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Facility Lifecycle 3D Model Standard (FL3DMS)

Specification Document

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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 suppliers (incl. sub-contractors and/or packaged unit suppliers) as a practical standard.

This first version 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.

FL3DMS Participants

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AVEVA
Baker Hughes
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Bentley
Digital Construction Works
Equinor
ExxonMobil
Hexagon PPM
McDermott
Shell
Talent Swarm
Technip Energies
TotalEnergies

USPI Partners
DEXPI
IOGP-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 businesses.

In the remainder of this Introduction, the scope and intended use (section 1.1), and the content (section 1.2) of the specification are explained in more detail.

1.1 Scope & Intended Use

The name Facility Lifecycle 3D Model Standard indicated 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 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 necessarily 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. Reference to other 3D models is assumed to be clear based on the context or will be 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 three main sections being 3D Model Configuration in section 4, 3D Model Content in section 5, and 3D Model Deliverables & Handover in section 6.

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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..

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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 making, operating, maintaining, or decommissioning industrial facilities.
  - Everyone in the information supply chain – Operators, contractors and equipment manufacturers, and suppliers.

  It 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.

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- **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

	Description
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
DEXPI	Data EXchange in the Process Industry
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
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
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
RDL	Reference Data Library
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

	Description
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
Clash	A 'clash' is 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
Contractor	The legal entity delivering the ordered 3D Model (s) to Company

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	Description
Element	Object (solid and soft volumes) included and visualized in the 3D Model that forms part of the integrated design
EPC contractors	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
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
Generic geometry	The level of representation of the object should allow for identification of the object
Non-tagged objects	Objects not tagged following the naming convention in accordance with Project's Engineering Numbering System (ENS)
Project	The Project for which this specification is used
Shop weld	Weld made in the workshop before delivery to the construction site
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
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

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4 3D Model Configuration

4.1 Configuration

4.1.1 Plant Grid System and Datum Point

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

b. The 3D Model shall use a local coordinate system, which has been agreed upon with Company.

c. The 3D datum point shall be:

   1. Related to the real-world coordinate system.
   2. Documented by the Contractor.

d. The axes convention for the positive direction shall be East, North, and up.

e. The coordinates in the 3D Model shall be consistent with the datum coordinates shown on the facility's plot plan.

4.1.2 Language Characters

Characters used in the 3D Model shall be in accordance with the governing procedure and language agreed upon for the Project.

4.2 Naming Conventions

4.2.1 Tagged Objects

All tagged objects shall follow the naming convention in accordance with Project's Engineering Numbering System (ENS).

4.2.2 Non-Tagged Objects

a. Non-tagged objects are objects not tagged, based on the requirement in section 4.2.1. For non-tagged objects, Contractor shall submit a naming convention for agreement with Company.

b. The naming convention for non-tagged objects shall:

   1. Be homogeneous, logical, and consistent throughout the Model.
   2. Guarantee the uniqueness of the names.
   3. Be as clear and as explicit as possible.
   4. Avoid incremental numeric identification.

4.2.3 Discipline Code

Discipline codes used by Contractor in the 3D Model shall be in conformance with CFIHOS RDL unless otherwise instructed by Company.

4.2.4 Plant Breakdown Structure and Area Coding

a. Contractor shall base the Plant Breakdown Structure of CFIHOS unless instructed otherwise by Company.

b. Area codes in the 3D Model shall be in accordance with Project's ENS.

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4.3 Hierarchy

Contractor shall define and execute a 3D model hierarchy such that:

a. There is clear alignment with the plant breakdown structure defined in section 4.2.4.
b. It is representative of the physical plant.
c. Users can easily find objects and groups of objects.
d. Users can identify the objects within specific volumes.

4.4 Tagged Objects

a. All tagged objects shall hold a position, geometry, and orientation according to section 4.1.1.
b. 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. 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. For tagged objects that are not modelled from vendor documentation, the datum coordinates shall be logical and at least connected to or within the volume of the object.
e. 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.
f. The storage positions referred to in 4.4e shall be allowed for in the 3D Model.

4.5 Requirements for Soft Volumes

4.5.1 Introduction

The requirements in section 4.5 use soft volumes to represent areas in the facility that will be empty during normal operation.

4.5.2 General Requirements

Soft volumes shall be made visible by turning the related level of detail within the 3D model software on and off.

