Area and volume calculations, structural analysis and energy analysis can all be BIM-based. The advantage is that the time and effort required to prepare input for the analyses is greatly reduced and the potential for erroneous interpretation of the drawings is removed. In addition to improved accuracy of the analysis assumptions, this technique allows the Design team to explore more options and to optimize building performance through rapid analysis iterations.

Owners are interested in using BIM to obtain accurate inventories of space and equipment to support downstream operations and maintenance activities. This is the step when owner-specific space and equipment attributes are included in the BIMs. To be usable downstream, the space and equipment types and attributes captured in the BIMs must align with the receiving facility management (FM) systems. The COBie standard assists owners in achieving this alignment.

These TN OSA BIM requirements comprehend all of these steps.

Looking to the future, and particularly to the increased use of alternative project delivery approaches such as Integrated Project Delivery, there are additional, powerful uses of BIM that involve the sharing of BIMs between Designer and Contractor. With this step, BIMs include sufficient detail to support quick and accurate cost estimating as well as construction phase optimization of schedules and logistics.

BIM is a relatively new technology and the industry can expect additional applications to evolve.

This is Version 1.0 of TN OSA BIM Requirements. This is not a static document. As BIM technology and industry expertise advance, OSA’s BIM requirements will also advance to exploit the newly created opportunities to deliver higher performance facilities more predictably and cost effectively.

2. Obligation to Use BIM and General Principles

BIM shall be used in the ☐ Design and/or the ☐ Construction of this Project, as described below.

2.1. General Principles

2.1.1 These Tennessee OSA BIM Requirements ("Requirements"), do not change the contractual relationship between the parties to the contractual agreement into which these Requirements are incorporated by reference (the "Agreement"), or shift the risks between those parties, unless otherwise expressly stated herein;

2.1.2 These Requirements do not create contractual privity between or among any of the parties to the project that is at issue in the Agreement (the "Project"), other than privity of contract expressly created by the terms of the Agreement or any other contract relating to the Project, or otherwise created by law;

2.1.3 All parties to any contract relating to the Project are required to insert language that also incorporates these Requirements by reference into all other contracts into which they enter on the Project, and requiring all other such contracts to also contain flow down clauses requiring the other parties to those contracts to also incorporate these Requirements by reference into any other contracts into which they enter;

2.1.4 Nothing in these Requirements relieve the Designer of any of its obligations contained in the Owner/Designer Agreement;

2.1.5 Nothing in these Requirements modify, amend, suspend or abrogate any express or implied warranty otherwise given by Designers to the Owner and by the Owner to Contractors relating to the sufficiency of the design of the Project;

2.1.6 These Requirements do not consider any additions to, modifications of, or other contributions by the Contractor or any of its subcontractors to any BIM Models to be the performance of design services, and do not require or allow any person, entity, or authority to consider or define such as the performance of design services;

2.1.7 No party is entitled to rely on any Design or other Model to provide the level of detail required to accurately take off any quantities of any specific Project materials or components, unless otherwise expressly stated in the BIM Execution Plan;

2.1.8 Any and all dimensional tolerances contained in the Contract Documents defined in the Agreement shall apply to any Model generated or utilized under these Requirements, unless otherwise expressly stated in the BIM Execution Plan;

2.1.9 The contents of any Design Model shall control to the extent that they conflict with the contents of any other Model;

2.1.10 All parties to any contract which relates to the Project are required to bring to the attention of the other party to those contracts, and to the attention of all other parties to any other contracts relating to the Project, any conflict between any Design Model and any other Model and any conflict between any Design Model and any other provision of any other contract relating to the Project of which that party becomes aware;

2.2. Ownership and Rights of Data

The Owner shall have ownership of and rights to all BIMs, electronic CAD files, and building data developed during the Project.

2.3. Definitions

- **Architectural and Structural Proxy BIMs** - Simplified Architectural and Structural BIMs created by the Contractor that are sufficient for coordination purposes only.

- **As-Built BIMs**: Multiple Construction BIMs, delivered by the Contractor, organized by building system and floor and registered spatially, that represent the final as-constructed building and components.

- **As-Built Drawings**: Drawings at ¼" = 1'-0" or smaller scale that have been extracted from the final, coordinated Construction BIMs and delivered by the Contractor.

- **Building Information Model (BIM):** Digital representation of the physical and functional characteristics of a building (Source: The National BIM Standard – United States Version 2).

- **Building Information Model (BIM) Execution Plan (BEP):** Plan that lays out how BIM will be implemented on the Project as a result of the decisions of the Project Team (The National BIM Standard – United States Version 2).

- **Building Information Model (BIM) Object:** A component, such as space or piece of equipment, within a BIM that has properties associated with the object (BIM Handbook, 2008).

- **Conformed Bid BIMs**: BIMs, organized by floor and discipline, updated by the Designer and the Designer's Consultants at the end of the bidding period to include all changes from Addenda and accepted alternates to the Design BIMs.

- **Construction BIMs**: BIMs generated by the Contractor, the Contractor's Subcontractors, and Major Suppliers, typically representing a single building system. BIM objects are accurate in terms of size, shape, location, quantity and orientation and may include fabrication, assembly, detailing and non-

geometric information. Construction BIMs include facility management data required by the Owner.

- **Construction Operations Building information exchange (COBie):** Format for the exchange of information about building assets such as equipment, products, materials, and spaces.
- **Construction Operations Building information exchange (COBie) Worksheets:** Spreadsheet format of COBie.
- **Coordination BIM**: Composite BIM that includes multiple Construction BIMs, registered spatially, used for the purposes of interference checking (clash detection), visualization and 4D applications during construction.
- **Equipment Inventory:** Inventory of equipment types and their attributes delivered in COBie format. See Appendix D.
- **Equipment Object:** A piece of equipment within a BIM that has properties associated with it.
- **Design BIMs**: BIMs produced by the Designer and the Designer's consultants from which construction drawings at ¼" = 1'-0" scale and smaller scales are extracted by Designers and their Consultants.
- **Project Team:** The project Owner, parties in privity with the Owner, and additional parties not in privity with the Owner who are contributing services and/or materials to the project.
- **Space Inventory:** Inventory of spaces and their attributes delivered in COBie format. See Appendix C.
- **Space Object:** A space within a BIM that has properties associated with the space.

2.4. Risk Allocation

Each non-Owner party shall be responsible for any contribution that it makes to a BIM or that arises from that party's access to a BIM. Such responsibility includes any contribution or access to a BIM by a Project Team member in privity with that party and of a lower tier than that party.

2.5. Designer's Obligations

All BIMs shall be geometrically and dimensionally accurate in both 2D and 3D: plan, elevation, and section views.

The Designer shall extract all Construction Documents plans, sections, and elevations at ¼" = 1'-0" scale or smaller from the BIMs. The Designer represents

that plans, sections, and elevations at ¼" = 1'-0" scale or smaller and the BIMs are equivalent. The Designer shall not modify the drawings after extraction.

The Designer shall not be responsible for any use of the BIM for quantity take-off or cost estimating by any other parties use.

3. BIM Requirements for Designers

3.1. Disciplines Required to Produce BIMs

The Owner has indicated in the list below the disciplines that shall produce BIMs.

☐	Architectural
☐	Structural
☐	Mechanical
☐	Plumbing
☐	Electrical
☐	Civil (3D geometry)
☐	Landscape (3D geometry)
☐	Communications
☐	Fire Protection
☐	Other:_____
☐	Other:_____
☐	Other:_____
☐	Other:_____

3.2. Compliance with IFC and COBie

The BIM authoring software shall be compliant with the Industry Foundation Classes (IFC) Coordination View (buildingSMART 2013) and should be able to export to the Construction-Operations Building information exchange (COBie) format based on the IFC FM Handover View (East and Chipman 2011).

3.3. Open Standards and Collaboration

The Owner encourages the use of open standards and collaboration tools to facilitate interoperability among Designers, between Designers and Contractors, and between Designers and the Owner.

3.4. BIM Use

The Designer and the Designer's Consultants shall use BIM authoring software to generate BIMs that include all of the geometry, physical characteristics, and data needed to describe the design and construction work of the Project.

3.4.1. BIM Software

The following 3D modeling software products are acceptable to the State of Tennessee effective February 1, 2013.

- Autodesk Revit
- Autodesk Revit Architecture
- Autodesk Revit Structure
- Autodesk Revit MEP
- Autodesk AutoCAD Architecture
- Autodesk AutoCAD MEP
- Autodesk AutoCAD Civil 3D
- Bentley Architecture
- Bentley AECOsim
- Bentley Inroads
- Graphisoft ArchiCAD
- Graphisoft ArchiCAD MEP
- Tekla Structures
- Digital Project: Designer
- Nemetschek Vectorworks

Other products will be considered on request. It is the obligation of the Designer to ensure that the software products are correctly configured to produce the required deliverables.

3.4.2. BIM-based Analyses

During the Project, the BIMs developed by the Designer and the Designer's Consultants shall be used to:

3.4.2.1. Perform area calculations
3.4.2.2. Generate input for energy analysis
3.4.2.3. Identify and resolve interferences between disciplines
3.4.2.4. Generate space and equipment inventories

See Section 4 for additional detail.

3.4.3. BIM Deliverables

3.4.3.1. At each design submission, the BIMs shall be provided in IFC format. See Section 4 for details of BIM deliverables at each phase.

3.4.3.2. All plans, sections, and elevation drawings and CAD files at ¼" = 1'-0' or smaller scale, as well as schedules and 3D views, shall be extracted from the BIMs.

3.4.3.3. BIMs shall be used to perform all area and volume calculations.

3.4.3.4. BIMs shall be used as the basis for energy analysis.

3.4.3.5. BIMs shall be used to produce space and equipment inventories. See Appendices C and D for details of space and equipment inventory requirements.

3.5. Geo-referencing

The Designer and the Designer's Consultants are required to geo-reference BIMs, site plans and associated construction drawings to ensure interoperability with existing State of Tennessee Geographic Information Systems (GIS).

Geo-referencing shall be maintained throughout the design of the building project. See Section 4 for additional detail.

