Stichting USPI-NL
Arnhemseweg 6
3817 CH Amersfoort
The Netherlands
Tel: +31(0)33 4657679
Fax: +31(0)33 4450357
E-mail: stichting@uspi.nl
Web: www.uspi.nl

Facility Lifecycle 3D Model Standard (FL3DMS)

Implementation Guide for Principal

FL3DMS
LEVERAGING YOUR 3D MODEL

Document Title	FL3DMS Implementation Guide for Principal
Document Number	F-GU-002
Document Revision	1.0
Document Status	Approved
Issue Date	26/11/2025

Revision History

Version	Date	Comments/History
1.0	26/11/2025	Initial revision for FL3DMS Release 1.3

Acknowledgements

This guide document was prepared by the Facility Lifecycle 3D Model Standard (FL3DMS) Project organized by USPI-NL, in which specialists from several companies in the process and energy industry participated and provided their input.

Disclaimer

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, neither USPI-NL nor any of its Members past, present, or future warrants its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made thereof, which liability is hereby excluded. Consequently, such use is at the recipient's own risk on the basis that any use by the recipient constitutes agreement to the terms of this disclaimer. The recipient is obliged to inform any subsequent recipient of such terms. This publication is made available for information purposes and solely for the private use of the user. USPI-NL will not directly or indirectly endorse, approve or accredit the content of any course, event or otherwise where this publication will be reproduced.

Copyright notice

The copyright of the contents of the downloadable documents is assigned to the author of the document concerned. The content may be freely distributed or copied, in full or in part, provided due acknowledgement is made, the content of the documents is not modified in between, and provided that the copied contents are not used for commercial publications. In the latter case, prior permission must be obtained from the author.

The contents of these pages are © Uitgebreid Samenwerkingsverband ProcesIndustrie-Nederland (USPI). Permission is given to reproduce this report in whole or in part provided (i) that the copyright of USPI and (ii) the sources are acknowledged. All other rights are reserved. Any other use requires the prior written permission of USPI.

Foreword

The Facility Lifecycle 3D Model Standard (FL3DMS) is an industry-standard that provides a specification developed to standardise how 3D models are configured, its content, and what is to be handed over to optimize the return on the investment in a 3D model. This includes the definition of the objects in the 3D Model.

FL3DMS is being developed collaboratively by Principal (Owner/Operator) companies, EPC contractors, software providers, service providers, and equipment vendors (incl. sub-contractors and/or packaged unit vendors) as a practical standard.

This Guide describes how to implement FL3DMS from a Principal's perspective and aims for both projects' and operations' use of 3D Models. It educates how to implement FL3DMS in contracts with 3rd parties or in the your internal organisation, such that the organisation can extract optimal value from their 3D models.

FL3DMS consists of multiple documents:

1. **F-SP-001 – FL3DMS 3D Model Specification** – specifies requirements for the 3D model on greenfield and brownfield projects to be developed and handed over in the process and energy industries.
2. **F-CR-001 – FL3DMS 3D Model Content Requirements Matrix** – a uniquely numbered list of 3D model content requirements per engineering discipline and mapped against NORSOK WA-Z-020 standard and providing suggested mappings to CFIHOS.
3. **F-SP-002 – FL3DMS 3D Model Specification Unique Numbering Record** – a list of FL3DMS uniquely numbered requirements with tracking and status of the individual requirements.
4. **F-SP-003 – FL3DMS 3D Model Deliverables List** – a list of deliverables generated from the 3D Model, with suggested CFIHOS classification.
5. **F-SP-004 – FL3DMS 3D Data Model and Dictionary** – outlines the data model structure and data dictionary integral to the FL3DMS standard, which supports 3D model-based engineering and construction workflows.
6. **F-GU-001 – FL3DMS 3D Model Lifecycle Management Guide** – Documents how to manage a 3D model over the lifecycle of the plant
7. **F-GU-002 – FL3DMS 3D Model Implementation Guide for Principal** – This document.
8. **F-CL-001 – FL3DMS OwnerOperator Specification Checklist** – guides the Principal in the verification process if the requirements in a SoW with a contractor cover their needs.
9. **F-CL-002 – FL3DMS EPC 3D Model Setup Checklist** – guides the EPC in the verification process if the requirements in a SoW with a Principal are covered in the setup of the 3D Model application.

This Guide document has been developed based on strong and open cooperation between the participants. It is based on current best practices and capabilities within the participants' organisations and aligns with relevant industry data standards such as DEXPI, CFIHOS, Standards Norway and CII-AWP.

© 2025 FL3DMS

FL3DMS Participants

FL3DMS Members
Aker Solutions
AVEVA
Baker Hughes
Bechtel
Bentley
bp
DMS365
ExxonMobil
Fluor
Gizil
Hexagon
McDermott
Mitosis Digital Technologies
Revisionz
Shell
Technip Energies
TotalEnergies
Twintech
Wood
xclerate
Yara

USPI Partners
DEXPI
IOGP-CFIHOS
Standards Norway
CII

© 2025 FL3DMS

Table of Contents

1 Introduction 8
1.1 General 8
1.2 Scope 8
1.3 References 8
1.3.1 Normative References 8
1.3.2 Informative References 8
1.4 Target Audience 9
1.5 FL3DMS Document Structure 9
1.6 Terms, Definitions, Acronyms and Abbreviations 10
1.6.1 Abbreviations 11
1.7 Information Management Principles and Processes in Projects 11
2 Principal's 3D Ambition and Strategy 13
2.1 Introduction 13
2.2 Identification of use cases 13
2.3 Project type and execution strategy 14
2.4 Governance and ownership of the 3D Model 15
2.5 Organisational maturity, 3D model management 15
2.6 Verification 17
3 Contract 3D Model Requirements 18
3.1 Contractual 3D Model Requirements Overview 18
3.2 Contract 3D Model Management Scope of Work (SoW) 19
3.3 Contract 3D Model Specification 20
4 How to use the FL3DMS Standard on a Project 21
4.1 Introduction 21
4.2 3D Organization, Roles, and Responsibilities 21
4.3 Stakeholders 22
4.3.1 Review and Approval Responsibilities 22
4.4 Initiation Phase 22
4.4.1 Owner/Operator Specification Checklist 23
4.5 Content Development FEED Phase 23
4.5.1 EPC 3D Setup Checklist. 24

© 2025 FL3DMS

4.6 Handover Phase 24
4.7 Content Development Execute Phase 24
4.8 Final Handover Phase 25
4.9 Maintain & Use Phase 25
5 Informative on FL3DMS Requirements 26
5.1 3D Model Application 26
5.2 3D Model Configuration 26
5.2.1 Configuration 26
5.2.2 Naming Conventions 26
5.2.3 Hierarchy 27
5.2.4 Tagged Objects 27
5.2.5 Requirements for Soft Volumes 27
5.3 3D Model Content 28
5.3.1 3D Model Content Requirement Matrix 28
5.3.2 3D Model - General Requirements 28
5.3.3 Object Representation in the 3D Model 28
5.3.4 Handover and As-Built 28
5.3.5 Vendor Packages/Vendor Engineering 33
5.3.6 Laser and Photogrammetry Survey Data 34
5.3.7 Model Attributes 34
5.3.8 Construction Support 35
5.3.9 Integrity Management 35
5.4 3D Model Review 36
5.5 3D Model Deliverables & Handover 37
5.5.1 Reports Generated from the 3D Model 37
5.5.2 Drawings Generated from the 3D Model 37
5.5.3 Clash Status 37
5.5.4 Handover: Format 37
6 The FL3DMS Data Model 38
6.1 Introduction 38
6.2 3D Spatial Component 38
6.3 Related Data object definitions (main objects only) 39

© 2025 FL3DMS

6.4 FL3DMS Data Dictionary.....40

© 2025 FL3DMS

1 Introduction

1.1 General

This Facility Lifecycle 3D Modeling Standard (FL3DMS) Implementation Guide for Principal is an educational document which complements the FL3DMS Specification and describes how to implement it in projects from a Principal's perspective. A Principal is a contract holder, who wants to specify 3D Model requirements to sub-suppliers. A Principal can be an Owner Operator who specifies requirements to an EPC Contractor, or an EPC Contractor who specifies 3D Model requirements to a sub-Contractor or an engineered Equipment Supplier.

The document describes the activities needed for efficient use and delivery of 3D models, including the "who" (roles, responsibilities, and required skill sets) required to deliver the "what" (i.e. the deliverables defined in FL3DMS Specification Document) and the "when" and the "how".

Since each project has different requirements depending on its size, scope, complexity, and delivery schedule, not all topics in this document will apply to an individual project. This document may be used as an informative to the FL3DMS 3D Model Specification.

The document also indicates organizational maturity requirements for effective implementation of the FL3DMS specification.

It is recommended that the documents listed in section 1.3.1 Normative References are read in conjunction with this document.

1.2 Scope

This document clarifies how a Principal how to implement the FL3DMS Specification:

- in contracts for projects and assets
- in a specification for the development, validation and handover of a facility 3D Model between Contractor and Principal that is tailored to the scope of the project or asset
- what roles, responsibilities, and required skill sets are needed for successful execution development, use, implementation and handover of the 3D Model.
- Provides clarification to requirements in the FL3DMS Specification.

1.3 References

1.3.1 Normative References

When using this document, the following should be referenced and understood together:

- FL3DMS Specification Document [F-SP-001]
- FL3DMS Model Content Requirements Matrix [F-CR-001]

1.3.2 Informative References

- FL3DMS 3D Model Deliverables List [F-SP-003]
- FL3DMS Data Model and Dictionary [F-SP-004]
- FL3DMS Lifecycle Management Guide [F-GU-001]
- FL3DMS OwnerOperator Specification Checklist [F-CL-001]
- FL3DMS EPC 3D Model Setup Checklist [F-CL-002]
- CFIHOS Scope and Procedures (C-TP-001) (V2.0)
- CFIHOS Specification Document (C-SP-001) (V2.0)
- CFIHOS Implementation Guide for Principal (C-GD-001) (V2.0)
- CFIHOS Implementation Guide for Contractor (C-GD-002) (V2.0)

© 2025 FL3DMS

- CFIHOS Data Dictionary (C-DM-002) (V2.0)
- CFIHOS CORE Reference Data Library (C-ST-001) (V2.0)
- DEXPI Process Information Model 1.0

1.4 Target Audience

This document should be read by:

- Project Managers who are typically accountable for the delivery of the 3D model to the asset
- Engineering and Operations Managers who typically are accountable for integrating, managing and using the 3D models in projects and operations
- Project or Asset Information Managers and IM consultants who are typically responsible for specifying the information including 3D models and implementing the handover process between the various stakeholders
- The technical disciplines who own the data within the 3D Model, including Piping Layout, Structural, Mechanical, Civil, Instrumentation and Electrical. Note that civil tags are typically mastered within the 3D Model application.
- Users of the 3D model including construction, commissioning, operations, maintenance and integrity management.
- Personnel who configure IT systems needed to produce, validate or store the data, (3D) models and documents to be handed over.

