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The [CAD Standards Manual online](#) (LANL internal/external)

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1.0 Introduction

1.1 Purpose

The Building Information Modeling (BIM) Standards — Section 400 of the CAD Standards Manual (CSM) — was developed by the Engineering Services Virtual Build Environment Office (VBEO) to establish a formal system of 3D graphical modeling, 2D drawing, and data capture required by multiple LANL sources.¹

The primary purpose of the BIM program is to enable the Design Agency (architect, engineer, or LANL in-house), Constructor, and LANL Owners (e.g., Capital Projects, Engineering, Operations, and Maintenance) to leverage BIM technology to enhance the design and construction process. This technology allows for the resolution of conflicts before construction begins, reducing rework and improving productivity and efficiency throughout the project's development and implementation.

In addition, the BIM program's focus is associated with configuration management and the long-term lifecycle use of BIM for operations and maintenance along with data integration with their computer applications, e.g., GIS (ArcGIS, Trimble e-Builder), CMMS (Asset Suite), portfolio and space management (Archibus), and EDRMS (Documentum).

A. General Applicability

For buildings, facility systems in or around them, and infrastructure systems and their associated models, following Section 400 is required when creating or modifying a BIM — and/or drawings or sketches derived from the BIM.² For such tasks, it is applicable to, and mandatory for, LANL personnel engaged in preparing, coordinating, reviewing, approving, and controlling structure, system, or component (SSC) models and engineering drawings. Architect-engineering (AE) subcontractors are also subject to the requirements of Section 400 except where specifically indicated as LANL scope herein.

Deviation from Section 400 may be permitted with written approval from the LANL BIM Standards POC (or Alternate) or [VBEO](#) Director.

B. Usage on Specific Projects

See Table 400-1 for when a BIM is required for a given project. In addition, BIM is required when identified in the Statement of Work.³

¹ ESM Chapter 1 Section Z10 R15 requires(ed) BIM in limited circumstances and CSM Section 100 R5 and 200 R5.2 acknowledged BIM. The most recent driver for this BIM standard was [memo](#): Anderson and Kennedy to Simpkins and Teter, *Charter for Institutional Virtual Build Environment Office to Support Total Asset Lifecycle Virtual Information Management Approach*, ALDFO-23-34, December 22, 2023, in its Appendix 4 titled BIM Lifecycle Standards Initiative.

² Section 400 is required of projects even when CSM Sections 100–300 are not, as are the specific CSM Sections and their requirements specifically invoked herein. Also, any differences between Section 400 and Sections 100–300 of the CSM are not considered conflicts but are BIM-specific requirements; as such, Section 400 takes precedence in these cases.

³ Use of BIM on projects is always encouraged and should be strongly considered. The size and complexity of a project are used in determining which projects must be modeled using BIM.

Table 400-1. When BIM is Required by Project Category and Size⁴

Renovation: A largely architectural effort that can involve other disciplines. System or equipment installation or modification alone is not renovation.

Project Size	Complexity Level	Use of BIM?	Rationale
Renovation or Equipment Installation or Modification <u>When a Master BIM Already Exists</u>			
All	All	Required	Maintaining the accuracy of Master BIM files preserves LANL's investment in them and is a cost-effective approach to configuration management.
Renovation <u>When No Master BIM Exists</u>			
Terms are defined below Table 400-1			
Small (< \$1 million)	Low	Optional	May not be cost-effective for simple, low-budget projects. Traditional design and documentation methods are often sufficient and more cost-effective.
Small (< \$1 million)	Moderate	Recommended	Often cost-effective for low-budget projects of medium complexity.
Small (< \$1 million)	High	Required	Normally cost-effective for complex, low-budget projects. It can also capture new data or update existing data supporting the lifecycle of a facility.
Medium (\$1M-\$5M)	Low and Moderate	Recommended	Helps in visualizing design changes and coordinating between different stakeholders. It can also capture new data or update existing data supporting the lifecycle of a facility.
Medium (\$1M-\$5M)	High	Required	Normally cost-effective for complex, medium-budget projects. It can also capture new data or update existing data supporting the lifecycle of a facility.
Large (≥ \$5M)	All	Required	Enhances coordination, reduces errors, and optimizes project planning and execution. It can also capture new data or update existing data supporting the lifecycle of a facility.
New Construction Including Additions			
Small (< 10,000 sq. ft.)	All	Optional	While BIM can provide benefits such as improved visualization and coordination, the cost and time investment may not always be justified for small projects. Decision-makers should weigh the complexity and specific needs of the project when considering BIM usage.

⁴ Table 400-1 supersedes criteria in ESM Ch. 1, Section Z10 (e.g., Rev. 15, 11.5.B – i.e., all line item projects) where less Z10 is stringent.

Project Size	Complexity Level	Use of BIM?	Rationale
Medium and Large (≥ 10,000 sq. ft.)	All	Required	For medium projects, BIM aids in design optimization, clash detection, and better project management. It enhances collaboration, improves design accuracy, and aids in efficient project delivery, though it may not be as critical as for large projects. For large projects, BIM is essential for managing complexity, ensuring quality, and improving collaboration. They benefit from BIM's capabilities in managing complexity, ensuring coordination across disciplines, and reducing risks associated with design and construction errors. Projects capture data providing a foundation for BIM use throughout lifecycle of facility operations and maintenance.

