هيئة كفاءة الإنفاق والمشروعات الحكومية
Expenditure Efficiency & Projects Authority

EXPRO National Manual for Projects Management

Volume 6, chapter 6

3D Model Review Procedure

Document No. EPM-KE0-PR-000010 Rev 001

Document Submittal History:

Revision:	Date:	Reason For Issue
000	31/10/2019	For Use
001	15/08/2021	For Use

THIS NOTICE MUST ACCOMPANY EVERY COPY OF THIS DOCUMENT

IMPORTANT NOTICE

This document, (“Document”) is the exclusive property of Government Expenditure & Projects Efficiency Authority.

This Document should be read in its entirety including the terms of this Important Notice. The government entities may disclose this Document or extracts of this Document to their respective consultants and/or contractors, provided that such disclosure includes this Important Notice.

Any use or reliance on this Document, or extracts thereof, by any party, including government entities and their respective consultants and/or contractors, is at that third party’s sole risk and responsibility. Government Expenditure and Projects Efficiency Authority, to the maximum extent permitted by law, disclaim all liability (including for losses or damages of whatsoever nature claimed on whatsoever basis including negligence or otherwise) to any third party howsoever arising with respect to or in connection with the use of this Document including any liability caused by negligent acts or omissions.

This Document and its contents are valid only for the conditions reported in it and as of the date of this Document.

Table of Contents

1.0 PURPOSE

This procedure describes the workflow process for conducting three dimensional (3D) model reviews, including the division of responsibilities for conducting reviews, the generation and resolution of action items, and the reporting of results. Required model contents and their maturity are also addressed.

3D model reviews are conducted for the purpose of verifying that all aspects of the design and physical arrangement of the facility is safe, provides for adequate and compliant egress, provides maintenance and access space, meets the project scope and contract requirements, agrees with the latest project information, allows for safe and efficient construction and commissioning, implements best practices for lower total installed cost (TIC), and is compliant with the project-specific Building Information Modeling (BIM) Execution Plan (BEP). The review team will strive for the most cost effective design and delivery methods (TIC) perspective), ensuring:

- Code compliance
- Safety
- Constructability and coordination
- Interfaces
- Maintainability
- Operability
- Functionality
- Data management
- Ease of use (of the 3D model) by other functions

NOTE: The 3D model review is not a forum to redesign the building or facility during the review. Those involved in model reviews should review and commit to the Model Review Covenants in Attachment 1. Any changes that do not fit the acceptable reasons for model review changes as defined in Attachment 2 require an approved trend that addresses both cost and schedule impact for the redesign.

2.0 SCOPE

This procedure is applicable to all Entity projects where the Architect/Engineer (A/E) is required to develop a 3D model as part of the Building Information Model (BIM) or is responsible for the review of the BIM model developed by others. In addition to satisfying the design review project milestone requirements set out in EPM-KE0-PR-000002, Design Review Procedure, the model content and level of development (LOD) of model elements must be as defined in the attachments to this document.

The requirements described in this procedure should be flowed down, where possible, into agreements with joint venture partners and design sub consultants.

3.0 DEFINITIONS

3D Model - Model depicting components in three dimensions.

4D Model - 3D Model with schedule information included.

5D Model - 3D Model with costs/quantities included.

6D Model - 3D Model with O&M information included
Note: 5D and 6D models don't necessarily mean they include 4D model information or for 6D models they don't need to include either or both 4D and 5D model information.

BIM - Building Information Model(ing)

VERB: A cross-departmental collaborative process of creating, collecting & managing information to virtually design, procure, schedule, construct, commission, start-up and operate a facility. BIM therefore develops a digital representation of the physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.

NOUN: The collection of files and databases used in building the information model of the facility.

BEP – BIM Execution Plan; A cross-departmental project specific execution plan providing the project team with guidance as to the scope, staffing, tools, processes, procedures and systems required to facilitate the flow of information to support the design, procurement, construction and operation of the project

Data Attributes – Data attributes are defined in the project specific BIM Execution Plan and are used to aid in project delivery across all functions of the project. Key attributes may be criteria for managing 4D and/or 5D applications of BIM.

Design Area – A geographic area of the facility segregated to facilitate detailed design, progress tracking, and 3D Model Reviews, i.e., 3D model volumes.

Safety in Design – A review protocol conducted in accordance with Safety in Design in EPM-KE0-GL-000014, Codes, Standards & References. When practicable, these reviews should be conducted simultaneously with 3D Model Reviews.

Exchange Requirements (ER) – Pre-tender document setting out the information to be delivered and the standards and processes to be adopted by the A/E and/or suppliers.

Level of Development (LOD) – Used to define the design development state of a single design component across the delivery milestones of the project. Model Reviews should be performed with consideration of the project-defined LOD requirements, which includes both graphical and model data, in accordance with the project-specific BIM Execution Plan (BEP). Examples of several typical LODs are:

LOD 100 - elements are not geometric presentations. They may be symbols or other generic representations of information that can be derived from other model elements. Any information derived from LOD 100 elements must be considered approximate.
LOD 200 - elements are represented graphically but are generic placeholders, e.g., volume, quantity, location, or orientation. Any information derived from LOD 200 elements must be considered approximate
LOD 300 - elements are graphically represented as specific systems, objects, or assemblies from which quantity, shape, size, location, and orientation can be measured directly, without having to refer to non-modeled information such as notes or dimension call-outs
LOD 350 - elements are enhanced beyond LOD 300 by the addition of information regarding interfaces with other building systems. For example, an LOD 350 masonry wall element would include jamb conditions, bond beams, grouted cells, dowel locations, and joints – information that enables the model user to coordinate the wall element with other systems in the structure
LOD 400 - elements are modeled at sufficient detail and accuracy for fabrication of the represented component. For example, pipe spool pieces could be developed from the model.
LOD 500 - facilities management - This level will have suitable geometry and information to support operations and maintenance. Geometry and data should be as-built and field verified.

Model Review – A detailed review of a facility or building area/ system focusing on safety, constructability, cost-effectiveness, maintainability, operability, ease of start-up, and system functionality. Reviews may be internal (with any Joint Venture (JV) partners and sub-consultants) or external (with clients, vendors, etc.) and will also focus on graphical correctness (including geographical), compliance with requirements, and model data completeness in accordance with the BIM LOD requirements and milestones.

O&M – Operations and Maintenance

Scope Change – Items or activities not included in the scope or to be removed from the scope of the base project contract.

Trend – A projected deviation from an established baseline. It is an item of change that causes an addition or reduction to the cost and /or schedule baseline, project scope, pricing, unit rates, schedule, or intended plant quality that causes any change to the trend base estimate. This also includes corrections for scope/estimate omissions. For this procedure trends are classified as Scope Change Trends and Other Trends. They are divided into 2 categories: resolved (approved or cancelled) and unresolved (in progress).