1.5 FL3DMS Document Structure

The documents which form part of and support the FL3DMS standard are organized as shown in Figure 1. This guide, Implementation Guide for Principal, is indicated in the red circle.

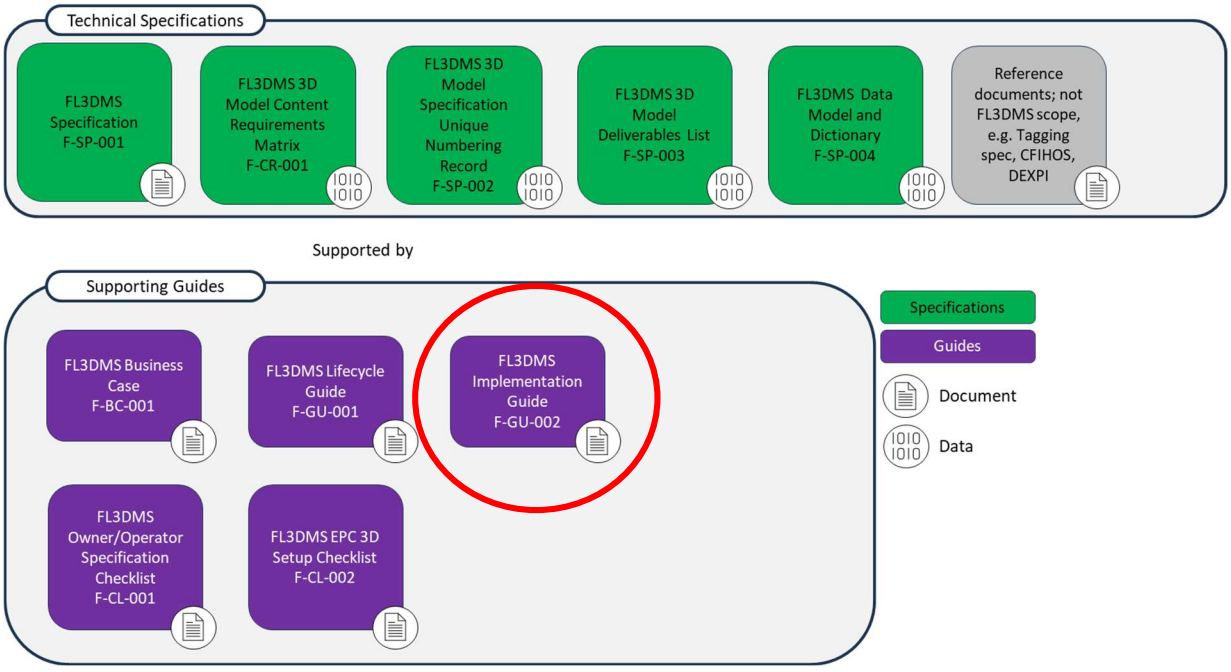


Figure 1 FL3DMS Document Structure

It is recognized that Principals may organise contract documents in different ways. For example, some Principals might include detailed descriptions of requirements within a Scope of Work, whereas others' Scopes of Work might be a high-level description, with detailed requirements described in separate Specifications and Administration or Coordination

© 2025 FL3DMS

Procedures, for which the Contractor may be asked to provide input based on their experience. The contractual requirements for design and delivery of the facility 3D Model need to be included in this approach.

Another difference is that some Principals collect all Information (Data and Document) Requirements into a single Information Management (IM) Scope of Work, whereas others define Information (Data and Document) Requirements alongside technical discipline requirements within the Scope of Work. Principal's approach will have an impact on where the 3D Model requirements are included within a contract.

Regardless where the Principal locates the 3D Model requirements, the following aspects should be addressed:

1. "What" 3D model is to be provided.
2. "How" the 3D model is to be provided.
3. "When" the 3D model is to be provided. Based on the review approach and use of the 3D model, several moments during the project can be defined.
4. The quality management activities needed to ensure the completeness, timeliness, and accuracy of the 3D model and underlying data. These requirements will typically differ depending on the moments of the 3D Model use and handover.

1.6 Terms, Definitions, Acronyms and Abbreviations

A complete definition of terms is available in the FL3DMS Specification Document [F-SP-001]. A few key terms used in this document are included below.

⚠ This symbol identifies important points to consider for the specific section where it is located.

Catalogues and Specifications (Cats & Specs): Catalogues are organized collections of information about models, materials and configurations. Specifications refer detailed requirements or standards that defined the characteristics, dimensions, performance and quality of the models, materials and configurations.

Contract 3D Scope of Work: In this contractual document the Principal specifies the terms and conditions for 3D model delivery by the Contractor, typically including the "when" and "how". Where applicable, quality benchmarks and criteria on how the Contractor is to fulfil these requirements may be included. Requirements can either be referred to in specific specification documents or included within the scope of work. The term Project 3D Model Scope of Work can also be used.

As the 3D Model is part of the Engineering Information developed, aligned and handed over during the project, and handed over with the other Engineering Information, definitions and guidance from CFIHOS are applicable for the 3D Model as well. The CFIHOS Scope and Procedure document [C-TP-001] is used as a reference to create the project or contract specific Information Management Scope of Work.

Contract 3D Model Specification: The technical requirements for the 3D Model, i.e. the "what", that are referenced from the Scope of Work. The FL3DMS Specification Document is the basis for creating a project or contract specific 3D model Specification. This is a document that is scaled to the relevant project phase deliverables and contact scope. The scaling should be executed in accordance with this FL3DMS Implementation guideline.

Contractor (EPC Contractor): This is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

© 2025 FL3DMS

Principal (or Owner / Operator): This is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

Prime Contract: This is the main contract for the project/scope of work between the Principal and the Contractor. There might be additional sub-contracts related to the project/scope of work, which must refer to the main contract and its terms and conditions - for example, contracts between contractor and sub-contractors.

Reference Data Library (RDL): Reference Data Library of the metadata of Data and Documents described in CFIHOS Specification Document [C-SP-001].

1.6.1 Abbreviations

Abbreviation	Description
AWP	Advanced Work Package
CCTV	Closed-Circuit Television
CFIHOS	Capital Facilities Information Hand Over Specification
CII	Construction Industry Institute
CoG	Centre of Gravity
DEXPI	Data Exchange in the Process Industry
E&I	Electrical & Instrumentation
EDW	Engineering Data Warehouse
EID	Equipment Interface Data
ENS	Engineering Numbering System
EPC	Engineering, Procurement and Construction
FEED	Front-end Engineering Design
FL3DMS	Facility Lifecycle 3D Model Specification
GA2D	General Arrangement 2D Drawing (Vendor model)
GA3D	General Arrangement 3D Model (Vendor model)
HAZOP	Hazard and Operability Study
HSE	Health, Safety, Environment
IM	Information Management
LOTO	Lock-Out-Tag-Out
MoC	Management of Change
MTO	Material take off
P&ID	Piping & Instrumentation Diagram
PA	Public Address
PO	Purchase Order
RACI	Responsible, Accountable, Consulted, Informed – typically used to describe roles & responsibilities.
RDL	Reference Data Library
SDI	Supplier Document Instruction
SIMOPS	Simultaneous Operations
SIRL	Supplier Information Requirements List
SME	Subject Matter Expert
SoW	Scope of Work

1.7 Information Management Principles and Processes in Projects

The 3D model management principles and processes in projects are part of the information management principles and processes in projects. In the CFIHOS context the purpose is to get information handed over at the end of the facility project. In the case of FL3DMS (the 3D

© 2025 FL3DMS

model management) it is also important to focus on the use of the 3D Model for project purposes.

Important Information Management aspects to consider for large engineering projects:

- A Capital Project typically delivers two assets to the Principal organization; a physical asset and an information asset including model-based information like a 3D model
- Principals are responsible for the specification of the requirements for both the physical asset and the information asset
- The Project Prime Contract contains requirements and terms and conditions for both the physical asset ("Technical Requirements") and the information asset ("Information Requirements")
- Contractors, Suppliers/Manufacturers (Vendors) and other third parties are responsible for creating and delivering high-quality information assets to the Principal during the project execution and at the handover of the facility, which in turn can be used for Operations and Maintenance
- The information asset will include both Documents (printed or electronic, for human interpretation) as well as Data (stored in a structured format and manipulated using software applications).
  A 3D Model is a special information asset in which the provided (embedded and linked) data are model-based.

From a Principal perspective, the 3D model management process involves three steps:

1. **Specify the 3D Model Requirements** to support both project execution and operations & maintenance activities. FL3DMS seeks to establish a consistent industry standard for such 3D Model Requirements, to make the process of specifying easier and to reduce the cost of the 3D Model asset. The overall 3D Model Requirements are contained in the Prime Contract. The 3D Model requirements are based on the FL3DMS specification. The level of detail and as-build requirements selected will be informed by the asset lifecycle strategy for the 3D Model, which can be based on the 3D Model lifecycle guide.
2. **Controlling the 3D Model development:**

Validate that the 3D Model generated by Contractors, Suppliers/Manufacturers (Vendors) and others is compliant with the 3D Model Requirements; to track quality, progress and completeness against the Contract 3D Model Specification. Controls should ideally be executed as closely as possible to the source of information to reduce the time and cost of correcting any issues, and can be executed via quality reports on the an technical reviews.

Validate that the 3D Model design of the plant meets the technical requirements of the different disciplines and is compliant with what has been contractually defined and agreed. This validation should ideally be combined with the multidisciplinary reviews i.e. 30, 60, 90-% reviews, and reviews of drawings generated from the 3D Model.

3. **Capture, Handover, Use & Share** the 3D Model asset to optimize its value, e.g. from Suppliers/Manufacturers (Vendors) to Contractors to Principal Project and Asset Operations teams.

© 2025 FL3DMS

2 Principal's 3D Ambition and Strategy

2.1 Introduction

Before selecting requirements from the FL3DMS Specification Document, Principals are advised to define their ambition and strategy for 3D Model use through the lifecycle of the facility.

Various aspects could be considered by defining this ambition and strategy:

1. The use cases applicable to the Principal's asset management strategy, operations philosophy and project delivery approach;
2. The type of project, i.e. greenfield or brownfield, and project execution strategy
3. The governance and ownership of the Model and the associated requirements – in operations and in projects
4. The maturity of the organization around 3D Model and data governance in general and the available competence within the Principal's organization

This chapter identifies key considerations that drive different requirements for the 3D Model, for more information see also the FL3DMS Lifecycle Guide [F-GU-001].

2.2 Identification of use cases

The Principal will need to identify which use cases in the asset lifecycle need to be supported by the 3D Model, which in turn will drive requirements for specific content or levels of detail within the model. For example, in case the Operations organization requires to use the 3D Model for regular Turnaround planning, the level of details in the 3D Model differs from only using the 3D Model for determining material take off in the project Execute phase.