4.5.3 Escape and Access Routes

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

a. An opaque footprint box with height 20 mm above the top of the deck or finished floor level
b. A headroom box with 50% transparency above the footprint box with the escape route's actual height
c. The footprint box and headroom box are of the same width.

4.5.4 Maintenance and Access Volumes

Elements representing maintenance and access volumes shall be identified as soft volumes with a 50% transparency. These volumes reserve space for:

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a. Personnel access to operate/maintain equipment
b. Removal/extraction volumes
c. Equipment laydown areas.

4.5.5 Fire Water Nozzle Coverage Elements

Cone and pyramid graphical elements are placed in the Model to show the volume and area that a fire water nozzle covers and shall be identified as soft volumes.

4.5.6 Coverage and Line of Sight

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.

4.5.7 Crane Radius

Design elements used to represent the radius of movement of a crane in the facility shall be included as soft volumes.

4.5.8 Moveable and Material Handling Equipment

a. Soft volumes covering the complete range of moveable and material handling equipment shall be included.
b. If moveable equipment already exists in the as-built Model, all updates shall be based upon existing coordinates.

4.6 Temporary Objects

a. Temporary objects, e.g., representing studies during design or temporary construction objects, shall be identifiable.
b. It shall be possible to switch temporary objects on and off during model review.

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5 3D Model Content

5.1 3D Model Content Requirement Matrix

A matrix for 3D model content is included in this section. All content requirements mentioned in this matrix shall be fulfilled with the 3D Model.

For further details of the 'Exact/Generic Geometry' and 'As-built Tolerance', please refer to Sections 5.3 and 5.4.

The requirements addressed in this section are also available in a spreadsheet file that is part of the FL3DMS deliverables.