For “Renovation-When-No-Master BIM” category above, related definitions:

Cost is Total Project Cost (TPC) ⁵	
Renovation Complexity Levels ⁶	
Low	Minimal impact on building services, and primarily architectural but minor work on doors, windows, or hard-walls, including non-load-bearing wall systems [e.g., Kreuger International Genius]. At most, minor structural work such as anchorage may be involved, but it can include any amount of office furniture reconfiguration, including systems furniture/office cubicles, and furniture, finishes, or accessories.
Moderate	More-than-minor <u>hard-wall office work</u> and more-than-incidentals changes to mechanical, electrical, plumbing, fire sprinkler, fire alarm, or other building services. May involve moderate structural modifications and other architectural changes such as multiple doors, windows, and systems furniture (partitions/office cubicles)
High	Extensive reconfiguration of space and significant changes to building services. Examples include: An International Existing Building Code (IEBC) Level 3 Alteration Modernization: The comprehensive replacement or restoration of virtually all major systems (plumbing, mechanical, electrical, fire sprinkler, fire alarm), interior finishes (ceilings, partition walls, doors, and floor finishes), and building features (such as space reconfiguration or exterior wall, window, or roof replacement) [ESM. Ch. 14 r12.1] May include structural changes driven by the IEBC or ESM Ch. 5 Section I (e.g., RP-8)

1.2 Responsibilities of Design Agency (except as noted)

A. Architects, Engineers, and Designers

Ensure the BIM file contains physical characteristics, geometry, and data necessary to convey design, facilitating procurement, operability and constructability. Model the facility, infrastructure, systems, and equipment to a level of development (LOD) as detailed within this document.⁷

All site plans, floor plans, sections and elevations, scheduled data (for all BIM objects’ Model data), and details must be extracted directly from the model. Use BIM objects

⁵ Regarding cost — because an AE may not know this, the SOW for their services should require BIM efforts based on Table 400-1 (and failing that, share cost estimate later as needed, since Table 400-1 must be followed regardless of SOW explicitly requiring BIM).

⁶ If unsure of level, contact Section 400 [POC](#) for resolution.

⁷ The intent is to provide a means for clash detection; conflict resolution; identification of clearance requirements; access zones; coordination among disciplines; and consideration for space, operations, and maintenance.

supplied by manufacturers where available; if unavailable, create objects that closely correspond to the actual dimensions.

B. BIM Coordinator

The BIM coordinator will manage and oversee the building information model (BIM) process within a project by:

- Providing guidance to ensure the BIM files are coordinated across engineering disciplines and constructor (e.g., LANL-self-perform and/or Subcontractors)
- Ensure the consistent use of the Autodesk Revit® templates or other engineering model templates
- Monitor introduction of non-LANL-standard elements
- Oversee consistency in Autodesk Revit® files across disciplines, facilities, and projects
- Oversee the integration of BIM data with other project management tools, systems and engineering model tools.
- Manage BIM deliverables, including models, drawings, and documentation, required by the project
- Lead the development of BIM Execution Plan (BEP), obtaining approval from design professional

Ensure BIM files use the LANL shared coordinate system (ref. ESM [Chapter 3](#), Civil G10-30GEN), ensuring BIM is located accurately. See §4.6 Revit Template Legends – LANL Revit Guides for further information on how to update the BIM shared coordinates.

C. Constructor (Subcontractors and LANL Self-Perform)

Guidance: Constructors are encouraged to perform 3D clash coordination, coordinate BIM changes with the Design Agency. Any desired constructor processes and workflows with BIM should be determined by the Integrated Project Team and promulgated by the SOW or construction documents (e.g., Specification Section 01 4000, Quality Requirements).

D. Interface with Constructor

Coordinate BIM files as needed with the project team per approved BIM Execution Plan (BEP⁸, see article 2.1 herein) to ensure primary BIM files and any additional BIM files (including approved deferred and delegated design BIM) are provided and or updated with field as-constructed changes and data for chosen/installed SSCs (e.g., as reflected in submittals) for use in compiling the Record BIM files.

E. Model Progression Meetings

Coordinate the design (not limited to clash checks, constructability reviews, weekly status meetings, safety etc.) and deliver and present the Project BIM files' progress during the applicable project design review meetings (e.g., 30%, 60%, 90% 100%). As a minimum, the BIM LOD progression at each project review milestone shall meet ESM [Chapter 1](#), Section Z10, Attachment C, and as directed by the BIM Execution Plan (BEP).

Guidance: After construction has begun, Design Agency is encouraged to participate in model progression meetings with project team for 3D coordination and updating the Project BIM and approved field changes.

⁸ AP-350-100-FM12, *Building Information Modeling (BIM) Execution Plan*, when issued [here](#), will provide a template that may be used by the project team to create the BEP.

1.3 Master BIM Concept and Management, and Master Maintenance by LANL

The facility and system BIMs (managed by VBEO) are considered master living models or Master BIMs. These BIMs are maintained and deemed critical for configuration management and part of the technical base line documents.

- A. The project design and construction BIM files (Project BIMs) must be created with the understanding that they will form part of an as-constructed (Record) BIM at project completion. *Once delivered and validated, this Record BIM will update or become the Master BIM.*

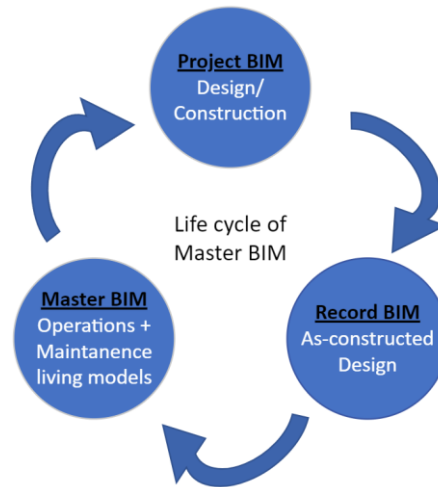


Figure 1. Master BIM Lifecycle

2.0 General Requirements (Design Agency)

Section 400 relies heavily on, and in some cases amends, the National CAD Standard (NCS); thus, comply with the latest edition of the NCS.