Examples of use cases to consider, are:

1. **Design and Procurement**: determine the plant layout, enable the 30/60/90% reviews, generate deliverables, and calculate material take off (MTO) for procurement
2. **Construction**: use of Advanced Work Packaging to manage and optimize the construction flow safely
3. **Brownfield modification**: using the original As Built 3D Model for the plant as an input for minor or major modifications, e.g. layout reviews, constructability review, MTO
4. **Turnaround Management**: use the 3D Model for planning of and monitoring the progress of Turnarounds
5. **Inspection and Corrosion management:** Visualisation of corrosion looks, Identification of inspection points, External corrosion inspection and automated detection, Design of scaffolding required for inspection purposes.
6. **Operator training**: use of the model to help field operators understand the situation of work at hand before they go into the field (immersive training) and onboarding new operators
7. **Digital Twin**: visualization of the current state of the facility, not limited to: risk visualization (e.g. corrosion), LOTO, isolations, process data, maintenance status, remote operations
8. **Decommissioning**: Support the approach and planning of the decommissioning

These use cases can be detailed to address specific objectives and generation of specific engineering deliverables such as:

1. Basic plant layout
2. Clash-free design / clash management process
3. Deliverable drawings and engineering lists
4. Path of construction and materials availability management
5. Identification of hazardous areas related to explosion protection requirements

© 2025 FL3DMS

6. Flare exposure
7. Emergency response
8. Fire & Gas detector reach / mapping
9. Field Telecommunications requirements including PA systems, CCTV, Wi-Fi and other technologies coverage
10. Lighting calculations
11. Piping stress
12. Structural calculations
13. Environmental impact including sound
14. Material take-off
15. Weight & centre of gravity analysis (CoG)

The selected use cases impact which 3D Model requirements and engineering deliverables are relevant to include in the 3D Model specification, which in turn affect the level of detail required in the 3D Model, the level of as-building required at handover (see also FL3DMS Specification [F-SP-001], FL3DMS Lifecycle Guide [F-GU-001] and par. 5.3.4 below) and the effort required to maintain the content. They also impact the required level competences to manage and derive value from the 3D Model.

A reference to the FL3DMS Business Case is made to help understand the potential financial impact and value of the choices made. Note that by deselecting any given use case, regret cost might be incurred later in the facility's lifecycle.

2.3 Project type and execution strategy

The Principal will also need to consider how the 3D Model can best be used to enable the project execution and contracting strategy, and what the related requirements are.

Projects consist of several phases which may be delivered by different contractors using different 3D tools, owing to the competitive bidding process. Where possible such a situation should be avoided. When evaluating the bids for a given project phase, the Principal should consider whether contractor is able to reuse the model developed in the previous phase. To this end it is important that the contractors use the same software tools, and that the model created by one contractor is delivered in full, so that it can be developed further by subsequent contractors, for example when moving from Feed to Execute.

The number of contractors that need to work together in the model within a given project phase can also influence the requirements for the 3D Modelling. Here the objective is that content generated by multiple parties can be integrated into one model, which affects both software format and hosting requirements. Principals should consider to require the contractors to use the same 3D modelling application and hosting instance to avoid data migration and conversion cost, and to mitigate the risk of data loss.

Another aspect to consider the level of fidelity required after handover to support operations and additional plant modification, which in turn drive the handover requirements – i.e. as designed, logically accurate or dimensionally accurate.

Brownfield projects need to consider how best to get an existing 3D model of the facility ready to be used to support the project. If the 3D Model has not been maintained as-built, it should be updated to the required level of fidelity by the contractor before using it for the project. Associated requirements for laser scanning and photogrammetry should be included in the project 3D Model specification.

Brownfield projects also need to consider how to re-integrate the project model with the existing asset model. The guidance is to use the same application and configuration that was used to create the original plant to avoid unnecessary re-work and loss of data quality. Ideally the project should work on a satellite environment, hosted from the plant model, such

© 2025 FL3DMS

that the new content can be merged into the master plant model at the completion of the project.

Considerations affecting 3D tool choices include

- Cost/time required of conversion from one application format to another
- Data loss and data integrity issues are typical consequences of format migrations
- Alternative software maybe inherited as a consequence of acquisitions.
- 3D application capabilities may vary according to in-country preferences and ability.

Refer to the Section 9 of the Lifecycle Management Guide F-GU-001 for further information.

2.4 Governance and ownership of the 3D Model

The 3D Model is an engineering deliverable that integrates content from many disciplines and are used by even more disciplines. Typically such integrated engineering deliverables are the responsibility of the Engineering Manager, supported by the relevant discipline engineering leads that own or use content from the model, e.g. Mechanical, Civil, E&I, Operations, etc.

For this reason, it is proposed that the owner of the 3D Model is the Engineering Management Discipline, operationalized as follows:

- **For a facility or asset in operation, the owner of the 3D Model is the Asset Engineering Manager.** The engineering manager owns the 3D Model lifecycle management strategy and the technical requirements for the model, which is based on input from all relevant disciplines. The Facility Engineering Manager is responsible for ensuring the 3D model specification, hosting, support and budget are in place to maintain the 3D model for the lifecycle of the facility. The engineering manager should consider the facility management plan and the expected lifetime of the facility when specifying the 3D model environment. The approach is likely to be different for a new facility compared to an existing facility with a limited lifespan. (Note: An Owner operator Engineering Manager may be responsible for several facilities, depending on the facility size).
- **For a project, ownership of the project 3D Model is assigned to Principals project Engineering Manager**, who obtains the plant 3D Model requirements from the Asset Engineering Manager and implements them in the project requirements. The EPCs Engineering Manager is responsible for delivering the project 3D Model against these requirements. (Note: The Owner operators 3D model SME reviews the contractor organisation and model configuration and provides a report to the Engineering Manager)

2.5 Organisational maturity, 3D model management

During the operate phase of the plant, the owner-operator should have a 3D model support organisation, either available in-house or via a support contract to manage the model. This should include access to a 3D model SME, who can audit contractor specifications and capability for projects.

It is good practice to develop the competency of the owner-operators engineering team to understand the 3D model strategy, and to be able to correctly specify and verify the associated engineering deliverables and requirements. It is also good to practice to make the model available to all technical owner-operator staff, and to train them in how to extract the information they need out of the model. The more people using the model, more value it generates, and the better the feedback to drive its quality.

The selected 3D Model use cases also affect the maturity required in the organization.

© 2025 FL3DMS

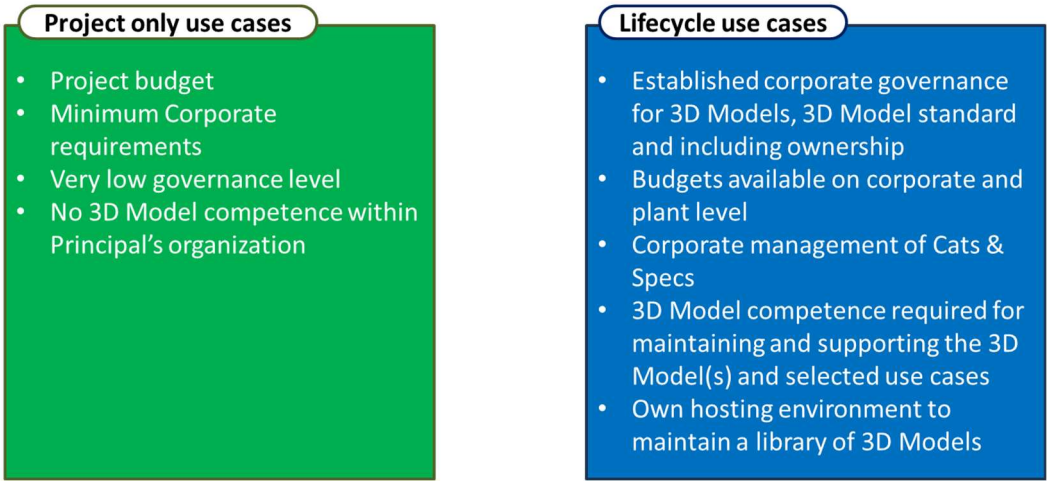


Figure 2:Organizational effects of use case selection and strategy definition

In an owner operator setting, the Principal might be confronted not only with FL3DMS industry standard requirements, but also with additional corporate or local requirements. In line with the envelope concept, such requirements may be added to the 3D Model specification, to allow an enterprise to leverage the FL3DMS requirements while also satisfying corporate and local requirements.

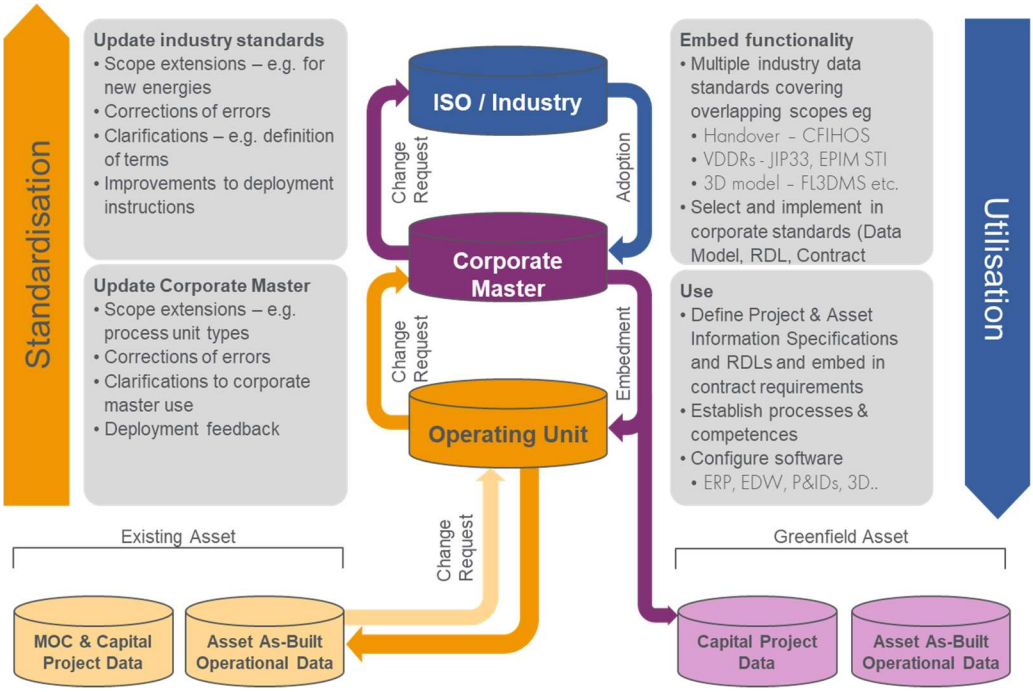


Figure 3: Overview of the envelope concept

The Envelope Concept is a methodology that

- Enables use of and reference to requirements from standards via references or mappings.
- Enables your company to embed multiple your standards in your corporate standards & software.
- Accommodates scaling up or down of requirements content to specific scopes.
- Accommodates corporate or local variations as required
- Enables improvement of the parent standards

© 2025 FL3DMS

This mechanism provides flexibility, but also requires governance and associated assurance.