3.6. Existing Conditions

The Designer and the Designer's Consultants shall model all existing conditions that are needed to describe the design and construction work of the building project.

3.7. Staffing

The Designer shall identify a qualified BIM Manager for each project who is acceptable to the Owner. The BIM Manager is responsible for managing the BIM deliverables from all disciplines during the design of the building project.

The Designers' Consultants using BIM shall each identify a BIM Coordinator. The BIM Coordinator is responsible for managing the BIM deliverables of that specific discipline or firm.

The responsibilities of the BIM Manager and the BIM Coordinators shall be documented in the BIM Execution Plan.

3.8. BIM Execution Plan

The Designer and the Designer's Consultants along with the Designer's BIM Manager shall develop a BIM Execution Plan that identifies the protocols for the development and management of BIMs during the design phases.

Appendix A includes the minimum topics that shall be addressed in the Design Phase BIM Execution Plan. Special project types may require additional topics.

3.9. Collaboration

The Owner may designate a web-based collaboration system for use by the Designer and the Designer's Consultants. If the Owner does not designate a web-based collaboration system for use by the Designer, then the Designer shall provide a web-based collaboration system for the sharing of individual and merged BIM files.

The web-based collaboration system shall provide:

- Real-time access to the Project Team which includes but is not limited to the Owner, Designer, Designer's Consultants, and other users as required by the Owner.
- Automated versioning of BIM files.
- Maintenance of the previous versions of BIM files.
- Access-controlled workspace or folders for each organization to upload their BIM files.

The web-based collaboration system shall be password-protected. The Designer shall ensure that the collaboration system conforms to any Information Technology (IT) or security requirements required by the Owner.

Detailed protocols associated with the use of the web-based collaboration system shall be documented in the BIM Execution Plan.

4. Details of the Requirements for Designers

All required disciplines shall use intelligent, 3D modeling. For engineering disciplines, model all pipes, conduits, or bundles 2” or greater in diameter.

4.1. Well-Structured BIM

- Parametric links shall be maintained within the models to ensure the automatic extraction of Plans, Sections, Elevations, Schedules, and 3D views. All drawings at ¼” = 1’-0” scale or smaller shall be representations of the BIM.
- Use correct object and spatial classifications that support the IFC Coordination view, COBie extraction, and energy analysis.

4.2. BIM Content

The BIM content is the geometric, physical characteristics, and data needed to describe the design and construction work of the building project.

The Project Team shall identify the BIM content required to meet the project needs and the deliverable requirements at each design phase in the BIM Execution Plan.

4.3. Geo-referencing

BIMs, site plans and associated construction drawings shall be registered to the respective Tennessee State Plane Coordinate System; shall utilize the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). The State’s GIS are maintained by the Office of Information Resources, GIS Services (OIR GIS).The BIMs shall include a marker for the registration point and identify the rotation and origin of rotation from Project North to True North.

The BIMs shall also include a polyline of the building footprint of the lowest floor of the lowest enclosed area including basement. An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building's lowest floor. For further clarification see FEMA’s definition of lowest floor (FEMA 2012).

4.4. Space Object Naming

Space objects shall be named, classified, and assigned attributes per Appendix C. The space inventory shall be extracted into the COBie format.

- For UT and TBR projects, reference the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, Postsecondary Education Facilities Inventory and Classification Manual (FICM) (NCES 2006).
- For STREAM projects, reference the GSA Public Buildings Service, Office of Real Property Asset Management, National Business Space Assignment Policy (GSA 2013).

4.5. Equipment Object Naming

Equipment objects shall be named, classified, and assigned attributes per the requirements in Appendix D or as required by the Owner. The equipment inventory shall be extracted into the COBie format.

4.6. BIM Applications

At a minimum, BIM shall be used for the analyses indicated below.

4.6.1. Space Area Calculations and Program Validation

BIM shall be used to develop and validate the space program requirements as defined by the Owner. Area measurements shall be automatically generated from BIM.

A space inventory validating that the design meets the Owner's space programming requirements shall be generated from the BIM and submitted in COBie format with each design phase deliverable as required by the Owner.

4.6.2. Energy Analysis

If the Project is using BIM and has an energy analysis requirement, then the BIMs shall be used as the basis for energy analysis. It is the responsibility of the Designer to set up the BIMs accurately from the beginning of design to support energy analysis. Detailed information about IFC-based building energy analysis requirements can be found in *Chapter 4.4 Design to Building Energy Analysis* of the National BIM Standard- United States Version 2 (NIBS 2012).

The BIMs shall be used to generate zone volume calculations for energy analysis.

See Appendix B for tips on preparing a BIM for export for energy analysis in an external application.

4.6.3. Coordination

Starting in the Design Development phase, the Designer and the Designer's Consultants shall use an automated interference checking application to identify and resolve interferences among all of the disciplines creating BIMs.

At each design phase milestone, the Designer shall submit a report identifying the statuses of all interferences between disciplines.

Detailed protocols of the automated interference checking process shall be included in the BIM Execution Plan.

4.6.4. Space and Equipment Inventories

The space and equipment inventories defined in Appendices C and D shall be delivered in COBie format.

4.7. BIM Deliverables by Phase for Designers

For each design phase BIM deliverable, BIMs in IFC format shall be submitted along with the required design deliverables for clarification. If applicable, site and landscape information may be submitted in 3D .DWG format, with all custom objects converted to native 3D AutoCAD objects.

4.7.1. Pre-Design/Programming Phase

BIM is not required.

4.7.2. Schematic Documents Phase

For the approved design concept, all information needed to create schematic design documents shall be graphically or alphanumerically included in and derived from the BIMs.

The Designer shall submit a space inventory in COBie format.

4.7.3. Early Design Stage Presentation (or Early Design Review)

All information needed for the Early Design Stage Presentation (or Early Design Review) to the State Building Commission (SBC) shall be graphically or alphanumerically included in and derived from the BIMs.

4.7.4. Design Development Phase

Information needed to create the design development documents shall be graphically or alphanumerically included in and derived from the BIMs. Details at scales larger than ¼" = 1'-0" are not required to be included in the BIMs.

The Designer shall submit space and equipment inventories in COBie format. The equipment inventory shall identify the expected systems required to provide heating, cooling, electricity, water, fire protection, and other services. At this stage, the system information provided shall be in name and classification. The specific components that comprise these systems are not required.

4.7.5. Construction Documents Phase

Information needed to create construction documents shall be graphically or alphanumerically included in and derived from the BIMs. Details at scales larger than ¼" = 1'-0" are not required to be included in the BIMs.

The Designer shall submit space and equipment inventories in COBie format.

The space and equipment inventories shall reflect the complete set of all spaces, scheduled products, and equipment assets as presented on the corresponding deliverable drawings. This list of products and equipment is expected to be complete. The attributes of the spaces and equipment shall reflect the design intent.

4.7.6. Bid Phase

During the Bid phase, the Designer shall update the Construction Documents Phase BIMs with accepted alternates and addenda. The updated BIMs are the Conformed Bid BIMs. The Designer shall submit the Conformed Bid BIMs partitioned by building floor and discipline in IFC and native formats.

If applicable, site and landscape information may be submitted in native and 3D .DWG formats, with all custom objects converted to native 3D AutoCAD objects.

The Designer shall extract all Conformed Construction Drawings at ¼" = 1'-0" scale or smaller from the Conformed Bid BIMs. The Designer shall submit updated space and equipment inventories in COBie format to include changes from Addenda and accepted alternates.

4.7.7. Project Closeout Phase

At Project Closeout, the Designer shall review the As-Built BIMs as developed by the Contractor, to verify that the BIMs meet the original design intent as formally modified throughout the construction process.

Table 4-1 summarizes the Designer's BIM deliverables.

Milestone	BIM Deliverables
Pre-Design/Programming	BIM is not required, but encouraged for Programming.

Milestone	BIM Deliverables
Schematic Design	Massing BIM indicating siting and orientation.
	Submit space inventory in COBie format (COBie worksheets: Contact, Facility, Floor, and Space only).
	Drawings and 3D views shall be extracted from the BIMs.
Early Design Stage Presentation (or Early Design Review)	BIM in IFC format and if applicable, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
Design Development	BIM partitioned by discipline and floor in IFC format only. If applicable, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
	BIM-based energy analysis reports
	Interference report
	Submit space and equipment inventories in COBie format (COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, System, and Attribute).
	All ¼" = 1'-0" or smaller scale drawings - Plans, Sections, and Elevations – in addition to Schedules and 3D views shall be extracted from the BIMs.
Construction Documents	BIM partitioned by discipline and floor in IFC format only. If required, a site model in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
	BIM-based energy analysis reports
	Interference Report
	Submit space and equipment inventories in COBie format (COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, and Attribute).
	All ¼" = 1'-0" or smaller scale drawings - Plans, Sections, and Elevations – in addition to Schedules and 3D views shall be extracted from the BIMs.

Milestone	BIM Deliverables
Bid	Submit separate Conformed Bid BIMs for each floor and discipline, in native and IFC file formats. If required, a site model in native and 3D .DWG formats, with any custom (ARX) objects converted to native AutoCAD objects.
	Extract all Conformed Construction Drawings at ¼" = 1'-0" scale or smaller from the Conformed Bid BIMs.
	Submit updated space and equipment inventories in COBie format to include changes from Addenda and accepted alternates. (COBie worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, and Attribute).
Project Closeout	Review the As-Built BIMs as developed by the Contractor for conformance to the original design as formally modified throughout the Construction process.

Table 4-1 – BIM Deliverables by Phase for Designers

5. The BIM Process for Designers

The following description includes the recommended process for the development of and the management of BIMs by Designers.