4.0 REFERENCES

- EPM-KE0-PR-000002 - Design Review Procedure
- EPM-KE0-GL-000012 - General Engineering Procedures
- EPM-KE0-GL-000016 - General Design Guidelines
- EPM-KE0-GL-000020 - Project Automation Requirements and Deliverables Guideline
- EPM-KE0-TP-000025 - BIM Execution Plan template
- EPM-KE0-GL-000014 - Codes, Standards and References

5.0 ROLES AND RESPONSIBILITIES

Based on the project size, number of project's stakeholders and their locations/positions in the project; one or multiple roles of the below roles may reside in the same individual:

5.1 Architecture/Engineering

5.1.1 Project 3D Model Champion

Enforces the 3D model engineering instructions in conjunction with the BIM Coordinator and ensures approval and closure of all actions resulting from the model reviews. The 3D Model Champion conducts the model review together with the model driver. See section 6.4 for details of the 3D Model Champion's responsibilities when conducting 3D Model Reviews.

5.1.2 BIM Coordinator

Responsible for management of the various data formats associated with the BIM model and assures that clash checks are completed and documented. Also assures that the BIM models are being developed in accordance with project specific requirements and standards as well as is authorized to resolve inter-discipline interface issues related to the 3D model. The BIM Coordinator coordinates/prepares for 3D model reviews and provides support during model reviews as required. The specific responsibilities of the BIM Coordinator may vary depending on the type of project and will be detailed in the project specific BIM Execution Plan (BEP). This position must be filled early in the project life cycle to assure proper setup of the BIM model, associated data formatting, and assure the A/E follows the project specific requirements/standards.

5.1.3 Senior Engineer/ Architect

Responsible for overall activities of their respective disciplines. The Senior Engineers or Architects have primary responsibility for their respective design area(s) and discipline's scope's compliance with all applicable volumes of the NMPM in addition to applicable international codes and standards. Moreover, the Senior E/A will be responsible for implementing all safety aspects for their discipline package in the 3D model The senior E/A may nominate an individual from their discipline to run the Model Review session in his stead.

5.1.4 Model Clash Coordinator

Depending on the size of the project, this role may be delegated to a project representative from one of the disciplines, e.g., Architectural, Civil, Electrical, Mechanical, for the purpose of the model review. In addition, this individual helps create and evaluate 3D model clash resolution metrics and validates daily project compliance to applicable procedures or instructions that apply to clash detection requirements. The model clash coordinator will coordinate the design effort between project disciplines and / or consortium partners. Moreover, the Model Clash Coordinator is responsible to conduct all technical review workshops between different disciplines for resolving clashes.

5.1.5 Model Driver

A project representative (e.g. architect, engineer, or designer) assigned by the project to conduct the 3D Model Review (manipulate the approved visualization software).

5.1.6 Project Engineering Manager (PEM) or Project Manager (PM)

Responsible for the overall design on the project. The PM/PEM is responsible for incorporating the 3D model review milestones into the project schedule and for ensuring model reviews are conducted in accordance with this procedure. Inherent in the responsibility of the PM/PEM is to ensure the appropriate members of the engineering team (Senior Engineers and Architects etc.) participate in the model reviews. Equally important is

that the appropriate representatives from other functions (Construction, etc.) participate in model reviews, and that the representatives have sufficient authority and experience to fulfill their responsibilities.

5.2 Construction

The Project Field Engineer (PFE) or a designee, such as the project Construction Coordinator and/or a rigging specialist, is responsible for the constructability review of a design area. The PFE will provide constructability feedback in model review sessions, as well as providing input on design features that will promote safe construction. PFE is also responsible for providing feedback on best practices for lowering total installed cost (TIC) and increasing construction productivity.

5.3 Commissioning & Operating Services (Startup)

A representative from Commissioning & Operating Services is responsible for providing input at the model review regarding considerations for start-up and testing arrangements, equipment and instruments, temporary piping for flushing and steam blow, access to motor operated valves, etc., that need to be addressed during the design phase of the project.

5.4 Health, Safety, Security & Environment (HSSE)

A representative from ES&H is responsible for providing input at the model review regarding safety and environmental considerations for construction, start-up, and operations.

5.5 Automation or BIM Manager

Depending on the size of the project the Automation Manager or BIM Manager shall be overall responsible and point of contact for 3D model reviews, including the coordination of 3D model reviews with all key internal and external stakeholders.

6.0 PROCESS

6.1 Required Model Review Milestones

The project will determine required project model review milestones, which will vary depending on the type of project and business line. Model review milestones are typically defined in the contract. Model review milestones may be based on:

- Percent of design complete, e.g., 30%/60%/90%
- Scheduled release of key deliverables
- Contract requirements (including those that may be specified in the exchange requirements)
- Other reasons as determined by the Senior Engineer/Architect, PM/PEM, or Entity.

Typical model review milestones are defined in the Attachments and contain the minimum requirements for 3D model reviews. Additional informal and/or unscheduled reviews with specific objectives can and should be utilized as required during all phases of the project.

6.2 Types of Model Reviews

6.2.1 Types of Review

The type of 3D model review at each milestone depending on the industry sector will be as identified in the Attachments and the review dates will be incorporated into the project Level 3 schedule. The reviews are conducted by facility areas and/or by system, depending on the business line and/or contractual requirements. The review types are as follows:

- Engineering/Architectural Review (E)
- Multi-Departmental Review (D)
- Entity Review (C)
- Design for Safe Construction and Startup Review (S)

6.2.2 Engineering/Architectural Review (E)

This review consists of a detailed review of the model by the Engineering disciplines, but is also a good opportunity to allow a constructability review by the constructors. The review should be done, at a minimum, in each of the phases described in the Attachments and as required to maintain overall project schedule. In addition, an Engineering Review is required prior to any Entity review.
Each engineering group and/or discipline is responsible for ensuring the model meets equipment requirements, project requirements, interferences are resolved, checking any specific design requirements, other requirements corresponding to the design documents within their responsibilities continuously throughout design development. Each discipline may conduct their own separate routine reviews, provided that the reviews comply with the requirements of this procedure (i.e., action item tracking, follow Attachment 5 requirements, etc.). The disciplines shall generate their own model review checklists, which may vary between review areas.
Personnel that are to be invited to the Engineering Reviews are:

- PM or PEM
- 3D Model Champion (attendance is mandatory)
- BIM Coordinator
- Responsible BIM/Model Clash Coordinator (attendance is mandatory)
- Model Driver
- Construction (attendance is highly recommended, especially at the earliest milestones)
- Architectural/Plant Design, Electrical, Mechanical, and other discipline leads (attendance is mandatory)
- Responsible Engineers/Designers for the model area/system being reviewed (attendance is mandatory)

6.2.3 Multi-Department Review (D)

The Multi-Departmental Review should be conducted concurrently with the Engineering Review but may be conducted as a separate event. In addition to the attendees for an Engineering Review, the following additional personnel should attend the Multi-Departmental Review:

- Construction Representative (attendance is mandatory)
- Project Controls Representative (as required/necessary)
- Contracts & Procurement Representative (as required/necessary)
- Testing and Commissioning, & Operating Services Representative (as required/necessary)
- HSSE

The Construction Representative should generate a constructability checklist, which may vary between review areas.

If 4D, 5D or 6D BIM aspects of the project are included in the review, representation by other departmental representatives will be required.