It is recommended that

- Owner operators develop a 3D model specification to identify their minimum requirements for the lifecycle of the facility, based on FL3DMS.
- The EPC develop a detailed 3D model requirements for the project, based on the Owner Operator requirements. The Owner operator engineering manager and relevant disciplines review and approve this project specification.

Alternatively; the Owner operator may provide the EPC with a detailed 3D model specification that identifies complete configuration of the 3D environment which the EPC must align with and deliver upon.

2.6 Verification

When the ambition and 3D Model management strategy is identified, the Principal can use the FL3DMS 3D Model Owner/Operator Specification Checklist [F-CL-001] to verify that adequate requirements have been identified.

The 3D Model Specification Checklist should be applied when reviewing the document produced by the project EPC to ensure it contains all the required content.

© 2025 FL3DMS

3 Contract 3D Model Requirements

3.1 Contractual 3D Model Requirements Overview

The objective of the Principal is to ensure that the Contractor delivers the 3D Model required to effectively execute the project and manage its asset during operation.

A Principal typically has a contracting and procurement process by which a contract or another contractual vehicle will be agreed with a Contractor to deliver a project scope. The Principal's 3D Model Requirements need to be included or invoked via a requirement in this contract, as appropriate.

These 3D Model Requirements normally consist of the following elements to be created by the Principal (based on the FL3DMS Standard) and contractually mandated to the Contractor via the contract:

1. Contract 3D Model Scope of Work, including
    - High-level description of the 3D Model and deliverables generated out of the 3D Model that should be delivered, "When"
    - A framework of rules and principles covering the "How" of 3D model exchange and management (incl. required updates e.g. by the discipline staff involved).
2. Contract 3D Model Specification providing detailed requirements of "What" 3D model(s) should be delivered and in which format the 3D model(s) should be delivered, including:
    - A 3D Model specification based on the FL3DMS specification, with appropriate choices made regarding modelling of modules and equipment supplier elements, and of as-build requirements
    - A list of 3D Model content requirements based on the FL3DMS content requirements list
    - Reference Documents (ex: Principal's Transmittal specification, Tagging convention, etc. not in FL3DMS scope).

Depending on the structure of each Principal's Prime Contract, the above contractual requirements addressing 3D Model management and handover may be addressed in different parts of the Prime Contract.

Typically, the development of the 3D Model is part of a project. In that case other, outside of the 3D Model information requirements are also applicable. The Principal could consider the application of CFIHOS.

Per CFIHOS guidance, a IM SoW and a Contract Information Specification are to be developed with requirements outside the 3D Model scope. The 3D Model SoW and the Contract 3D Model Specification may be referenced or included within this Contract Information Requirements Package. Figure 4: Relation of 3D Model SoW and Contract 3D Model Specification to the CFIHOS Contract Information Requirements PackageFigure 4 shows how the Principal might link the various contract documents to each other.

In case this option is used, it is strongly recommended to reference or include the Contract 3D Model requirements in the Engineering SoW as well to ensure that the Engineering Manager has the accountability for the 3D Model:

1. CONTRACTOR shall generate engineering deliverables utilizing a 3D Model application in accordance with the "Contract Information Specification" in <*a reference to the correct section of the contract that contains the Contract Information Specification*>.
2. CONTRACTOR shall develop and review the 3D Model in compliance with the requirements of the Facilities Lifecycle 3D Model Standard (FL3DMS) as set out in <*a*

© 2025 FL3DMS

reference to the correct section of the contract that contains the Contract Information Specification>.

3. CONTRACTOR shall hand over a single model that integrates the designs of any SUB-CONTRACTORS.

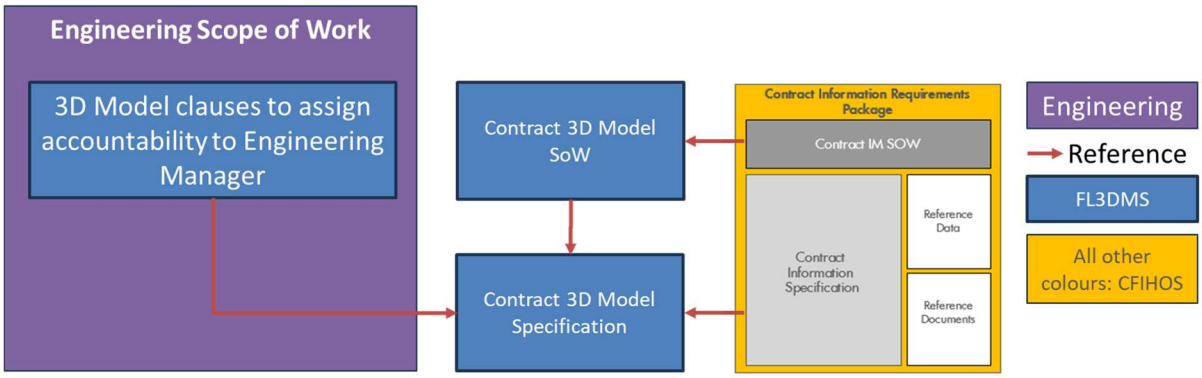


Figure 4: Relation of 3D Model SoW and Contract 3D Model Specification to the CFIHOS Contract Information Requirements Package

An alternative approach is to have the Contractor create a 3D model (development) procedure (equivalent of the 3D Model SoW and Contract 3D Model Specification) for approval by the Principal. The resulting mutually agreed document can then be included as part of the Prime contract.

In addition to the Contract 3D Model Requirements, the complete Contractual Requirements include the Technical Requirements, also containing Scope of Work and Specifications. The 3D Model Requirements will cover the handover of the 3D model asset, while the Technical Requirements cover the physical asset.

Note: The specification for the internal processes of the Contractor or the Principal are not part of the scope of FL3DMS and are not covered in this document. The Technical requirements for the physical asset are not within the scope of FL3DMS and are also not covered in this document.

3.2 Contract 3D Model Management Scope of Work (SoW)

The Contract 3D Model SoW identifies to a Contractor their contractual responsibility to deliver the 3D Model to the Principal. The Contract 3D Model SoW should also point to the Contract 3D Model Specification, which should identify what 3D model is to be delivered and the format of that 3D model.

The goal of the Contract 3D SoW document is to define the scope, processes, interdependencies and acceptance criteria for the exchange and handover of the 3D model between Contractor and Principal. The Contract 3D SoW should allow Contractor to understand the expected deliverables, their timing and other success criteria, such as material take-off and AWP. It should also enable the Principal to monitor the quality and progress of 3D model creation and delivery in a progressive manner before the final handover. In summary, the 3D Model SoW will point to the relevant Contract 3D Model Specification (which identifies what 3D model(s) need(s) to be delivered in executing a contract).

The considerations for the Principal's ambition and strategy (see chapter 2 Principal's 3D Ambition and Strategy) should be taken into account during the definition of the Contract 3D Model SoW, e.g. the use cases, project type and organisation maturity. The phase of the project and the contract strategy are also determining requirements. For example, a FEED-

© 2025 FL3DMS

contract has different requirements then an EPC-contract; sometimes you might see a combination of FEED and EPC.

The 3D Model SoW will then also typically define:

- 3D Model Standards, including a reference to the Contract 3D Model Specification
- 3D Model lifecycle, principles and security
- Manage Information and Data: the deliverables that will need to be generated from the 3D Model. Reference is made to FL3DMS 3D Model Deliverables List [F-SP-003] and – if in combination with CFIHOS application – the CFIHOS application neutral data requirements.
- Data Governance, defining the creation, processing, maintenance and data quality control and assurance of the 3D Model content and who is involved in these activities;
- Reference Data – e.g. Component Library, Plant Breakdown Structure and area coding
- IT requirements related to the 3D Model
- 3D Model organization and roles
- 3D Model processes, activities, phases and milestones, including:
  - Clash Management
  - Progress monitoring
  - As-building
  - Handover
  - Change Management process on the structure, reference data, catalogues and specifications, component library
  - Interface Management with disciplines and tools

3.3 Contract 3D Model Specification

The goal of the Contract 3D Model Specification is to define the technical aspects of the 3D Model Requirements, for which FL3DMS forms the basis. FL3DMS identifies a set of requirements for the 3D model to be produced in a project as far as configuration, content and deliverables are concerned. Principals may choose to augment this basic set of requirements with their corporate and project specific requirements.

However, Principals are encouraged to challenge and consider the costs vs. benefits of their additional requirements. In practice, the 3D Model requirements should be aligned with the Principal's 3D ambition and strategy and with the project scope.

The Contract 3D Model Specification will:

- Provide the definition of the 3D Model to be delivered as part of the contract scope. This will be based on the FL3DMS Specification [F-SP-001] and further tailored for the project
- Specify the related Reference Data tailored for the project, existing 3D libraries and catalogues
- Define the quality validation rules
- Specify the handover format

Principal might consider to include the Contract 3D Model Specification in the Contract Information Specification when CFIHOS is being used for specification of the information requirements.

© 2025 FL3DMS

4 How to use the FL3DMS Standard on a Project

4.1 Introduction

This section describes how the FL3DMS Standard should be applied to a project. The subsequent steps are shown in Figure 5 below:

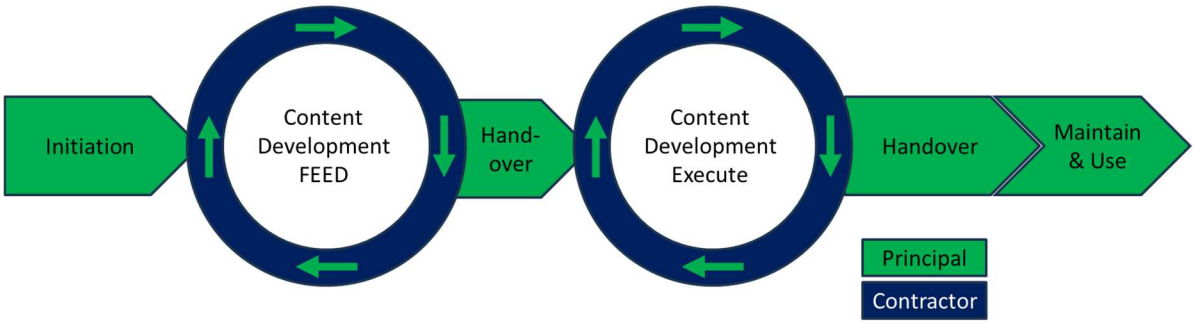


Figure 5 How to use FL3DMS on a Project - Overview

1. **Initiation Phase:**
   a. Architecture and Lifecycle: (1) Distribution of information; (2) Contract models
   b. Specification & Contracting
   c. Configuration template
2. **Content Development FEED Phase:**
   a. Regular handover (e.g. quarterly or continuous) for integration in Principal's landscape with an option for continuous access to the 3D Model
   b. Integrated reviews
3. **Handover Phase:**
   a. Completion check methods
   b. Optional: Specification & Contracting for Execute Phase
4. **Content Development Execute Phase:**
   a. Regular handover (e.g. quarterly or continuous) for integration in Principal's landscape with an option for continuous access to the 3D Model
   b. 30-60-90 integrated reviews
5. **Final Handover Phase:**
   a. Completion check methods
   b. Including as-built check methods
6. **Maintain and Use Phase:**
   a. Including Management of Change (MoC) procedure for modifications and brownfield projects
   b. Including translation to format used for Operations purposes and embedding in operational environment

4.2 3D Organization, Roles, and Responsibilities

The focus of the 3D Model lifecycle picture shown in section 4.1 may seem to be on the development and handover of the 3D Model as such. It may not sufficiently reflect the actual position and use of the 3D Model during the project phase (number **Error! Reference**

© 2025 FL3DMS

source not found. in the 3D Model lifecycle picture). The 3D Model has become a crucial element in project execution nowadays as is reflected by the use cases during this phase (see 2.2 Identification of use cases).

