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Facility Lifecycle 3D Model Standard (FL3DMS)

Specification

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1.0	29 October 2021	The first official release
1.1	1 June 2023	Intermediate release to include unique numbering system
1.2	2 September 2024	Clarified potentially confusing statements, added definitions, repositioned the 3D model content requirements table, and made some parts easier to read.
1.3	26 November 2025	Extended As-Built requirements, Vendor Packages/Skids requirements; Integrity management requirements; Construction Mgt requirements; Added a suggested deliverables list; Added a data model and data dictionary

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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 revision 1.3 of the specification has been developed based on good and open cooperation between the participants and based on current best practices and capabilities within the participants' organisations and relevant industry data standards such as CFIHOS.

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1 Introduction

This document specifies requirements for the 3D Model on greenfield and brownfield projects to be developed and handed over in the process and energy industries.

1.1 Scope & Intended Use

The name Facility Lifecycle 3D Model Standard indicates that the focus is on the lifecycle use of 3D models. This means that, although this specification is project-related, requirements are specified with lifecycle use in mind. This is, for example, the case for the as-built requirements, where having an accurate 3D model is a good basis for a trusted Digital Twin.

This specification is based on a set of general principles such that the facility 3D model can be:

- Efficiently and effectively used throughout the lifecycle of the facility.
- Used to visualise the design and validate the layout of the facility.
- Used for design reviews.
- Used as the basis for fabrication and construction documentation.
- Issued to contractors carrying out subsequent work on the facility.
- Received from multiple contractors and consolidated into a single 3D model irrespective of the engineering contractor(s) that have worked on the design.
- Efficiently maintained throughout the lifecycle of the facility.

Out of the scope of this specification are procedural steps for developing the 3D Model by Contractor, specific application tools for 3D model development, how Company maintains the 3D Model, and how it will be integrated with other software applications and data repositories.

This specification is not a replacement for contractor specific 3D model requirements for performing work execution.

Note: The term 3D model will refer to the facility 3D model in the remainder of this specification. If reference is made to other types of 3D models this made explicit.

1.2 Content

This document specifies the requirements for 3D model content, its representation method, and accuracy of the objects, including relationships with and references to disciplines. Both tagged and non-tagged objects are included from a 3D model content point of view. Elements that are included are generic in nature, irrespective of application areas.

It is assumed that users of this specification are familiar with the project and application-related terminology used in this specification. An example would be obstruction areas, which is commonly used concerning 3D model development.

The requirements are detailed categorized in five main sections being 3D Model Application (section 4), 3D Model Configuration (section 5), 3D Model Content (section 6),3D Model Review (section 7) and 3D Model Deliverables & Handover (section 8).

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Note: The development of this specification is being executed in an agile manner. This release is based on the knowledge and information available in the participating organisations at the time of its development but considered as minimum viable product with a view to continuously improve the content and level of details in future releases.

The FL3DMS project encourages all the users of this specification to suggest improvements to this specification. This can be done through a change request procedure. The change request procedure and the related form to submit change requests can be found here.

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2 References

2.1 Normative References

- **Capital Facility Information Handover Specification (CFIHOS)**: The aim is to offer practical standardized specifications for information handover that work for:
  - Anyone involved in designing, constructing, operating, maintaining, or decommissioning industrial facilities.
  - Everyone in the information supply chain – Operators, contractors and equipment manufacturers and suppliers.

  CFIHOS organizes data and documents in a structured way so users:
  - Have the information they need to operate, maintain and decommission a facility.
  - Can share information easily with other users/systems.
  - Can find information quickly.

  Elements relevant to this version of the FL3DMS 3D model specification include:
  - CFIHOS data model
  - CFIHOS Reference Data Library (RDL).

2.2 Informative References

- **ISO 10303**: Titled “Industrial automation systems and integration - Product data representation and exchange,” it is a standard for the computer-interpretable representation and exchange of industrial product data. The objective is to provide a mechanism capable of describing product data throughout the life cycle of a product, independent from any particular system. It is also known as STEP or the “Standard for the Exchange of Product model data.”

  For FL3DMS, **ISO 10303-21** that provides a data exchange form of STEP with an ASCII structure, is relevant.

- **ISO 15926**: It is titled: "Industrial automation systems and integration—Integration of lifecycle data for process plants including oil and gas production facilities." The purpose of ISO 15926 is to facilitate the integration of data to support production facilities' lifecycle activities and processes. Elements it provides that are relevant for FL3DMS include a conceptual data model for computer representation of technical information about process plants and a Reference Data Library (RDL).

- **ISO 16739**: Titled Industry Foundation Classes, it specifies a conceptual data schema and an exchange file format for Building Information Model (BIM) data. The conceptual schema is defined in EXPRESS data specification language or XML Schema definition language (XSD). Alternative exchange file formats may be used if they conform to the data schemas. It is a platform-neutral, open file format specification that is not controlled by a single vendor or group of vendors.

- **ISO 19650**: It is titled: “Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling.” The purpose of ISO 19650 is to provide recommendations for a framework to manage information, including exchanging, recording, versioning, and organizing for all actors. An interesting aspect of ISO 19650 is that it includes a lifecycle perspective regarding the detail, granularity, content, and structure of the engineering and design data, including 3D models.
  Note: The focus of this specification is on the 3D model requirements and not on the

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process of the development of the 3D model. It can be useful for actors involved in 3D modelling to combine the use of ISO 19650 and FL3DMS.

- **DEXPI P&ID Specification**: This specification by the DEXPI group (Data EXchange for the Process Industry) provides a general method for data exchange, data interoperability, and data integration for the process industry covering all phases of the lifecycle of a (petro-)chemical plant, ranging from specification of functional requirements to assets in operation. It covers both formats and content.