6.2.4 Entity Review (C)

The Entity review is to be held as necessary to meet contractual requirements. The Entity review may also be necessary to obtain operating and maintenance personnel input. The Entity Review is a collaborative review to ensure Entity expectations are being met as the design develops, helping streamline the design and minimize any engineering re-work. It is important to remember that this is a review and any modifications requested by the Entity could be scope changes requiring trend approval prior to implementation unless it is at the conceptual stage of the design.

Prior to any Entity Review, an Engineering/Architectural model review shall be conducted as close to the date of the Entity Review as reasonably achievable. It is desirable that all action items generated during the internal review be closed out prior to the Entity Review; but at a minimum, all action items noted during the internal review shall be recorded and tracked to resolution.

The same A/E personnel involved in the internal model reviews are typically involved in the Entity Reviews, and the model reviews are executed using a similar agenda. The Entity should be encouraged to provide input from their operations and maintenance personnel. Whenever practical, comments made by the Entity should be closed during the execution of the model review to avert action items unless they require trend approval. When unavoidable, the action item shall be documented on the project action items list that identifies the review item and other relevant information as required for tracking. The Project Manager or Prime Contract Administrator

should be in attendance at this review to assure that any comments that could affect project scope or schedule are adequately addressed and documented.

Model action items should be closed out prior to initiation of the next phase of the model review. The Senior Engineer/Architect is to ensure that all 3D model trends (up or down) be identified to the Project Manager (PM) via the trend program and that any design actions receive prior approval from the PM.
It is the responsibility of each supervisor to ensure implementation of review comments applicable to their discipline. The Senior Engineer/Architect and supervisors shall ensure that all comments are resolved.

The following should be represented at the Entity Review: we should specify in detail who should attend form entity/strategic partner sides

- Entity (includes corresponding representatives of the A/E representatives below but also include representation from Operations
- Project Management
- Construction
- Testing and Commissioning
- HSSE
- Engineering Manager (or designee)
- A/E personnel (Architectural, Structural, Mechanical, Electrical, etc.)

6.2.5 Design for Safe Construction and Start-up Review(s)

This review is to be conducted concurrently with an Engineering review when practicable, and is administered in accordance with Safety in Design in EPM-KE0-GL-000014, Codes, Standards & References. A construction representative, testing and commissioning representative, and safety representative are required to be present during a Safe Construction and Start-up review.

6.3 Prerequisites for Model Review

6.3.1 Model Content

The project/Entity shall establish the design features that are to be completed by each discipline prior to the commencement of the various model reviews. See Attachment 7 for an example of the recommended design content by milestone. The discipline deliverables list shall meet the LOD milestone requirements as identified in the BEP.

6.3.2 Interference / Clash Checks

As a minimum 3D model clash checking shall be performed in accordance with project specific procedures. It is not necessary to resolve all the clashes prior to the review, but the resulting clash review tag files shall be available during the review. It is recommended that clashes be resolved as early in the process as possible and not left until just before the formal model review. All clashes shall be resolved before the 90% 3D model design review.

6.3.3 Data Quality Checks

Data that originates in the 3D model may be electronically exchanged with various downstream applications and users must periodically check to assure that the data is free of errors. Common data errors found in 3D models include duplicate tag numbers, incorrect format or missing component tag numbers. As applicable, each discipline shall perform data quality checks as described in the project specific BEP and make all necessary corrections prior to scheduled model reviews. Data quality and completeness reports should be addressed during model review sessions as required in the BEP.

Note: Data used for 4D and 5D BIM models may also be present within the 3D design models. Data quality checks should also insure that these attributes are correct. 4D and 5D aspects of the project may be reviewed during separate review sessions and with other departmental representatives.

6.4 Conducting the Model Review

The 3D Model Champion with assistance from the BIM coordinator and responsible designer/engineer for the area being reviewed assure that the review sessions are conducted according to the Model Review Schedule and shall:

- organize, schedule, and direct the model reviews, including identifying the specific areas of the design that will be reviewed at each session and identifying the key individuals who are required to be in attendance.
- make an advanced distribution of the meeting agenda. If the model review includes the Entity, then notification shall be made in accordance with the contract (if contract is silent on this, then at least one-week advance notice is required).
- assemble (consolidate) the various discipline and/or facility models into a single model for the review. Clash and data quality reports shall be distributed as part of the meeting agenda.
- capture all comments as electronic location-based tags during the review.
- ensure that all comments and decisions made during the model reviews are recorded and captured in a Model Review Action Items List, similar to the example shown in Attachment 5. This list may be developed using a comments export feature from the chosen software tool used during the model review.
- issue 3D Model Review Meeting Notes to all participants within 3 working days following each review.
- coordinate the resolution of all action items.
- provide periodic status to the Senior Engineer/Architect on the progress of action items closeout.
- ensure the 3D Model Review Meeting Notes for each review are entered into the project Enterprise Data Management System (EDMS).
- prior to reviews including the Entity, the A/E Senior Engineer/Architect, 3D Model Champion, and the appropriate supervisor(s) should have a planning meeting to establish the following items:
    - Objectives and scope of the 3D Model Reviews
    - Expectations (A/E, Partners, and Entity)
    - Extent of optional reviews

The preparation and use of a model review checklist is required to assure that space allocations are adequate to satisfy life safety/building codes and contractual obligations for the O&M of the plant/facility (refer to Attachment 8 - 3D Model Engineering Review Checklist).

6.5 Recording and Resolution of Comments

6.5.1 General

The comments and decisions from a model review session are recorded in a 3D Model Review Action Items List, similar to Attachment 5, or recorded in meeting notes which shall be maintained for each review and retained in the project EDMS as a project record. Wherever possible all
comments made during the model reviews shall be noted, or tagged, within the model using
commenting/mark-up tools.

When possible model snapshots shall be included with the comments to aid engineers and designers in the explanation and implementation of changes. This is beneficial for understanding and clarity especially in facilitating subsequent verification with the Entity.

6.5.2 Comment Implementation and Verification

Model review comments and their related tag files shall be tracked, the status updated, and closed via a project action items list. If a comment is not implemented, the reasons for non-implementation shall be stated.