2.1 Develop and Maintain BIM Execution Plan (BEP)

- A. Develop and issue a BEP at the beginning of each BIM project. Subsequently, review, refine, and update the BEP with support from BIM Coordinator's support during Model Progression Meetings (i.e., at each Design Review milestone).
- B. A BEP defines how the Design Agency will use BIM to meet LANL design/construction requirements. A BEP can be simple or complex depending on the project size, cost, team or schedule. The National Institute of Building Sciences (NIBS) [NBIMS-US](#) Standard offers a standardized BEP that can be used as a resource.⁹ A BEP should define the following:
- **Project Goal or Objective:** Define the overall goals outlining how BIM will be used for project's success.
 - **BIM Uses:** How will the BIM be used on the project. This can include creation of drawings to quantity take-off to clash detection.

⁹ Regarding two future LANL Capital Projects (ALDICP) documents: (a) AP-350-100-FM12, *Building Information Modeling (BIM) Execution Plan*, when issued [here](#), may provide a template that may be used by the project team create the BEP; (b) WI-100-005, *VDC BEP Work Instruction*, when issued [here](#), may provide additional direction on BEP development. Follow these in lieu of the above guidance when contractual, and consider doing so when LANL-in-house design.

- **Project BIM Requirements:** Outline BIM deliverables and formats as well as BIM levels of development (LOD).
- **BIM Team Roles:** Identify BIM stakeholders and their roles and responsibilities.
- **Communication Protocols:** Describe how stakeholders communicate, exchange and collaborate BIM data.
- **Technology Infrastructure:** Describe software and hardware needs for BIM and collaboration.
- **Quality Control:** Define quality control procedures ensuring accuracy and integrity of BIM data. Reviewing, approving and validating BIM data throughout project life cycle.

2.2 BIM Software and File Formats

Use approved software and CAD/GIS/Drawing Management platforms and file formats, i.e.:

- Autodesk Revit® version 2024.2 or later, file extensions .rvt, .rfa, .rte
- Autodesk AutoCAD® 2018 or later DWG format, file extension .dwg
- Autodesk Civil 3D®, (Civil/Landscape drawings only), saved in 2018 or later DWG format, file extension .dwg
- Autodesk Interoperability Tools (plug-in to Autodesk Revit for Verification & Validation), file extension .xml
- Autodesk Navisworks®, file extensions .nwc, .nwd, .nwf
- Configura Designer® CET Furniture Design Software (furniture design only, not required; saved in 2018 DWG format) *The Plugin for importing Configura Furniture layouts is [RevLink Add-In](#). It allows one to import .cmrfl files into the Revit file.*
- Environmental Systems Research Institute (ESRI®) Geographic Information Systems (GIS) software
- Industry Foundation Class, version 4.3 or later, open International Standard ISO 16739 BIM, file extension .ifc
- LiDAR file formats (point clouds): Autodesk Recap® (.e57, .rcs or .rcp) or Cloudworx (.lgxs)

2.3 Revit Template Files

BIM files must be created using current LANL Revit templates and shared parameters files. The Revit template files are available on the CAD Standards Manual [webpage](#) with Section 400. If a discipline-specific template does not exist, it is acceptable to use the template provided by the Design Agency.

LANL Project Engineers: Master BIM files, if available, must be requested from the LANL-internal [VBEO Portal](#) and used as technical baseline models for supporting project BIM creation.

2.4 Level of Development

- A. The Level of Development (LOD) of the BIM files shall comply with requirements identified in NIBS National BIM Standard-US™ ([NBIMS-US](#)) v4 or later and the [BuildingSMART BIMForum LOD Specification Model Element Table](#). Use the BIMForum Specification's LOD 300 to provide a baseline, which includes modeling of elements with accurate quantity, dimensions, orientation, location and data equivalent to traditional construction documents and shop drawings.

1. As-Built Exception: For the very small subset of construction documents that must be truly verified-by-LANL as-built per ESM Ch. 1 Section Z10 (subsection on Code of Record, 7.0)¹⁰, incorporate such actual as-built corrections and data following walkdowns.¹¹
- B. Incorporate additional BIM content and appropriate LOD according to the project's specific specifications, requirements, or BEP.
- C. The BIM Coordinator shall ensure the design team is aware of and is modeling according to the project's requirements and Section 400.
- D. **Modeling Existing facilities:** Use of the above NIBS standard and BIMForum LOD Specification to model objects and data to LOD 300 applies to new project design data only. Modeling of existing facilities, either from existing LiDAR data or from existing 2D technical baseline documents is not required to be at LOD 300 unless specifically required by the SOW. At a minimum, model existing facilities Structure, Systems, or Components (SSCs) to reflect project design intent and interfaces to existing on drawings. *It is highly encouraged to model existing facilities SSCs to capture, with as much detail and data as possible, with LiDAR data, existing 2D technical baseline documents and/or field walk downs.*¹²

At a minimum, the SSCs in Table 400-2 shall be included and modeled to LOD 300 for new work:

Table 400-2. Minimum BIM Modeled SSCs Elements for New Work

Structural	
<ul style="list-style-type: none"> • Foundations • Framing (columns, trusses, beams, braces, etc.) • Floors, roofs • Structural walls • Overall – Plan drawings representing all facility areas for each system type 	<ul style="list-style-type: none"> • Ramps • Grids • Grid lines • Stairs
Architectural	
<ul style="list-style-type: none"> • New interior/exterior walls and components within (doors, windows, etc.) • Floor, finish floor, ceiling, and roof • Architectural wall types • Elevators, stairs, and ramps • Railing (handrail and guardrails) • Site Plan (as needed) • Furniture walls in open areas to show cubicle configurations • Rooms 	<ul style="list-style-type: none"> • Furnishings and fixtures (except furniture) • Plumbing fixtures • Equipment • Clearance zones • Casework and shelving • Overall – Plan drawing representing all facility areas for each system type • Areas

¹⁰ At LANL, the term “as-built” is reserved for “Important documentation (e.g., electrical one-line diagrams, database records) that is (1) verified by physical inspection as depicting the actual physical configuration and (2) verified as consistent with the design requirements. [based on DOE-STD-1073-16 and AP-341-405; AP-341-610]. These are a subset of the entirety of Project Record Documents (PRDs). PRDs not an as-built are therefore just as-designed. [GLOS-COE-1]

¹¹ When such as-builts are provided for these SSCs, the models element accuracy may approach LOD 500 per the latest BuildingSMART BIM Forum LOD Specification, Model Element Table. Per [BuildingSMART BIMForum LOD Specification Part I \(2024-02-27\)](#), “The Model Element is a graphic representation of an existing or as-constructed condition developed through a combination of observation, field verification, or interpolation. The level of accuracy shall be noted or attached to the Model Element... it indicates that the element's geometry is determined through observation of an existing item rather than design of a future item. The LOD 500 definition requires that the model element's accuracy be specified...”

¹² Modeling of existing facilities is encouraged to support the new project design and drawings.

Mechanical	
<ul style="list-style-type: none"> • Equipment • Supply/Return distribution systems • Pipes and ducts with minimum outer diameter (OD) as define by BEP 	<ul style="list-style-type: none"> • Clearance zones • Overall – Plan drawing representing all facility areas for each system type • Spaces and zones
Electrical/Telecommunications/Security	
<ul style="list-style-type: none"> • Interior and exterior transformers and other equipment • Main and distribution panels and switchgear • Equipment and devices • Receptacle and devices 	<ul style="list-style-type: none"> • Feeders and conduit with minimum OD as defined by BEP • Permanently mounted lighting fixtures • Clearance zones • Overall – Plan drawing representing all facility areas for each system type
Plumbing	
<ul style="list-style-type: none"> • Waste and vent piping with OD of 2 inches and larger • Fixtures (lavatories, water closets, roof and floor drains, drinking fountains, etc.) • Overall – Plan drawing representing all facility areas for each system type 	<ul style="list-style-type: none"> • Clearance zones • Supply pipes with OD of 2 inches and larger
Fire Protection/Fire Alarm	
<ul style="list-style-type: none"> • Clearance zones • Sprinkler pipes with OD of 2 inches and larger • Clearance Zones 	<ul style="list-style-type: none"> • Fire protection heads and cabinets • Fire alarm devices and cabinets • Overall – Plan drawing representing all facility areas for each system type
Electrical, Mechanical, Utility Chases, and Corridors	
<ul style="list-style-type: none"> • All equipment, devices, and systems within room modeled per BEP stipulated requirements • Pay special attention to areas of piping or conduits where stacked or flat configurations create congestion for coordination 	
Civil (Civil 3D or 2D CAD)	
<ul style="list-style-type: none"> • Site & Utility Plan • Topography – 3D terrain of all sitework 	<ul style="list-style-type: none"> • Landscaping elements

3.0 Data Management (Design Agency except as noted)

3.1 Importance of Data Integrity¹³

- A. Design Agencies working on LANL projects must ensure that data nomenclature, integrity, accuracy, and completeness are maintained throughout project delivery and transfer between software applications.
- B. Master BIMs must be managed by LANL within a data repository with backup feature.

3.2 BIM File Types

- A. Project BIM Files

¹³ LANL considers facility/structure and infrastructure data to be a strategic asset that must be managed appropriately to maintain its value.

Project BIM files are created for a project design or modification using current engineering modeling software, so use current Revit (or other engineering modeling) template files when creating the Project BIM.

If the project involves modification to an existing facility, structure, or infrastructure, the project (e.g., LANL project engineer) must first determine if useful Master BIM files are available via VBEO and/or [VBEO Portal](#). Request these files from VBEO and provide them to the Design Agency as a technical base-line model for reference. The LANL BIM Manager will work with Project IPT members to establish the best workflow for integrating Master BIM files and subsequently creating the Project BIM file.