  The underlying DEXPI information model is a conceptual model that describes the objects that appear in a P&ID from an engineering point of view.

  P&ID's and 3D models are important elements in the development of facilities. The process-related objects represented in both models should be aligned.

  The DEXPI P&ID Specification is relevant for FL3DMS for cross-referencing purposes (e.g., in Digital Twin environments), cross-checking purposes, or object recognition purposes (creating object-oriented 3D model from point cloud from laser scanning).

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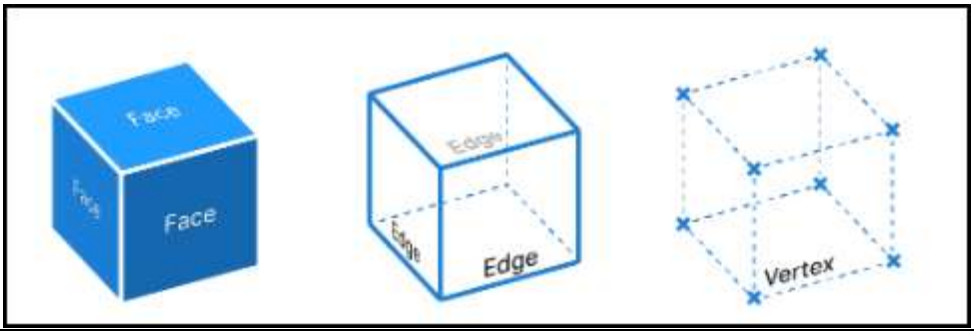
3 Abbreviations, Terms & Definitions

3.1 Abbreviations

Abbreviation	Description
3D-CAD	Three Dimensional Computer-Aided Design
b-rep	Boundary representation. A representation of a solid model that defines a product in terms of its surface boundaries that are faces, edges, and vertices 
CAD	Computer-Aided Design: The use of computers to aid in the creation, modification, analysis, or optimization of a design
CFIHOS	Capital Facilities Information Handover Specification. It aims to make information handover quicker, easier and safer for operators, contractors, equipment manufacturers, and suppliers by using standardized specifications and changing how projects and facilities manage their data. The goal of CFIHOS is to give you the tools to get the right information to start, operate, maintain
CoG	Centre of Gravity
DEXPI	Data EXchange in the Process Industry
EID	Equipment Interface Data
ENS	Engineering Numbering System
EPC	Engineering, Procurement, and Construction
FL3DMS	Facility Lifecycle 3D Model Standard. An industry-standard being developed to improve how 3D models are developed, integrated, handed over, and maintained during the lifecycle of a facility to optimize the return on the investment in a 3D model
GA2D	General Arrangement Drawing
GA3D	General Arrangement 3D Model (3D geometry coming from vendor CAD application – vendor 3D model)
HVAC	Heating, Ventilation and Air-Conditioning
IFC	Industry Foundation Classes (described in ISO 16739)
IOGP	International Association of Oil & Gas Producers: The petroleum industry's global forum in which members identify and share best practices to achieve improvements in health, safety, the environment, security, social responsibility, engineering, and operations
IP	Intellectual Property
MEL	Master Equipment List
MoC	Management of Change
MTO	Material Take-Off: Refers to a list of materials with quantities and types that are required to build a designed structure or element
NPD	Nominal Pipe Diameter
PCS	Plant Coordinate System
PO	Purchase Order
RDL	Reference Data Library

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Abbreviation	Description
SDI	Supplier Document Instruction
SIRL	Supplier Information Requirements List
STEP (STP)	Standard for the Exchange of Product model data (described in ISO 10303)
USPI(-NL)	Uitgebreid Samenwerkingsverband ProcesIndustrie-Nederland. USPI-NL is a non-profit association. The mission of USPI is to enable companies in the process industries to share and/or exchange electronically the information needed to design, build, operate and maintain process and power plants using internationally accepted standards

3.2 Terms & Definitions

Term	Description
3D datum point	A fixed reference point in the 3D model which is aligned with a real world location
3D model	A three-dimensional representation of an object or a group of objects
3D modelling software	A class of 3D computer graphics software used to produce 3D models
As-built tolerance	Deviation between the actual installation/assembly position of an object compared to the object's position in the 3D Model
Battery limit	A defined boundary between two areas of responsibility, which could be physical (i.e., flange on pipe) or represented by a map coordinate
Clash	The result of two elements in the design taking up the same space
Company	The legal entity ordering the delivery of the 3D Model (s) from Contractor
Computer-Aided Design	The use of computers to aid in the creation, modification, analysis, or optimization of a design
Contractor	The legal entity delivering the ordered 3D Model to Company
Element	Object (solid and soft volumes) included and visualized in the 3D Model that forms part of the integrated design
Engineering Numbering System	The system that allows for identification of the objects being engineered
EPC contractor	An EPC contractor is made responsible for all the activities from design, procurement, construction to commissioning and handover of the Project to the End-User or Owner
Exact geometry	The representation with a level of detail that matches the geometry of the object represented by the 3D Model as closely as possible
Execute phase	The project phase where detailed design, procurement, fabrication and construction takes place.
Faceted	Models which consist of groups of polygons which is often triangles.
Facility	Process and utility plants, tanks, buildings, marine structures, pipe racks and roads located within a site boundary. For example, a refinery

