Rolling Out Open BIM Standards State-wide

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Why TN OSA Wants BIM

- Lower the State’s Total Cost of Ownership through more efficient and effective Operations and Maintenance of facilities

- Improve the productivity of those providing services and products in the Design and Construction industry
TN BIM Standards Overview

- All of a designated BIM project’s team members must use BIM
- Open (non-proprietary) Standards
  - No requirement to use a specific software product
  - All BIMs to be delivered in Industry Foundation Classes (IFC) format
  - All Space and Equipment Inventories to be delivered in Construction to Building information exchange (COBie) format
- All major drawings must be extracted from the BIM
- BIMs must be the basis for:
  - Area and volume calculations
  - Energy analysis
  - Interference checking
  - Space and equipment inventories
- Design and Construction teams must use collaboration technology to share models and other project information
### Intended Result: As-Designed

#### Component Naming Standard

<table>
<thead>
<tr>
<th>Component Attribute</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Load Fuel Consumption</td>
<td></td>
</tr>
<tr>
<td>Thermal Efficiency</td>
<td></td>
</tr>
<tr>
<td>Water Flow</td>
<td></td>
</tr>
<tr>
<td>Entering Water Temp</td>
<td></td>
</tr>
<tr>
<td>Leaving Water Temp</td>
<td></td>
</tr>
<tr>
<td>Vent Diameter</td>
<td></td>
</tr>
<tr>
<td>Passes</td>
<td></td>
</tr>
<tr>
<td>Fuel Type</td>
<td></td>
</tr>
<tr>
<td>Output Media</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
</tr>
</tbody>
</table>

#### Office

- Office: [Office Details]
Add Construction Phase COBie Data
Export to COBie

### COBie Worksheet

<table>
<thead>
<tr>
<th>Component</th>
<th>Required Content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COBie Worksheet</strong></td>
<td>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</td>
</tr>
</tbody>
</table>

### Properties

- **Boiler-59-440 kW BLR-GAS**

### Mechanical Equipment (1)

| **COBieCreatedBy** | gwilliams@kfa-inc.com |
| **COBieCreatedOn** | 2013-04-21T15:57:40 |
| **COBieDescription** | Boiler-59-440 kW |
| **COBieInstallationDate** | 2013-10-21T12:40:35 |
| **COBieSerialNumber** | 97547890-0409 |
| **COBieTagNumber** | BLR-GAS-105-02.B205-002 |
| **COBieWarrantyStartDate** | 2013-10-21T12:40:35 |

### Table

<table>
<thead>
<tr>
<th>Name</th>
<th>CreatedBy</th>
<th>CreatedOn</th>
<th>TypeName</th>
<th>Space</th>
<th>Description</th>
<th>SerialNumber</th>
<th>InstallationDate</th>
<th>WarrantyStartDate</th>
<th>TagNumber</th>
</tr>
</thead>
</table>

Office of the State Architect
Transfer COBie Data to FM System

1. BIM Manager Exports COBie Data
2. Import into FM System
3. OK

COBie Spreadsheet

Errors
COBie Data in FM System

COBie Attributes

Attributes for COBIE

<table>
<thead>
<tr>
<th>Key Value</th>
<th>Attribute Name</th>
<th>Type</th>
<th>Attribute Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blr</td>
<td>Frequency</td>
<td>Type 60</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Thermal Efficiency</td>
<td>Type 14</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Specification Section</td>
<td>Type 23 00 00 - Heating Ventilating and Air Conditioning</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Entering Water Temp</td>
<td>Type 55</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Voltage</td>
<td>Type 230</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Pressures</td>
<td>Type 2</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Leaving Water Temp</td>
<td>Type 95</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Full Load Fuel Consump</td>
<td>Type 1000</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Vent Diameter</td>
<td>Type 8</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Output Media</td>
<td>Type Water</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Fuel Type</td>
<td>Type Natural Gas</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Current</td>
<td>Type 120</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Blr</td>
<td>Water Flow</td>
<td>Type 15</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
Merged BIMs in IFC Format
TN BIM General Principles

These BIM Requirements do not change the contractual relationship between the parties or shift the risks between those parties.

All parties to any contract relating to the Project shall contain flow down clauses requiring all other parties to those contracts to comply with these BIM Requirements.