1. File Naming Convention for Project BIM

Create the filename as follows (letters uppercase):

PID#-TA-BLDG-Y.rvt

For example, 123456-03-0234-A.rvt,

where

- **PID#** is the unique project number; use ESR# when no PID (in the example, PID# is 123456)
- **TA** is the 2-digit TA (in the example, TA is 03)
- **BLDG** is the 4-digit facility/structure number (in the example, bldg. number is 0234). Use MULT when more than one building included.
- **Y** is the BIM Discipline Initial per Table 400-3 (in the example, Discipline Initial is A for Architecture)
- **.rvt** is the file format extension (in lower case)

Table 400-3. Filename Discipline Initials

BIM Discipline Initial	BIM Discipline Represented	BIM Discipline Description
A	Architecture	Architectural elements
S	Structure	Structural elements
MEP	Mechanical, Electrical, Plumbing	Mechanical, Electrical Plumbing elements. These can be separate models each representing their discipline. It is encouraged to model these disciplines together as a single BIM to take advantage of systems integrations within Revit platform
M	Mechanical	Mechanical elements
E	Electrical	Electrical elements
P	Plumbing	Plumbing elements
FN	Furniture	Furniture elements; can be represented as part of Arch model
EQ	Equipment	Equipment elements not represented by MEP, Fire, Telecommunication or Security elements or systems. Can be represented as part of Arch model
F	Fire Protection	Fire protection and alarm elements. Can be represented as part of MEP model; add "F" to end of MEP (e.g. MEPF)
J	I&C (Control Systems)	Instrumentation and Control systems for operating HVAC equipment, process equipment, and other building services
T	Telecommunication	Telecommunication elements. Can be represented as part of MEP model, add "T" to end of MEP (e.g., MEPT)

X	Security	Security elements. Can be represented as part of MEP model, add “X” to end of MEP (e.g., MEPX)
SP	Space	Room/Area/Space/Zone elements. Room and Area are represented as part of Arch model and Space and Zone are represented as part of MEP model. SPACE BIM files need a minimum of BIM objects represented by Arch or MEP elements to be created
ST(X)	Site/Civil/Utilities	Site/Civil elements. For site utilities in specific disciplines, add a suffix of the specific discipline initial after ST in the optional “X” location; e.g., STE for Electrical such as site lighting)

B. Record BIM Files

Record BIM files represent the final deliverable of the Project BIM at project completion. Record BIM files are managed and delivered to LANL by the Design Agency with support from a BIM Coordinator. Record BIM files capture all as-constructed field changes and updates during construction (including approved deferred and delegated design BIM). This includes updating the 3D objects physically installed, their physical locations, and model data that reflect as-constructed conditions and information.

1. Naming Convention for Record BIM Files: Follow the same naming convention as the Project BIM (see 3.2.A.1 above).

C. Master BIM Files (LANL only)

Master BIM files represent a LANL facility/structure. The Master BIM files are living models and are maintained, managed and updated by VBEO. Master BIM files are created or updated from Record BIM files received by VBEO from Design Agency at project completion.

1. Naming Convention for Master BIM files
Create the file name as follows (letters uppercase):

TA-BLDG-Y.rvt

For example, 03-0234-A.rvt,

where

- **TA** is the 2-digit TA (in the example, TA is 03)
- **BLDG** is the 4-digit facility/structure number (in the example, bldg. number is 0234)
- **Y** is the BIM Discipline Initial per Table 400-3 (in the example, Discipline initial is A for Architecture)
- **.rvt** is the file format extension (in lower case)

3.3 Spatial Objects and Data

A. Rooms

Room objects conceptually provide data about a space. Room objects must have Room names and Room numbers. Room objects should not overlap and must be generated with the appropriate BIM tool and associated with bounding elements (walls, doors, windows, floors, columns, ceilings, underside of deck.) Remove non-placed Room objects in their entirety.

1. Room Numbering should comply with ESM [Ch. 4 Architectural](#), C Interiors (Appendix A – Room Numbering). A four-digit room numbering scheme will be provided by LANL after a conceptual floor plan is developed, received, and

approved. *Conceptual drawings should be sent to fpr_team@lanl.gov to assign numbering scheme.*

B. Spaces

Use spaces to define mechanical/electrical/plumbing (MEP) boundaries. The boundaries should be modified vertically and horizontally to identify their service extents.

1. Space numbers: Spaces should be coordinated with Room objects.

C. Areas

Create and place Area boundaries and Areas to support Life Safety Area Schemes and Schedules included in the Revit template. Ensure each area is named and assigned occupancy classifications and space functions in accordance with IBC Chapter 10 Means of Egress and its Table 1004.5.

3.4 PEL/MEL Data and Information

Enter Project equipment list (PEL) information into the Project BIM files. Follow ESM (STD-342-100) [Chapter 1](#) Sections Z10–General and 200–Item Numbering and Labeling [e.g., Attachment 1: CMMS Upload Workbook (multi-tab xls)], capturing the PEL information in the defined “LANL_O” parameter fields in the Project BIM. The Record BIM file shall include the PEL data including as-constructed information from the constructor.¹⁴

Note: Successful LANL MEL integration into the BIM Project Model requires upfront IPT coordination and targeted dialogue with the constructor through the approved BEP. The standard MEL data fields require translation into typical engineer modeling tools so the SSCs being specified during design and procurement processes achieve proper attribute entry. For example, Revit Type Properties requires a review with IPT and ultimate end-user SME to properly define which parameters receive the proper Type vs. Instance definition within to effectively baseline data capture.

4.0 Template Settings (Design Agency)

4.1 Template Settings

Discipline-specific templates are pre-defined to provide consistency across all disciplines for all models.

For additional information on Template settings, refer to subsection 4.6 Revit Template Legends – LANL Revit Guides.

4.2 Project Units

Discipline: All

Format				
Data	Units	Rounding	Unit Symbol	Check Boxes
Length	Feet and fractional inches	To the nearest 1/256"	' - "	Suppress 0 feet, use digit grouping, suppress spaces
Area	Square feet	1 decimal place	SF	Suppress trailing 0s, use digit grouping
Volume	Cubic feet	2 decimal places	CF	Suppress trailing 0s, use digit grouping

¹⁴ Construction-phase SSC information comes to Design Agency primarily through submittals such as catalog data and shop drawings. Other avenues include field change requests (FCRs) and other documents.