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Term	Description
Facility 3D model	3D model at facility level to be delivered by Contractor to Company based on the requirements defined in this specification
Facility project	Project to develop a facility or considerably modify the facility
Field weld	Weld made at a location other than a shop or the place of initial construction
Formal model review	A review of the 3D model between Contractor and Principal at the milestone of 30%, 60% or 90% progress as applicable and in accordance with the contract
GA Package	One document or information bundle contains EID, GA2D and GA3D files
Generic geometry	The representation with the minimum level of detail that allows the identification of the objects and critical interfaces.
Incremental numeric identification	Method through which unique identifiers are created for objects based on incrementing a number used for the unique identifier each time a new object is added.
ISO metric units	Derived from a system of measurement that is a decimal system based on the International System of Units.
Layout	One or more of the following deliverables: site master plan, plot plans and mechanical general arrangement drawings
Material Take-Off	Refers to a list of materials with quantities and types that are required to build a designed structure or element
Mechanical General Arrangement Drawings	Overall spatial arrangement of equipment within the available unit boundaries
Native File	Elaboration: Various File with format as used in vendors 3D model
Navisworks	Elaboration: NWD Autodesk Navisworks. File type .NWD, without expiry dates or any password protection, version used shall be documented.
Non-tagged objects	Objects to which no tag is assigned following the naming convention in accordance with Project's Engineering Numbering System (ENS)
Parasolid	Elaboration: Text (.x_t) Parasolid is a geometric modelling kernel owned by Siemens PLM Software (formerly UGS Corp.), that can be licensed by other companies for use in their 3D computer graphics software products. (Binary (.x_b) – is not accepted) Parasolid file (x_t) should be saved in scheme 34 or lower.
Plot plan	Overall spatial arrangement drawing of one or more units and related general facilities within a plot boundary, showing the arrangement of equipment within units
Project	A project is a set of tasks which must be completed in order to arrive at a deliverable. In the context of this standard Project is defined as the project for which this specification is used
Purchaser	Company or Contractor purchasing a skid or package

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Term	Description
Shop weld	Weld made in the workshop before delivery to the construction site
Shrink Wrapped	A method of simplification of a 3D model
Site	Plot of land with defined boundaries
Soft volumes	Volumes in the 3D Model representing reserved areas such as personnel access, escape- and equipment maintenance requirements. During normal operation, soft volumes will be free of obstructions
STEP	Elaboration: STEP (stp) In accordance with NS-ISO 10303 (all parts), STEP Files shall be AP-242. Use of newer application protocols shall be clarified with Purchaser See link
Sub- Contractor	A legal entity delivering part of the facility to Contractor. The related scope may include 3D model scope or a complete 3D model
Tag	A unique functional identifier in the facility, which is a keyword, number or label that is assigned for identification and reference purposes
Tagged object	Object to which a tag is assigned following the naming convention in accordance with Project's Engineering Numbering System (ENS)
Tessellation	A pattern of repeating shapes that fit together perfectly without any gaps or overlaps.
Top tag	Skids tag name containing sub-skids or sub-tags
Uitgebreid Samenwerkingsverband ProcesIndustrie-Nederland	USPI-NL is a non-profit association. The mission of USPI is to enable companies in the process industry to share or exchange electronically the information needed to design, build, operate and maintain process and power plants using internationally accepted standards
Vendor Package / Skid	A vendor package or skid is an assembly of more than one equipment, tag or product and is delivered as one or more units, normally designed and delivered by the contractor's vendor of the skid.

3.3 File formats for Vendor Packages/Skids

File Format	Elaboration	Notes
STEP	STEP (stp)	In accordance with NS-ISO 10303 (all parts), STEP Files shall be AP-242. Use of newer application protocols shall be clarified with Purchaser See link
Parasolid	Text (.x_t)	Parasolid is a geometric modelling kernel owned by Siemens PLM Software (formerly UGS Corp.), that can be licensed by other companies for use in their 3D computer graphics software products. (Binary (.x_b) – is not accepted) Parasolid file (x_t) should be saved in scheme 34 or lower.
IFC	IFC (ifc)	Industry Foundation Classes. IFC2X3 Schema or newer if available, see NS-EN ISO 16739-1 See link
Native File	Various	File format that the vendor package/skid was originally created in
Navisworks	NWD	Autodesk Navisworks. File type .NWD, without expiry dates or any password protection, version used shall be documented.

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4 3D Model Application

a. [FSP001-0089-01] The 3D modelling application to be used by the Contractor shall be a multi-discipline design tool that meets the requirements of this specification, including interference checking, drawing and report creation, material procurement details and quantities.
b. [FSP001-0090-01] Contractor shall provide details of the application and version of software to be used for the project prior to start of work.
c. [FSP001-0091-01] Contractor shall provide details of the 3D model database naming convention to be applied to the project prior to start of work.
d. [FSP001-0092-01] Contractor shall provide details of the supporting reference data to be used on the project, e.g. catalogues and specifications for piping, steel, cable tray, etc.
e. [FSP001-0093-01] Contractor shall provide details of any workshare and division of work.
f. [FSP001-0193-01] Contractor shall provide details of the units of measure used for Nominal Pipe Diameter and dimensions.

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5 3D Model Configuration

5.1 Configuration

5.1.1 Plant Grid System and Datum Point

[FSP001-0001-01] The overall plant grid lines/system(s) developed by Contractor and approved by Company during project execution shall be defined in the 3D Model.

[FSP001-0002-02] The 3D Model shall use a Plant Coordinate System (PCS) and orientation, which has been agreed upon with Company. The datum point for PCS is also known as project datum or site datum. Additional local reference coordinate systems and respective datum points can be used for specific situations, readouts, deliverables and facilitate the modelling tasks.

[FSP001-0003-02] Each 3D datum point shall be related to the real-world coordinate system.

[FSP001-0004-02] The Contractor shall document each 3D datum point.

[FSP001-0005-02] The axis convention for the positive direction shall be East, North, and up.