Having the right organization in place within the Principal's organization, Contractors, Sub-Contractors and Vendors, and the roles and responsibilities clearly defined and covered by the right people is crucial for successfully delivering the 3D Model requirements.

See CFIHOS for general IM related organization, roles and responsibilities requirements.

4.3 Stakeholders

The stakeholders are dependent on the selected use cases and they co-exist in the various parties involved:

Stakeholder	Principal	(Sub-)Contractor(s)	Vendors
Operations	X		
Maintenance & Inspection, including Turnaround	X		
Commissioning	X	X	
Project Management	X	X	X
Engineering	X	X	X
Procurement		X	
Construction/Fabrication		X	X
Project Services	X	X	
Information Management	X	X	X

4.3.1 Review and Approval Responsibilities

Review responsibilities for the Principal are related to assure that the requirements from the Contract 3D Model SoW and Specification are met. The Principal does not approve engineering designs, they accept after assuring of the requirements.

The Contractor has the responsibility to ensure the requirements are met through review and acceptance of their internal engineering activities as well as those of the sub-contractors and vendors, taking the accountability for a correct design.

4.4 Initiation Phase

In this phase, the Principal will determine the ambition and strategy (see chapter 2 Principal's 3D Ambition and Strategy) and translate these into a Contract 3D Model Specification based on the FL3DMS Specifications and their additional requirements. Alignment with stakeholders within the Principal's organization is crucial to set expectations for the use during the project execution and the final delivery towards the OPERATE phase.

Understanding the contracting situation for the project, a Contract 3D Model SoW will be developed for the FEED phase or for the FEED phase and the EXECUTE phase combined. In the latter situation, it is still advisable to make distinctions in what requirements are expected when during the project, which could include a handover after the FEED-phase.

© 2025 FL3DMS

The greenfield or brownfield situation determines what Principals should provide into the requirements. Especially the brownfield situation requires more consideration:

1. defining the 3D software application, version,
2. existing configurations – e.g. reference data, catalogues, plant breakdown, etc. – and how to extend when necessary, and
3. the as-built state of the current 3D model.

Apply the FL3DMS OwnerOperator Specification Checklist [F-CL-001] to verify the completeness of the Contract 3D Model SoW and Specification.

4.4.1 Owner/Operator Specification Checklist

The FL3DMS OwnerOperator Specification Checklist [F-CL-001] shall be used by the Principal in preparation of the 3D Model Specification document to assure that in the Contract 3D Model SoW and Specification all necessary functional and data requirements are included to meet the Principal's objectives.

The Contract 3D Model SoW and Specification can be developed following two scenarios:

1. Principal fully develops the SoW and Specification based on their own standards
2. Principal assign a SoW to develop the actual Contract 3D Model SoW and Specification.

The checklist can be used to verify all the 3D model specific requirements from Principal to EPC contractors and sub-contractors that will be detailed 3D Model Specification document, are included in the actual SoW.

The checklist can be modified to address project specific requirements and principal expectations.

Checklist includes a reference to FL3DMS Specification Id and/or FL3DMS Implementation Guide where applicable.

Indicate in the checklist requirements as follows:

- Yes – Principal indicates 3D model content requirement in the 3D Model Specification.
- No – Principal has no specific 3D model content requirement in the 3D Model Specification. However this may still subject to Principal approval based on contractor proposal.
- N/A - No applicable for the 3D Model Specification of this particular project or facility.

4.5 Content Development FEED Phase

To assure the correct delivery of the requirement by the Contractor, the Principal needs to assure from an early stage to avoid costly changes or rework at the end of the FEED Phase.

Means to perform this assurance is through:

a. Regular handover (e.g. quarterly or continuous) for integration in Principal's landscape with an option for continuous access to the 3D Model

b. Integrated reviews on the structure of the 3D Model, naming, integration of sub-contractor(s) and – potentially – long lead item vendor(s), and deliverables generation, including the detailing of the 3D Model in alignment with the engineering requirements.

In combination with CFIHOS application neutral data deliveries, the correctness and completeness of the tagged objects from the 3D Model in the application neutral data and vice versa can be verified.

© 2025 FL3DMS

4.5.1 EPC 3D Setup Checklist.

In this phase, the Contractor is encouraged to use theFL3DMS EPC 3D Model Setup Checklist [F-CL-002] to ensure that they can develop the 3D content according to requirements in the SoW.

This check list shall be filled by the Contractor in preparation of the 3D Model Setup tasks.

The check list shall be used to indicate all the 3D model critical setup activities and related requirements from Principal to EPC Contractors and sub-Contractors that are detailed FL3DMS Specification document.

This check list can be modified to address project specific requirements, Principal and Contractor expectations.

The check list includes a suggested categorized items indicating different aspects to considered by EPC during 3D model setup. For each item shall be indicated if this is requested by the Principal in the Contract 3D Model Specification. Also shall be indicated if this item in the check list has been completed during the 3D Model Setup and provide additional comments for clarification.

Indicate in the check list requirements as follows:

- Yes – Item requested by principal and/or completed by Contractor during 3D Model Setup.
- No – Principal has no particular requirement for this item and/or Contractor has not completed this item in the setup check list.
- N/A – Item no applicable for Principal requirement and/or Contractor completion for 3D Model Setup.

4.6 Handover Phase

The handover phase after FEED focuses on the acceptance of the 3D Model deliverable. With applying the proposed assurance activities in the previous phase of content development, the completion checks are minimal, yet they need to be executed a last time.

The risk of lacking assurance activities in the content development phase is that issues are to be expected at this handover, causing non-acceptance and rework to bring the 3D Model to the required quality level.

Develop or review the Contract 3D Model SoW and Contract 3D Specification for the EXECUTE phase. Ensure continuation of the 3D Model as developed in the FEED phase to avoid redevelopment cost. Adopt lessons learned from the FEED phase where necessary and keep alignment with the ambition and strategy formulated under the Initiation step.

In this phase, the FL3DMS 3D Model Owner/Operator Specification Checklist [F-CL-001] can be applied to verify the SoW for the EXECUTE phase. For more information on the checklist: see par. 4.5 Content Development FEED Phase.

4.7 Content Development Execute Phase

To assure the correct delivery of the requirement by the Contractor, the Principal needs to assure from an early stage to avoid costly changes or rework at the end of the EXECUTE Phase.

Means to perform this assurance is through:

a. Regular handover (e.g. quarterly or continuous) for integration in Principal’s landscape with an option for continuous access to the 3D Model

© 2025 FL3DMS

b. Integrated reviews on the structure of the 3D Model, naming, integration of sub-contractor(s) and vendor packages/skids, and deliverables generation, including the detailing of the 3D Model in alignment with the engineering requirements.

c. Key moments are the 30-60-90 reviews. Principal is encouraged to use the FL3DMS checklist for confirming that at those milestones the 3D Model is data-wise meeting the requirements.

In combination with CFIHOS application neutral data deliveries, the correctness and completeness of the tagged objects from the 3D Model in the application neutral data and vice versa can be verified.

In this phase, the Contractor is encouraged to use the FL3DMS EPC 3D Model Setup Checklist [F-CL-002] to ensure that they can develop the 3D content according to requirements in the SoW.

4.8 Final Handover Phase

The handover phase after EXECUTE focuses on the acceptance of the 3D Model deliverable. With applying the proposed assurance activities during the EXECUTE phase, the completion checks are minimal, yet they need to be executed a last time.

The risk of lacking assurance activities in the content development phase is that issues are to be expected at this handover, causing non-acceptance and rework to bring the 3D Model to the required quality level.

Depending on the selected as-built requirements, Principals wants to assure themselves that these are met. In addition to the normal assurance checks, the following additional verifications can be considered:

1. Review of the Contractor's as-built procedure to ensure that 3D Model updates are triggered based on Construction, Completion and Commissioning redline markups and change notes.

4.9 Maintain & Use Phase

Once the 3D Model is handed over, two things need to be taken care of:

a. Ensure that a Management of Change (MoC) procedure for modifications and brownfield projects exists.

b. Create a translation of the 3D Model in an Operations format.

The MoC procedure should include updating the 3D Model in accordance with the Specifications earlier used to develop the 3D Model. The used as-built requirements need to be considered. Often, the 3D Model is not maintained as to the same levels as it was originally developed. Over time, such practice might diminish the business case.

A translation of the 3D Model in a format for Operations purposes is needed for embedding the model in the operational environment for viewing or integration with other data sources to support selected use cases. Such translation is required to be maintained or regenerated after updates of the 3D Model itself.

© 2025 FL3DMS

5 Informative on FL3DMS Requirements

The reader is encouraged to read this chapter in conjunction with the FL3DMS Specification [F-SP-001]. This chapter follows the same structure as the Specification.

5.1 3D Model Application

No further clarification.

5.2 3D Model Configuration

5.2.1 Configuration

5.2.1.1 Plant Grid System and Datum Point

The 3D model represents the same grid line and coordinate system approved for the project to provide a consistent approach to 3D modelling. The use of a local coordinate system and orientation simplifies 3D design and export of layout and fabrication documents.

Correct geolocation and rotation requires availability of control points in 3D models aligned with true geological coordinates. These documented 3D datum points allow the 3D model content to be geolocated to the real-world position.

The use of an axes convention provides a consistent approach to 3D modelling.

5.2.1.2 Language Characters

No further clarification.

5.2.2 Naming Conventions

5.2.2.1 Tagged Objects

To ensure all objects can be differentiated from one another based on the conventions premised by the Project or Asset, applying the ENS is crucial. It will support correct identification of the objects and correlation with other project deliverables and – of course – the actual physical objects in the facility in all the different stages of the lifecycle.

5.2.2.2 Non-Tagged Objects

Non-tagged Objects require unique naming to ensure all items in the model are given a logical name. All Contractors' design teams should use the same naming conventions for consistency purposes in support of correct interpretation.

