KUWAIT OIL COMPANY (K.S.C.)

A subsidiary of Kuwait Petroleum Corporation



PRODUCTION & PROJECTS (GAS) GROUP

GAS PROJECTS TEAM - II

Mutriba Remote Boosting Facility (MRBF) at North Kuwait

Appendix 15

3D Model Requirements

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KUWAIT OIL COMPANY (K.S.C.)
(Register of Commerce No. 21835)
Mutriba Remote Boosting Facility (MRBF), at North Kuwait
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3D Model Requirements

1.0 PURPOSE

This document defines the requirements and procedure of 3D model review to ensure the following:

- The design meets the Project specific requirements.
- The design complies with the requirements of health, safety, plant constructability and environmental considerations.
- The design results in a facility that can be safely installed, inspected, tested, operated and maintained to the specified requirements.

This document elaborates the procedures and formats for the 3D model reviews carried out during engineering of a project. Emphasis in this document is to explain the requirements for the milestone reviews, which are generally joint reviews by COMPANY and CONTRACTOR.

2.0 ABBREVATIONS

The list of abbreviations with description is as follows:

Table: Abbreviations

ABBREVATIONS	DESCRIPTION
HVAC	Heating Ventilation and Air Conditioning
EOT	Electric Overhead Travelling
CCTV	Close Circuit Television
PDMS	Plant Design Management System
P&ID	Piping & Instrument Diagram
AFD	Approved for Design
AFC	Approved for Construction
IFR	Issued for Review

3.0 MODEL REVIEWS

Contractor has to develop 3D Model using software approved by Company. The Model shall be reviewed with Company to discuss and comply with accessibility, operability, maintainability and constructability aspects in line with Project standards. Modifications / Changes suggested by Company during Model Review shall be mutually agreed.

Formal model reviews shall be conducted by Contractor when the model design reaches pre-defined levels of completion – 30 %, 60% and 90%. In these reviews the COMPANY representatives shall be invited to participate. The purpose of these reviews is to freeze the engineering done till that stage in agreement with the COMPANY.

These reviews are further elaborated in the next section.

The Contractors Model Review Manager has the responsibility to manage the model in its entirety to bring it to required level of quality and completeness.

4.0 PARTICIPATION FOR MODEL REVIEW

The Personnel from the following teams are generally expected to participate in the model reviews:

COMPANY:

- Projects
- Engineering
- Maintenance
- Operations

CONTRACTOR:

- Project Engineering Manager (PEM)
- Model Review Manager
- All discipline leads or their deputies
- Construction representative
- Pre-commissioning / Commissioning Engineer

Contractor's Project Management shall make a request to COMPANY for the attendance of their representatives for the review sufficiently (at least two weeks) in advance, along with agenda and schedule for Model review.

5.0 PREPARATORY WORK FOR MODEL REVIEW

Facilitator for model reviews shall be Contractor's Model Review Manager or his office representative.

He shall arrange for the following facilities:

- Conference room with adequate seating capacity.
- Computer with model review software installed
- Projectors and screen, laser pointers.
- Attendance sheet for attendees.
- Agenda for the Proposed Model Review.
- Arrange adequate hard copies of Documents like P&IDs, PFDs, Overall Plot Plan and Section Plot Plan.

The Contractor's Model Review Manager shall be responsible for doing the following preparatory work:

- Issue a timetable listing all the areas that will be covered in the review with proper time allocation for every area.

- List all the exclusions for the model review with reasons.
- Decide on the cut-off date for the model and save the review file for presentation.
- Prepare copies of all reference and back-up documents.
- Ensure that model is clash free.
- Model progress report

The reference and back-up documents shall be arranged by Contractor's Model Review Manager are listed below:

- Overall Plot Plan (soft copies + hard copies)
- Unit Plot Plans (soft copies + hard copies)
- P&IDs (soft copies + hard copies)
- Equipment List (soft copies)
- Piping Material Specification (PMS) – (soft copy)
- Pipe support Specification (soft copy)
- Maintenance equipment details like mobile cranes, EOTs, tube bundle extractors, etc.(soft copies)
- Piping design basis (soft copies)
- Equipment spacing and unit spacing charts (soft copies)
- Line List (soft copies)
- Instrument vendor details (mainly actuated valves and other special instruments) (soft copies)
- Mechanical datasheets/vendor drawings of equipment (soft copies)
- Stress Critical Line List (soft copy)
- Tie-in list (if applicable) (soft copy)
- Instrument hookup sketches & instrument-piping interface drawings (soft copy)
- 3D CAD Modelling Procedure
- Overall Electrical Single Line Diagram (soft copy)
- Electrical Load List (soft copy)
- Electrical Equipment vendor details (mainly major equipment like Switchgears/MCC, Transformers, etc.) (soft copies)

6.0 MODEL REVIEW STAGES

The milestone reviews will take place at 3 stages. These stages are:

- 30 % model review
- 60 % model review
- 90 % model review

Each stage of model review is further described in the sections below.