Format				
Data	Units	Rounding	Unit Symbol	Check Boxes
Angle	Decimal degrees	2 decimal places	°	Suppress trailing 0s, use digit grouping
Slope	Rise / 12"	To the nearest 1/256"	n/a	Use digit grouping
Currency	Currency	2 decimal places	\$	Suppress trailing 0s, use digit grouping
Mass Density	Pounds per cubic foot	2 decimal places	lb/ft ³	Suppress trailing 0s, use digit grouping
Time	Seconds	1 decimal place	s	
Speed	Miles per hour	1 decimal place	mph	

4.3 Parameters

Standard Parameters exist in all Master BIM files and discipline-specific template storing and communicating information about all elements in a BIM. Parameters define and modify elements as well as communicate model information in tags and schedules.

Refer to the resources that are webposted with Section 400 for list of current parameters within the Revit template that support data coordination and efficiencies. A Shared Parameters .txt file is available with the Revit templates.

4.4 Worksets

Standard Worksets exist in all Master BIM files and discipline-specific templates to ensure consistency, visibility control across all models and most importantly model health.

For further information on Worksets in the Revit template, see 4.6 Revit Template Legends – LANL Revit Guides.

4.5 Phasing in BIM Files

Phases in BIM Files define distinct periods in the life of the facility, structure, or infrastructure. The Design Agency shall ensure BIM phase names and descriptions are coordinated with the project team. The discipline-specific templates include two phases, existing and new:

- **Existing** – assigned to all model content that represents the existing physical elements including elements that represent the existing site.
 - Master BIM files will only have the Existing phase, as it represents the physical characteristics of the existing facility or structure.
 - Master BIM files may also have appended Existing phases with past PID# (ESR#) providing a history of updates, renovations or modifications over the life cycle of the facility.
- **New** – assigned to all model content that represents new design components. All elements modeled at LOD 300 per NIBS National BIM Standard-US™ (NBIMS-US) v4 or later and the BuildingSMART BIMForum LOD Specification Model Element Table. Includes demolition work.
- **Filters:** All objects are assigned a Phase when created and when demolished. Filters for Phases are applied to a View to display the objects for each distinct period — existing, demolition, and new — or a combination of the three. For more on phasing in the Revit template, see the Revit Template Legends article below.

4.6 Revit Template Legends – LANL Revit Guides

Legends in each discipline template provide requirements for modeling and organizing the Project BIM. General and discipline-specific annotation symbols, families, line types, line weights, etc., are listed.

Legend Title	Legend Description	Legend Location
00 LANL Revit Guide - Etiquette	LANL BIM Guidance/Etiquette	All Models
*01 LANL Revit Guide - Project Setup	LANL BIM Project Setup	All Models
02 LANL Guide – Project location and Coordination	LANL Model Coordinate Alignment Process	All Models
03 LANL Revit Guide – Authoring Content	LANL Best Practice creating content	All Models
04 LANL Revit Guide – Coordination and Delivery	LANL Coordination When Sharing and Delivering Models	All Models
05 LANL Revit Guide – Annotations General	LANL General Sheet Content/Info	All Models
06 LANL Revit Guide - Dimensions	LANL Standard Dimensions	All Models
07 LANL Revit Guide - Text Styles	LANL Standard Text Styles	All Models
08 LANL Revit Guide - Line Styles	LANL Standard Line Styles	All Models
09 LANL Revit Guide - Line Weights	LANL Standard Line Weights	All Models
10 LANL Revit Guide – Project Navigation	LANL Project Browser Navigation	All Models

4.7 BIM Objects (Revit Families)

Master BIM files and discipline templates contain both out-of-box and custom BIM objects representing a group of elements with a common set of Properties or Parameters and a related graphical representation. Many of the custom BIM objects are annotation symbols. Use LANL custom-annotation BIM objects and align with the standard text styles and line weights.

BIM objects must be modeled or created using the tool within the software that is designed to be used for the specific object or purpose. BIM objects must have proper classification and or data attributes for the project and object type. BIM objects must report properly the objects they represent rather than unassigned graphic primitives allowing the information associated with them to be properly updated, reported and available for export and reuse.

Do not edit LANL BIM objects (Revit Families) in provided Master BIM files or discipline-specific templates without BIM Standards POC approval.

A. Naming Convention for BIM Objects (Revit Families)

The naming convention for a BIM object (Revit Family) shall be Title Case (capitalize all words except non-initial articles), separating fields with underscore and within fields with space and/or fields with a hyphen.

BIM object (Revit Family) Naming Convention (uppercase/lowercase as shown):

ZZZZ_Y_MD_Description1_Description2_Type/Configuration.rfa

For example, LANL_A_08_Door Single_Exterior_HM Frame - HM Panel.rfa,

where

- | |
|---|
| <ul style="list-style-type: none"> • ZZZZ field is LANL (exception below) • Y field is the Discipline (in this example Y is A for Architecture) |
|---|

<ul style="list-style-type: none"> • MD field is the CSI <u>MasterFormat Division</u> (in this example, MD is 08 for Openings per the MasterFormat spec work breakdown structure)
<ul style="list-style-type: none"> • Description1 field describes Object/Use (in this example, Description1 is Door Single)
<ul style="list-style-type: none"> • Description2 field describes Location/Manufacturer (in this example, Description2 is Exterior)
<ul style="list-style-type: none"> • Type/Configuration field provide further type or configurations of the Description fields (in this example Type/Configuration is HM Frame - HM Panel)
<ul style="list-style-type: none"> • .rfa is the file format extension

Note: Unique custom or manufacturer project BIM objects (Families) may be created and added during design. When by external design agency (AE), substitute the ZZZZ field with initials or short name.