[FSP001-0006-01] The coordinates in the 3D Model shall be consistent with the datum coordinates shown on the facility's plot plan.

5.1.2 Language Characters

[FSP001-0007-01] Characters used in the 3D Model shall be in accordance with the governing procedure and language agreed upon for the Project.

5.2 Naming Conventions

5.2.1 Tagged Objects

[FSP001-0008-01] All tagged objects shall follow the naming convention in accordance with Project's Engineering Numbering System (ENS).

5.2.2 Non-Tagged Objects

a. [FSP001-0009-02] For non-tagged objects, Contractor shall submit a naming convention for agreement with Company.

b. [FSP001-0010-02] For non-tagged items, the naming convention shall be applied consistently throughout the Model.

c. [FSP001-0011-02] Each non-tagged item shall be assigned a unique identifier.

d. [FSP001-0013-02] The unique identifier for non-tagged items shall not be based on a method using incremental numeric identification.

e. [FSP001-0094-01] The name of any non-tagged objects that are deleted from the model, shall not be re-used for new content.

5.2.3 Discipline Code

[FSP001-0014-01] Discipline codes used by Contractor in the 3D Model shall be in conformance with CFIHOS RDL unless otherwise instructed by Company.

5.2.4 Plant Breakdown Structure and Area Coding

a. [FSP001-0015-02] Contractor shall base the Plant Breakdown Structure on CFIHOS unless instructed otherwise by Company.

b. [FSP001-0016-01] Area codes in the 3D Model shall be in accordance with Project's ENS.

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5.3 Hierarchy

a. [FSP001-0017-03] Contractor shall define and execute a 3D model hierarchy such that there is clear alignment with the plant breakdown structure defined in section 5.2.4.

b. [FSP001-0018-02] The 3D model hierarchy shall be representative of the physical plant.

c. [FSP001-0019-02] Users shall be able to find objects and groups of objects based on the 3D model hierarchy.

d. [FSP001-0020-02] Users shall be able to identify the objects within specific volumes.

e. [FSP001-0095-01] The Hierarchy shall remain consistent through the asset lifecycle.

f. [FSP001-0096-01] Contractor shall seek approval from Company before adding, changing or deleting items in the Hierarchy.

5.4 Tagged Objects

a. [FSP001-0021-02] All tagged objects shall hold a position, geometry, and orientation according to section 5.1.1.

b. [FSP001-0022-01] Object datum points for tagged objects in the 3D Model shall be located such that they provide correct dimensional measures when shown on a general arrangement drawing or equipment layout drawing.

c. [FSP001-0023-01] For tagged objects that are modelled from vendor documentation (e.g., catalogues that do not contain datum positions), the location of the datum coordinates shall be according to the Contractor's guideline that covers standard shapes.

d. [FSP001-0024-02] For tagged objects that are not modelled from vendor documentation, the datum coordinates shall be a fixed point on the object or the centre of the object.

e. [FSP001-0025-01] Tagged mobile equipment without a fixed position, but located onboard/inside the facility asset battery limits, shall be placed in the storage position in the 3D Model.

5.5 Requirements for Soft Volumes

5.5.1 Introduction

The requirements in section 5.5 use soft volumes to represent areas in the facility that will be empty during normal operation.

5.5.2 General Requirements

a. [FSP001-0028-02] Soft volumes shall be made visible by turning the related level of detail within the 3D Model software on and off.

b. [FSP001-0097-01] Soft volumes shall be included in the clash/interference checking process.

5.5.3 Escape and Access Routes

Escape and Access routes shall be represented in the 3D Model as soft volumes with at least two equipment primitive boxes as follows:

a. [FSP001-0029-02] An opaque footprint box with height 20 mm above the top of the deck or finished floor level

b. [FSP001-0030-02] A headroom box with 50% transparency above the footprint box with the escape route's actual height

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c. [FSP001-0031-02] The footprint box and headroom box are of the same width and length.

5.5.4 Muster and Assembly Points

Muster and Assembly points shall be represented in the 3D Model as soft volumes with at least two equipment primitive boxes as follows:

a. [FSP001-0098-01] An opaque footprint box with height 20 mm above the top of the deck or finished floor level

b. [FSP001-0099-01] A headroom box with 50% transparency above the footprint box with the muster and assembly point's actual height

c. [FSP001-0100-01] The footprint box and headroom box are of the same width.

5.5.5 Maintenance and Access Volumes

a. [FSP001-0085-01] Elements representing maintenance and access volumes shall be identified as soft volumes with a 50% transparency.

b. The maintenance and access volumes reserve space for:

1. [FSP001-0032-02] Personnel access to operate/maintain equipment
2. [FSP001-0033-02] Removal/extraction volumes
3. [FSP001-0034-02] Equipment laydown areas.

5.5.6 Fire Water Nozzle Coverage Elements

[FSP001-0035-02] The volume and area covered by a fire water nozzle shall be indicated as soft volumes that are represented in the 3D Model as cone and pyramid graphical elements.

5.5.7 Coverage and Line of Sight

[FSP001-0036-01] Soft volumes representing the coverage shall be included where equipment functionality requires line of sight.

Note: Examples of soft volumes covering line of sight include CCTV cameras, fire and gas detectors, and nodes in a Wi-Fi network.

5.5.8 Crane Radius

[FSP001-0037-01] Design elements used to represent the radius of movement of a crane in the facility shall be included as soft volumes.

5.5.9 Moveable and Material Handling Equipment

a. [FSP001-0038-02] Soft volumes covering the complete range of moveable and material, including locations where moveable equipment is used, handling equipment shall be included.

b. [FSP001-0039-02] If moveable equipment already exists in the as-built 3D Model, all updates shall be based upon existing coordinates.