Table 5-1: Facility 3D Model Content Requirement Matrix

				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
1	Architectural	Architectural Engineering	Buildings and rooms	X		X	± 50	Size and location of rooms and location of doors
2	Architectural	Architectural Engineering	External and internal walls, ceilings, and floors	X		X	± 50	
3	Architectural	Architectural Engineering	Blast and fire ceilings, floors, doors, and walls	X		X	± 10	
4	Architectural	Architectural Engineering	Removable access/maintenance panels	X		X	± 50	
5	Architectural	Architectural Engineering	Internal stair and elevator cases	X	X		± 50	
6	Architectural	Architectural Engineering	All tagged architectural objects	X	X		± 50	
7	Architectural	Architectural Engineering	Weather cladding and louvres	X		X	± 50	
8	Architectural	Architectural Engineering	Potable water supply and sanitary sewer lines	X	X		± 50	
9	Architectural	Architectural Engineering	External and internal doors and windows	X		X	± 50	
10	Civil	Civil Engineering	Geotechnical site terrain	X	X		NA	Seabed for subsea installations Copy of selected information to be included in 3D Model (onshore and seabed contours, area borders, safety zones, etc.) where relevant
11	Civil	Civil Engineering	Foundations, embedment plates	X		X	± 10	
12	Civil	Civil Engineering	Access roads for maintenance and fire-fighting vehicles	X		X	± 250	
13	Civil	Civil Engineering	Construction routes	X		X	± 250	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
14	Civil	Civil Engineering	Jetties/marine facilities, rail loading facilities	X		X	± 250	
15	Civil	Civil Engineering	Piles, foundations, and concrete works	X		X	± 50	
16	Civil	Civil Engineering	Concrete slabs, wellpads, paving, and roads	X		X	± 250	
17	Civil	Civil Engineering	Mobile crane aprons	X		X	± 10	
18	Civil	Civil Engineering	Equipment foundations	X		X	± 10	
19	Civil	Civil Engineering	External walls	X		X	± 50	
20	Civil	Civil Engineering	Bund walls and decks	X		X	± 50	
21	Civil	Civil Engineering	Catch basins, manholes, hubs	X		X	± 50	
22	Civil	Civil Engineering	Pits, sumps, and stormwater or storage water ponds	X		X	± 250	
23	Civil	Civil Engineering	Trenches for underground piping	X	X		± 100	
24	Civil	Civil Engineering	Trenches for underground electric and instrument cables	X	X		± 100	
25	Civil	Civil Engineering	Underground sewer systems and collecting and separation systems	X		X	± 50	
26	Civil	Civil Engineering	Duct banks	X		X	± 50	
27	Civil	Civil Engineering	Tunnels	X		X	± 250	
28	Civil	Civil Engineering	Bridges	X		X	± 250	
29	Crane / Lift	Mechanical Engineering	Cranes, incl. platform cranes, crane radius, boom rests, crane capacity, and maintenance platforms	X		X	± 10	
30	Crane / Lift	Mechanical Engineering	Elevators	X		X	± 50	Permanent and temporary
31	Crane / Lift	Mechanical Engineering	Lifting, withdrawal, and material handling volumes	X		X	± 50	
32	Crane / Lift	Mechanical Engineering	Portable lifting gear storage	X		X	± 50	
33	Crane / Lift	Mechanical Engineering	Material handling equipment incl. monorails and padeyes and chain hoist	X		X	± 50	
34	Electrical	Electrical Engineering	Interfaces with existing facilities or third parties	X		X	± 100	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
35	Electrical	Electrical Engineering	All tagged electrical equipment	X		X	± 250	
36	Electrical	Electrical Engineering	Sub-stations and LER (Local Equipment Rooms)	X		X	± 50	
37	Electrical	Electrical Engineering	Transformers/rectifiers/bus ducts and anodes	X		X	± 250	
38	Electrical	Electrical Engineering	Above ground cable ladder and trays	X		X	± 100	
39	Electrical	Electrical Engineering	Underground cable routes, ladders, trays, conduit	X		X	± 100	
40	Electrical	Electrical Engineering	Deck/wall cable penetrations	X		X	± 100	
41	Electrical	Electrical Engineering	Cable ladder/trays supports	X		X	± 100	
42	Electrical	Electrical Engineering	Cathode protection above and under ground	X		X	± 100	
43	Electrical	Electrical Engineering	Electrical heat tracing boxes	X		X	± 250	
44	Electrical	Electrical Engineering	Equipment support	X		X	± 10	
45	Electrical	Electrical Engineering	Junction boxes	X		X	± 250	
46	Electrical	Electrical Engineering	Distribution panels	X		X	± 250	E.g. for lighting or convenience outlets
47	Electrical	Electrical Engineering	Push button stations, local panels and emergency stops	X		X	± 250	
48	Electrical	Electrical Engineering	Equipment and enclosures, high mast towers/poles for lighting	X		X	± 250	
49	Electrical	Electrical Engineering	Road and fence lighting system	X		X	± 250	
50	Electrical	Electrical Engineering	Lighting and lighting supports	X		X	± 250	
51	Electrical	Electrical Engineering	Socket outlets and welding sockets	X		X	± 100	
52	Electrical	Electrical Engineering	Earthing bosses/grids	X		X	± 100	
53	Maintenance and handling	Maintenance Management	Access/clearance/maintenance volumes	X		X	± 50	
54	Maintenance and handling	Maintenance Management	Area for future modules/equipment/risers/J-tube access (pull-in arrangement requirement)	X		X	± 50	
55	Maintenance and handling	Maintenance Management	Laydown areas and drop zones	X		X	± 50	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
56	Maintenance and handling	Maintenance Management	Reserved areas for maintenance	X		X	± 50	Simple shapes for equipment space allocation and future equipment
57	Maintenance and handling	Maintenance Management	Maintenance trolley routes	X		X	± 50	Simple shapes for equipment space allocation and future equipment
58	Maintenance and handling	Maintenance Management	Temporary refuge/muster points			X	± 50	
59	Maintenance and handling	Maintenance Management	Temporary structure for installation (bumpers, guides, access platforms, sling laydown, jacket buoyancy tanks, etc.)			X	± 50	
60	Maintenance and handling	Maintenance Management	Temporary structure for load out and transportation (load-out beams, skidding shoes, trailers, grillage, barge, and sea fastening)			X	± 50	
61	Maintenance and handling	Maintenance Management	Transportation access ways and volumes			X	± 50	
62	Maintenance and handling	Maintenance Management	Access routes	X		X	± 50	
63	HVAC	Heating, Ventilating, and Air Conditioning	Main equipment, e.g., AHU, Filters, etc.	X		X	± 50	
64	HVAC	Heating, Ventilating, and Air Conditioning	HVAC ducts and tagged inline objects, including inlet/outlets	X	X		± 100	For air intakes, ductwork and support designed by structural discipline shall follow structural requirements
65	HVAC	Heating, Ventilating, and Air Conditioning	HVAC access and maintenance envelopes	X		X	± 50	
66	HVAC	Heating, Ventilating, and Air Conditioning	Ducting supports	X		X	± 100	
67	Instrumentation	Instrumentation Engineering	All main equipment, e.g. Termination/system cabinets, analysers, etc.	X		X	± 250	
68	Instrumentation	Instrumentation Engineering	All field equipment	X		X	± 250	
69	Instrumentation	Instrumentation Engineering	Offline instrument stands & supports	X		X	± 250	
70	Instrumentation	Instrumentation Engineering	Reserved areas and view directions for Instruments			X	± 50	Simple shapes for equipment space allocation and future equipment
71	Instrumentation	Instrumentation Engineering	Instrument removal volume and control valve air receivers	X		X	± 50	
72	Instrumentation	Instrumentation Engineering	Instrument cable ladder, tray & supports	X		X	± 100	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
73	Instrumentation	Instrumentation Engineering	Tubing trays and supports	X		X	± 100	
74	Instrumentation	Instrumentation Engineering	Deck/wall cable & tube penetrations	X		X	± 100	
75	Instrumentation	Instrumentation Engineering	Junction boxes	X		X	± 250	
76	Instrumentation	Instrumentation Engineering	Push button stations, local panels and power housings	X		X	± 250	
77	Mechanical	Mechanical Engineering	All main equipment, e.g., compressors, pumps, vessels, tanks, furnaces, etc.	X		X	± 50	Connection points shall be positioned in the exact position
78	Mechanical	Mechanical Engineering	Analyser houses and shelters	X		X	± 250	
79	Mechanical	Mechanical Engineering	Built-in ladders/stairs/platforms for packaged equipment, equipment pulling areas and cranes operation radius	X		X	± 100	
80	Mechanical	Mechanical Engineering	Equipment casings	X		X	± 50	
81	Mechanical	Mechanical Engineering	Equipment pulling areas	X		X	± 50	
82	Mechanical	Mechanical Engineering	Inspection doors/manways (with door swing)	X		X	± 50	
83	Mechanical	Mechanical Engineering	Skirt access and vent holes	X		X	± 50	
84	Mechanical	Mechanical Engineering	Vessel fireproofing	X		X	± 50	
85	Piping & Layout	Piping Engineering	Battery Limits, property lines and/or plot limitations	X		X	± 100	
86	Piping & Layout	Piping Engineering	Interfaces and tie-ins with existing facilities or third parties	X		X	± 50	
87	Piping & Layout	Piping Engineering	Piping 2" and larger A/G piping	X		X	± 50	
88	Piping & Layout	Piping Engineering	Piping 3/4" – 2" A/G	X		X	± 50	
89	Piping & Layout	Piping Engineering	Critical piping routes, e.g. vents, flares, drains	X		X	± 50	
90	Piping & Layout	Piping Engineering	Piping inline elements, e.g., instruments, meter runs, special elements, etc. (including withdrawal volumes)	X	(X)	X	± 50	
91	Piping & Layout	Piping Engineering	Field welds	X		X	± 50	Updated to “as-built” status from construction red-line mark-ups
92	Piping & Layout	Piping Engineering	Corrosion inspection points	X		X	± 50	