7.0 30% MODEL REVIEW

Purpose of 30% Model Review

30% model review shall take place at the completion of the conceptual design of the project. This review is primarily aimed at freezing the following information:

- Plant layout with regard to access to equipment, spacing, process flow sequence, personnel movement and escape routes.
- Establishing the construction, operating, safety and maintenance philosophy.
- Facilitate early start of site work.

Content of model at 30% model review

The general contents of model expected at this review stage are listed below:

- Major large bore & critical process piping determining the equipment location.
- Pipe racks and sleeper ways.
- Major technological structures and major platforms as a simple outline.
- All Process equipment on equipment list, modelled to the basic shape.
- Packages will be modelled as boxes.
- Nozzles, Manholes & associated platforms for static equipment in the required orientations and location.
- Roads, main access ways.
- Dropout / lay down areas and davits if any.
- Bundle pulling areas.
- Mobile and permanent maintenance equipment access area.
- Construction and erection considerations.
- Escape routes on grade, tech structures and platforms.
- All Ladders and staircase landings.
- Spray Water Rings on the Static equipment in the required number and location.
- Concrete slabs and paving.
- Outlines of all Buildings.
- Major equipment structures, foundations.
- Shelters.
- Major underground drainage/sewage systems.
- Bund walls / firewall.
- Main electrical, instrumentation and telecom cable trenches and cable trays/ladders racks.
- Plant Boundary fence with gates and emergency exits.
- Muster points.
- ESDV conceptual location.
- Space for future facilities.
- Battery limit interfaces with others.
- Major layout critical lines routing based on preliminary stress analysis.
- Substations & Transformers will be modeled as boxes

8.0 60% MODEL REVIEW

This is the intermediate model review, which will take place when the steel structures, buildings, equipment, foundations, etc. are modelled as per their final sizes. All piping

2"and above, cable trays/ladders and trenches have been modelled. The piping is supported. The supporting includes incorporation of Stress analysis results.

Once the design is frozen after the incorporation of 60% model review comments, it may not be reviewed again during 90 % model review, unless exceptional circumstances make it necessary to do so.

Purpose of 60% model review

The primary purpose of this review is to check and confirm that:

- The pipe routings and locations of valves and instruments meet the process requirements.
- The plant layout complies with the requirements of construction, operation, safety and maintenance
- Release of piping isometrics

Content of model at 60% model review

The general contents of model expected at this review stage are listed below:

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- All underground piping systems.
- All above ground piping from 2" and above and piping within Package vendor scope.
- Pipe supports locations and types based on stress analysis.
- All equipment trims such as stand pipes/level gauges ,level transmitters etc
- Utility stations locations shown by volume box.
- Fire Fighting Systems, Water Spray Systems.
- Eye wash and Safety Shower locations.
- Access and egress, Operation and Maintenance of Valve and instruments.
- Vendor information for packages.
- All equipment with platform and ladders.
- All mechanical handling equipment like cranes, monorails, davits, eye pads, EOT's etc.
- All structural steel, e.g. pipe racks, technological structures, shelters, platforms, staircases /ladders, supports designed by civil etc.
- All Paving and curbing.
- All foundations.
- All buildings.
- All Shelters
- All Instrument items like field mounted junction boxes, field mounted panels, field mounted cabinets, etc. (Inclusive of supports).
- All Electrical items like junction boxes, panels, cabinets, outdoor lightings (fence, road, area, platform, roof & stairs) etc. (Inclusive of supports/pole/stanchion).
- All Telecom items like junction boxes, panels, cabinets, CCTVs, PAGA speakers, telecom tower, etc., inclusive of supports
- All above ground cable tray routing with sizes 150 mm and above with supports

- All underground cable trenches.
- Analyzer shelters.
- PFP zones.
- All fire and Gas Equipment.
- Construction access.
- Operation and maintenance access.
- Location and orientation of valve hand wheels for operability.
- Any exclusions from 30% model review.
- Tie-ins /Interface connection (if applicable).
- Instrument Air Volume Bottles
- Substations & Transformers including busduct (with support) and equipment's installed inside the building.
- Cathodic Protection facilities related to Tanks & piping, including Transformer Rectifier Units, Anodes, Junction Boxes, Test boxes, header cables, Anode tail cables, etc.
- Drainage system (i.e. Storm water, sanitary, chemical, oily water, etc.)