Re-use or duplication of naming for non-tagged objects should be avoided to avoid misinterpretation and duplication of effort in design reviews and clash checking.

5.2.2.3 Discipline Code

The use of CFIHOS Discipline Code standards will enable the inter-operability of the engineering data coming from multiple data sources.

5.2.2.4 Plant Breakdown Structure and Area Coding

The use of CFIHOS Plant Breakdown Structure standards will enable the inter-operability of the engineering data coming from multiple data sources.

For Area Coding, the 3D Model need to represent the same area coding used across the project.

© 2025 FL3DMS

5.2.3 Hierarchy

The Hierarchy aims to provide a consistent structure within the 3D model for grouping similar items in a particular area within the facility.

5.2.4 Tagged Objects

This section is about ensuring that all tagged objects in the 3D Model are correctly represented in terms of location and the physical object's geometry.

Rationales for the provided requirements:

- [FSP001-0021-01] To ensure the 3D model represents all physical objects named on the project.
- [FSP001-0022-01] To ensure correlation between the 3D model location and the physical item.
- [FSP001-0023-01] To ensure datum points are relevant and related to the physical object's geometry.
- [FSP001-0024-02] To ensure the datum is in a logical position which is related to the object's geometry.
- [FSP001-0025-01] To reserve the storage location for the mobile equipment and avoid other objects/design utilising the space.

5.2.5 Requirements for Soft Volumes

5.2.5.1 Introduction

No further clarification.

5.2.5.2 General Requirements

Visibility of soft volumes ensures adequate understanding of the spatial matters within the 3D model based on the level of detail being assessed. During normal operation, soft volumes are empty and therefore do not need to be shown

5.2.5.3 Escape and Access Routes

To be able to review escape and access routes the footprint box is required to indicate the escape/access route as a pathway during model reviews with the headroom box included in model interference checks to ensure the complete route is free of obstructions.

5.2.5.4 Muster and Assembly Points

To be able to review muster and assembly points the footprint box is required to indicate the muster and assembly point as a location during model reviews with the headroom box included in model interference checks to ensure the complete location is free of obstructions allowing to observe wind direction.

5.2.5.5 Maintenance and Access Volumes

Maintenance and access volumes of sufficient space must be allowed for in the design and must be clash checked to ensure they are free of obstructions.

5.2.5.6 Fire Water Nozzle Coverage Elements

The soft volume for Fire Water Nozzle Coverage Elements is required to ensure the sprinkler/deluge system provides full coverage of the equipment and piping forming the fire hazard and there are no obstructions.

© 2025 FL3DMS

5.2.5.7 Coverage and Line of Sight

The Coverage and Line of Sight requirement is needed to ensure that there is visibility of coverage and avoid possible blockages. Examples of soft volumes covering line of sight include CCTV cameras, fire and gas detectors, and nodes in a Wi-Fi network.

5.2.5.8 Crane Radius

A soft volume to represent the radius of movement of a crane is required to ensure that the crane rotation and extents are sufficient for reaching all the identified heavy lift locations.

5.2.5.9 Moveable and Material Handling Equipment

Soft volumes indicating the complete range of moveable and material handling equipment ensures that space required remains free of obstructions.

Adding existing coordinates to movable equipment ensures that the equipment remains in the same location in the 3D model as where it is currently stored in the physical asset.

5.2.5.10 Temporary Objects

Temporary objects are for design and construction purposes only and do not form part of the final asset. Temporary content is named as such to simplify removal from the as-built handover model.

5.2.5.11 Hazardous Area Zone

No further clarification.

5.3 3D Model Content

5.3.1 3D Model Content Requirement Matrix

No further clarification.

5.3.2 3D Model - General Requirements

No further clarification.

5.3.3 Object Representation in the 3D Model

No further clarification

5.3.4 Handover and As-Built

5.3.4.1 Handover and integration of models from different sources

Within a capital project, there are typically several handover scenarios and challenges

- **Asset to Project handovers for Brownfield projects.** In a Brownfield situation, a 3D Model typically exists of the asset that will be modified. The challenge here is to ensure that the new model developed by the project can be re-integrated into the asset 3D Model at the end of the project. This requires that the project aligns with the existing 3D Model specification used by the asset. The project may also make use of the existing 3D Model catalogue. The best way to ensure easy re-integration of the 3D Model is by having the project edit a "satellite" global workshare extension of the 3D Model, hosted by the asset. If such functionality is not available extensive verification is required to ensure that the project model is consistent with the asset model in terms of hierarchy, catalogue content, labelling and attribution.
- **Intermediate handovers between Project phases.** A 3D Model is typically developed as part of an engineering study or the front-end engineering design. To avoid re-work in

© 2025 FL3DMS

the next phase it is desirable that the model is handed over in such a way that it can be used by the contractor assigned to this phase.

- **Handovers between different contributors of 3D Model content, such as EPCs and Module Suppliers.** The challenges and solutions to of this scenario are similar to those of the Project to Asset Handover. To ensure that all the 3D Model can be consolidated, it is recommended to appoint one party as the consolidator, and to ensure that 3D Specifications, Catalogues and Content is developed consistently. This is most easily facilitated by having the integrator host the master 3D Model in a cloud-based environment and having all the contributors develop their content in satellite domains, based on clearly defined scopes and requirements, with regular compliance verifications
- **Final handover from the Project to the Asset and to its Target Operations Environment.** A project information handover plan shall be in place and within it, the 3D Model information handover plan should be spelled out. This shall cover the general scope, role, responsibility, schedule, Quality Control of information to be handed over from Project to Operations covering all forms of information (document, data, database/model) from the project team, contractors, and vendors. This plan shall also outline how interfaces between various parties (Owner Project team, Contractors, and vendors) will be managed at various stages of the handover process, and expected levels of maturity at each stage (Front-end Engineering, As Designed, etc). More details in the CFIHOS Scope and Procedure Document [C-TP-001].
  Where the project has not been able to align to the Operational 3D Model application, a procedure for validation and transformation and loading of the required subset of project collected data will usually be required.

Separation of Project and Operate systems (within the Principal environment) is very beneficial for avoiding information conflicts and could help create clear boundaries for managing concurrent/parallel engineering. Ideally consistency is managed of the two via cloud hosting of both environments and use of satellite environments for projects.

It is good practice to request interim handovers of the 3D model at regular intervals to allow verification and practice migration to the target environment.

It is also good practice to ensure final handover of the 3D Model before startup, as the model will be required to support asset modifications from MOCs directly after Handover. Several safety-critical engineering deliverables are generated from the 3D Model (see FL3DMS 3D Model Deliverables List [F-SP-003]), and these should ideally be available in As Built format prior to start up.

- **Manage and use of reality capture (such as laser scanning or photogrammetry).** Define use-case based requirements for reality capture / laser scanning and photogrammetry, and their integration with the 3D model. The level of definition specified should be sufficient to support the use-cases identified.
- **Define an asset 3D Model As-Built strategy.** Requirements for Handover and As Building are set out in the FL3DMS Specification [F-SP-001]

In the project 3D specification, Company is recommended to define which of the following as-built options shall apply, and which of the associated requirements shall be invoked, in accordance with below guidance.

Handover Type	Interim Handover	Final Handover at end of Execute		
3D Model Handover Options	Study phase or front-end engineering 3D Model Handover	As designed	Logically Accurate for process equipment	Dimension-ally Accurate

© 2025 FL3DMS

Handover Type	Interim Handover	Final Handover at end of Execute		
Use cases	Enables reuse of model in next project phase and avoids rework	For process facilities that do not handle hazardous substances	For facilities that handle hazardous substances, requiring HAZOP compliance	For facilities that handle hazardous substances, requiring HAZOP compliance and remote engineering enablement
Cost of compliance	Low	Low	Medium	High
3D Model Handover requirements				
a. [FSP001-0104-01] The 3D Model shall be consistent with Approved For Construction (AFC) Model Content and Engineering Deliverables, as used for generation of fabrication and construction documentation.	N/A	Applicable	Applicable	Applicable
b. [FSP001-0105-01] Any demolished equipment, temporary equipment, structures and studies of alternative design options shall be removed to ensure that the model reflects the situation in the field at handover.	N/A	Applicable	Applicable	Applicable
c. [FSP001-0106-01] Space reservations for future content shall be retained in the model.	Applicable	Applicable	Applicable	Applicable
d. [FSP001-0107-01] The contractor shall ensure that all application-specific 3D Model data delivered is consistent with corresponding information or engineering deliverables generated from the 3D Model, as set out in F-SP-003 FL3DMS 3D Model Deliverables List.	Applicable	Applicable	Applicable	Applicable
e. [FSP001-0108-01] The contractor shall submit application specific 3D Model databases to the principal in native format such that the principal can open and edit the information in the authoring application that was used to generate it in an error free manner. This requirement is consistent with CFIHOS-SPTR-129.	Applicable	Applicable	Applicable	Applicable
f. [FSP001-0109-01] The contractor shall submit 3D application specific databases which are restorable to the original native application used to create it and shall maintain the full functionality of the original application (e.g. ensuring catalogues and specifications used by the contractor to generate an original model are made available to the principal). This requirement is consistent with CFIHOS-SPTR-130.	Applicable	Applicable	Applicable	Applicable
g. [FSP001-0110-01] The model shall not contain an unusually large number of elements that affect the performance of loading the model onto the canvas. This requirement is consistent with NORSOK Z-020.	Applicable	Applicable	Applicable	Applicable
h. [FSP001-0111-01] All 3D Model content shall be verified against the As Built plant Drawings, including P&IDs, to ensure that all tagged process plant objects in the model are installed in the field and the logical layout of objects in the 3D Model (i.e. objects in piping layouts) is correctly representing the situation in the field.	N/A	N/A	Applicable	Applicable

© 2025 FL3DMS

Handover Type	Interim Handover	Final Handover at end of Execute		
i. [FSP001-0112-01] The contractor shall ensure that the 3D Model and the engineering deliverables generated from the 3D Model are As Built. This shall be achieved by implementation of "Red-Line Mark-Up" comments from mechanical completions checks within the 3D Model and thereby also withing the engineering deliverables that are generated from the 3D model.	N/A	N/A	Applicable	Applicable
j. [FSP001-0113-01] Brownfield modifications shall utilise reality capture technology to identify the current physical status of the plant for comparison with the 3D model.	N/A	N/A	N/A	Applicable
k. [FSP001-0051-01] As-built construction tolerance requirements are defined in the 3D model content requirement matrix in section 6.1. They specify the accuracy of the 3D model content in relation to the physical as-built position. If the tolerance requirements are exceeded, the 3D model shall be updated to be compliant. Compliance with the As-built construction tolerance requirements shall be demonstrated via comparison of the 3D Model and the physical status reflected in the reality capture model.	N/A	N/A	N/A	Applicable

The selected Final Handover As-Built 3D Model requirements should align with the overall lifecycle management strategy and provide the level of detail and accuracy necessary to support envisaged use cases.