1. As early as feasible after project award and prior to the completion of the Program verification phase, the Designer shall:
    a. Assign a BIM Manager.
    b. Develop the BIM Execution Plan.
    c. Set up the web-based collaboration system.
2. Develop the BIMs.
3. For each design phase milestone, use the BIMs to:
    a. Perform area calculations and validate spatial program requirements.
    b. Perform energy analysis.
    c. Perform automated interference checking and generate a report identifying any unresolved interferences.
    d. Produce space and equipment inventories in COBie format.
    e. Extract all views 1/4" = 1'-0" or smaller, schedules and 3D views from the BIMs.
    f. Submit the BIMs in IFC format along with the design phase drawings for clarification.
4. Prior to the Owner issuing Notice to Proceed (NTP) for Construction, provide Conformed Bid BIMs that include all changes to the design due to addenda and accepted alternates. The Conformed Bid BIM shall be partitioned by discipline and building floor and delivered in native and IFC formats.

    If applicable, the site model may be delivered in native and IFC or 3D .DWG formats, with any custom (ARX) objects converted to native AutoCAD objects.

5. At Project Closeout, the Designer shall receive and verify for the Owner that the As-Built BIMs meet the original design intent as formally modified during Construction.

6. BIM Requirements for Contractors

6.1. Trades Required to Produce BIMs

The Owner or the Owner's Representative has indicated in the list below the trades that shall produce BIMs:

☐	Structural Steel Fabrication
☐	Mechanical - HVAC

- ☐ Mechanical - HVAC Pipe
- ☐ Plumbing
- ☐ Electrical
- ☐ Fire Protection
- ☐ Fire Sprinkler
- ☐ Pneumatic Tube
- ☐ Building Automation Systems
- ☐ Communications
- ☐ Civil (3D geometry)
- ☐ Landscape (3D geometry)
- ☐ Other:_____
- ☐ Other:_____
- ☐ Other:_____
- ☐ Other:_____

6.2. Obligation to Model Complete Building

If the Project has been designed in BIM, the Contractor shall choose whether to maintain all of the BIM, or any portions thereof, and as to any portions of the BIM the Contractor chooses not to maintain, the Contractor shall cause the trade contractors to recreate those portions of the Conformed Bid BIMs depicting building systems, including architecture.

If the Project has not been designed in BIM, the Contractor shall provide the Architectural and/or Structural Proxy BIMs, for coordination purposes only and shall create or shall cause the trade contractors to create models of all building systems indicated in Section 6.1

6.3. Compliance with IFC and COBie

The BIM authoring software shall be compliant with the Industry Foundation Classes (IFC) Coordination View and should be able to export to the Construction-Operations Building information exchange (COBie) format based on the IFC FM Handover View.

6.4. Open Standards and Collaboration

The Owner encourages the use of open standards and collaboration tools to facilitate interoperability among the Contractor and Subcontractors, between Contractors and Designers and between Contractors and the Owner.

6.5. BIM Use

Conformed Bid BIMs, if available, will be provided to the Contractor in IFC and native file formats, with the exception of site and landscape models, which may be provided in 3D AutoCAD format with no custom objects.

The Contractor shall indemnify the Designer for the Contractor's use of the BIMs. The Contractor and the Contractor's subcontractors and suppliers shall use BIM authoring software to update the Conformed Bid BIMs or generate new Construction BIMs that include all of the geometry and clearances needed to perform trade coordination. In addition, the models shall include the facility management information required by the Owner.

The Contractor and the Contractor's subcontractors and suppliers shall continuously update and maintain the Construction BIMs throughout construction to reflect the current as-built conditions of the building. See Section 6.1 for the list of trades required to produce Construction BIMs.

If Conformed Bid BIMs have not been provided to the Contractor, the Contractor shall produce Architectural and/or Structural Proxy BIMs for coordination purposes only. The Contractor shall continuously update these Proxy BIMs to reflect the current as-constructed conditions of the building. See Section 7.6.1 for additional detail on BIM-based coordination.

During construction, the Contractor shall make available to the Owner the current Architectural Proxy, Structural Proxy and/or Construction BIMs in IFC format.

6.5.1. BIM-based Analyses

During the building project, the Construction BIMs shall be used to:

6.5.1.1. Identify and resolve spatial interferences between trades and building systems prior to fabrication and field installation

6.5.1.2. Generate equipment inventories

The Contractor and Subcontractors are encouraged, but not required to use Construction BIMs for:

6.5.1.3. Logistical planning and layout

6.5.1.4. 4D scheduling, where 4D scheduling is a 3D geometric model linked to a schedule

6.5.2. BIM Deliverables and Work Products

6.5.2.1. Coordinated Construction BIMs shall be used as the basis for Shop Drawings for those trades using BIM.

6.5.2.2. Coordinated Construction BIMs shall be used to generate Coordination Drawings for those trades using BIM.

6.5.2.3. Coordinated Construction BIMs shall be used to fabricate building components and systems for those trades using BIM.

6.5.2.4. Coordinated Construction BIMs shall be used to install building components and systems for those trades using BIM.

6.5.2.5. Coordinated Construction BIMs shall be used to produce equipment inventories which shall be delivered in COBie format. See Appendix D for details of the equipment types and their attributes required in the equipment inventory.

6.5.2.6. As-Built Drawings shall be extracted from the Coordinated Construction BIMs.

6.6. Geo-referencing

The Contractor is required to geo-reference all Construction BIMs, the Coordination BIM, As-Built BIMs, site plans, and As-Built Drawings to ensure interoperability with existing State of Tennessee Geographic Information Systems (GIS). See Section 7 for additional detail.

If geo-referencing was not established during the design of the project:

If BIMs are available from the Designer, geo-referencing should already be established. If the Contractor is creating the Architectural and/or Structural Proxy BIMs, the Contractor shall establish geo-referencing.

6.7. Staffing

The Contractor shall identify a qualified BIM Manager for each project who is acceptable to the Owner. The BIM Manager is responsible for managing the BIM deliverables from all Subcontractors and Major Suppliers during the construction of the building project.

Each party that is creating a Construction BIM shall identify a BIM Coordinator. The BIM Coordinator is responsible for managing the BIM deliverables of that specific subcontractor or supplier.

The responsibilities of the BIM Manager and the BIM Coordinators shall be documented in the BIM Execution Plan.

6.8. BIM Execution Plan

The Contractor and all parties providing Construction BIMs shall along with the Contractor's BIM Manager shall develop a BIM Execution Plan that identifies the protocols for the development and management of BIMs during the construction phase.

Appendix E includes the minimum topics that shall be addressed in the BIM Execution Plan for construction.

6.9. Collaboration

The Owner may designate a web-based collaboration system for use by the Contractor. If the Owner does not designate a web-based collaboration system for use by the Contractor, then the Contractor shall provide a web-based collaboration system for the sharing of individual and merged BIM files. The web-based collaboration system shall provide:

- Real-time access to the Project Team which includes but is not limited to the Owner, Designer, Designer's Consultants, Contractor, Subcontractors, and other users as required by the Owner.
- Automated versioning of BIMs.
- Maintenance of the previous versions of BIMs.
- Access-controlled workspace or folders for each organization to upload their BIMs.

The web-based collaboration system shall be password-protected. The Contractor shall ensure that the collaboration system conforms to any Information Technology (IT) or security requirements required by the Owner.

Detailed protocols associated with the use of the web-based collaboration system shall be documented in the BIM Execution Plan.

The Contractor shall provide on-site hardware and software to view individual and merged BIMs as well as clash detection results.

7. Details of the Requirements for Contractors

All required trades shall use intelligent, 3D modeling. The 3D modeling software shall be compliant with the Industry Foundation Class (IFC) Coordination View and shall be able to export to Construction-Operations Building information exchange (COBie) format based on the IFC FM Handover View.

7.1. Well-Structured BIM

- Parametric links shall be maintained within the models to ensure the automatic extraction of 3D views and all required drawings. All drawings shall be representations of the coordinated Construction BIM.
- Use the correct object types and attributes that support the IFC Coordination View and COBie extraction.

7.2. BIM Content

The BIM content is the geometry, physical characteristics, and data needed to describe the construction work of the building project.

The Project Team shall identify the BIM content required to meet the project needs and the deliverable requirements for construction in the BIM Execution Plan.

7.3. Georeferencing

BIMs and As-Built Drawings shall be registered to the respective Tennessee State Plane Coordinate System; shall utilize the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). The State's GIS are maintained by the Office of Information Resources, GIS Services (OIR GIS).The BIMs shall include a marker for the registration point and identify the rotation and origin of rotation from Project North to True North.

The BIMs shall also include a polyline of the building footprint of the lowest floor of the lowest enclosed area including basement. An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building's lowest floor (FEMA 2012).

7.4. Space Object Naming

The Contractor shall maintain the space object names, classifications, and designations that were developed during the design of the building, if the building was designed in BIM.

7.5. Equipment Object Naming

The Contractor shall maintain the equipment object types and attributes that were developed during the design of the building, if the building was designed in BIM.

Equipment objects shall be created, named, classified, and assigned attributes per the requirements in the Appendix D or as required by the Owner. The Contractor shall add any equipment objects that were not modeled by the Designer, but are required for Facility Management. The Contractor shall add equipment attribute data not available during design such as serial number.

The equipment inventory shall be extracted into the COBie format. See Appendix D for the COBie Worksheets required for the equipment inventory.

7.6. BIM Applications

At a minimum, BIM shall be used for the analyses indicated below.

7.6.1. Coordination

BIMs shall be used to identify and resolve spatial interferences between building systems and products prior to fabrication and field installation.

The Contractor shall include required clearances for maintenance and other access, code clearances, and other required clearances in the interference checking.

On a periodic basis, the Contractor shall schedule and manage on-site coordination meetings to resolve interferences. The Contractor shall publish and make available reports identifying the statuses of the interferences and the coordination progress.

The schedule and the detailed protocols of the BIM-based coordination process shall be included in the BIM Execution Plan.

7.6.2. Fabrication and Installation

Building components shall be fabricated and installed based on the coordinated Construction BIMs.

7.6.3. Equipment Inventory

An inventory of equipment designated in Appendix D shall be delivered in COBie format.

If the project required BIM in the design phase, the Contractor will receive a partially completed equipment inventory created by the Designer. This equipment inventory will contain specified equipment types and components and provide some of the required attributes.

7.7. BIM Requirements by Phase for Contractors

7.7.1. Coordination

Provide coordinated Construction BIMs in IFC format and interference reports upon request.