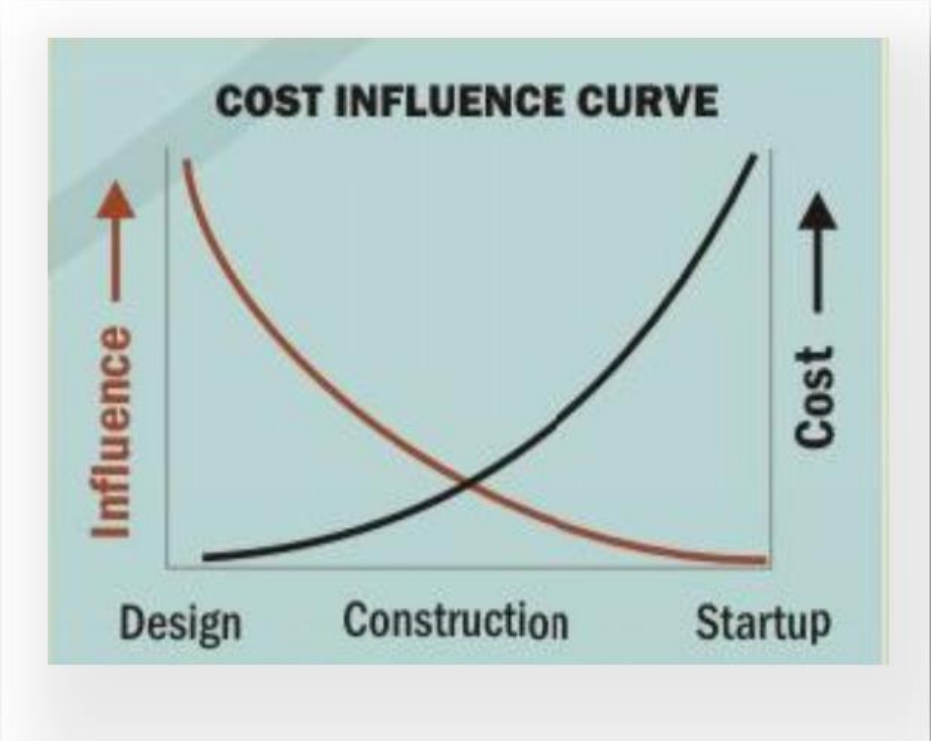
The 3D Model Champion, Senior Engineer/Architect, and discipline supervisors should, to the extent possible, ensure that action items generated during a model review are addressed prior to the next scheduled model review. The PM/PEM shall ensure that after the final model review of an area/system that all model review comments are resolved prior to release of design deliverables for construction/fabrication or that “HOLDS” are applied to the deliverables as appropriate.

7.0 ATTACHMENTS

1. Model Review Covenants
2. Acceptable Reasons for Model Review Changes
3. 3D Model Review Meeting Notes
4. 3D Model Review Record of Model Comment (Typical)
5. 3D Model Review Action Items List (Typical)
6. Example 3D Model Review Requirements for Building Projects: Review Milestones
7. General 3D Model Review Requirements: Recommended Design Content by Milestone
8. General 3D Model Review Requirements: 3D Model Engineering Review Checklist

Attachment 1 - Model Review Covenants

- The 3D model review is one of the primary tools to ensure the design is in compliance with contract commitments.
- The 3D model review ensures adequate access, constructability, operability, maintainability, and safety of the facility.
- The 3D model review ensures that the design model itself is being properly developed according to the project's requirements and BIM Execution Plan.
- Changes will result in rework and may lead to increased costs and schedule delays. Changes should be limited to those reasons as outlined in Attachment 2, "Acceptable Reasons for Model Review Changes."
- The P&IDs have been through all necessary reviews prior to the model reviews. Subsequent changes during model reviews should be limited to situations where the design will not function (not applicable to model reviews performed at the conceptual design/development milestones or for business lines other than Power).
- Any change is possible, but not all changes are required.
- A late change to save money may cost money.
- A minor change still costs time and money to address and close out.
- Early is good; late is bad. (Remember the Cost-Influence Curve shown below)
- As members of the model review team, it is imperative that everyone actively participates, provides relevant input, listens and considers the input of others, and supports the effort to progress the design towards successful project completion.



Attachment 2 - Acceptable Reasons for Model Review Changes

The purpose of the 3D model review session is to facilitate a check of the technical aspects and to assure the design conforms to the customer project requirements. Changes to the design are generally limited to the reasons noted below unless a trend is prepared and approved by the client. Acceptable reasons for changes include:

Safety

- Required to meet OSHA, other life safety, or contractual safety requirements
- Required to address a specific hazardous finding as defined in the contract

Cost

- Change will result in lower total installed cost (TIC) / higher construction productivity. Changes that will result in significant cost savings shall be identified for further evaluation and impact on the project design and construction schedule.

Operability / Maintainability as defined the contract

Required to meet the contractual facility O&M standards or facility instructions including:

- Emergency shutdown procedures
- Emergency response procedures
- Noise commitments to community / OSHA / local permit
- Environmental regulations
- Fire protection
- Safe isolation of equipment

It Won't Work as defined in the contract

- Required to fix O&M conditions
- Required to meet proper engineering design (system hydraulics, thermal stress, net positive suction head (NPSH), etc.)
- Required to meet start-up and shut-down operating conditions
- Required to meet the defined future expansion (if applicable)
- Required to meet process design parameters

Contractual Requirements have not been met

- Required to meet project standards including codes and design criteria (ASME, Building, etc.)
- Facility operating standards or facility instructions
- Operating / construction permit conditions
- To realize significant cost savings*
- To fix inoperable conditions (e.g., max. operating pressure exceeds allowable design pressure, nuisance popping of relief valves)
- Fruin level of service (pedestrian flows)

Constructability Requirements have not been met

- Interferences identified
- Crane and heavy haul loads during construction
- Does not support construction sequence
- Not cost effective to construct

Attachment 3 - 3D Model Review Meeting Notes

Cover Sheet (Typical)
[A/E company] 3D Model Review Meeting Notes

PROJECT	JOB NUMBER	DOCUMENT NUMBER	DATE(S) OF MTG.
Entity	Job	XXXXX-000-XX	Day, Month, Year

Project Name:

LOCATION/PURPOSE/OBJECTIVE
Location of model review area, e.g. location in facility
Purpose/objective of 3D model review e.g. 30 percent multi-departmental model review

---

[A/E company]:		
Mohammad Ali	Project Engineer	+966-11-345-6789
Attendee Name	Title	phone number
Attendee Name	Title	phone number
Attendee Name	Title	phone number
Entity or Vendor or ???:		
Ahmed AlOmar	Project Manager	+966-11-345-6789
Attendee Name	Title	phone number
Attendee Name	Title	phone number
Consultant or Other???:		+966-11-345-6789
Attendee Name	Title	phone number

DISCUSSION/COMMENTS:

ACTION ITEMS:
See Attachment 5, 3D Model Review Action Items List

APPENDICES:
1. Title (number of pages) for example see Attachment 4
2. Title (number of pages) for example data report, clash report

---

PREPARED BY	SIGNATURE	COMPANY	DATE
Mohammad Ali	_____	A/E Company	XX/XX/XXXX

Note: The comments will be clear, concise, and descriptive and include attributes, as appropriate, such as object names, object ID numbers, equipment tag numbers or line numbers, and the respective model volume location, as well as recording the discipline responsible for resolution.