5.5.10 Temporary Objects

a. [FSP001-0040-01] Temporary objects, e.g., representing studies during design or temporary construction objects, shall be identifiable.

b. [FSP001-0041-01] It shall be possible to switch temporary objects on and off during model review.

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5.5.11 Hazardous Area Zone

[FSP001-0101-01] Soft volumes representing hazardous area zones shall be included in the model identifying the area classification.

5.5.12 Cable Ladders/Trays

a. [FSP001-0191-01] The cable ladder/tray design shall include a soft volume above the opening to ensure clearance is available for pulling and dressing cables.

b. [FSP001-0192-01] The cable ladder/tray design shall include nodes and segments for integration with cable management applications for routing cables and estimating cable lengths.

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6 3D Model Content

6.1 3D Model Content Requirement Matrix

[FSP001-0042-02] A matrix for 3D Model content is provided as a separate deliverable of FL3DMS. Company shall instruct which content requirements shown in the matrix shall be fulfilled within the 3D Model.

Note: The list of content requirements is comprehensive but is not fully exhaustive. It contains a detailed and an aggregated level of requirements. It is the responsibility of Company to identify the 3D model content required for its project. The scope of model content should be based on the requirements for construction of the project and future use of the 3D model for the lifecycle of the facility.

The matrix for 3D Model content addressed in this section is available in F-CR-001 FL3DMS 3D Model Content Requirement Matrix.

For further details of the ‘Exact/Generic Geometry’ and ‘As-built Tolerance’, refer to Sections 6.3 and 6.4.

6.2 3D Model - General Requirements

The following general requirements shall apply:

a. [FSP001-0043-02] The complete scope of work shall be represented by one consolidated 3D model.

b. [FSP001-0045-02] A native 3D model shall be based to catalogues and specifications.

c. [FSP001-0046-02] The 3D Model shall be updated to as-built status as defined in 8.4 a2.

6.3 Object Representation in the 3D Model

a. [FSP001-0047-02] All objects shall be represented as geometric objects either with an exact geometry or a generic geometry (see section 3.2) for the type of object in the 3D model content-related requirement matrix in section 6.1.

b. [FSP001-0048-01] The dimension of an object modelled with a generic geometry shall represent the maximum dimension of that object to allow for clash checking.

c. [FSP001-0049-01] Equipment elements including more than one tag number shall be modelled as separate objects.

d. [FSP001-0050-02] All objects, except soft volumes, shall be visible by default in the graphical environment.

e. [FSP001-0102-01] Insulation, personnel protection and coatings shall be represented in the 3D model and included in the clash checking process.

f. [FSP001-0103-01] Insulation, personnel protection and coating volumes shall be made visible by turning the related level of detail within the 3D Model software on.

6.4 Handover and As-built

6.4.1 Selection of 3D Model Handover and As-built requirements

NOTE for reader – select the appropriate handover requirements. Dependent on its selected 3D Model use-cases, Company shall define which of the following as-built options shall be

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used, and which of the associated requirements shall apply, in accordance with below guidance.

1. The Study Phase or **Front-End Engineering 3D Model** shall be handed over in compliance with requirements c, d, e, f, g. This option is suitable for handovers between project phases, and enables reuse of model in the next project phase to avoid rework.

2. The Execute Phase 3D model shall be handed over **As Designed** which in compliance with requirements a, b, c, d, e, f, g. This option is suitable for final handover at end of execute phase for process facilities that do not handle hazardous substances

3. The Execute Phase 3D model shall be handed over **Logically Accurate** for process equipment which in compliance with requirements a, b, c, d, e, f, g, h, i. This option is suitable for final handover at end of execute phase for process facilities handling hazardous substances, requiring safety study (e.g. HAZOP) compliance verification.

4. The Execute Phase 3D model shall be handed over **Dimensionally Accurate** in compliance with requirements a, b, c, d, e, f, g, h, i, j, k. This option is suitable for final handover at end of execute phase for process facilities handling hazardous substances requiring HAZOP compliance verification and remote engineering support enablement.

Additional guidance and considerations for the identification of As Built requirements by Owner/Operators can be found in the F-GU-002 FL3DMS Implementation Guide for Principal.

6.4.2 3D Model Handover and As-built 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.

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.

c. [FSP001-0106-01] Space reservations for future content shall be retained in the model.

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.

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.

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.

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.

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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.

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.

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.

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.

6.5 Vendor Packages

a. [FSP001-0052-02] Objects that represent packaged equipment and skids in the 3D Model shall be modelled with the same level of detail as is applied outside of packaged equipment and skid boundaries.

b. [FSP001-0053-02] In the final handover model, all tagged and non-tagged objects shall be included in the 3D Model as objects with generic or exact geometry indicating "as-built" location as defined in the 3D model content requirement matrix in section 6.1.

c. [FSP001-0054-01] All interface points shall be aligned with the interface points from the remainder of the 3D Model.

d. [FSP001-0114-01] Vendor model imports shall result in a manageable representation, with constituent parts grouped together as opposed to multiple individual parts or one block representing the overall equipment.

e. [FSP001-0153-01] Prior to delivery, the Vendor shall ensure the model reflects the delivered equipment and drawings. If required, the Vendor shall move the model origin to reflect the drawings and other relevant information.

f. [FSP001-0154-01] Final version shall be an as-built and in operational state of the deliverables according to the requirements if otherwise is not agreed with purchaser.