Extract the related Shop and Coordination Drawings from the coordinated Construction BIMs.

7.7.2. Construction

Fabricate and install building elements based on the coordinated Construction BIMs.

Update and maintain equipment inventory and documents in COBie format.

7.7.3. Closeout

Update all coordinated Construction BIMs to reflect as-built conditions. These are the As-Built BIMs. Extract all related As-Built Drawings and space and equipment inventories in COBie format from the As-Built BIMs.

If no Architectural and/or Structural Conformed Bid BIMs were provided by the Designer, the Contractor shall deliver updated Architectural and/or Structural Proxy BIMs.

The As-Built BIMs shall be partitioned by building floor and trade and delivered in IFC file format. Site and landscape information may be submitted in IFC or 3D .DWG file format, with all custom objects converted to native 3D AutoCAD objects.

Submit updated space and equipment inventories in COBie format.

Milestone	Deliverables
Coordination Phase	Shop Drawings shall be extracted from the coordinated Construction BIMs.
	Coordination Drawings shall be extracted from the coordinated Construction BIMs.
Closeout Phase	As-Built BIMs partitioned by discipline and floor in IFC format. Site and landscape information may be submitted in IFC or 3D .DWG file format, with all custom objects converted to native 3D AutoCAD objects.
	As-Built Drawings shall be extracted from the As-Built BIMs.
	Submit updated space and equipment inventories in COBie format (COBie Worksheets: Contact, Facility, Floor, Space, Zone, Type, Component, System, Document, and Attribute).

Table 7-1 – BIM Requirements by Phase for Contractors

8. The BIM Process for Contractors

The following description includes the recommended process for the development of and the management of BIMs by Contractors.

1. As early as feasible after project award, the Contractor shall assign a BIM Manager.
2. Develop the BIM Execution Plan.
3. Conduct a BIM Kickoff Meeting.
4. Set up the web-based collaboration system.
5. Develop the Construction BIMs.
6. Prior to fabrication and installation, identify and resolve spatial conflicts between building systems and products.
7. During construction:
    a. Fabricate and build from the coordinated Construction BIMs.
    b. Update the coordinated Construction BIMs to reflect changes to the building that include but are not limited to Requests for Proposal (RFPs), Change Orders, Requests for Information, Architects Supplemental Instructions (ASIs), and field changes.
    c. Extract all Coordination Drawings from the coordinated Construction BIMs.
    d. Use the coordinated Construction BIMs as the basis for generating the Shop Drawings.
    e. Update and maintain the space and equipment inventories in COBie format.
8. At project closeout,
    a. Provide As-Built BIMs partitioned by discipline and floor in IFC format. Site model may be provided in IFC or 3D .DWG format, with any custom (ARX) objects converted to native AutoCAD objects.
    b. Provide Architectural and/or Structural Proxy BIMs, if any, updated to reflect as-built conditions in IFC format.
    c. Provide the updated equipment inventory in COBie format.

References

buildingSMART (2013). “Coordination View Version 2.0” < http://www.buildingsmart-tech.org/specifications/ifc-view-definition/coordination-view-v2.0> (Nov. 21, 2012).

East, B. and Carrasquillo-Mangual, M. (2012). “The COBie Guide” <http://buildingsmartalliance.org/index.php/projects/cobieguide/> (Nov. 21, 2012).

East, B. and Chipman, T. (2011). “Facilities Management Handover.” <http://buildingsmartalliance.org/docs/BSADOC_COBIE/index.htm > (Nov. 27, 2012).

(FEMA) Federal Emergency Management Agency (2012). “Lowest Floor.” <http://www.fema.gov/national-flood-insurance-program-2/lowest-floor> (Dec. 28, 2012).

(GSA) GSA Public Buildings Service, Office of Real Property Asset Management (2013) “National Business Space Assignment Policy” <http://www.gsa.gov/portal/content/102002> (April 19, 2013).

(NCES) U.S. Department of Education, National Center for Education Statistics. (2006). *Postsecondary Education Facilities Inventory and Classification Manual (FICM)*, 2006 Edition (NCES 2006-160). U.S. Department of Education. Washington, DC.

(NIBS) National Institute of Building Sciences “Chapter 4.4 Design to Building Energy Analysis” *National BIM Standard- United States Version 2.* <http://www.nationalbimstandard.org/nbims-us-v2/pdf/NBIMS-US2_c4.4.pdf> (Feb. 21, 2013).

Appendices

Appendix A – BIM Execution Plan Outline - Designers

Project Information

- Identify project name, SBC number, location (address & geo-reference)
- Identify Owner
- Identify effective date or revision date of plan

Project Designer and Designer's Consultants Information

- Designer firm
    - Firm name
    - Firm address
    - BIM Manager name
    - BIM Manager contact information
- All Consultants
    - Firm name
    - Firm address
    - BIM Coordinator name
    - BIM Coordinator contact information

BIM Goals and Objectives

- Identify owner's intended goals or end uses of the model
- Identify the Designer's and the Designer's Consultants use of the models during the project

Roles and Responsibilities

- Briefly describe each organization's responsibility for:
    - Model creation
    - Model quality
    - Model analysis
    - Model management
- Describe the roles of the BIM Manager and BIM Coordinators

Collaboration Plan

- Describe the collaboration system(s) you will use to exchange, merge and visualize models
- Describe the schedule for or frequency of model updates and interference checks
- Describe tools and process to be used for interference checking
- Describe process to be used to generate drawings from coordinated models

Software for Model Authoring

- Identify all software products to be used for model creation and the software version

Planned Models

- Identify model name and phase of delivery
- Detail contents of each model by phase – components and properties
- Identify authoring company
- Identify authoring tool(s)
- Identify analysis tools to be used and their modeling requirements
- Identify file formats required

Modeling Standards

- Common coordinate system
    - Units
    - File origin (X,Y,Z)
    - Geolocation
- Model partitions
- Naming
    - Files
    - Building level designators
    - Building area designators
    - Discipline designators
    - Layers (if applicable)
    - Properties required for:
        - COBie deliverables
        - Owner-requested analyses
        - Designer and the Designer's Consultants-initiated analyses
    - Units and values for properties (e.g.- cubic feet per minute, space use codes from FICM)
- Level of precision and dimensioning
- Any exclusions from models

Model Analysis Plan

- For each project phase, define:
    - Each analysis that will be performed
        - Software to be used
        - Model(s) to be analyzed
            - File format required
        - Responsible team member(s) for
            - Performing the analysis
            - Producing the required model(s)
    - Contents of COBie deliverable
        - Responsible Designer and Designer's Consultants team member(s)
    - Clash detection
        - Software to be used
        - Model(s) to be analyzed
            - File formats acceptable
            - Any object enablers required
        - Responsible team member(s) for
            - Performing the check
            - Producing the required model(s)
        - Process for resolving clashes

Project Deliverables

- Identify electronic models, drawings, renderings, analyses and reports to be delivered
- Identify all space and equipment types and attributes to be included in the COBie deliverables
- Describe process to be used to extract all deliverables from coordinated models
- Describe quality assurance and quality control measures to be implemented
- For Design-Assist projects only, address model sharing and the transition of model responsibilities to the Design-Assist contractor

Sign-Off

- Authorized signature from the Designer and the Designer's Consultants indicating agreement to comply with this BIM Execution Plan.

Appendix B – Tips for Preparing a BIM for Export for Energy Analysis

The following are general tips on preparing a BIM for export for use in external energy analysis software programs. gbXML and IFC are two formats currently supported for energy analysis. Refer to your particular BIM software application's help or resource manual for "how-to" Information related to these tips.

- Only include in the data exported for energy analysis the building elements necessary for energy analysis. This includes exterior walls, windows, doors, floors, ceilings, roofs, and volumetric heating and cooling zones. Make sure these elements are defined accurately: for example, do not use generic exterior walls for the analysis; the anticipated exterior wall construction should be used instead.

- Area calculations for zones should be set to calculate both area *AND* volume.

- All zones should be contained by bounding elements (wall, floor, ceiling, or roof). One hundred percent of the building volume should be contained within identified zones. Define the sliver space tolerance (if this option is available).

- Overall, keep the geometry of the energy model simple. A complex model may produce errors and will not yield a more accurate analysis.

Related Reference Documents

The following list of documents and/or websites provide additional information on best practices, tips, and data requirements for preparing BIMs for energy analysis.

- GSA BIM Guide: 05 - BIM Guide for Energy Performance Version 2.0 – March 2012
  http://www.gsa.gov/bim

- ERDC-CERL TR-11-41 Early Design Energy Analysis Using Building Information Modeling Technology:
  http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA552789

- IFC MVD Definition Diagram: Concept Design to Building Energy Analysis (BEA) – Exchange Requirements Model diagram
  http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003_ERM_%28BEA%29_Design_to_BuildingEnergyAnalysis.pdf

- AECOO-1 Testbed Information Delivery Manual (IDM) for Building Performance and Energy Analysis (BPEA) Thread
  http://zeroemissiondesign.com/uploads/BPEA_IDM_FINAL.pdf

- National BIM Standard – United States Version 2, Chapter 4.4 - Design to Building Energy Analysis
  http://www.nationalbimstandard.org/nbims-us-v2/pdf/NBIMS-US2_c4.4.pdf

- Utilizing gbXML with AECOsim Building Designer – Building Performance Analysis Using Bentley Products
  http://ftp2.bentley.com/dist/collateral/docs/white_papers/WP_%20gbXML_LTR_v03.pdf

- Graphisoft ArchiCAD YouTube Channel – Search for "Energy Model" or "Energy Analysis"
  http://www.youtube.com/user/Archicad

- Mastering Autodesk Revit Architecture 2013 – Autodesk Official Training Guide

Appendix C – State of Tennessee Office of the State Architect (TN OSA) Space Inventory Requirements

The space inventory shall include the following space data fields:

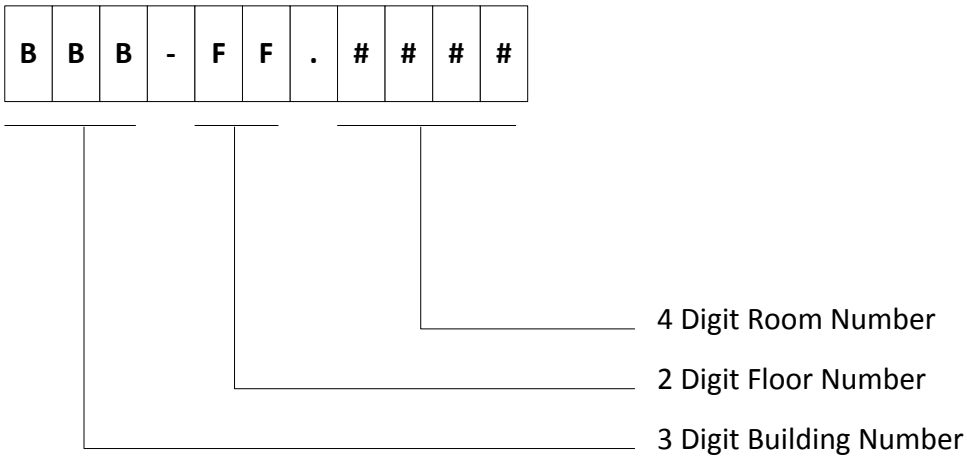
General Attributes		COBie Worksheet Location			
PLACEMENT REQUIREMENT	ATTRIBUTE	SHEET	COLUMN	ASSOCIATION	COMMENTS
ONCE PER PROJECT	BuildingName	Facility	ProjectName	-	Owner's Building Number
ONCE PER PROJECT	FacilityIdentification	Facility	Name	-	State of TN Treasury Risk Management Building Number
ONCE PER PROJECT	RegionCode	Facility	SiteName	-	Optional. May be used to indicate campus or office complex.
EACH FLOOR	FloorIdentification	Floor	Name	-	Floor level
EACH SPACE	RoomDesignator1	Attribute	-	Space	Room naming standard provided by owner. See below for example room designator 1 format.
EACH SPACE	RoomDesignator2	Attribute	-	Space	Optional field. Not Required.
EACH SPACE	FICMUseCode	Atrribute	-	Space	TBR and UT only (see Note 1).
EACH SPACE	GSASpaceCode	Attribute	-	Space	STREAM only (see Note 2).
EACH SPACE	UniqueSpaceID	Space	ExtIdentifier	-	Unique Identifier that should be generated by BIM-authoring software.
EACH SPACE	GrossAreaSquareFoot	Space	GrossArea	-	In SF (see FICM for TBR and UT, see GSA PBS National Business Space Assignment Policy for STREAM)
EACH SPACE	NetAssignableAreaSquareFeet	Space	NetArea	-	In SF (see FICM for TBR and UT, see GSA PBS National Business Space Assignment Policy for STREAM)

Notes:

1. For TBR and UT projects, reference the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, Postsecondary Education Facilities Inventory and Classification Manual (FICM) (NCES 2006).

2. For STREAM projects, reference the GSA Public Buildings Service, Office of Real Property Asset Management, National Business Space Assignment Policy (GSA 2013).

Room Designator 1 Format:



For example, Room 1223 on the 12th Floor in Building 100 shall have a Room Designator 1 as:

100-12.1223

The space inventory shall be submitted in COBie format. The table below lists the COBie Worksheets and the high-level information that shall be provided in each Worksheet for a space inventory.

COBie Worksheet	Required Content
Contact	One row for each discipline or organization that provides COBie information. Fields required to be completed include: Email, CreatedBy, CreatedOn, Category, Company, and Phone
Facility	One building per COBie file. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, ProjectName, SiteName, LinearUnits, AreaUnits, VolumeUnits, CurrencyUnit, AreaMeasurement, and Description
Floor	One row for each vertical level to include foundations, floors, roofs, and site. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, Elevation, and Height

COBie Worksheet	Required Content
Space	One row per functional space, per room. Multiple spaces in a room are possible. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, FloorName, Description, GrossArea, and NetArea
Zone	One row for each COBie.Space and COBie.Zone type. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, and SpaceNames

Additional guidance on the COBie Worksheets can be found in The COBie Guide (East and Carrasquillo-Mangual 2012).

Space category shall be entered as an OmniClass Table 13 code. Below are mappings of GSA Space Codes and FICM Use Codes to OmniClass Table 13 numbers.

GSA Space Code Mapping to OmniClass Table 13			
GSA		OMNICLASS	
GSA Space Code	GSA Space Description	OmniClass Number	OmniClass Title
ADP	Automated Data Processing	13-49 19 00	Data Center
AUD	Auditorium	13-31 13 19	Assembly Hall
CFT	Conference/Training	13-31 00 00	Education and Training Spaces
CLD	Child Care	13-57 15 17	CLD–Child Care
CRJ	Courtrooms/Judiciary	13-35 11 11	Courtroom
CST	Custodial	13-23 23 13	Custodial Space
FDS	Food Service	13-57 13 00	Food Service
FIT	Fitness Center	13-33 17 11	Fitness Center
GNS	General Storage	13-63 13 11	Storage Room
HUT	Health Unit	13-51 00 00	Healthcare Spaces
INS	Light Industrial	13-59 00 00	Production, Fabrication, and Maintenance Spaces
JCC	Judges Chambers, US Courts	13-35 11 13	JCC–Judicial Chambers
JHR	Judicial Hearing Room	13-35 11 19	JHR–Judicial Hearing Room
LAB	Laboratory	13-53 00 00	Laboratory Spaces
PTL	Private Toilet	13-65 13 13	Toilet Space
QRR	Quarters & Residence	13-65 00 00	Private Residential Spaces
TFC	Tenant Floor Cut	13-69 00 00	Building Associated Spaces
TTO	Total Office	13-55 11 00	Office Spaces
WRH	Warehouse	13-63 11 00	Warehouse Spaces
ANT	Antennas	13-69 17 00	Antenna Farm
CRH	Circulation Horizontal	13-25 00 00	Circulation Spaces
CRV	Circulation Vertical	13-25 00 00	Circulation Spaces
MCH	Mechanical	13-23 11 11	Mechanical Circulation
STP	Structured Parking	13-11 19 00	Planned Parking Space
TLT	Toilet	13-65 13 13	Toilet Space
UFO	Unsuitable for Occupancy	13-23 29 00	Unimproved Shell

FICM Use Code Mapping to OmniClass Table 13			
FICM		OMNICLASS	
FICM Number	FICM Description	OmniClass Number	OmniClass Title
100	Classroom Facilities		
110	Classroom Facilities	13-31 13 00	Lecture and Classroom Spaces
115	Classroom Service	13-23 23 21	Service Space
200	Laboratories		
210	Class Laboratory	13-31 15 00	Class Laboratories
215	Class Laboratory Service	13-31 15 15	Laboratory Service Space
220	Open Laboratory	13-31 15 11	Open Class Laboratory
225	Open Laboratory Service	13-31 15 15	Laboratory Service Space
250	Research/non-class Laboratory	13-31 15 13	Research/non-class Class Laboratory
255	Research/non-class Laboratory Service	13-31 15 15	Laboratory Service Space
300	Office Facilities		
310	Office	13-55 11 00	Office Spaces
315	Office Service	13-55 11 11	Office Service
350	Conference Room	13-55 29 21	Conference Room
355	Conference Room Service	13-55 29 21	Conference Room
400	Study Facilities		
410	Study Room	13-31 19 13	Study Room
420	Stack	13-63 19 21	Book Stacks
430	Open-Stack Study Room	13-63 19 21	Book Stacks
440	Processing Room	13-59 25 00	Production Support Spaces
455	Study Service	13-31 19 15	Study Service
500	Special Use Facilities		
510	Armory	13-35 15 11	Armory
515	Armory Service	13-35 15 13	Armory Service Space
520	Athletic or Physical Education	13-33 11 00	Athletic Recreation Spaces
523	Athletic Facilities Spectator Seating	13-33 11 11	Athletic Spectator Seating
525	Athletic or Physical Education Service	13-33 11 00	Athletic Recreation Spaces
530	Media Production	13-37 15 17	Media Production
535	Media Production Service	13-37 15 17 11	Media Production Support
540	Clinic	13-51 47 00	Clinical Laboratory Spaces
545	Clinic Service	13-51 51 00	Clinical Laboratory Support Spaces
550	Demonstration	13-55 17 00	Demonstration Spaces
555	Demonstration Service	13-55 17 01	Demonstration Spaces
560	Field Building	13-63 13 00	Non-Warehouse Storage Spaces
570	Animal Facilities	13-61 11 00	Animal Securing Spaces
575	Animal Facilities Service	13-61 11 00	Animal Securing Spaces
580	Greenhouse	13-59 29 00	Greenhouse Spaces
585	Greenhouse Service	13-59 29 11	Greenhouse Support Space
590	Other (All Purpose)	13-37 15 00	Creative Spaces
600	General Use Facilities		
610	Assembly	13-31 13 19	Assembly Hall
615	Assembly Service	13-31 13 20	Assembly Hall
620	Exhibition	13-37 13 13	Exhibit Gallery
625	Exhibition Service	13-37 13 13	Exhibit Gallery
630	Food Facility	13-57 13 13 11	Food Preparation Space
635	Food Facility Service	13-57 13 00	Food Service
640	Day Care	13-57 15 13	Child Day Care Space
645	Day Care Service	13-57 15 14	Child Day Care Space
650	Lounge	13-33 00 00	Recreation Spaces
655	Lounge Service	13-33 00 00	Recreation Spaces
660	Merchandising	13-55 19 00	Sales Spaces
665	Merchandising Service	13-55 19 01	Sales Spaces
670	Recreation	13-33 00 00	Recreation Spaces
675	Recreation Service	13-33 00 00	Recreation Spaces
680	Meeting Room	13-55 29 21	Meeting Spaces
685	Meeting Room Service	13-55 29 22	Meeting Spaces
700	Support Facilities		
710	Central Computer or Telecommunications		
715	Central Computer or Telecommunications Service	13-49 23 14	Computer Server Room
720	Shop	13-23 23 15	Shop Area
725	Shop Service	13-23 23 16	Shop Area
730	Central Storage	13-63 13 11 11	GNS–General Storage
735	Central Storage Service	13-63 13 11 12	GNS–General Storage
740	Vehicle Storage	13-63 15 11	Vehicle Storage Compartment
745	Vehicle Storage Service	13-63 15 12	Vehicle Storage Compartment
750	Central Service	13-23 23 00	Building Service Support Spaces
755	Central Service Support	13-23 23 00	Building Service Support Spaces
760	Hazardous Materials Storage	13-63 19 19	Hazardous Material Storage Space
770	Hazardous Waste Storage	13-23 21 12	Hazardous Waste Storage
775	Hazardous Waste Service	13-23 21 13	Hazardous Waste Storage
780	Unit Storage	13-63 13 23	Unit Storage
800	Health Care Facilities		
810	Patient Bedroom	13-51 14 35	Patient Room
815	Patient Bedroom Service	13-51 14 35	Patient Room
820	Patient Bath	13-65 13 00	Bathroom