For example, XYZ_A_08_Door Single_Exterior_HM Frame - HM Panel.rfa,
where

<ul style="list-style-type: none"> • ZZZZ field is external Design Agency (in this example, XYZ is Design Agency firm name, initials, or acronym)

5.0 BIM File Deliverables –Design Reviews and Project Completion (Design Agency)

5.1. Project Design Review BIM File Deliverables

A. BIM Quality Checks (QC)

Complete a BIM QC with support from the BIM Coordinator before each design review delivery and reviewed for compliance at each design review model progression meeting.

The Revit template files provide the format and the baseline for compliance and adherence to Section 400. Well-coordinated BIM files should include oversight and periodic checks from the beginning throughout a project’s design and construction.

QC checks shall include, but not be limited to, the following:

<ul style="list-style-type: none"> • Review against the templates: formatting of the project browser, views, sheets, legends, etc. 	<ul style="list-style-type: none"> • Appropriate filenames
<ul style="list-style-type: none"> • Use of standard line styles and weights 	<ul style="list-style-type: none"> • Elements placed on proper worksets
<ul style="list-style-type: none"> • Use of standard text styles 	<ul style="list-style-type: none"> • Navisworks views displaying appropriate information
<ul style="list-style-type: none"> • Use of pre-defined sheet set-up and format 	<ul style="list-style-type: none"> • Index sheet filled out appropriately
<ul style="list-style-type: none"> • Use of standard dimension styles 	<ul style="list-style-type: none"> • Project history filled out appropriately
<ul style="list-style-type: none"> • Use of keyed and general notes 	<ul style="list-style-type: none"> • Images embedded
<ul style="list-style-type: none"> • Use of pre-defined view templates set-up and format 	<ul style="list-style-type: none"> • LOD requirement met
<ul style="list-style-type: none"> • Object styles 	<ul style="list-style-type: none"> • Linked CAD files are converted to Revit components and inserted into the model
<ul style="list-style-type: none"> • Verify BIM georeferenced and coordinate system used identified 	

B. 2D Output **Deliverable Files from BIM Files**

2. CAD and PDF Files

When required by the SOW or Subcontract (will be in most cases), 2D AutoCAD and PDF files of the drawings and sketches must be exported from Project BIM following the maturity level specified in ESM [Chapter 1](#), Section Z10, Attachment C, *Design Deliverable Schedule 30-60-90-100%*. File naming convention of drawing and sketches shall follow the requirements in CSM [Section 200](#).

3. Other Data Files

Additional data file types can be exported from the Project BIM satisfying ESM [Chapter 1](#), Section Z10, Attachment C, *Design Deliverable Schedule 30-60-90-100%*. This may include but not be limited to:

- Project Equipment List
- Project Document List
- Life Safety Design Criteria
- Structural Design Criteria data/calculations or component/quantity lists
- Systems Design Criteria data/calculations or component/quantity lists

C. BEP Deliverable Review and Update

Submit BEP for review to refine, update and version the BEP at each Design Review.

5.2. Record BIM File Deliverables at Project Completion

At project completion, the Design Agency, in coordination with the constructor and supported by the BIM Coordinator, shall transition the Project BIM to a Record BIM. This as-constructed Record BIM file shall compile all design and construction data, including field walkdowns, FCRs and DRNs, as-constructed redlines, shop drawings, and 3D point cloud information obtained post-construction. *By aggregating all project information throughout the project life cycle, the Record BIM is prepared to either become a living Master BIM file or serve as an update to an existing Master BIM file.*

A. Record BIM Quality Check (QC)

A final QC check of the Record BIM shall be completed as defined per the approved BEP before final delivery. The final QC shall include but not be limited to the items in table described in article 5.1.A, BIM Quality Checks (QC).

B. Submission of Record BIM Files

Submitted Record BIM files and supporting/linked files must be quality checked and in compliance with the requirements listed within Section 400, to include any additional SOW or performance specification requirements. In addition, refer to the ESM (or TSM) for possible additional requirements.

Follow the CSM Section 200 – CAD Requirements (e.g., Subsection 214 Article 3.0, *CAD File Format for Electronic Deliverables*) when submitting Record BIM files. In addition, send notification to bim-submissions@lanl.gov for LANL BIM Manager awareness and as necessary for large files use <https://transfer.lanl.gov> to transfer the BIM files to same and Document Control.

LANL BIM Manager or delegatee will overcheck the delivered files for compliance.

6.0 Definitions

Additional definitions are contained in the *Conduct of Engineering Glossary*, [GLOS-COE-1](#). The following are generally reproduced from Rev. 0 of that document for convenience or are unique to Section 400; the Glossary has the official definition should these conflict with it.