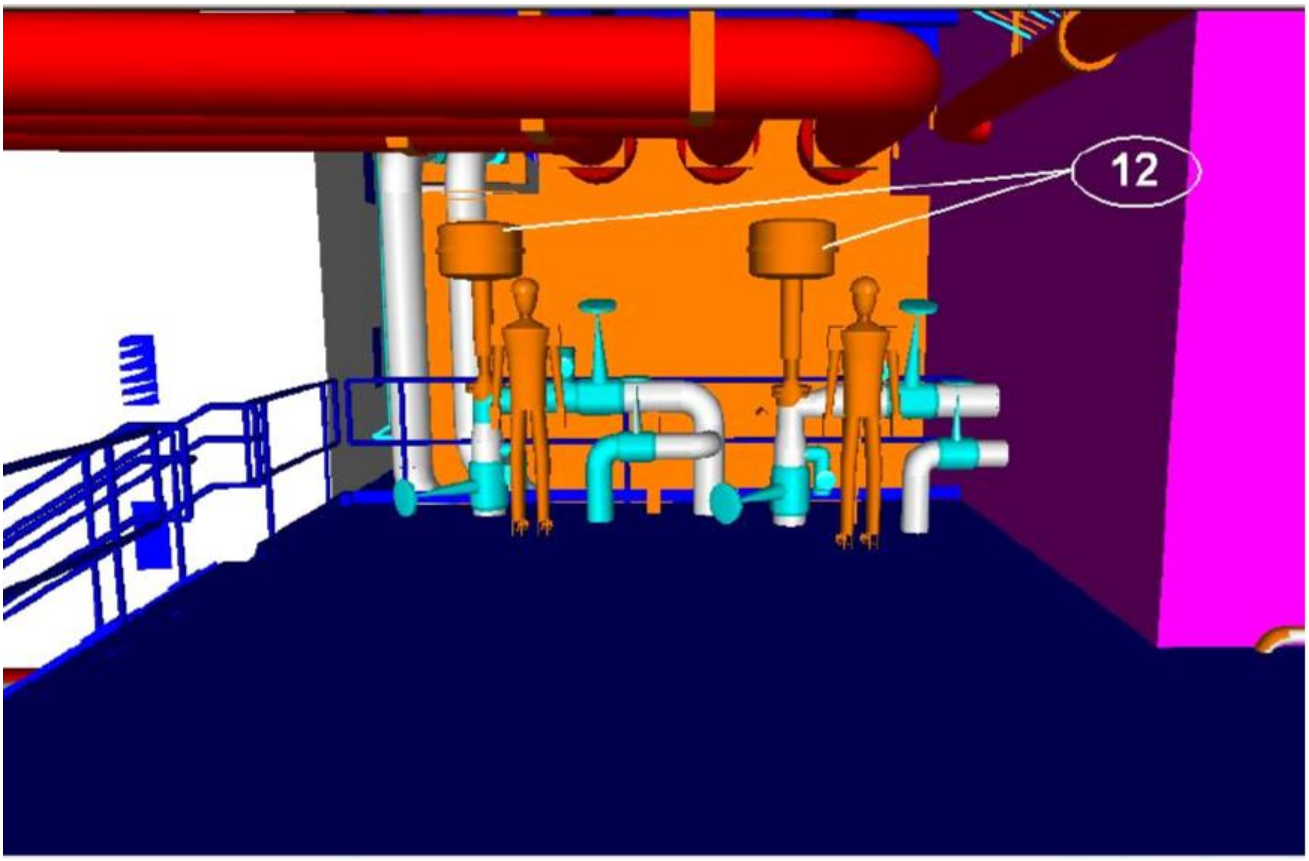
Attachment 4 - 3D Model Review Record of Model Comment (Example)

Model Review Milestone: 30% Date:
Comment Tag No.: 12

Model Area: xxxx

Comment: *Verify that adequate removal space is provided for removal of valve actuators.*

Assigned to: Piping



Response by assigned discipline:

Attachment 5 - 3D Model Review Action Items List (Typical)

Project:

Review Milestone:

Review Date:

Review Item No.	Model Location	Description of Item	Action Required	Responsible Discipline (Name of Person)	Status (Open or Closed)	Required Completion Date	Forecast Completion Date	Actual Completion Date	Remarks

Attachment 6 - Example 3D Model Review Requirements for Building Projects - Review Milestones

The following table defines the typical 3D model development review milestones for building projects. Other types of projects shall modify the table to fit their needs as appropriate.

Ref. No	Review Milestone Topic	Review Type	Schedule	Comments
1	10% Complete – Conceptual Design	E, D	-Prior to Rev. A Architectural Drawing Issue	-General Building Layout Established -No MEP model content at this time. -Arch. design concept, criteria/basis review
2	30% Complete – Schematic Design	E, D, S, C	-After routing of major piping/duct runs, and access spaces -Prior to detailed piping/duct component placement	-Major Equipment and Bulk Commodity Space Allocation -Arch. Design Development-complete, space allocation, big picture constructability review.
3	60% Complete – Detailed Design	E, D, S, C	-After preliminary vendor equipment information received and modeled	-Constructability Review
4	90% Complete – Detailed Design	E, D, S, C	-After final system design and typical vendor information chosen as design basis -After detailed plumbing and HVAC design to final LOD	-Plans, Details & Sections complete
5	100% Complete – Issued for Design Intent or Construction	E, D, S, C	-Prior to 100% Drawing Submission -After incorporation of review comments	

Review Type:
E = Engineering
D = Multi-Departmental
C = Entity (must to be conducted after E,D and S reviews)
S = Design for Safe Construction and Startup – To be conducted separately from Entity review

Attachment 7 - General 3D Model Review Requirements: Recommended Design Content by Milestone

Add or delete requirements to suit industry sector

NOTE: "X" indicates the review milestone for the item or commodity.

RESPONSIBLE DISCIPLINE	ITEM	10%	30%	60%	90%	100%
Architectural						
	LOD Matrix Compliance	X	X	X	X	X
	Applicable Codes and Regulations	X	X	X	X	X
	Use and Occupancy Classification	X	X	X	X	X
	General Building Heights and Areas	X	X	X	X	X
	Types of Construction and Occupancy Separations – Fire Barriers, Fire Proofing		X	X	X	X
	Interior Space – Proximity and Size verification.	X	X	X	X	X
	Existing Conditions	X	X	X	X	X
	Means of Egress: Doors, Stairs, Ladders, Corridors, Exit Travel Distances, Common Path of Travel, Number of Exits	X	X	X	X	X
	Shaft Enclosures and Fire rated Walls and Penetrations		X	X	X	X
	Site– Fire Department Access, Exit Discharge, Fire Separation Distances, Sidewalks, Service Areas, Fence Enclosures		X	X	X	X
	Equipment Platforms, Catwalks and Guards and Operational Clearances		X	X	X	X
	Toilets and Bathrooms-Plumbing Fixture Count and Travel Distance		X	X	X	X
	Coordination with MEP		X	X	X	X
	Fire Department Connections and Fire Protection Measures			X	X	X
	Accessibility, Hand Rails at Ramps, Accessible Entrances, Parking			X	X	X
	Roof Equipment, Roof access, Roof Pitch, Gutters & Downspouts, Vents, Window Wash, Fall Arrest, Snow Guards (where required)			X	X	X
	Building Materials- Interior and Exterior Walls, Ceilings and Soffits, Weatherproofing, Construction and Expansion Joints			X	X	X
	Exterior Openings, Penetrations and Canopies			X	X	X
	Energy Efficiency and LEED Compliance	X	X	X	X	X
	Pedestrian Walkways, Vehicle Barriers, Communication Towers, Radio Masts.			X	X	X
	Seismic Design Considerations,	X	X	X	X	X
	Flood Mitigation Measures		X	X	X	X
RESPONSIBLE DISCIPLINE	ITEM	10%	30%	60%	90%	100%
	Signage – Exterior and Interior				X	X
	Card Readers and Security				X	X
	Landscape design			X	X	X