775	Hazardous Waste Service	13-23 21 13	Hazardous Waste Storage
780	Unit Storage	13-63 13 23	Unit Storage
800	Health Care Facilities		
810	Patient Bedroom	13-51 14 35	Patient Room
815	Patient Bedroom Service	13-51 14 35	Patient Room
820	Patient Bath	13-65 13 00	Bathroom
830	Nurse Station	13-51 17 23	Nurse Station
835	Nurse Station Service	13-51 17 23	Nurse Station
840	Surgery	13-51 44 00	Surgical Spaces
845	Surgery Service	13-51 44 01	Surgical Spaces
850	Treatment/Examination Clinic	13-51 34 85	Treatment Room, Healthcare
855	Treatment/Examination Clinic Service	13-51 34 85	Treatment Room, Healthcare
860	Diagnostic Service Laboratory	13-51 21 00	Diagnostic Imaging Spaces
865	Diagnostic Service Laboratory Support	13-51 24 00	Diagnostic Imaging Support Spaces
870	Central Supplies	13-63 13 21	Supply Room
880	Public Waiting	13-55 29 23	Waiting Space
890	Staff On-Call Facility	13-65 11 00	On-call Room
895	Staff On-Call Facility Service	13-65 11 00	On-call Room
900	Residential Facilities		
910	Sleep/Study Without Toilet or Bath	13-51 34 79	Sleep Study Room
919	Toilet or Bath	13-65 13 00	Bathroom
920	Sleep/Study With Toilet or Bath	13-51 34 79	Sleep Study Room
935	Sleep/Study Service	13-51 34 79	Sleep Study Room
950	Apartment	13-65 00 00	Private Residential Spaces
955	Apartment Service	13-65 00 00	Private Residential Spaces
970	House	13-65 00 00	Private Residential Spaces
000	Unclassified Facilities		
050	Inactive Area	13-00 00 00	No Space Use
060	Alteration or Conversion Area	13-00 00 00	No Space Use
070	Unfinished Area	13-23 29 00	Unimproved Shell
WWW	Circulation Area		
W01	Bridge/Tunnel	13-25 13 00	Transitional Circulation Spaces
W02	Elevator	13-23 11 00	Vertical Penetration
W03	Escalator	13-23 11 11	Escalator
W04	Loading Dock	13-23 15 00	Loading Dock
W05	Lobby	13-25 13 13	Entry Lobby
W06	Public Corridor	13-25 11 11	Corridor
W07	Stairway	13-23 11 13	Stairway
XXX	Building Service Area		
X01	Custodial Supply Closet	13-23 23 00	Building Service Support Spaces
X02	Janitor Room	13-23 23 00	Building Service Support Spaces
X03	Public Rest Room	13-23 17 00	Restroom
X04	Trash Room	13-23 21 00	Waste and Recycling Spaces
YYY	Mechanical Area		
Y01	Central Utility Plant	13-23 19 00	Utility Equipment Room
Y02	Fuel Room	13-23 19 17	Fuel Room
Y03	Shaft	13-23 11 11	Elevator Shaft
Y04	Utility/Mechanical Space	13-23 23 00	Building Service Support Spaces
AAA01	Arenas - Open Air	13-33 00 00	Recreation Spaces
AAA02	Baseball Fields	13-33 11 13	Baseball Field
AAA03	Basketball Courts	13-33 11 13	Basketball Courts
AAA04	Bleachers	13-33 11 11 11	Bleacher
AAA05	Circuit Training Courses	13-33 11 15 35	Circuit Training Course Area
AAA06	Climbing Walls	13-33 11 15 47	Climbing Wall
AAA07	Dugouts	13-33 11 13 15	Dugouts
AAA08	Field Light Poles	13-33 11 13 27	Field Light Poles
AAA09	Grass Playing Fields	13-33 11 13 17	Grass Playing Fields
AAA10	Hard Playing Surfaces	13-33 11 15 11	Hard Playing Surfaces
AAA11	Press Boxes	13-55 29 21 13	Press Conference Room
AAA12	Rope Course Elements	13-33 11 15 49	Ropes Course Elements
AAA13	Running Tracks	13-33 11 15 37	Running Tracks
AAA14	Scoreboards	13-33 11 13 31	Scoreboards
AAA15	Shooting Ranges	13-33 15 17	Outdoor Shooting Range
AAA16	Ski Lifts	13-33 11 15 39	Ski Lift Space
AAA17	Softball Fields	13-33 11 13 13	Softball Fields
AAA18	Stadiums	13-33 11 11	Athletic Spectator Seating
AAA19	Swimming Pools – Open Air	13-33 13 11	Outdoor Swimming Pool
AAA20	Synthetic Fields	13-33 11 13 19	Synthetic Fields
AAA21	Tennis Courts	13-33 11 15 13	Tennis Courts
AAA22	Volleyball Courts	13-33 11 15 15	Volleyball Court
AAA23	Other Miscellaneous and Not Defined Athletic - Outdoor	13-33 11 00	Athletic Recreation Spaces

Appendix D – State of Tennessee Office of the State Architect (TN OSA) General and Equipment Inventory Requirements

General Attributes

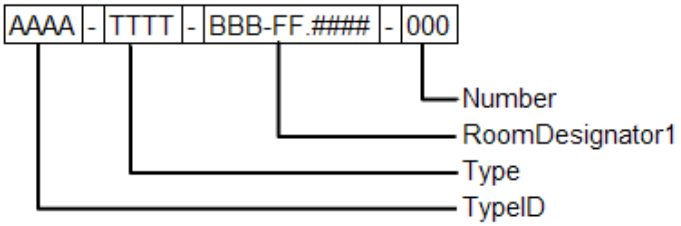
All equipment types shall have the following common attributes (see table below).

General Attributes		COBie Worksheet Location				
PLACEMENT REQUIREMENT	ATTRIBUTE	SHEET	COLUMN	ASSOCIATION	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
EACH COMPONENT	TagNumber	Component	TagNumber	-		X
EACH COMPONENT	SerialNumber	Component	SerialNumber	-		X
EACH COMPONENT	WarrantyStartDate	Component	WarrantyStartDate	-		X
EACH TYPE	SpecificationSection	Attribute	-	Type	X	X
EACH TYPE	Type	Type	Name	-	X	X
EACH TYPE	WarrantyDurationLabor	Type	WarrantyDurationLabor	-		X
EACH TYPE	WarrantyDurationParts	Type	WarrantyDurationParts	-		X
EACH TYPE	Manufacturer	Type	Manufacturer	-		X
EACH TYPE	ModelNumber	Type	ModelNumber	-		X

Equipment Inventory

The following tables list the required equipment types, attributes and naming standards for TN OSA.

Component Naming Standard Format:



Example: AHU-5000C-100-12.1223-001

Equipment types shall have specific equipment attributes as indicated in the tables below.