Term	Definition
BIM/Building Information Model or Modeling	<p>A digital representation of physical and functional characteristics of a facility, facility systems in or around them, or infrastructure systems. A BIM is a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle; defined as existing from earliest conception to demolition.</p> <p>Typically, BIM is authored by 3D CAD software with interactive (“smart”) objects that includes or may interface with a database of object attribute data. This is the key component of a virtual build environment (VBE). Autodesk Revit® is currently the BIM standard software within LANL.</p>
BIM Coordinator	<p>With a LANL-in-house-designed project, the BIM Coordinator is responsible for facilitating the implementation and coordination of BIM processes and standards by the design team, supporting the design team in maintaining high-quality BIM models, and facilitating smooth collaboration with all project stakeholders assuring project meets LANL BIM requirements. This may be a part-time or collateral duty fulfilled by a team member with appropriate background or by consultation basis by the Virtual Build Environment Office (VBEO).</p> <p>Within an external-to-LANL Design Agency (AE), there is also a BIM coordination need (role) for ensuring the effective implementation and coordination of BIM processes within the design agency’s projects.</p> <p>Therefore, for simplicity’s sake, Section 400 uses the term to mean the person(s) fulfilling that role for the design team without regard to employer, actual job title, or other roles/functions.</p>
BIM Execution Plan (BEP)	<p>A written plan detailing the development and use of, and protocols related to, Process Models and setting forth each of the Design Agencies’ responsibilities related thereto.</p>
BIM Manager (LANL)	<p>An institutional or Division-level role responsible for overseeing the implementation and management of BIM processes and standards across all design, construction, and handover phases for all BIM. This role ensures that BIM is effectively utilized to enhance project delivery, improve coordination, and support LANL’s long-term asset management goals for facility operations.</p>
BIM Standards POC (LANL)	<p>Maintains this document (Section 400) and associated resources and references including the BIM template, and who is empowered to grant permission to vary from same in writing. References and resources may be revised by POC independently of Section 400 revisions. POC normally indicated on CAD Standards webpage; there may also be Alternate POCs.</p>
BIM Subject Matter Expert – SME (LANL)	<p>SME having sufficient knowledge to review BIM models for compliance with this Section (may be discipline-specific or multi-discipline)</p>
Clash Detection	<p>The process of locating conflicting spatial data in the BIM files where two elements are occupying the same physical space</p>
Constructor	<p>Term for the entity performing fabrication or physical construction activity. When not LANL self-performed, this is the SUBCONTRACTOR. Constructor term used primarily in the Engineering Standards but not preferred term in contract pro forma (boilerplate).</p>
Design Agency	<p>The LANL organization or subcontractor (AE) responsible for the preparation of engineering design and documentation [P342]</p>
Master BIM	<p>BIM that is managed, maintained and updated throughout the entire life cycle of a physical facility, from design, construction, operation, maintenance, and decommissioning. The Master BIM is used for analyzing facility data, enhancing decision making, efficiency and sustainability for all stakeholders providing up to date information, better coordination, reducing errors and optimizing facility performance over time. A Master BIM is managed by the LANL BIM Manager and VBEO team. Where they exist, they may be provided to Design Agency to alter.</p>
Model Data	<p>Information applied to BIM or BIM object (element) properties. A model object or element is a discrete object within a BIM; future LANL ALDICP document WI-100-005, VDC BEP Work Instruction, when issued here, may provide discussion.</p>

Project BIM	BIM a project team creates, manages and updates throughout project delivery phases representing a new design, renovation or modification of a facility. A Project BIM is coordinated and managed by a Design Agency and supported by a BIM Coordinator. At project completion, a Project BIM becomes a Record BIM.
Record BIM	Project BIM finalized for delivery at project completion incorporating all as-constructed design and construction updates. A Record BIM can either update a Master BIM or become a new one.
Virtual Build Environment Office – VBEO (LANL internal)	Team or office within Engineering Services (e.g., Operations Group) who’s mission is to collaboratively implement VBE workflows in stages across the ALDFO and ALDIP directorates. [CSM Section 400 draft] Goals include (1) defining BIM standards; (2) facilitating technology adoption through communication and training (3) centralizing VBE service requests into a single system for streamlined coordination; (4) establish and maintain an on premise data management solution, (5) managing data, including the establishment of an approved enclave with appropriate partitions segregating non-sensitive from sensitive data on a central server; and (6) laying the groundwork for the compliant and secure implementation of industry-standard cloud-based environments in the next phase.

7.0 Acronyms and Abbreviations

Additional acronyms are contained in the *Conduct of Engineering Glossary*, [GLOS-COE-1](#).

Term	Definition
AE or A/E	Architect/Engineer (outside of LANL)
BEP	BIM Execution Plan
BIM	Building Information Model or Modeling
CAD	Computer-Aided Design
CSM	CAD Standards Manual, STD-342-300 (LANL)
DOE	Department of Energy
ESM	Engineering Standards Manual, STD-342-100 (LANL)
GIS	Geographic Information System
IPT	Integrated Project Team
LiDAR	Light Detection and Ranging
LOD	Level of Development
MEL	Master Equipment List
MEP	Mechanical/Electrical/Plumbing (sometimes including fire protection and other services depending on context)
NCS	National CAD Standard (NIBS)
NIBS	National Institute of Building Sciences (e.g., for NCS and NBIMS-US Standard)
OD	Outer Diameter
PEL	Project Equipment List
POC	Point of Contact
QA	Quality Assurance
QC	Quality Control, or quality check

SME	Subject matter expert
SOW	Statement of Work
SSC	Structure, System, or Component
TSM	Tailored Standards Manual
VBEO	Virtual Build Environment Office

8.0 Contact

Please contact the BIM Standards [POC](#) for assistance. LANL users should seek assistance and make suggestions [here](#); otherwise please email bim-submissions@lanl.gov.