6.5.1 General Arrangement Package (GA Package)

a. [FSP001-0115-01] For top tag equipment documentation (Vendor skid top tag), where a Vendor General Arrangement 3D model (GA3D) is required, a GA Package type document bundle shall be established and delivered according to project requirements.

b. [FSP001-0116-01] Each delivery shall have a unique document number and revision.

c. [FSP001-0117-01] The GA Package shall include the following files:

- Equipment Interface Data (EID file)
- Vendor 2D general arrangement drawings (GA2D files)
- Vendor 3D general arrangement model (GA3D file)

d. [FSP001-0131-01] Each GA Package shall only contain required deliverable based upon 1 skid or top tag.

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6.5.2 Equipment Interface Data (EID File)

a. The equipment interface data file shall contain the following:
   1. [FSP001-0118-01] Information regarding nozzle position and orientation relative to Skid datum.
   2. [FSP001-0119-01] Information regarding Nozzle size and specification relative to Skid datum.
   3. [FSP001-0120-01] Skid tag index, listing of all tags and positions on the vendor skid (See section 6.5.8).
   4. [FSP001-0121-01] The skids datum point (See section 6.5.7).
   5. [FSP001-0122-01] The skids Dry and Wet Centre of Gravity (CoG) position relative to the datum point.
   6. [FSP001-0123-01] Other suitable tabular digital data submission agreed with the purchaser.

b. [FSP001-0124-01] The Equipment Interface Data (EID file) shall be submitted as a supplied template excel file or in any other method agreed with the purchaser.

6.5.3 Vendor 2D general arrangement drawing (GA2D file)

a. The following shall be included on the GA2D file:
   1. [FSP001-0125-01] Information regarding nozzle position and orientation
   2. [FSP001-0126-01] Information regarding Nozzle size and specification
   3. [FSP001-0127-01] Location of the Skid Datum point (See section 6.5.7)
   4. [FSP001-0128-01] Location of the Dry and Wet CoG position relative to the Skid Datum point

b. [FSP001-0129-01] Shims (or space for-) shall not be included in the measured, nominal, arrangements on GA2D drawings, but only be included as part of a support figure to illustrate its layout and how it fits into the installation.

6.5.4 Vendor 3D general arrangement model (GA3D file)

a. [FSP001-0130-01] For submission of multiple GA3D files that belong in the same GA Packet, i.e. as sub-components of a top tag, all GA3D files shall be included into the same document and have the same relative assembly position for each model so that reassembly can be reestablished.

b. [FSP001-0132-01] Vendor neutral GA3D model file for Multi-discipline vendor model shall be split into discipline models if not other subdivision is agreed with purchaser.

c. [FSP001-0133-01] Vendor GA3D model for large assemblies or module skids, shall be split into smaller models, i.e. split into discipline models if not other subdivision is agreed with purchaser.

6.5.5 Handover formats for the GA3D model file

The vendor shall deliver the following files to the purchaser:

a. [FSP001-0134-01] The GA3D vendor models shall be delivered in the neutral STEP format if not otherwise agreed with the purchaser.

   NOTE: See section 3.3 File formats for Vendor Packages/Skids.

b. [FSP001-0135-01] The GA3D vendor models native format shall be delivered if not otherwise agreed with purchaser.

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c. [FSP001-0136-01] A complete 3D model assembly of vendor's scope of work in a review model format, without expiry dates or any password protection, tool version used shall be documented and agreed with Company..

6.5.6 Vendor 3D model content

a. [FSP001-0137-01] All GA3D models shall contain all permanent content of the designed equipment or top tag (main tag, see also section 6.5.8 Tag Index), including enclosures and any content from sub-vendors.

b. [FSP001-0138-01] All GA3D models shall reflect the operating status of the equipment.

c. [FSP001-0139-01] The GA3D models shall be exported directly from the model's Source authoring system.

d. [FSP001-0140-01] All GA3D models shall contain names of all parent tags and child tags located on the skid.

e. [FSP001-0141-01] All tagged items in GA3D models shall be identified and named in accordance with the facility tagging specification.

f. [FSP001-0142-01] All GA3D models shall not contain support shims (or space for-) or any other non-nominal content not part of the permanent installation of the top-tag.

g. [FSP001-0143-01] All GA3D models shall not contain elements intended for installation only (i.e. lifting slings, transportation supports).

h. [FSP001-0144-01] All GA3D models shall not contain elements outside of Vendor scope.

i. [FSP001-0145-01] All GA3D models shall not contain elements intended for maintenance, no-go areas or removal volumes.

j. [FSP001-0146-01] All GA3D models shall not contain any temporary elements or volumes.

k. [FSP001-0147-01] The GA3D models shall not include text elements created as model primitives, e.g. typical signs on doors and fabricator names.

l. [FSP001-0148-01] Vendor may remove intellectual property (IP) design or geometry representing internal details from the GA3D model, except where information is required for securing interfaces and/or material handling/access.

6.5.7 Datum Point

a. All GA Package files shall include or have reference to:

   1. [FSP001-0149-01] A Datum Point / origin in a physically measurable point, to be agreed on the GA2D, prior to formal submissions of the GA Package.

   2. [FSP001-0150-01] Contain local axis system (Origin at Datum Point, where orientation, if looking in positive Y, Z = UP and Positive X = RIGHT, i.e. right-handed Cartesian coordinate system).

b. [FSP001-0151-01] The datum point shall be defined in the 3D model with the exact same coordinates as shown on drawings and other relevant documentation.

c. [FSP001-0152-01] If the 3D model is divided in smaller models or into separate discipline models, the suppler shall ensure that all sub-models have the same datum point.