Nothing in the BIM Requirements modify, amend, suspend or abrogate any obligation of the Designer to the Owner or the Owner to the Contractor relating to the constructability of the Project’s design.

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

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 contract with that party and of a lower tier than that party.
COBie Overview

- Computable asset inventory:
- Direct transfer to Facility Management system
- Can be checked for completeness and compliance with software
- Delivered faster
- Savings in paper handling, shipping, reproduction and storage
- COBie is an open standard broadly supported by BIM Facility Management software
- Phased delivery of project documentation
- Capture the information when it is created
## COBie Worksheets

<table>
<thead>
<tr>
<th>Designer</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>Contact</td>
</tr>
<tr>
<td>Facility</td>
<td>Facility (from design)</td>
</tr>
<tr>
<td>Floor</td>
<td>Floor (from design)</td>
</tr>
<tr>
<td>Space</td>
<td>Space (from design)</td>
</tr>
<tr>
<td>Zone</td>
<td>Zone</td>
</tr>
<tr>
<td>Type</td>
<td>Type (manufacturer, model, warranty information)</td>
</tr>
<tr>
<td>Component</td>
<td>Component (serial number, installation date, warranty start date)</td>
</tr>
<tr>
<td>System</td>
<td>System</td>
</tr>
<tr>
<td>Attribute</td>
<td>Document</td>
</tr>
<tr>
<td></td>
<td>Attribute</td>
</tr>
<tr>
<td>DISCIPLINE / SYSTEM</td>
<td>ASSET TYPE</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td>LIGHT FIXTURES</td>
<td>LTG</td>
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<tr>
<td>DISTRIBUTION PANEL</td>
<td>DPNL</td>
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<tr>
<td>SWITCHGEAR</td>
<td>SWGR</td>
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<td></td>
</tr>
</tbody>
</table>
TN BIM Requirements for Designers

• Provide a BIM execution plan
• The designer and all consultants shall use BIM to produce a design model including required facilities-related information in COBie format
• At each design submission, the BIMs shall be provided in IFC format and partitioned by discipline and floor
• 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
• BIMs shall be used to perform all area and volume calculations
• BIMs shall be used as the basis for energy analysis
• BIMs shall be used to identify and resolve spatial conflicts between building systems
• BIMs shall be used to produce space and equipment inventories in COBie format
• Review the contractor produced as-built BIMs for conformance to the original design as formally modified throughout the Construction process
TN BIM Requirements for Contractors

- Provide a BIM execution plan
- The contractor and all subcontractors and suppliers shall use BIM to either update the Conformed Bid BIM or generate new Construction BIMs that include all of the geometry and clearances needed to perform trade coordination.
- Provide a BIM Manager to oversee BIM usage during construction and BIM Coordinators for each party creating a Construction BIM to manage BIM deliverables
- Construction BIMs shall be continuously updated and maintained to reflect current as-built conditions and be available to the project team.
- BIM software must export models in IFC format, support the IFC Coordination View and export space and equipment inventories to the COBie format
- Collaboration software must be web-based, provide real-time access to project team, support versioning of BIM files, provide access-controlled folders for the team members and conform to any Owner IT or security requirements
TN BIM Requirements for Contractors

- All construction coordination drawings and shop drawings shall be extracted from the coordinated Construction BIMs.
- Identify and resolve spatial interferences between trades and building systems prior to fabrication and field installation.
- Coordinated Construction BIMs shall be used to fabricate and install building components and systems for those trades using BIM.
- Provide as-built BIMs partitioned by discipline and floor in IFC format with the facility management information required by the Owner and maintaining the space inventory provided by Designer.
- Coordinated Construction BIMs shall be used to produce equipment inventories showing installed information delivered in COBie format.
- Provide as-built Drawings extracted from the as-built BIMs.
### TN OSA PM BIM Checklist - Designers

**Pre-Planning**
- Designate design disciplines required to produce BIM
  - All building systems will be modeled
- Designate construction trades required to produce BIM
  - All building systems will be modeled