This approach ensures that the model delivers optimal value by remaining relevant and reliable throughout the asset's entire lifecycle, from construction to operation and decommissioning.

The level at which this strategy is defined typically depends on use-cases. It typically makes sense to invest in a high quality 3D Model for assets that are:

- Difficult to access such as off-shore platforms
- Likely to undergo regular Brownfield Engineering revisions
- Rely on remote engineering support from high value centres
- Wish to implement high fidelity Digital Twins

5.3.4.2 Considerations for different Final Handover Options

As-designed

- This option is suited for process facilities that do not handle hazardous substances.
- Where engineering deliverables generated from the 3D model are deemed safety-critical, this method may be inadequate. See also FL3DMS 3D Model Deliverables List [F-SP-003].
- The model may not be fully trusted for engineering or operational purposes due to potential inaccuracies. Additional manual updates may be required before reuse.
- Laser Scanning: This may be used to verify the model's accuracy before undertaking new engineering modifications.

© 2025 FL3DMS

Logically accurate (most likely candidate to be chosen)

- This option is suited for process facilities that handle hazardous substances.
- Typically several safety-critical engineering deliverables are generated from the 3D Model. This option ensures that both the engineering deliverables generated from the 3D Model and the Plant is consistent with design documents such as P&IDs which have undergone HAZOPs and other safety studies.
- This option is often the most cost-effective while ensuring that the model is sufficiently accurate for ongoing engineering and operational use.
- Ideal for assets with ongoing modifications that don't require full dimensional precision.
- Laser Scanning: Scanning may be used to confirm the logical accuracy of the model before beginning new modifications.

Dimensionally accurate

- This option is suited for process facilities that handle hazardous substances and remote engineering enablement.
- Typically several safety-critical engineering deliverables are generated from the 3D Model. This option ensures that both the engineering deliverables generated from the 3D Model and the Plant is consistent with design documents such as P&IDs which have undergone HAZOPs and other safety studies.
- This level of accuracy is costly and is typically necessary for highly critical or unmanned, remotely-managed facilities that require exact modelling for safe operations.
- Laser Scanning: Regular scans or similar methodologies ensure the model stays up-to-date and aligned with the physical conditions.

5.3.4.3 How to manage as-building

A commonly used method to achieve as-building is by using a red-line procedure. In a red-line procedure as-designed drawings generated from the as-designed 3D Model are used by field crews to collect data and information capturing changes and modifications during construction by creation of red-line drawings. These red-line drawings can then be used to update the 3D Model based on the changes and turn it into an as-built 3D Model. The decision which changes to implement in the as-built 3D Model is part of the procedure.

Communication related errors may occur in the red-line procedure and subsequent process of turning the 3D Model into as-built status. They typically occur if not enough relevant data are provided in the documents being used for the red-line procedure and not enough support is provided by IT-tools to retrieve additional information.

It is recommended that contractor is required to issues a procedure describing the planned as-built process. This procedure shall contain the following:

- Activities and sequence of performing As-built of the project design scope.
- A RACI matrix for the process
- Quality controls, to verify that the process has been executed correctly
- A status report format to track progress of the process

© 2025 FL3DMS

5.3.4.4 Use of smart reality capture solutions during as-building

Contractor is encouraged to leverage technology to automate verification and increase accuracy. A range of field based data acquisition technologies may be deployed including Incorporate laser scanning, drones, and AI-driven verification to lower the cost of maintaining a dimensionally accurate model, enabling automated comparison and updates to the 3D model based on the physical asset.

5.3.4.5 Define an asset Management of Change (MoC) procedure that addresses upkeep of 3D Model content

For brownfield engineering service contracts, adopt a methodology for integrating modifications into the master 3D model, ensuring that the model stays evergreen. This will accurately reflect any modifications and ensure that the model remains a trusted source for future engineering work. In general an asset Management of Change (MoC) procedure shall be defined that addresses upkeep of 3D Model content. This shall be aligned with the as-building method chosen for the 3D Model.

5.3.5 Vendor Packages/Vendor Engineering

5.3.5.1 Objective

The purpose of this paragraph is to clarify the Purchaser‘s requirements to Vendor models. This requirement shall be included in any Purchase orders relevant packages in respective project / PO document. (Typically, SIRL or SDI).

5.3.5.2 Target group and responsibility

The target group for this requirement are all Purchaser’s projects where vendor models shall be included into the overall delivery requirements related to vendor documentation.

5.3.5.3 Premise for Use of Vendor 3D Models

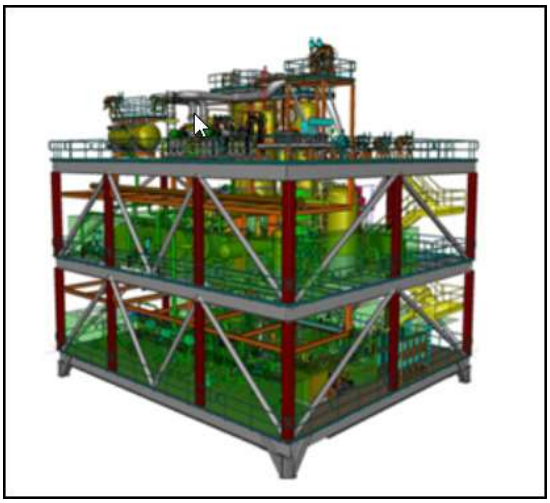
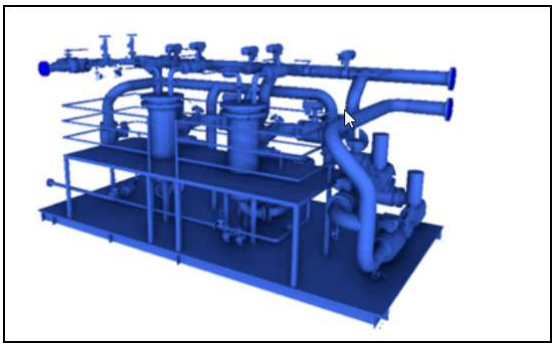
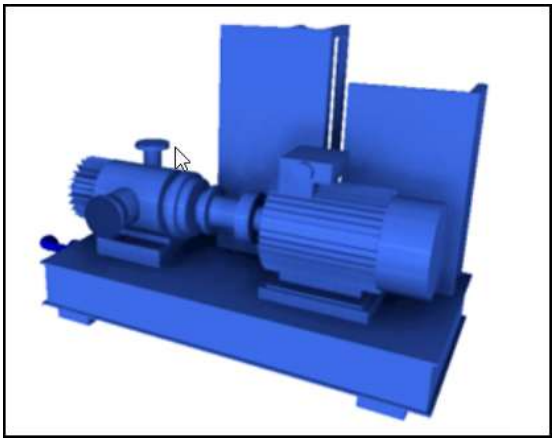
The vendor 3D models (GA3D) will be used, together with the General arrangement 2D drawing (GA2D) drawing and equipment interface data (EID), to support the project interfaces requirement between the project’s overall 3D model and the vendor model. This includes allowing insight into access, working environment, operations, material handling and support the project digital twin. The vendor 3D models shall also, if required, be able to meet the requirement if the vendor 3D models shall be included into the overall project 3D global model.

5.3.5.4 Typical types of skids

Three typical types of skids are described in the below table.

Skid Types	Description
Module skids	Skids represent a full area that contain multi-discipline tags including piping, structural and other discipline design.
Multi-discipline skids	Skids that contain multi-discipline tags including piping, structural and other discipline design.
Equipment skids	Skids with multi discipline tags with no major structure or piping.

© 2025 FL3DMS

Module skids	
Multi-discipline skids	
Equipment skids	

5.3.6 Laser and Photogrammetry Survey Data

No further clarification.

5.3.7 Model Attributes

No further clarification.

© 2025 FL3DMS

5.3.8 Construction Support

5.3.8.1 Work Face Planning

The inclusion of the division of work within the 3D model allows the project to align the generation of construction and procurement (material take-offs) documentation with the execution schedule, thus helping to create a constraint-free work environment and improve productivity. Refer to CII Implementation guideline SR19-01 for further information on AWP process.

EPC may have a dedicated application that manages all aspects of construction, including data requirements, procurement, material management, fabrication, etc.

The master hierarchy shall follow the requirements stated in Section 5.3 Hierarchy, of the FL3DMS Specification [F-SP-001].

5.3.8.2 4D Models

The 4D model enables the schedule to be optimised and validated, by highlighting potential SIMOPS, heavy lifts, vehicle movements, to visualise the “path of construction” and improve collaboration and safer construction. The schedule should be coded in accordance with the work packaging codes to enable the activities to be linked to the relevant 3D model content for visualisation of the path of construction

To enable auto-matching of 3D model content to procurement and construction management systems, there needs to be provision in the 3D model’s data model that allows for that matching.

5.3.9 Integrity Management

5.3.9.1 Corrosion Management and supporting 3D Model Data

Corrosion is a significant risk to the integrity of any process plant, as well as to onshore and offshore civil structures that support the plant. It may manifest itself in the form of internal or external corrosion, or corrosion under insulation or fireproofing. Protection systems include corrosion allowances in piping and steel structures, painting and cathodic anodes. Corrosion is mitigated using integrity management systems to plan inspections, track corrosion rates, assess integrity risks and initiate corrective actions to avoid failure and potentially catastrophic leaks.

The 3D model combined with other data systems such as P&ID diagramming software, an Engineering Data Warehouse (EDW), an Integrity Management System and a Maintenance Management System, should contain the information required to manage corrosion risks, including the objects listed below:

- Ensure that corrosion loops can be identified within the 3D model to visualise parts of the plant expected to experience the same rate of internal corrosion
- Ensure that inspection measurement points can be located by having them numbered and visualised in the 3D model, such that scaffolding needs can be identified prior to inspections
- Ensure that flanges can be identified withing the 3D model via tagging for construction and operations to record and maintain joint integrity records, such as torque data.
- Ensure that piping and equipment covered by insolation materials can be identified within the 3D model to visualise parts of the plant that may be subject to external corrosion under insulation

© 2025 FL3DMS

- Ensure that sacrificial anodes and their locations can be identified by having them numbered and visualised in the 3D model to enable planning of inspections and regular replacement.
- Ensure that fire-proofing of onshore and offshore civil structures can be identified and that it is named such that they can be included in a maintenance system.

It is common for corrosion instrumentation and coupons to be identified on P&ID's and incorporated in the 3D model during the design process. It should be possible to generate corrosion isometrics from the 3D model.

Integrity and Maintenance systems typically require information about equipment and tags that are on the P&IDs as well as information that is not shown on the P&IDs, such as onshore and offshore civil structures. The 3D model should include such additional information to enable visualization of all relevant objects and population of the operational systems. It should also be possible to locate corrosion measurement points and cathodic anodes in the model for maintenance planning purposes.

All objects should be named to the level of granularity aligned with the requirements of facility integrity and maintenance systems, and consistently with the requirements set out in the facility tagging specification.