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				Requirement	Object Representation			
Id No.	3D Discipline	CHIFOS Discipline (Level 1)	3D Model Content Requirement	As-built	Exact Geometry	Generic Geometry	As-built Tolerance (mm)	Comments
93	Piping & Layout	Piping Engineering	Insulation of piping, valves, and equipment	X	X		± 50	
94	Piping & Layout	Piping Engineering	Tubing (not including instrument tubing)	X		X	± 100	
95	Piping & Layout	Piping Engineering	Space allocation for risers and umbilicals, with pulling arrangement including winches and sheave	X		X	± 100	
96	Piping & Layout	Piping Engineering	Control valves with actuators	X	(X)	X	± 50	
97	Piping & Layout	Piping Engineering	Shutdown valves with actuators, e.g., ESDV's, BDV's, SDV's, etc.	X	(X)	X	± 50	
98	Piping & Layout	Piping Engineering	Pipe supports	X	(X)	X	± 250	
99	Piping & Layout	Piping Engineering	Deck/wall pipe penetrations	X		X	± 50	
100	Piping & Layout	Piping Engineering	Aboveground manhole vents	X		X	± 50	
101	Piping & Layout	Piping Engineering	All manifolds	X	(X)	X	± 50	
102	Piping & Layout	Piping Engineering	Drain boxes / gullies / tundishes	X	X		± 50	
103	Piping & Layout	Piping Engineering	Equipment acoustic enclosures	X	X		± 50	
104	Piping & Layout	Piping Engineering	Exhaust outlets. Location - personnel exposure/proximity to air intakes	X		X	± 250	
105	Piping & Layout	Piping Engineering	Firewater hydrants, monitors, and hose reels	X		X	± 250	
106	Piping & Layout	Piping Engineering	Flare exclusion zones	X		X	± 250	
107	Piping & Layout	Piping Engineering	Main equipment	X		X	± 50	
108	Piping & Layout	Piping Engineering	Measuring points	X		X	± 50	
109	Piping & Layout	Piping Engineering	Spading points including storage facilities and mechanical handling	X		X	± 50	
110	Piping & Layout	Piping Engineering	Sprinkler/deluge systems (including coverage volumes)	X		X	± 50	
111	Piping & Layout	Piping Engineering	Steam distribution/recovery stations (condensate return)	X		X	± 50	
112	Piping & Layout	Piping Engineering	Tap orientation for orifice flanges and venturis	X		X	± 50	