**Design Project Startup**
Prior to completion of program verification phase:
- Review Resume of BIM Manager:
  - Professional qualifications
  - BIM knowledge
  - Previous experience in BIM management role
- Review Pre-Proposed Web-Based Collaboration System
  - Ability of Owner to access all content
  - Automated versioning of BIM and other files
  - Ability to access previous versions of BIM files
- Review BIM Execution Plan:
  - All disciplines required to produce BIM are included
  - All topics are covered
  - All disciplines are required to upload BIM revisions to the collaboration site promptly
  - Modeling standards cover all indicated subtopics
  - Modeling standards, especially naming conventions, are consistent across all disciplines
  - Model naming indicates that models will be segmented by discipline and floor
  - Model naming makes it easy to identify contents of each model file
  - Model naming indicates that collaboration system versioning rather than dates will be used to manage model revisions
  - Description of generating drawings is clear that drawings will be derived from the models and that they will not be edited subsequent to extraction
  - Verify with team that all software used by firms authoring are IFC and COBIE compliant
  - Model analysis plan indicates that model will be used for:
    - Space and calculations
    - Energy analysis (if required for project)
    - Building system coordination
    - Space and equipment inventory in COBIE format
  - Project deliverables include all BIM requirements
  - Project deliverable section describes how each deliverable will be extracted from the coordinated models
  - PIFs team describes acceptable level of quality control
  - All organizations providing BIM deliverables have signed

**Schematic Design**
- Review BIM Deliverables
  - Missing BIM in IFC format

**Bidding Phase**
- Review Conformed Bid BIMs

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### TN OSA PM BIM Checklist - Contractors

**Pre-Construction**
- Provide Conformed Bid BIMs in IFC and native format, as well as COBIE spreadsheet to Contractor:
  - Conformed Bid BIMs and COBIE spreadsheet have been delivered to the Contractor

**Within 30 days:**
- Review Resume of BIM Manager:
  - Professional qualifications
  - BIM knowledge
  - Previous experience in BIM management role
- Review Pre-Proposed Web-Based Collaboration System
  - Ability of Owner to access all content
  - Automated versioning of BIM and other files
  - Ability to access previous versions of BIM files
  - The collaboration site is configured to provide all trades with access to all models
  - The collaboration site prevents changes to one trade's model(s) by another trade
- Review BIM Execution Plan:
  - Construction team is modeling the complete building
  - All trades required to produce BIMs are indicated
  - Each trade has designated a BIM Coordinator
  - All topics are covered
  - All trades are required to share BIM models via the collaboration site
  - A computer with software capable of viewing merged models is provided on site
  - Modeling standards cover all indicated subtopics
  - Modeling standards, especially naming conventions, are consistent across all trades
  - Model naming indicates that model will be segmented by discipline and floor
  - Model naming makes it easy to identify contents of each model file
  - Model naming indicates that collaboration system versioning rather than dates will be used to manage model revisions
  - Model naming indicates that model will be used for:
    - Space and calculations
    - Energy analysis (if required for project)
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    - Space and equipment inventory in COBIE format
  - Project deliverables include all BIM requirements
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**Construction Phase**
- Verify that the analysis input came from the Design BIMs

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**Office of the State Architect**
Initial Assessment

• Getting output in standard formats from common BIM authoring software is hard
  – Getting the “intelligence” in and out of BIMs is very difficult
• Setup is tricky
• Necessary software features are not well integrated
• New software versions change functionality and introduce incompatibilities
Step 1: Install COBie Plug-In on Each Machine
Step 2: Ensure Correct COBie Template

Navigate to the Directory Where the Default COBie Template is Placed During Install (listed below)

Delete the existing COBie.Extension.Template.USA.xlsx

Download the Correct Version of the COBie Template from the NIBS Website: http://www.nibs.org/?page=bsa_cobiemm

Rename the COBie template file downloaded from the NIBs website to match the name of the previously deleted file: COBie.Extension.Template.USA.xlsx

Place new template in same directory as default template

Spreadsheet Template

While the most effective way to create and use COBie is within software systems listed above, some may be interested in directly using the COBie in the spreadsheet version. The following three templates are provided based on COBie version 2.4:

- Blank Template (Without color coding of any type)
- Design Template (With color coding reflecting expected content of design deliverables)
- Handover Template (With color coding reflecting expected content of construction handover)

The Corps of Engineers has developed templates that replace paper-based construction submittals per COBie guide specification. These templates may be found here.
Step 3: Update BIM Objects with COBie Attributes