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
HVAC	CHILLERS	CH	CH-TypeXX-Room#-No.	Power	TYPE	X	X
				Capacity	TYPE	X	X
				WaterFlow	TYPE	X	X
				EnteringWaterTemp	TYPE	X	X
				LeavingWaterTemp	TYPE	X	X
				MotorController	TYPE	X	X
				ChillerType	TYPE	X	X
				RefrigerantType	TYPE	X	X
				EnergyEfficiencyRatio(EER)	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				VariableSpeedDrive	TYPE	X	X
				Frequency	TYPE	X	X
	BOILERS	BLR	BLR-TypeXX-Room#-No.	FullLoadFuelConsumption	TYPE	X	X
				ThermalEfficiency	TYPE	X	X
				WaterFlow	TYPE	X	X
				EnteringWaterTemp	TYPE	X	X
				LeavingWaterTemp	TYPE	X	X
				VentDiameter	TYPE	X	X
				Passes	TYPE	X	X
				FuelType	TYPE	X	X
				OutputMedia	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
	AIR HANDLING UNITS	AHU	AHU-TypeXX-Room#-No.	FanFlow-Maximum	TYPE	X	X
				FanFlow-Nominal	TYPE	X	X
				FanOutsideFlow	TYPE	X	X
				FanMotorHorsepower	TYPE	X	X
				FanMotorEfficiency	TYPE	X	X
				FanBrakeHorsepower	TYPE	X	X
				FanSpeed	TYPE	X	X
				CoilFlow	TYPE	X	X
				CoilCapacity	TYPE	X	X
				EnteringAirTempDB	TYPE	X	X
				EnteringAirTempWB	TYPE	X	X
				LeavingAirTempDB	TYPE	X	X
				EnteringWaterTemp	TYPE	X	X
				LeavingWaterTemp	TYPE	X	X
				CoilAirPressureDrop	TYPE	X	X
				CoilWaterPressureDrop	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
HVAC	FAN COIL UNITS	COIL	COIL-TypeXX-Room#-No.	AirFlow	TYPE	X	X
				FanSpeed	TYPE	X	X
				ExitStaticPressure	TYPE	X	X
				EnteringAirTempDB	TYPE	X	X
				EnteringAirTempWB	TYPE	X	X
				LeavingAirTempDB	TYPE	X	X
				LeavingAirTempWB	TYPE	X	X
				TotalCapacity	TYPE	X	X
				SensibleCapacity	TYPE	X	X
				EnteringWaterTemp	TYPE	X	X
				LeavingWaterTemp	TYPE	X	X
				ChilledWaterFlow	TYPE	X	X
				CoolingCoilDeltaP	TYPE	X	X
				CoolingRows	TYPE	X	X
				FanMotorHorsepower	TYPE	X	X
				FanMotorEfficiency	TYPE	X	X
				FanBrakeHorsepower	TYPE	X	X
				Phase	TYPE	X	X
				CabinetType	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
	PUMPS	HVACP	HVACP-TypeXX-Room#-No.	RatedFlow	TYPE	X	X
				ChurnPressure	TYPE	X	X
				ControllerType	TYPE	X	X
				PumpMotorHorsepower	TYPE	X	X
				PumpMotorEfficiency	TYPE	X	X
				PumpBrakeHorsepower	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
	FANS	FAN	FAN-TypeXX-Room#-No.	Service	TYPE	X	X
				FlowRate	TYPE	X	X
				Pressure	TYPE	X	X
				ControlType	TYPE	X	X
				Interlock	TYPE	X	X
				FanMotorHorsepower	TYPE	X	X
				FanMotorEfficiency	TYPE	X	X
				FanBrakeHorsepower	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
HVAC	COMPRESSORS	COMPR	COMPR-TypeXX-Room#-No.	RefrigerantType	TYPE	X	X
				Capacity	TYPE	X	X
				Speed	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
	VAV BOXES	VAV	VAV-TypeXX-Room#-No.	InletSize	TYPE	X	X
				AirFlow-Minimum	TYPE	X	X
				CoolingMaximumAirflow	TYPE	X	X
				CoolingMinimumAirflow	TYPE	X	X
				HeatingMaximumAirflow	TYPE	X	X
				PressureDrop	TYPE	X	X
				NCLevel-Discharge	TYPE	X	X
				NCLevel-Radiated	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
	VALVES	HVACV	HVACV-Room#-No.	OperatingPosition-Normal	COMPONENT		X
				OperatingPosition-Emergency	COMPONENT		X
	TRAPS	TRAP	TRAP-Room#-No.	InspectionFrequency	TYPE	X	X
				MaintenanceFrequency	TYPE	X	X
	STRAINERS	STN	STN-Room#-No.	InspectionFrequency	TYPE	X	X
				MaintenanceFrequency	TYPE	X	X
PLUMBING	WATER TREATMENT ASSEMBLIES	WTRTASSY	WTRTASSY-TypeXX-Room#-No.	***Only include General Attributes.***			
	PLUMBING VALVES	PLBGV	PLBGV-Room#-No.	OperatingPosition-Normal	COMPONENT		X
				OperatingPosition-Emergency	COMPONENT		X
	PLUMBING FIXTURES	PLBGFIXT	PLBGFIXT-TypeXX-Room#-No.		TYPE		

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE / SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
FIRE SUPPRESSION	FIRE SUPPRESSION PUMPS	FSUPPRP	FSUPPRP-TypeXX-Room#-No.	Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Rated Flow	TYPE	X	X
	FIRE SUPPRESSION VALVES	FSUPPRV	FSUPPRV-Room#-No.	Operating Position - Normal	COMPONENT		X
				Operating Position - Emergency	COMPONENT		X
	FIRE SUPPRESSION SPRINKLER HEADS	FSUPPRSH	FSUPPRSH-Room#-No.	Head Type	TYPE	X	X
				Thread Size	TYPE	X	X
	FIRE SUPPRESSION FIRE EXTINGUISHERS	FSUPPRFEXT	FSUPPRFEXT-TypeXX-Room#-No.	Capacity	TYPE	X	X
				Rating	TYPE	X	X
ELECTRICAL	LIGHT FIXTURES	LTG	LTG-TypeXX-Room#-No.	Lamp type	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	DISTRIBUTION PANEL	DPNL	DPNL-TypeXX-Room#-No.	Phase	TYPE	X	X
				Number of Wires	TYPE	X	X
				Number of Poles	TYPE	X	X
				Main Bus Current	TYPE	X	X
				Predominant Load Type	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	SWITCHGEAR	SWGR	SWGR-TypeXX-Room#-No.	Short Circuit Interrupting Rating	TYPE	X	X
				Enclosure Rating	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	GENERATOR	GEN	GEN-TypeXX - Room#-No.	Maximum Power Output	TYPE	X	X
				Fuel Type	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	COMPONENT ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
ELEVATOR SYSTEMS	ELEVATORS	ELEV	ELEV-TypeXX-Room#-No.	Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Capacity	TYPE	X	X
				Speed	TYPE	X	X
				StartingAmps	TYPE	X	X
				AcceleratingAmps	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMPONENT		X
BUILDING AUTOMATION SYSTEMS	CONTROL SENSORS	CTRLSNSR	CTRLSNSR-TypeXX-Room#-No.	Mounting	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMPONENT		X
	CONTROL CONTROLLERS	CTRLCONT	CTRLCONT-TypeXX-Room#-No.	Mounting	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMOPENT		X
ARCHITECTURAL	DOORS	DR	DR-TypeXX-Room#-No.	DoorWidth	TYPE	X	X
				DoorHeight	TYPE	X	X
				DoorThickness	TYPE	X	X
				DoorType	TYPE	X	X
				DoorMaterial	TYPE	X	X
				DoorFinish	TYPE	X	X
				GlazingType	TYPE	X	X
				FireLabelClass	TYPE	X	X
				FireLabelRating	TYPE	X	X
				HardwareSet	TYPE	X	X
				Pressurization	TYPE	X	X
				EgressDoor	TYPE	X	X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	COMPONENT ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
SITE	SITE WATER PUMPS	SWTRP	SWTRP-TypeXX-Room#-No.	Power	TYPE	X	X
				Flow Rate Min	TYPE	X	X
				Flow Rate Max	TYPE	X	X
				Pressure Head	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	SITE VALVES	SV	SV-TypeXX-Room#-No.	Operating Position - Normal	COMPONENT		X
				Operating Position - Emergency	COMPONENT		X
	SITE WATER TANKS	SWTRTNK	SWTRTNK-TypeXX-Room#-No.	Access Type	TYPE	X	X
				Storage Type	TYPE	X	X
				Capacity	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	SITE FIRE SUPPRESSION HYDRANTS	SFSUPPRHYD	SFSUPPRHYD-TypeXX-Room#-No.	Flow Rate	TYPE	X	X
				Pressure Rating	TYPE	X	X
				Body Color	TYPE	X	X
				Cap Color	TYPE	X	X
				Electrical Panel Name	COMPONENT		X
				Electrical Panel Circuit	COMPONENT		X
	SITE FIRE SUPPRESSION VALVES	SFSUPPRV	SFSUPPRV-Room#-No.	Operating Position - Normal	COMPONENT		X
				Operating Position - Emergency	COMPONENT		X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
SITE	SITE FIRE SUPPRESSION PUMPS	SFSUPPRP	SFSUPPRP-TypeXX-Room#-No.	Power	TYPE	X	X
				FlowRateMin	TYPE	X	X
				FlowRateMax	TYPE	X	X
				PressureHead	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMPONENT		X
	WATER SUPPLY WELL PUMPS	WTRSPLYWP	WTRSPLYWP-TypeXX-Room#-No.	Power	TYPE	X	X
				FlowRateMin	TYPE	X	X
				FlowRateMax	TYPE	X	X
				PressureHead	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMPONENT		X
	SEWER MANHOLES	SWRMH	SWRMH-TypeXX-Room#-No.	NorthCoordinate(Y)	TYPE	X	X
				EastCoordinate(X)	TYPE	X	X
				Top	TYPE	X	X
				Inv.In	TYPE	X	X
				Inv.Out	TYPE	X	X
	SEWER PUMPS	SWRP	SWRP-TypeXX-Room#-No.	RatedFlow	TYPE	X	X
				ChurnPressure	TYPE	X	X
				ControllerType	TYPE	X	X
	SEWER TANKS	SWRTNK	SWRTNK-TypeXX-Room#-No.	AccessType	TYPE	X	X
				StorageType	TYPE	X	X
				Capacity	TYPE	X	X

State of Tennessee - EQUIPMENT NAMING STANDARDS AND ATTRIBUTES							
DISCIPLINE/ SYSTEM	ASSET TYPE	TYPE ID	COMPONENT NAMING STANDARD	ATTRIBUTE	TYPE OR COMPONENT ATTRIBUTE?	SPECIFIED BY THE DESIGNER	PRODUCT DATA PROVIDED BY THE CONTRACTOR
SITE	FUEL DISTRIBUTION PUMPS	FDP	FDP-TypeXX-Room#-No.	Service	TYPE	X	X
				FlowRateMin	TYPE	X	X
				FlowRateMax	TYPE	X	X
				TotalHead	TYPE	X	X
				RotationSpeed	TYPE	X	X
				Power	TYPE	X	X
				Phase	TYPE	X	X
				Current	TYPE	X	X
				Voltage	TYPE	X	X
				Frequency	TYPE	X	X
				ElectricalPanelName	COMPONENT		X
				ElectricalPanelCircuit	COMPONENT		X
	FUEL DISTRIBUTION TANKS	FDTNK	FDTNK-TypeXX-Room#-No.	AccessType	TYPE	X	X
				Service	TYPE	X	X
				FuelType	TYPE	X	X
				Capacity	TYPE	X	X
				DryWeight	TYPE	X	X
				WetWeight	TYPE	X	X
	FUEL DISTRIBUTION SWITCHES	FDSW	FDSW-TypeXX-Room#-No.	***Only include General Attributes.***			

The equipment inventory shall be submitted in COBie format. The table below lists the COBie Worksheets and the high-level information that shall be provided in each Worksheet for an equipment inventory.

Additional guidance on the COBie Worksheets can be found in The COBie Guide (East and Carrasquillo-Mangual 2012).