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				Requirement	Object Representation			
Id No.	3D Discipline	CHIFOS Discipline (Level 1)	3D Model Content Requirement	As-built	Exact Geometry	Generic Geometry	As-built Tolerance (mm)	Comments
113	Piping & Layout	Piping Engineering	Tote tank area. Hose connections and valve arrangement - functional from an operational perspective	X		X	± 50	
114	Piping & Layout	Piping Engineering	Utility (closed drain and potable water) & firewater piping	X		X	± 50	
115	Piping & Layout	Piping Engineering	Utility and sample stations	X	X		± 50	
116	Piping & Layout	Piping Engineering	Vessel trim and nozzles	X	X		± 50	
117	Piping & Layout	Piping Engineering	Risers	X	X		± 50	
118	Piping & Layout	Piping Engineering	Acoustic enclosures	X			± 50	
119	Safety	Health, Safety, Environmental, and Security	Alarms, e.g., Horns, Beacons, etc.	X		X	± 250	
120	Safety	Health, Safety, Environmental, and Security	Escape routes including emergency, egress & stretcher routes	X		X	± 250	
121	Safety	Health, Safety, Environmental, and Security	Fire and gas detectors and pushbuttons	X		X	± 50	
122	Safety	Health, Safety, Environmental, and Security	Line of sight gas detectors including volume for beams	X		X	± 50	
123	Safety	Health, Safety, Environmental, and Security	Fire fighting and safety equipment	X		X	± 250	
124	Safety	Health, Safety, Environmental and Security	Life boat stations	X		X	± 250	
125	Safety	Health, Safety, Environmental, and Security	Loose safety equipment (e.g. portable extinguishers, life rings, etc.)	X		X	± 250	
126	Safety	Health, Safety, Environmental, and Security	Safety Shower, eyewash stations	X		X	± 250	
127	Safety	Health, Safety, Environmental, and Security	Safety equipment supports			X	± 250	
128	Structural	Structural Engineering	Primary structure (including lifting nodes, joints, columns and braces, and no-go areas)	X	X		± 10	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
129	Structural	Structural Engineering	Secondary structure	X	X		± 50	
130	Structural	Structural Engineering	Stair towers, access platforms	X		X	± 50	
131	Structural	Structural Engineering	Ladders, stairs, platforms on vessels, including gate swing, lift bar	X		X	± 50	
132	Structural	Structural Engineering	Helideck	X		X	± 250	
133	Structural	Structural Engineering	Flare boom/tower and stack	X		X	± 50	
134	Structural	Structural Engineering	Caissons and guide-tube including support structure	X		X	± 50	
135	Structural	Structural Engineering	Chain tube, chain locker, and support for fairleads	X		X	± 50	
136	Structural	Structural Engineering	Communication towers/watch towers	X		X	± 50	
137	Structural	Structural Engineering	Crane support structure, pedestal, and boom rest	X		X	± 50	
138	Structural	Structural Engineering	Dropped object structure	X		X	± 50	
139	Structural	Structural Engineering	Pipe racks, bridges, sleepers	X		X	± 50	
140	Structural	Structural Engineering	Accessibility for blasting, welding, painting and coating	X		X	± 50	
141	Structural	Structural Engineering	All tagged structural objects	X	X		± 50	
142	Structural	Structural Engineering	Anodes	X		X	± 250	
143	Structural	Structural Engineering	Enclosures	X		X	± 50	
144	Structural	Structural Engineering	Equipment support Structures - Bracings	X		X	± 50	
145	Structural	Structural Engineering	Equipment support Structures - Main Steel	X		X	± 50	
146	Structural	Structural Engineering	External and internal structural walls (including firewalls, blast walls, and no-go areas)	X		X	± 10	
147	Structural	Structural Engineering	External railing and flexibarriers	X		X	± 50	
148	Structural	Structural Engineering	Fences/Boundaries/Gates	X		X	± 250	
149	Structural	Structural Engineering	Grounding	X		X	± 50	
150	Structural	Structural Engineering	Gusset plates	X		X	± 50	