6.5.8 Tag Index

a. [FSP001-0155-01] All tags shall be listed with relative coordinates to skid datum point.

b. [FSP001-0193-01] The following physical tag hierarchy shall be applied:

Main tag	Skid/Package tag

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Parent tag	Parent to tag
Tag	Actual tag

c. [FSP001-0156-01] For a sensor in a junction box on a motor in a skid, the following relation shall apply:(Sensor on a Junction box on a Motor on a Skid)

Main tag	Skid tag
Parent tag	Junction box
tag	Sensor

d. [FSP001-0157-01] For the junction box on a motor, the following relations shall apply: (Junction box on a Motor on a Skid)

Main tag	Skid tag
Parent tag	Motor
Tag	Junction box

e. [FSP001-0158-01] For the motor, the following relation shall apply: (Motor on a Skid on a Skid)

Main tag	Skid tag
Parent tag	Skid tag
Tag	Motor

6.5.9 Large Assemblies

[FSP001-0159-01] For very large assemblies (i.e. modules) with multiple top tags (multiple GA Packets), a special coordinate reference system shall be agreed with the purchaser on a case-by-case basis, prior to formal submission.

NOTE: This can be based on local Datum Points, referencing a common Assembly Datum Point. This is required to be able to reassemble all equipment in their correct relative position to each other, in case where local Datum Points are required for referencing i.e. nozzles and other internal coordinates

6.5.10 File Size

a. [FSP001-0160-01] The vendor model neutral file size should not be more than 200 Mb.

b. [FSP001-0161-01] In cases where the complete model cannot be transferred in one file, it shall be divided into more files.

c. [FSP001-0162-01] The origin and coordinate system shall be the same for all part models.

d. [FSP001-0163-01] Native files shall be delivered as used by vendor according to content requirements.

6.5.11 Geometric Quality

The following requirements apply to maintain the geometrical quality for a GA3D file:

a. [FSP001-0164-01] 3D model shall contain solid elements only (not surfaces or wireframe) whenever possible.

b. [FSP001-0165-01] 3D models shall not be “Shrink Wrapped” for simplification before transfer.

c. [FSP001-0166-01] The function “remove internal faces” (or similar) shall be used with care and only with internal design to be removed or simplified.

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NOTE: As these may make the models look okay when shaded and viewed from standard directions but can break up b-rep models making them open-shells.

d. [FSP001-0167-01] Only primitive solid type geometry elements shall be used.

e. [FSP001-0168-01] Tessellated or facetted geometry shall not be used.

6.6 Laser and Photogrammetry Survey Data

a. [FSP001-0055-01] Where a laser and photogrammetry survey has been conducted, the deliverables generated shall be converted by the Contractor into the point cloud format compatible with the applicable 3D model software agreed to be used for the Project by Company and Contractor.

b. [FSP001-0056-01] The point cloud's coordinate system and orientation shall be in accordance with the 3D Model coordinate system unless instructed otherwise by Company.

c. [FSP001-0057-01] The point cloud and photogrammetry data shall be in layers which can be turned on and off.

6.7 Model Attributes

a. [FSP001-0058-01] Company Attributes shall be set on all objects as instructed by Company.

b. [FSP001-0059-03] The Attributes in F-SP-003 FL3DMS Data Model shall be set when a new object is created.

c. [FSP001-0060-01] Referential integrity for attributed data shall be maintained throughout the information management system in which the 3D Model is used or developed.

Note: As an example, the value of attributes shall be referenced from the corresponding tag or drawing number in the central tag and document database(s).

d. [FSP001-0061-01] For post-start-up (brownfield) modifications, all changes in the Model shall reference the number associated with the approved change according to the Management of Change (MoC) procedure.

e. [FSP001-0169-01] Contractor shall base the Tag Status attribute code on CFIHOS Engineering status code, unless otherwise instructed by Company.

f. [FSP001-0170-01] The Contractor shall lock the object to restrict further modification once the design has been approved for fabrication or construction.

6.8 Construction Support

6.8.1 Work Face Planning

a. [FSP001-0171-01] If the Advance Work Packaging (AWP) process, or similar, is applied to the project, the division of work shall be contained within the 3D model.

b. [FSP001-0172-01] If the Advance Work Packaging (AWP) process, or similar, is applied to the project, the extent of data stored within the 3D model shall be defined within a supporting data specification document providing the complete scope of data required for construction, identifying what data resides in the 3D model.

c. [FSP001-0173-01] The construction work area breakdown shall not be used as the basis for the 3D model hierarchy, although it may be used as a secondary hierarchy if the CAD application allows.

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6.8.2 4D Models

4D modelling is the process where 3D models are linked with time management capabilities such as schedules, sequences, duration, and milestones, allowing project stakeholders to visualise and analyse construction sequences, recognise potential conflicts, and make more informed decisions throughout the building process.

a. [FSP001-0174-01] If a 4D model is to be used to support construction planning and progress, the 3D model content shall include suitable data to enable linking to relevant tasks in the execution schedule.

b. [FSP001-0175-01] The 3D model shall include data to enable individual items to be linked to procurement and logistics applications for verification of adherence to the project schedule.