Civil / Structural – Buildings						
	Design Code	X	X	X	X	X
	Special Entity Requirements	X	X	X	X	X
	Site Specific Challenges (seismic, wind loads, etc)	X	X	X	X	X
	Type of construction	X	X	X	X	X
	Fire Rating		X	X	X	X
	Architectural exposed structure	X	X	X	X	X
	Acoustical Requirements		X	X	X	X
	Exterior Wall System (tilt wall, metal stud, masonry)		X	X	X	X
	Modeling platform geo-located to project site	X	X	X	X	X
	Grid layout & Column Locations	X	X	X	X	X
	Exterior Wall Assembly (dimension from outside face of building to center line of column)			X	X	X
	Factory Mutual or other Insurance Criteria/Requirements	X	X	X	X	X
	Any special vibration requirements	X	X	X	X	X
	Special Equipment requirements	X	X	X	X	X
	Owner specific foundation requirements (Crawl Space, Inspection)	X	X	X	X	X
	Steel Requirements	X	X	X	X	X
	Special roof loading (solar panels, green roof)	X	X	X	X	X
	Roof assembly to establish dead load		X	X	X	X
	Heavy hanging loads	X	X	X	X	X
	Special floor requirements (recesses, topping slabs)	X	X	X	X	X
	LEED Certification	X	X	X	X	X
	Building clear height requirements (top of slab to bottom of roof steel)		X	X	X	X
	Expansion Joints		X	X		X
	Special drawing standards (title block, north arrow, coordinate system)	X	X	X	X	X
	Any future expansion requirements (horizontal or vertical)	X	X	X	X	X
	Roof & Floor framing vs loading		X	X		
	Floor Penetrations		X	X	X	X
	Roof Penetrations		X	X	X	X
	Floor recesses, slopes, steps, curbs		X	X	X	X
	Sky Lights		X	X	X	X
	Elevator (pit and shaft requirements)		X	X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Equipment Pads		X	X	X	X
	Roof top Units (locations, weights)		X	X	X	X
	Roof screening requirements		X	X	X	X

	Parapet Heights		X	X	X	X
	Roof Drain locations		X	X	X	X
	Openable Partitions		X	X	X	X
	Rolling or tilt-up overhead doors		X	X	X	X
	Window washing from roof supports		X	X	X	X
	Roof elevation and slope		X	X	X	X
	Stair Requirements	X	X	X	X	X
	Mechanical shafts	X	X	X	X	X
	Finish floor elevations	X	X	X	X	X
	Ribbon Windows & Curtain Walls		X	X	X	X
	Masonry shelf angles and supporting structure deflection criteria		X	X	X	X
	Masonry control joints		X	X	X	X
	Girts & purlin shapes, material, grade, spacing		X	X	X	X
	Framing deflection criteria		X	X	X	X
	Lateral load path (diaphragms, bracing, moment frames)	X	X	X	X	X
	Load Bearing Walls		X	X	X	X
	Gusset plates		X	X	X	X
	Column shapes, material, grade, spacing		X	X	X	X
	Column base plates & Anchor Rods		X	X	X	X
	Ladders		X	X	X	X
	Handrails		X	X	X	X
	Vendor supplied steel & girts		X	X	X	X
	Foundations vs utilities (new & existing)		X	X	X	X
Civil / Structural – Overpass & Viaducts						
	Design code	X	X	X	X	X
	Special Entity Requirements	X	X	X	X	X
	Owner specification and design requirements	X	X	X	X	X
	Modeling platform geo-located to project site	X	X	X	X	X
	Bridge span layout and span length limitation	X	X	X	X	X
	Type of bridge superstructure	X	X	X	X	X
	Structure max nature frequency requirements if apply	X	X	X	X	X
	Precast vs cast-in-place		X	X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Site condition for material delivery and erection			X	X	X
	Any special staging construction required during bridge erection			X	X	X
	Any special equipment required during bridge erection			X	X	X
	Min vertical clearance under and above the bridge if required	X	X	X	X	X
	Type of bridge railing		X	X	X	X

	Type of bridge bearings use		X	X	X	X
	Type of bridge pier and foundation	X	X	X	X	X
	Bridge pier protection if required	X	X	X	X	X
	Type of bridge abutment and foundation	X	X	X	X	X
	Abutment protection if required	X	X	X	X	X
	The slope around abutments and retaining wall			X	X	X
	Bridge drainage			X	X	X
	The bridge location required EQ design	X	X	X	X	X
Civil - Rail						
	Typical Section and Space proofing of rail elements (trackwork, third rail, overhead electrical, signaling, communications, emergency walkway, ballast, sub ballast, rail and ties), dynamic vehicle envelope with respect to available right-of-way corridor.	X	X	X	X	X
	Horizontal Alignment		X	X	X	X
	Vertical Alignment		X	X	X	X
	Cant, speed, and running time check with respect to operational requirements			X	X	X
	Horizontal and Vertical Clearances verification			X	X	X
	Horizontal and vertical alignment check and platform locations with station design			X	X	X
	Track Charts			X	X	X
	Stabling Layout with respect to location and available right-of-way			X	X	X
	Stabling space proofing of vehicle with respect to buildings				X	X
	Stabling model coordination with respect to building floor levels and top of rail elevations				X	X
	MSF Layout with respect to location, available right-of-way and related buildings.			X	X	X
	MSF space proofing with respect to available right-of-way and related buildings				X	X
	MSF model coordination with respect to building floor levels and top of rail elevation				X	X
	Track model clash check with respect to overhead and underground utilities			X	X	X
	Grading and Drainage model coordination for overall site		X	X	X	X
	Drainage and Stormwater Management		X	X	X	X
	Rough Grading model development		X	X	X	X
	Finished Grading model coordination with respect to building model and foundation design.			X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Retaining wall design coordination with grading model.			X	X	X
Civil - Roads						
	Existing Property and Right-of-Way	X	X	X	X	X
	Existing Geolocation and Coordinate System	X	X	X	X	X