Leak path analysis may be used to review the piping design and identify joints that are more liable to fail. The potential leak point should be visible within the 3D model for use by the maintenance team during operations.

5.3.9.2 Joint Integrity Management and supporting 3D Model Data

Mechanical joint integrity involves the controlled and verified bolting of pipework, flanges, and other assemblies to eliminate the risk of hydrocarbon and non-hydrocarbon releases. It ensures the safe and effective tightening and bolting of mechanical joints, thereby maintaining structural integrity and minimising leaks.

To enable joint integrity systems to be used to track individual joint tightening requirements and history, all mechanical joints should be identified with a unique name. The piping joints are created and named in the 3D model, which also provides the joint location.

The 3D model should include a space allowance for access around flanges that require the use of hydraulic torque tensioning equipment. This should be in the form of a soft volume that will be included in any clash checking procedures and can be made visible in design reviews.

5.4 3D Model Review

The 3D model is subjected to formal design reviews in FEED, approximately 15% design maturity, and in Execute at 30/60/90% model maturity. The layout is also subjected to separate reviews for constructability, ensuring it is suitable for transportation routes, fabrication space requirements, etc.

The reviews enable the project team to walk through the 3D model and check the plant layout is safe and practical to fabricate, construct, commission, operate and maintain.

All reviews are to ensure the model content reflects the Contract 3D Model Specification.

The 3D Model reviews are performed to meet the following objectives:

- Design optimization during the FEED phase
- Verify the plant layout is suitable and fit for purpose, meeting Health, Safety and Environment (HSE) and Regulatory requirements

© 2025 FL3DMS

- The model content and associated data at each stage is aligned with the contract requirements
- Gain client approval at each stage of the design process prior to proceeding to the next stage
- To ensure all stakeholders, Engineering disciplines, Fabrication, Construction, Operations & Maintenance agree with the design prior to the generation of deliverables (e.g. piping spools/isometrics) from the model.

Comments received from each formal model review are recorded, tracked and resolved prior to the next review.

5.5 3D Model Deliverables & Handover

5.5.1 Reports Generated from the 3D Model

No further clarification.

5.5.2 Drawings Generated from the 3D Model

No further clarification.

5.5.3 Clash Status

No further clarification.

5.5.4 Handover: Format

5.5.4.1 Handover report

No further clarification.

5.5.4.2 Drawing(s) of the Plant Including the Plant Breakdown Structure

No further clarification.

5.5.4.3 Area and Sub-area Coordinates

No further clarification.

5.5.4.4 3D Vendor Package Models

No further clarification.

5.5.4.5 Laser and Photogrammetry Survey Data

No further clarification.

© 2025 FL3DMS

6 The FL3DMS Data Model

6.1 Introduction

The Data model structure and Data dictionary of the 3D model form an important part of the FL3DMS standard. Many data standards are already available, so the FL3DMS does not define a new data model standard, but relates back to available standards like CFIHOS, DEXPI and CII. The CII (Construction Industry Institute) Advanced Work Packaging (AWP) data model has been selected as the FL3DMS data model standard to be included in the specification.

The CII AWP data model provides a structured way to organize and manage information related to work packages, ensuring alignment and consistency throughout the project lifecycle. The unified data model integrates CII's AWP data requirements with IOGP's CFIHOS, establishing a standard for data exchange and enabling efficient collaboration among stakeholders, from engineering and procurement to construction and operations.

6.2 3D Spatial Component

The '3D spatial component' maintained by the FL3DMS specification, takes a central place in the Data model. A '3D spatial component' modelized in the 3D model can represent either:

- A CFIHOS Tag: The object capturing design requirements. In that situation the 3D spatial component materializes the maximum volume that the future selected Equipment will occupy.
- A CFIHOS Equipment: A physical object representing an object you can buy on the market from a specific vendor. Note that an Equipment includes elementary objects known as 'components' (e.g. a piping elbow).
- A CFIHOS Construction Assembly: A physical object representing the composition of CFIHOS Equipment, forming a bigger physical object

Below are two examples how to apply the data model for a "Piping Spool" and for a "Piping Isometric".

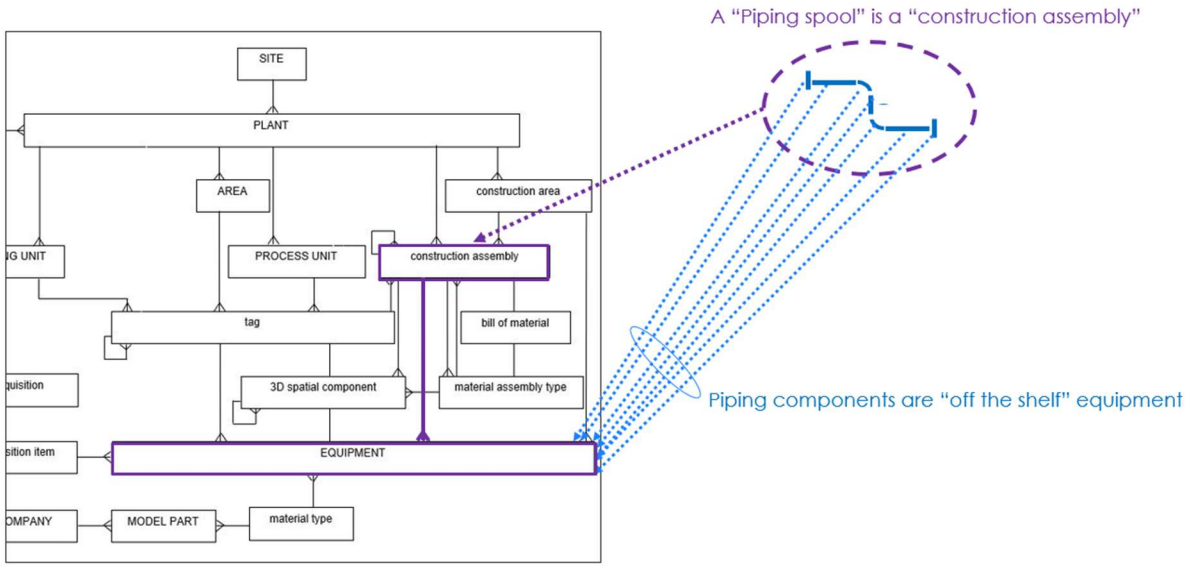


Figure 6: Usage of the model for a "Piping Spool"

© 2025 FL3DMS

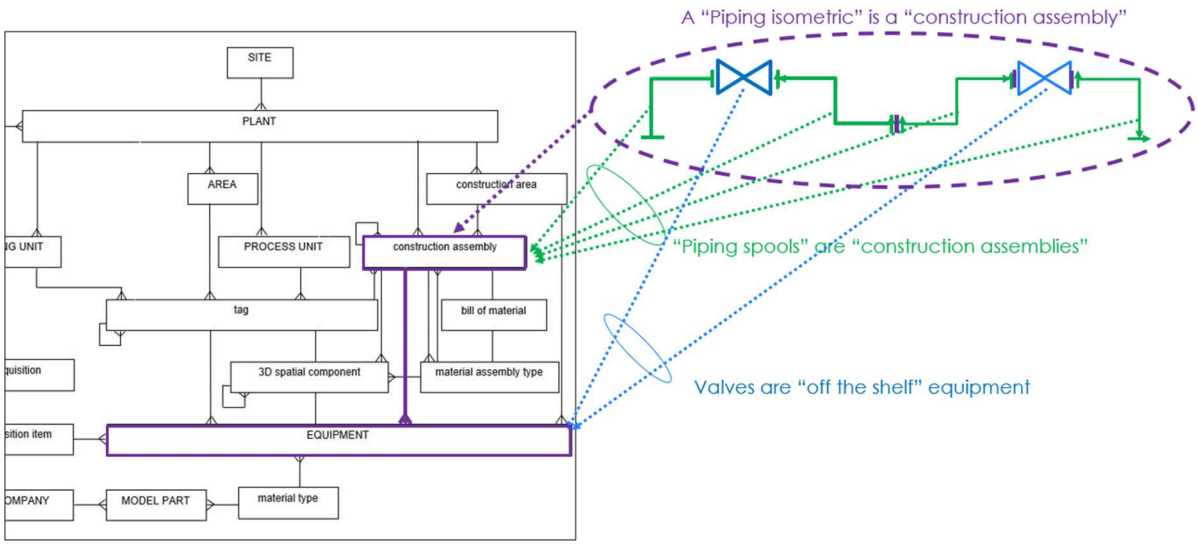


Figure 7: Usage of the data model for a "Piping Isometric"

Data definitions of the data model objects are specified within either CFIHOS or the CII AWP dictionary, as FL3DMS uses available standards and tends not to create any different definitions for related objects.

6.3 Related Data object definitions (main objects only)

As per AWP data dictionary the following definition is used for a 3D spatial component:

- *A 3D spatial Component representation of a functional (i.e. Tag) or physical (i.e. Equipment, construction area) engineering object modelized by the composition of primitive geometrical shapes. It shows the overall volume occupied by the object and elements can also be selected from a catalogue of Material Type.*

  E.g.
  - *a section of a pipe rack*
  - *vessel*
  - *piece of pipe*
  - *piping elbow*
  - *beam*

As per CFIHOS specification the following definitions are used for Equipment and Tag:

- *An equipment is a physical device designed to perform a function*

  E.g.
  - *vessel*
  - *instrument*
  - *valve*
  - *piece of pipe*
  - *piping elbow*
  - *beam*

- *A tag is a conceptual object capturing the design requirements for a particular function required within a plant design. The design requirements are defined by the engineering disciplines and shall be delivered by the Equipment installed to perform the Tag function.*

© 2025 FL3DMS

6.4 FL3DMS Data Dictionary

The 3D data dictionary as specified in FL3DMS Data Model and Dictionary [F-SP-004] provides a basis for 3D model attributes to be included in the FL3DMS specification.

Properties or attributes essential to represent a graphical presentation of the 3D spatial component are not included in the list, as these properties might differ in naming and structure based on the software application used.

Any 3D spatial component is a presentation of an object defined in some other information system. This could be a standard commodity based on the material type (piping class, structural section) or specific manufactured equipment bought from a vendor; the source of data is defined in other information system. As a minimum every 3D spatial component should therefor hold a few basic attributes, which provides relationships to these specifications and information in their source system (Engineering Data Management system).

However, during engineering and design, a large set of deliverables is produced from the 3D model for fabrication and construction. Making sure these deliverables can be produced from the 3D model only; additional attributes are required as part of the 3D spatial component. The data dictionary gives an overview of the expected deliverables and provides the data attributes required.

All data attributes within the FL3DMS data dictionary includes direct relationship to CFIHOS data properties with their corresponding CFIHOS id.

To support change management and references from other standards, the attributes within the data dictionary are provided with an unique FL3DMS id.

The FL3DMS specification provides the data dictionary as a guidance, it is expected that the Principal might adjust the data attributes based on the requirements of the facility and information maturity of the project stakeholders.

© 2025 FL3DMS