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				Requirement	Object Representation			
Id No.	3D Discipline	CHIFOS Discipline (Level 1)	3D Model Content Requirement	As-built	Exact Geometry	Generic Geometry	As-built Tolerance (mm)	Comments
151	Structural	Structural Engineering	Inspection/maintenance hatches	X		X	± 50	
152	Structural	Structural Engineering	Insulation/ Fire Proofing	X		X	± 50	
153	Structural	Structural Engineering	Jacket	X		X	± 250	
154	Structural	Structural Engineering	Ladders, handrails & gratings	X		X	± 250	
155	Structural	Structural Engineering	Lifting points	X		X	± 50	
156	Structural	Structural Engineering	Module Lifting gear/beams Modeled including lifting wire clear zones and bumper wire guide as preliminary pending lifting Contractor input	X		X	± 50	
157	Structural	Structural Engineering	Mudmat	X		X	± 250	
158	Structural	Structural Engineering	Structural nodes and joint cans	X	X		± 10	
159	Structural	Structural Engineering	Outfitting structure	X	X		± 50	
160	Structural	Structural Engineering	Skirt piling	X		X	± 50	
161	Structural	Structural Engineering	Steel foundations	X		X	± 50	
162	Structural	Structural Engineering	Temporary Support Steel			X	± 50	
163	Structural	Structural Engineering	Structural support cabling	X		X	± 50	
164	Structural	Structural Engineering	Main welds, primary structure	X		X	± 10	
165	Structural	Structural Engineering	Non-welded connections	X		X	± 10	
166	Telecommunication	Telecommunications	All main equipment, e.g. Satellite dishes, antennas, termination/system cabinets, etc.	X		X	± 250	
167	Telecommunication	Telecommunications	Navigational aids	X		X	± 250	
168	Telecommunication	Telecommunications	Junction boxes	X		X	± 250	
169	Telecommunication	Telecommunications	PA/ GA speakers, beacons, CCTV, telephones	X		X	± 250	In Outdoor plant area only
170	Telecommunication	Telecommunications	Push buttons and local panels	X		X	± 250	
171	Telecommunication	Telecommunications	Wifi Access Ports (WAP)	X		X	± 250	

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				Requirement	Object Representation			
Id No.	**3D Discipline**	**CHIFOS Discipline (Level 1)**	**3D Model Content Requirement**	**As-built**	**Exact Geometry**	**Generic Geometry**	**As-built Tolerance (mm)**	**Comments**
172	Telecommunication	Telecommunications	Equipment supports/stands	X		X	± 250	
173	Telecommunication	Telecommunications	Telecom tray & supports	X		X	± 250	
174	Subsea	Subsea Engineering	Subsea structures	X	X		± 250	

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5.2 3D Model - General Requirements

The following general requirements shall apply:

a. The complete scope of work represented by one consolidated 3D model.

b. All objects according to the requirement matrix in section 5.1 are represented in the 3D Model.

c. A native 3D model mapped to catalogues and specifications.

d. The 3D Model is updated to as-built status as defined in 6.4 a2.

5.3 Object Representation in the 3D Model

a. 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 5.1.

b. The dimension of an object modelled with a generic geometry shall represent the maximum dimension of that object to allow for clash checking.

c. Equipment elements including more than one tag number shall be modelled as separate objects.

d. All objects shall be visible by default in the graphical environment.

5.4 As-built Tolerance

The as-built tolerance, as defined in the 3D model content requirement matrix in section 5.1, is indicative to the accuracy of the 3D model content in relation to the physical as-built position. If values are exceeded, the 3D model shall be updated unless instructed otherwise by Company.