COBie Worksheet	Required Content
Contact	One row for each discipline or organization that provides COBie information. Fields required to be completed include: Email, CreatedBy, CreatedOn, Category, Company, and Phone
Facility	One building per COBie file. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, ProjectName, SiteName, LinearUnits, AreaUnits, VolumeUnits, CurrencyUnit, AreaMeasurement, and Description
Floor	One row for each vertical level to include

COBie Worksheet	Required Content
	foundations, floors, roofs, and site. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, Elevation, and Height
Space	One row per functional space, per room. Multiple spaces in a room are possible. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, FloorName, Description, GrossArea, and NetArea
Zone	One row for each COBie.Space and COBie.Zone type. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, and SpaceNames
Type	One row for each scheduled product type or tagged equipment type found in the BIMs. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, Description, AssetType, Manufacturer, ModelNumber, WarrantyGuarantorParts, WarrantyDurationParts, WarrantyGuarantorLabor, WarrantyDurationLabor, WarrantyDurationUnit, NominalLength, NominalWidth, and NomimnalHeight
Component	One row for each individually scheduled product or each instance of tagged equipment found in the BIMs. Fields required to be completed include: Name, CreatedBy, CreatedOn, TypeName, Space, Description, SerialNumber, InstallationDate, WarrantyStartDate, and TagNumber
System	One row for each Component identifying the related System. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, and ComponentNames
Document	One row for each associated deliverable document identifying the relevant equipment type or component. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, ApprovalBy, Stage, SheetName, RowName,

COBie Worksheet	Required Content
	Directory, and File
Attribute	One row for each required Space Attribute. One row for each required Type Attribute. One row for each required Component Attribute. Fields required to be completed include: Name, CreatedBy, CreatedOn, Category, SheetName, RowName, Value, and Unit

Document Naming Convention

In reference to the COBie Worksheet named “Document”, these are the document types related to managed assets that should be listed in the Document Worksheet in the COBie deliverable. The naming convention for each document type is as follows.

SBCProjectNumber_DocumentAbbreviation_TypeID_Type

For example, product data documentation for Air Handling Unit (AHU) Type 500C on SBC Project 440/006-01-2014 would have a naming convention of

440/006-01-2014_OM_AHU_500C

Document Type	Document Abbreviation	Document Naming Convention
Product Data	PD	SBC Project No._PD_TypeID_Type
Operations & Maintenance Data	OM	SBC Project No._OM_TypeID_Type
Material Warranty	MW	SBC Project No._MW_TypeID_Type
Commissioning Data	CX	SBC Project No._CX_TypeID_Type
Certificates	CT	SBC Project No._CT_TypeID_Type
Spare Parts List	SP	SBC Project No._SP_TypeID_Type

Equipment category shall be entered as an OmniClass Table 23 code. Below are mappings of TN managed asset types to OmniClass Table 23 numbers.

Equipment Asset Mapping to Omniclass Table 23			
Asset Type	**TypeID**	**OmniClass Number**	**OmniClass Title**
CHILLERS	CH	23-33 21 00	Chiller
BOILERS	BLR	23-33 11 00	Commercial Boiler
AIR HANDLING UNITS	AHU	23-33 25 00	Air Handling Unit
FAN COIL UNITS	COIL	23-33 35 11	HVAC Coil
PUMPS	P	23-27 17 00	Pump
FANS	FAN	23-33 31 19	Fan
MOTORS	M	23-35 15 00	Electric Motor
COMPRESSORS	COMPR	23-27 21 00	Compressor
VAV BOXES	VAV	23-33 41 17 13	Variable Air Volume Terminal Unit
VALVES	HVACV	23-27 31 00	Valve
TRAPS	TRAP	23-27 37 00	Liquid Traps
STRAINERS	STN	23-27 55 29	Liquid Strainers
WATER TREATMENT ASSEMBLIES	WTRTASSY	23-27 55 33 11	Water Treatment Package Units
PLUMBING VALVES	PLGBV	23-27 31 00	Valve
PLUMBING FIXTURES	PLBGFIXT	23-31 00 00	Plumbing Specific Products and Equipment
FIRE SUPPRESSION PUMPS	FSUPPRP	23-27 17 00	Pump
FIRE SUPPRESSION VALVES	FSUPPRV	23-27 31 00	Valve
FIRE SUPPRESSION SPRINKLER HEADS	FSUPPRSH	23-11 27 15 11 11	Installed Sprinkler Heads
FIRE SUPPRESSION FIRE EXTINGUISHERS	FSUPPRFEXT	23-29 25 19	Fire Extinguishers
LIGHT FIXTURES	LTG	23-35 47 00	Electrical Lighting
DISTRIBUTION PANEL	DPNL	23-35 31 13	Distribution Panel Board
SWITCHGEAR	SWGR	23-35 31 31	Switchgear
GENERATOR	GEN	23-35 11 00	Electrical Generator
ELEVATORS	ELEV	23-23 11 11	Elevator
CONTROL SENSORS	CTRLSNSR	23-27 11 15	Flow Measuring Instrument And Controls
CONTROL CONTROLLERS	CTRLCONT	23-27 11 15	Flow Measuring Instrument And Controls
DOORS	DR	23-17 11 00	Doors
SITE WATER PUMPS	SWTRP	23-27 17 00	Pump
SITE VALVES	SV	23-27 31 00	Valve
SITE WATER TANKS	SWTRTNK	23-27 29 00	Tanks and Storage Structures
SITE FIRE SUPPRESSION HYDRANTS	SFSUPPRHYD	23-29 25 13	Fire Hydrant
SITE FIRE SUPPRESSION VALVES	SFSUPPRV	23-27 31 00	Valve
SITE FIRE SUPPRESSION PUMPS	SFSUPPRP	23-27 17 00	Pump
WATER SUPPLY WELL PUMPS	WTRSPLYWP	23-27 17 00	Pumps
SEWER MANHOLES	SWRMH	23-39 29 11 13 11	Manhole (Goes in Prefab Concrete)
SEWER PUMPS	SWRP	23-27 17 00	Pump
SEWER TANKS	SWRTNK	23-27 29 00	Tanks and Storage Structures
FUEL DISTRIBUTION PUMPS	FDP	23-27 17 00	Pump
FUEL DISTRIBUTION TANKS	FDTNK	23-27 29 00	Tanks and Storage Structures
FUEL DISTRIBUTION SWITCHES	FDSW	23-35 37 00	Electrical Switch

Appendix E – BIM Execution Plan Outline - Contractors

Project Information

- Identify project name, SBC number, location (address & geo-reference)
- Identify Owner
- Identify effective date or revision date of plan

Project Construction Team Information

- Contractor firm
    - Firm name
    - Firm address
    - BIM Manager name
    - BIM Manager contact information
- Subcontractors and Major Suppliers
    - Firm name
    - Firm address
    - BIM Coordinator name
    - BIM Coordinator contact information

BIM Goals and Objectives

- Identify owner's intended goals or end uses of the BIM
- Identify Contractor, Subcontractors, and Major Suppliers members' uses of the BIMs during the project
- List of Construction BIMs to be delivered
- Organization responsible for each Construction BIM

Roles and Responsibilities

- Briefly describe each organization's responsibility for:
    - BIM creation
    - BIM quality
    - BIM analyses
    - BIM management
- Describe the roles of the BIM Manager and the BIM Coordinators

Collaboration Plan

- Describe the collaboration system(s) to be used to exchange, merge, identify interferences and visualize BIMs
- Describe the system(s) to be used to exchange other electronic documents such as meeting minutes, meeting agendas, and interference reports
- Describe the hardware and software to be provided for onsite viewing of Construction BIMs

Kickoff Meeting

- Identify the required and optional attendees
- Identify the meeting location and date
- Identity the agenda of the Kickoff Meeting.
    - Sample agenda could include:
        - BIM expectations
        - Project goals
        - BIM Coordination process

- BIM Coordination Meetings
- Other BIM analyses such as 4D Scheduling
- Review BIM Execution Plan
- Review modeling standards
- Review model content
- COBie deliverables and requirements
- BIM deliverables

BIM Coordination

- Describe the roles and responsibilities of required Project Team members for BIM Coordination
- Describe the schedule for or frequency of model updates and interference checks
- Describe tools to be used for BIM Coordination
- Define the clashes to be run (e.g. HVAC vs. Structure)
- Describe the process to identify and resolve interferences
- Describe the process for tracking action items from the meeting.
- Describe the process for tracking changes to the Construction BIMs
- Describe the process to be used to generate related Shop Drawings and Coordination Drawings from the coordinated Construction BIMs

BIM Coordination Meetings

- Identify the frequency of meetings
- Identify the required and optional attendees
- Identify the locations of the meetings

Software for Model Authoring

- Identify all software products to be used for BIM creation and the software version
- Identify all object enablers to be used for viewing BIMs
- Identify all software products to be used for BIM Coordination and interference reporting
- Identify software products that will be used to perform quality control on BIMs

Modeling Standards and Content

- Common coordinate system
  - Units
  - File origin (X,Y,Z)
  - Geolocation
- Modeling partitions
- File versioning
- Naming
  - Files
  - Building level designators
  - Building area designators
  - Discipline designators
  - Layers (if applicable)
  - Properties required for:
    - COBie deliverables
    - Owner-requested analyses
    - Construction-initiated analyses
  - Units and values for properties (e.g.- cubic feet per minute, space use codes from FICM)
- Level of precision and dimensioning
- Objects to be modeled per discipline or trade

- BIMs shall include clearances for access, maintenance, and code requirements
- Object properties to be included
- Any exclusions from the Construction BIMs

For Other Construction-phase Analyses,

- Each analysis that will be performed:
  - Software to be used
  - BIM(s) to be analyzed
    - File format required
  - Responsible team member(s) for
    - Performing the analysis
    - Producing the required BIM(s)

BIM Deliverables

- Identify electronic models, drawings, analyses and reports, to be delivered
- Identify all space and equipment types and attributes to be included in the COBie deliverables
- Describe process to be used to extract all deliverables from the coordinated, Construction BIMs
- Identify the file formats for all deliverables
- Describe quality assurance and quality control measures to be implemented

Sign-Off

- Authorized signature from the Contractor, Subcontractors, and Major Suppliers indicating agreement to comply with this BIM Execution Plan