	Existing Conditions (DTM)	X	X	X	X	X
	Existing Conditions Site Survey	X	X	X	X	X
	Existing Conditions Underground Utilities	X	X	X	X	X
	Existing Hydrology	X	X	X	X	X
	Existing Environmental Constraints	X	X	X	X	X
	Existing Flood Plain Analysis	X	X	X	X	X
	Existing Hazardous Materials and Underground Contamination	X	X	X	X	X
	Existing Land Use	X	X	X	X	X
	Existing Socio-Economic	X	X	X	X	X
	Future Proposed Road Improvements	X	X	X	X	X
	Future Proposed Adjacent Development	X	X	X	X	X
	Existing Traffic Models	X	X	X	X	X
	Future Traffic Models	X	X	X	X	X
	Existing Accident Analysis	X	X	X	X	X
	Existing Geotechnical Conditions	X	X	X	X	X
	Existing Noise Levels	X	X	X	X	X
	Feasibility Road Study	X	X	X	X	X
	Conceptual Road Design	X	X	X	X	X
	Preliminary Road Design		X	X	X	X
	Intersection Design		X	X	X	X
	Proposed Traffic Models		X	X	X	X
	Proposed Noise Levels		X	X	X	X
	Proposed Grading Design		X	X	X	X
	Proposed Offsite Drainage		X	X	X	X
	Proposed Onsite Drainage		X	X	X	X
	Proposed Utility Design		X	X	X	X
	Proposed Traffic Simulation		X	X	X	X
	Proposed Traffic Signals		X	X	X	X
	Proposed Signage		X	X	X	X
	Proposed Lighting			X	X	X
	Proposed Bridge Design		X	X	X	X
	Proposed Retaining Wall Design		X	X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Final Road Design			X	X	X
Civil - Site and Existing Conditions						
	Thrust blocks		X	X	X	X
	Storm water pipe		X	X	X	X

	Catch basins		X	X	X	X
	Sanitary piping		X	X	X	X
	Site grading contours		X	X	X	X
Civil / Structural - Tunnels						
	Modeling platform geo-located to project site	X				
	Clearance Envelope - Also informs size and shape include maintenance and evacuation walkways if required	X	X	X	X	X
	Cost Comparisons		X	X		
	Design Criteria, Agency/Code Requirements, Standards	X	X	X	X	X
	Durability, Serviceability and Functional Requirements	X	X	X	X	X
	Length – Will dictate approach. e.g. unlikely to be TBM if <700m	X	X			
	Size and shape of tunnel - Will dictate approach, e.g. single large or twin smaller bores?	X	X			
	Horizontal Alignment, Geometric Design	X	X			
	Tolerance review - Both in alignment control (TBM +/- 50mm?) and also in construction build tolerances	X	X			
	Aerodynamic review - From functional requirements, but high speed train needs larger free space than same size low speed	X	X			
	Cross passage, service audit, shaft requirements - Linked also to fire safety, but needs early identification of need	X	X			
	Location, accessibility and logistics - Drill and blast not possible in some locations, accessibility and logistics constraints can drive approach	X				
	Settlement/ Ground Movement Tolerances - linked to asset review along alignment, also dewatering settlement in soft ground?	X	X			
	Soil/Rock Chemistry and Mineralogy (staking, [illegible])	X			X	
	Soil/Rock in-situ Stress	X	X			
	Soil/Rock Structure Joints Influence on Behavior and Design	X	X			
	Tunnel Types- TBM Bored, Mined, Cut-and-Cover, Immersed tube, hybrid	X	X	X		
	Vertical Alignment, Geometric Design - Both in terms of rail grade and station accessibility from surface, but also cover to surface	X	X			
	Interface with track design	X	X			
	Interface with rail systems	X	X			
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Impacted asset review (buildings, utilities, foundations etc.)	X	X			
	Soil/Rock Types- Geotechnical Desk Study & Investigations	X	X	X		
	Tunnel Cross-Sections	X	X	X		
	Risk Assessment and Mitigation	X	X	X	X	X

	Fire Safety – Fire Code Requirements, Walkways etc., NFPA 130		X	X	X	X
	Fire Safety - permanent lining design – addition of polypropylene fibers?			X	X	X
	Groundwater Conditions	X	X	X		
	Single Track (Twin Tunnel) vs Double Track Tunnel Sections		X	X	X	X
	Soil/Rock Profile Along Tunnel Alignment	X	X	X		
	Tunnel Security Requirements		X	X	X	X
	Ventilation, Cooling, Drainage		X	X	X	X
	Construction Stages and Sequences		X	X	X	X
	Groundwater contol during construction		X	X	X	X
	Constructability, Tunneling Machine, Construction Equipment, etc.		X	X	X	X
	Existing Adjacent Structures, Existing Roads- Maintenance During/after Construction	X	X	X	X	X
	Permanent structural Types		X	X	X	X
	Seismic Considerations & Design	X	X	X	X	X
	Tunnel Portals		X	X	X	X
	Expansion, Contraction, Construction Joints- Spacing & Details			X	X	X
	Geotechnical Instrumentations - Including surface and asset monitoring			X	X	X
	Ground Improvement Requirements- Methods - Both for the tunnel itself and also for asset protection e.g. compensation grouting			X	X	X
	Initial Supports and/or Temporary Excavation Support systems			X	X	X
	Interfaces between Different Tunnel Types			X	X	X
	Interfaces/Connections to Existing Structures			X	X	X
	Lighting, Communications, etc.			X	X	X
	Permanent structures Design			X	X	X
	Waterproofing/Groundwater Control of Permanent Structures			X	X	X
Electrical						
	Design Code	X	X	X	X	X
	Entity Requirements	X	X	X	X	X
	Site Specific Challenges (seismic, wind loading, etc.)	X				
	Corridor Requirements	X	X	X	X	X
	UG duct bank and manholes		X	X	X	X
	Duct bank stub ups			X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	4" and larger aboveground conduit			X	X	X
	Electrical Equipment Modules		X	X	X	X
	Switchgear		X	X	X	X
	Transformers/Firewalls		X	X	X	X
	Load Centers and Switchboards		X	X	X	X

	MCC		X	X	X	X
	Local control panels and cabinets (including door swing)			X	X	X
	Equipment removal and reserved spaces			X	X	X
	Lighting Panels and Transformers			X	X	X
	Heat Trace Panels and Transformers			X	X	X
	DCS Cabinets		X	X	X	X
	Communications (panels, PA, stations)			X	X	X
	Cable Bus		X	X	X	X
	Non-Seg Bus		X	X	X	X
	Cable Tray		X	X	X	X
	Tray supports			X	X	X
	Bus supports			X	X	X
	Cable Tray Access Zones			X	X	X
	Electrical Safety Spaces		X	X	X	X
	Hazardous Area Zones		X	X	X	X
	Instrument Racks and Supports			X	X	X
	Instrument Enclosures			X	X	X
	Instrument Panels		X	X	X	X
	Instrument Connections on tanks, vessels, equipment			X	X	X
	Instrument piping bridle location, orientation, vent and drain clearances, etc.			X	X	X
	Special Analytical or other instrument locations		X	X	X	X
	Fire Protection Panels			X	X	X
	Power Factor Correction Capacitors			X	X	X
	Stray Current / Corrosion Control / Drainage Panels			X	X	X
	Cathodic Protection Equipment (rectifiers, test stations, junction boxes)			X	X	X
	Negative Grounding Devices			X	X	X
Mechanical/Plant Design						
	Building Layout:					
	Pedestrian & forklift access aisle		X	X	X	X
	Equipment removal space & monorails; removable floors & siding		X	X	X	X
	Misc. platform locations		X	X	X	X
RESPONSIBLE DISCIPLINE:	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Mechanical Equipment:					
	Mechanical equipment room locations and sizes identified	X	X	X	X	X
	Major mechanical equipment located in model		X	X	X	X
	Maintenance areas, equipment removal spaces identified		X	X	X	X
	Emergency shower/eye wash locations, plumbing fixtures, water meters modeled			X	X	X
	Stray Current / Corrosion Control / Drainage Panels			X	X	X