NOTE: Brownfield modifications shall utilise scan technology to support the 3D model and identify the current physical status of the plant.

5.5 Supplier Packages/Vendor Engineering

a. Objects that represent packaged equipment and skids in the 3D Model shall be modelled with the same level of fidelity as is applied outside of packaged equipment and skid boundaries.

b. 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-related requirement matrix in section 5.1.

c. All interface points shall be aligned with the interface points from the remainder of the 3D Model.

5.6 Laser and Photogrammetry Survey Data

a. 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. The point cloud’s coordinate system and orientation shall be in accordance with the 3D Model coordinate system unless instructed otherwise by Company.

c. The point cloud and photogrammetry data shall be in layers which can be turned on and off.

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5.7 Model Attributes

a. Company Attributes shall be set on all objects as instructed by Company.

b. The Attributes in Table 5-2 shall be set when a new object is created:

Table 5-2: Model Attributes

Nr.	Attribute Name	Description
1	Project code	Project identifier
2	Project name	Project name
3	Site name	Site name
4	Site code	Site code
5	Plant name	Plant name
6	Plant code	Plant code
7	Tag name	Object tag name
8	Process unit code	Process Unit (System) code
9	Area code	Area code
10	Discipline code	Discipline code
11	Tag status	Object (Tag) status
12	Safety critical item indicator	Safety critical item indicator
13	Operating weight	Operational Weight
14	Dry weight	Dry weight
15	Centre of gravity x	The X-axis of the centre of gravity
16	Centre of gravity y	The Y-axis of the centre of gravity
17	Centre of gravity z	The Z-axis of the centre of gravity
18	Commissioning unit code	Commissioning unit code
19	Construction assembly code	Construction work pack
20	Construction work area	Construction work area
For Piping, HVAC, Supports:		
21	Piping/HVAC line number	Piping/HVAC line number
22	Piping and instrumentation diagram document number	Piping and Instrument Diagram drawing number – P&ID
23	Ducting and instrument diagram document number	Ducting and Instrument Diagram drawing number – D&ID
For Structures, Pipe Supports, and Cable Ladders/Trays:		
24	Company drawing document number	Primary Company drawing number
For post-start-up (brownfield) modifications		
25	Management of Change number	Management of Change number

c. 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. 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.

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6 3D Model Deliverables & Handover

6.1 Reports Generated from the 3D Model

All reports that are generated from the 3D Model shall not require any manual editing.

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.

6.2 Drawings Generated from the 3D Model

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.

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

a. Plot plan
b. Discipline area layouts
c. Piping and system isometrics
d. Cable tray/ladder drawings (layouts or isometrics)
e. HVAC ducting drawings (layouts/isometrics)
f. Pipe support details
g. Inspection isometrics.

6.3 Clash Status

a. The final handed-over 3D model shall be clash-free.
b. 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. Contain the methodology for identifying, allocating, and resolving clashes to deliver a clash-free design.
    2. State when the clash system is employed, the frequency of clash checks, and statistics to be reported to Company.

6.4 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. Containing all 3D model databases/files and supporting reference data (e.g., piping/valve specifications, catalogues, and external references).

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2. 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 in section 5.1.
3. 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. With all required detailed specifications (e.g., on the operating system, database, and software versions).
5. With required instructions to restore the 3D Model within the Companies' environment (setup based on the specifications mentioned in 6.4 a4) for continued maintenance and support of the 3D Model.
6. 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. With the content and all required elements as specified in section 5.
8. With quality validation runs performed and resolved.
9. Without any database discrepancies.
10. Without any validation issues.

b. The final 3D Model for handover shall not contain temporary objects that are not used for plant operation and maintenance.

6.4.1 Handover report

A final handover report shall be supplied to Company detailing the model configuration, restoring instructions, as well as the Administrator username and password and the final state of the model content.

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

Drawing(s) of the plant including the Plant Breakdown Structure, illustrations of geographical area, and sub-area codes in plan and elevation, including coordinates and gridlines, shall be submitted to Company.

6.4.3 Area and Sub-area Coordinates

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

6.4.4 3D Vendor Package Models

a. In case vendor package 3D models are created in detailed Mechanical CAD applications these vendor package 3D models shall be handed over to Company as separate models, either in native format or in a neutral file format such as STP, IFC, or another agreed format.

b. If other neutral formats are to be used, this shall be agreed upon with Company.

6.4.5 Laser and Photogrammetry Survey Data

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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