1. Create Required COBie Attributes in external text file
2. Open or Create BIM Object and/or BIM Object Groups
3. Load COBie attributes
4. Choose and Apply COBie Attributes to Applicable BIM Objects and/or BIM Object Groups
5. Save

Repeat steps for each BIM Object and/or BIM Object Group required for your project
Step 4: Create a Project

Create New Project in BIM Authoring Software → Load required BIM Objects into Project → Save Project

_Load Family_
Step 5: Create BIM and Populate Attribute Values
Step 6: Define Export Settings for COBie File

- Open the COBie Plug-in Dialog Box
- Add/update Project Contacts
- Select the Classification System for Types (OmniClass, UniFormat, etc.)
- Select the Attribute Containing Description for Types
- Select the Project Units
- Select the Attribute Containing the COBie Name for Spaces
- Select the Attributes Containing the COBie Names for Types and Components

**Type Category**
- First Priority: OmniClass
- Second Priority: Assembly Code (UniFormat)
- Third Priority: Keynote
- Fourth Priority: Use 'n/a'

**Type Description**
- Family : Type
- Description Parameter from Type Properties

**COBie Type**
- Family Type: Family_Type Mark
  - Append Element ID

**COBie Component**
- Doors: Mark
- Windows: Mark
- Families: Mark
Step 6: Define Export Settings for COBie File

Select the Space and Equipment Attributes for Export

Save Settings

Assign Spaces to Zones

Select the BIM Objects for Export (Spaces, Types, Components, etc.)

Batch Modify Basic COBie Fields (CreatedBy, CreatedOn, Descriptions, etc.)
Step 7: Export COBie File

**Select COBie Worksheets to Populate**

- Contact
- Facility
- Floor
- Space
- Zone
- Type
- Component
- System
- Attribute
- Coordinate

**Create the Filename and Select the Save Location**

**Select Export to Export a COBie File**

**Choose an Action**

- Create New
- Append Existing

**Export to a File**
TN OSA BIM Schedule

Spring 2012 - Industry assessment:
Summer 2012 – Hired Kristine Fallon and Associates (KFA) as a consultant
September 2012 - KFA met with the state to gather initial perspectives
November 2012 - KFA developed first draft of BIMr
December 2012 - OSA established TNAEC industry BIM Working Group
January 2013 - Second draft of BIM Requirements
February 2013 - Incorporated comments from State, AEC industry attorneys, insurance and surety reps
March 2013 - Developed Owner’s O&M criteria for space and equipment management
March 2013 - Reviewed and incorporated additional comments from UT, TBR, and STREAM
April 2013 - BIM requirements version 1.0 presented to SBC and published on OSA website
July 2013 – First BIM pilot project awarded
August 2013 – TN PM Training and BIM Workshop for Industry
Lessons Learned

• Process is not well understood by either software vendors or end users
• Need to provide detailed instructions
• Need to provide links to software tools
• Need consultants to support teams in producing the deliverables
• This is Version 1 – updates expected
www.tn.gov/finance/osa
Click on current version link

BIM Standards

The intent of these BIM standards is to provide for the consistent development and management of Building Information Models on state building projects. These BIM standards 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. Additionally, these BIM standards 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.

BIM Standards Document

• Resources
  ▪ COBIE Validator Software
    A tool to check COBIE files based on TN OSA's BIM Standards. Contact Alan Robertson, Office of the State Architect, at 615-741-3259
    ▪ Microsoft Access or Access Runtime will be required
  ▪ The COBIE toolkit is an Add-In tool that will help teams to create and export COBIE compliant files.
    ▪ Tekla BIMsight [go to website for download]
      ▪ A tool used by State project managers to view the BIM model and register review comments. Note: administrative rights will need to be established by IT for utilization
      ▪ Project Manager BIM Checklists

• Training
  ▪ Town Hall Powerpoints
    ▪ April 30, 2013
  ▪ Training Videos
    ▪ Tekla BIMsight - Overview
    ▪ Tekla BIMsight - Getting Started
    ▪ Tekla BIMsight - Performing a SD Review
    ▪ Using Tekla BIMsight for D20 Review
    ▪ Using Tekla BIMsight for Final Deliverables Review
    ▪ Using COBIE Validator
Discussion