	Cathodic Protection Equipment (rectifiers, test stations, junction boxes)			X	X	X
	Negative Grounding Devices			X	X	X
Traction Power (including OCS system)						
	OCS Poles		X	X	X	X
	Manholes/Handholes (guideway)		X	X	X	X
	Duct Bank (guideway)		X	X	X	X
	Switch Machines			X	X	X
	Rail Heaters			X	X	X
	Switch Heaters			X	X	X
	Rail and Switch Heater Control Panels			X	X	X
Signaling						
	Security / CCTV			X	X	X
	Blue Light Beacons (EAS)			X	X	X
	Axle Counters			X	X	X
	SCADA/PLC/Server Enclosures		X	X	X	X
	Antenna Access Points			X	X	X
	PA Systems (speakers, call boxes, etc.)			X	X	X
	Traffic Controllers			X	X	X
	Signals			X	X	X
	Balise Transponders			X	X	X
Mechanical/Plant Design						
	Building Layout:					
	Pedestrian & forklift access aisle		X	X	X	X
	Equipment removal space & monorails; removable floors & siding		X	X	X	X
	Misc. platform locations		X	X	X	X
	Mechanical Equipment:					
	Mechanical equipment room locations and sizes identified	X	X	X	X	X
	Major mechanical equipment located in model		X	X	X	X
	Maintenance areas, equipment removal spaces identified		X	X	X	X
RESPONSIBLE DISCIPLINE	**ITEM**	**10%**	**30%**	**60%**	**90%**	**100%**
	Emergency shower/eye wash locations, plumbing fixtures, water meters modeled			X	X	X
	Major equipment modeled per vendor information with piping connections, access doors, maintenance pull spaces identified			X	X	X
	All equipment completely modeled with elevation and section views and references to standard details				X	X
	HVAC					
	HVAC equipment locations identified (inside or outside building, rooftop etc.)	X	X	X	X	X

	HVAC chases/shaft locations shown	X	X	X	X	X
	HVAC equipment modeled in appropriate areas with maintenance access space shown		X	X	X	X
	Major HVAC ductwork shown connecting equipment		X	X	X	X
	All HVAC duct in model			X	X	X
	HVAC access doors, instrumentation, damper locations			X	X	X
	Air Distribution devices (e.g., air terminals, louvers, return grills, registers) locations			X	X	X
	All HVAC sections, elevation views, standard details complete				X	X
	Insulation and silencers			X	X	X
	Piping/Plumbing					
	Underground stub up locations	X	X	X	X	X
	Pipe chases/shaft locations	X	X	X	X	X
	Major piping (≥ 3 inch)		X	X	X	X
	All large bore piping (≥ 2 inch)			X	X	X
	Small bore piping to LOD agreement per contract				X	X
	Sectional and elevation views, standard installation details				X	X
	In-line valves, instrumentation, components			X	X	X
	Piping insulation			X	X	X
	Pipe supports details or locations (if required by Contract LOD)				X	X
	Fire Protection					
	Sprinkler valve room location	X	X	X	X	X
	Fire pump/tank location	X	X	X	X	X
	Rooms/areas requiring suppression system coverage identified		X	X	X	X
	Fire damper locations		X	X	X	X
	Sprinkler piping/sprinkler head space allocation			X	X	X
	Standpipe system and hose reel locations		X	X	X	X
	Fire extinguisher locations			X	X	X
	Sectional and elevation views with references to standard installation details				X	X

Attachment 8 - General 3D Model Review Requirements: 3D Model Engineering Review Checklist

The model review will consider, but is not limited to, the following items:

1.0 GENERAL

1.1 Accessibility
1.2 Constructability
1.3 Environmental
1.4 Maintenance requirements
1.5 Operational requirements
1.6 Regulatory Requirements
1.7 Safety requirements
1.8 Technical Requirements
1.9 Code Requirements
1.10 Owner/Entity/Contract Requirements

2.0 ARCHITECTURAL/PLANT DESIGN/SPACE CONTROL

2.1 Access/egress paths shown and requirements met in occupied spaces
2.2 Fire Marshall Requirements considered
2.3 Access/egress paths shown and requirements met in industrial spaces
2.4 Stairs, ladders, cages, and handrails on platform meet safety requirements
2.5 Keep walkways and access paths clear of interferences
2.6 Architectural details such as siding, fire walls, windows, roll-up doors, stairs and doorways
2.7 Routine operating spaces identified, ease of operation considered
2.8 Maintenance spaces identified, ease of maintenance considered
2.9 Crane hook coverage, crane / hoist travel and clearance of drop zones, adequate sizing of equipment removal hatches, laydown space

3.0 PIPING

3.1 Economy of piping arrangement
3.2 Valve hand wheel and actuator access / orientation
3.3 High point vents and low point drains
3.4 Accessibility of all valves
3.5 Adequate maintenance space at equipment
3.6 Piping requirements at control valves and flow elements
3.7 Arrangement of connection to external utilities
3.8 Slope requirements

4.0 CONTROL SYSTEMS

4.1 In-line instrument location and orientation
4.2 Access to and orientation of instrument connections on vessels and storage tanks
4.3 Reserved space for externally mounted level gauges, level switches and transmitters
4.4 Verify flow element upstream and downstream straight run pipe length.
4.5 All temperature, sample and analyzer connections should be in a flowing line.
4.6 Reserve space for instrumentation stands and racks for transmitters and other instruments mounted off-line.
4.7 Location and orientation of instrument taps.

5.0 ELECTRICAL

5.1 Cable tray, isolated-phase bus, segregated phase bus routing.
5.2 Electrical panels and transformers, including panels mounted on skids
5.3 Location of local control stations
5.4 Rating of electrical equipment – driven by wash-down, corrosive environment, sprinkled areas, etc.

6.0 CIVIL/STRUCTURAL/ARCHITECTURAL

6.1 Major structures including bracing and gusset plates
6.2 Above & underground portion of foundation
6.3 Stairs ladders, cages and handrail on structures meet safety criteria
6.4 Keep walkways clear of interferences
6.5 Show miscellaneous electrical equipment supports, i.e., MCCs, load centers
6.6 Equipment pads
6.7 Site contours
6.8 Discuss/identify locations of concrete floor penetrations for pipe and/or field run conduit

7.0 EQUIPMENT

7.1 Maintenance space, including pull spaces
7.2 Removal clearance and means of handling for pumps, motors, heaters, etc.
7.3 Size of doorways and access openings for equipment removal
7.4 Access to control panels
7.5 Stairs, ladders, cages, and handrails on platforms meet safety criteria

8.0 HVAC

8.1 Duct Chase/Shaft locations
8.2 Duct routing
8.3 Duct supportability
8.4 Access to dampers, instrumentation in ductwork, and equipment access doors
8.5 Air Distribution devices (e.g. air terminals, louvers, return grilles, registers)
8.6 HVAC Duct Insulation and silencers