6.9 Integrity Management

NOTE for reader – select the appropriate facility integrity management data handover requirements for the 3D Model. This will depend on the overall facility integrity management data requirements and the subset to be included in the 3D Model, bearing in mind that such data requirements may be addressed in other datasets provided by Contractor.

a. [FSP001-0176-01] Company should identify facility integrity management data requirements to be provided by Contractor.

b. [FSP001-0177-01] Company should agree which of its integrity management data requirements are required to be included in the 3D model dataset by Contractor.

c. [FSP001-0178-01] The piping discipline shall assign and populate an attribute at the lowest part level of the piping hierarchy to facilitate the visualisation of corrosion points and loops.

d. [FSP001-0179-01] Inspection measurement points shall be located and identified in the 3D Model.

e. [FSP001-0180-01] Sacrificial anodes shall be located and identified to enable planning of inspections and regular replacement.

f. [FSP001-0181-01] Bolted joints shall be uniquely identified to record and maintain joint integrity records, such as torque data.

g. [FSP001-0182-01] Potential leak points identified by leak path analysis of the design shall be identified within the 3D model.

h. [FSP001-0183-01] Piping and equipment covered by insulation materials shall identified.

i. [FSP001-0184-01] Fire-proofing of onshore and offshore civil structures shall be identified

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7 3D Model Review

a. [FSP001-0185-01] The 3D model shall be subject to formal design and constructability reviews at designated points in the project, as agreed with Company.

b. [FSP001-0186-01] The Contractor shall state the purpose of each review prior to the event.

c. [FSP001-0187-01] The Contractor shall identify the 3D model content that is mature and will be included in each review.

d. [FSP001-0188-01] The Contractor shall have a formal review procedure to ensure every review is consistent.

e. [FSP001-0189-01] The Contractor shall have a process to ensure all review comments are captured and actioned.

f. [FSP001-0190-01] Attributed data shall be included in the formal review to ensure it is populated and consistent with other engineering applications.

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8 3D Model Deliverables & Handover

8.1 Reports Generated from the 3D Model

a. [FSP001-0062-02] All reports that are generated from the 3D Model shall not require any manual editing to the contained data.

b. [FSP001-0087-01] All reports that are generated from the 3D model shall be kept consistent with the 3D model.

Note: Such reports can be but are not limited to:

a. Modelled Object Status

b. Material Take-Off (MTO)

c. Clash statistics

d. Weight and Centre of Gravity

e. Battery Limit/Module Interfaces

f. Model quality verification reports

8.2 Drawings Generated from the 3D Model

a. [FSP001-0063-01] For all drawings that are generated from the 3D Model, enhancements of content and additional annotation shall not compromise the single source of truth of the 3D Model.

b. [FSP001-0088-01] All drawings that are generated from the 3D model shall be kept consistent with the 3D model.

See F-SP-003 FL3DMS Deliverables List for an extensive list of potential drawings and other deliverables to be generated from the 3D Model.

8.3 Clash Status

a. [FSP001-0064-01] The final handed-over 3D model shall be clash-free.

b. [FSP001-0065-01] Contractor shall include clash management detail in its 3D modelling work procedure as part of the Contractor's overall project implementation plan.

c. The clash management detail shall:

1. [FSP001-0066-01] Contain the methodology for identifying, allocating, and resolving clashes to deliver a clash-free design.

2. [FSP001-0067-01] State when the clash system is employed, the frequency of clash checks, and statistics to be reported to Company.

8.4 Handover: Format

On completion of all modelling, at the end of detailed design and construction phases of the Project,

a. Contractor shall handover to Company a 3D model:
   1. [FSP001-0068-01] Containing all 3D model databases/files and supporting reference data (e.g., piping/valve specifications, catalogues, and external references).
   2. [FSP001-0069-01] Updated to as-built status with all field modifications and changes in accordance with as-built content, object representation, and as-built tolerance requirements stated in this document, including the 3D model content-related requirement matrix referred to in section 6.1.

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3. [FSP001-0070-01] Such that the Model will open, function, and be editable with full intelligence on the same standard software and release the 3D Model was developed on without further development by Company.
4. [FSP001-0071-01] With all required detailed specifications (e.g., on the operating system, database, and software versions).
5. [FSP001-0072-02] With required instructions to restore the 3D Model within the Companies' environment (setup based on the specifications mentioned in 8.4 a4) for continued maintenance and support of the 3D Model.
6. [FSP001-0073-01] With additional specifications to incorporate the 3D Model into a different environment (using backup and restore procedures).
   Note: These specifications need to be agreed as part of the project-specific hand-over requirements between Contractor and Company.
7. [FSP001-0074-01] With the content and all required elements as specified in section 5.5.12.
8. [FSP001-0075-02] With content and related data quality validation checks performed and resolved.
9. [FSP001-0076-01] Without any database discrepancies.
10. [FSP001-0194-01] The 3D Model handed over to the operating asset owner shall be in a condition where it will open, function, and be editable with full intelligence in the same out-of-the-box application version from the same software vendor that the contractor used to design the 3D model. This includes reference catalogue and specifications, and any configurable files required to fully modify and edit the 3D model.

b. [FSP001-0078-01] The final 3D Model for handover shall not contain temporary objects that are not used for plant operation and maintenance.

8.4.1 Handover report

a. [FSP001-0079-02] A final handover report shall be provided to the Company.

b. [FSP001-0086-01] The final handover report shall include all of the following:

1. Final state of the model content;
2. Model configuration;
3. Restoring instructions;
4. Administrator username and password.

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

[FSP001-0080-02] The following drawings of the plant shall be provided to the Company:

1. Plant Breakdown Structure;
2. Illustrations of the geographical area;
3. Sub-area codes in plan and elevation, including coordinates and gridlines.

Note: Actual detail required will be outlined by Company.

8.4.3 Area and Sub-area Coordinates

[FSP001-0081-01] Area and sub-area coordinates shall be handed over in spreadsheet format containing the area's edges, boundaries, and borders.

8.4.4 3D Vendor Package Models

a. [FSP001-0082-02] Any vendor package 3D Models that were created using detailed Mechanical CAD applications shall be handed over to Company as separate models.

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b. [FSP001-0083-02] Vendor package 3D Models shall be handed over either in the native format or in a neutral file format agreed upon with Company.

8.4.5 Laser and Photogrammetry Survey Data

[FSP001-0084-01] Any point cloud/laser scan file generated during the Project shall be handed over to Company during handover according to Company procedure.

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