9.0 90% MODEL REVIEW

Purpose of 90% Model review

The final 90 % model review is intended to confirm the resolution of the outstanding issues of the 60 % model review.

Final Review is held when the 3D model has basically been completed. This occurs when all equipment, all piping including less than 2", all instruments, electrical, structural and other items have been modelled. The items to be reviewed will include things such as the location and orientation of valve hand wheels for operability for drains or small bore lines, the location of local and off-line instruments for maintainability and access and the locations of Fire and Gas detectors.

Content of model at 90% model review

The general contents of model expected at this review stage are listed below.

- All Equipment checked to IFC Vendor information.
- All piping modelled including piping below 2".
- All Pipe supports.
- All Stress comment incorporated.
- Completion of all Steel Structures.
- Completion of all Buildings.
- Model of inside building & shelter structures showing utilities ie. Lighting, cranes/monorails, etc
- Completion of all Foundations.
- Completion of all online and Off-line and equipment mounted Instruments.
- Completion of all Telecom items including CCTV's, PAGA speakers.
- Completion of all Lighting fixtures.

- Completion of all electrical panels / Distribution Boards.
- All U/G facilities.
- Instrument Air Network for Valves.
- Any exclusions from 60% model review.

This 90% model review is aimed at confirming all detail design aspects for construction. This is the final review by COMPANY so it is expected that all information is available without any HOLDS. If any information is not available, Contractor's Model Review Manager shall specifically make a list of such information under exclusions with reason for hold. The review can still be conducted with minor exclusions. These exclusions will be reviewed internally by Model Review Manager when the information is available. This review by Model Review Manager will be as per the guidelines set in the milestone reviews.

10.0 RECORDS

Recording of Comments

Comments generated during the model review shall be recorded by representative of Contractor's Model Review Manager, who will ensure that comments are:

- Recorded on line, on screen for concurrence of all attendees.
- Tagged with a unique number.
- Comments will be documented clearly with a snap shot.
- The discipline responsible for action will be identified in the format as per 3D Model Review Work sheet
- After the comment is resolved, the resolution shall be added to the same sheet.

The Contractor's Model Review Manager shall compile all the comments as per 3D Model Review Work. This consolidated summary shall be signed off by representatives of COMPANY and CONTRACTOR.

Recording of Resolutions

The Contractor's Model Review Manager should organize a resolution session with COMPANY representative and sign-off the resolutions.

The resolutions of previous stage review should be agreed before proceeding to the next stage review. In case some resolutions are not agreed then they shall be carried to next stage review as comments.

11.0 GENERAL REQUIREMENTS

Contractor has to ensure the following requirements while modelling:

- All actions resulting from the earlier model reviews are closed.
- All tagged items inline/off line instruments are modeled as per the P&ID's

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- All JBs along with support are modeled including packages/skid mounted.
- All package related JBs shall be marked with different color than Contractor supply JBs for easy identification of construction people.
- All local panels are modeled along with foundation.
- Cable trays are supported properly includes tray fittings.
- Distances between Instrument trenches and electrical trenches are meeting the project specifications.
- Distance between instrument tray and electrical trays are meeting the project specifications.
- Distance between HOT pipes and tray/trenches are meeting the project specifications.
- JB installation is properly modeled for paved/unpaved area.
- Instrument/JB installation is checked with operation/maintenance point of view.
- Instrument tag numbers as per P&ID's
- Straight length requirement for inline flowmeters as per vendor data.
- Orifice flanges installation as per services e.g. gas/vapor above tapping and liquid below tapings.
- Level instrument (capillary) installation with respect to HP/LP requirements.
- Sunshades are modeled as per project specifications
- Analyzer panel installation along with distance required from sampling points.
- Orientation of actuators of Control valves, MOV, ON-OFF valves, etc.
- Valve sizes are as per vendor approved drawings.
- Control room & sub-station cable entries to be shown.
- Lighting requirement for local indicators
- Any extra loop power indicator required apart from process requirement e.g. Instruments installed on high elevations or very low elevations.
- Foundation for major supports.
- Proper Tray fittings are modeled for perforated and ladder trays.
- Distance between two trays (vertical and Horizontal) is adequate.
- Off-skid instruments & JB's are modeled in different color.
- F&G instruments are modeled as per F&G mapping study.
- Underground pipe sleeves are modeled wherever instrument trench is crossing with electrical cable trenches.
- Duct banks are modeled for road and pipe trench crossings.
- Cable entries are as per vendor and cable bending radius requirement.
- Cable tray sizing is with respect to final cable count and IS/NIS philosophy.
- Cable tray routing is at substation for instrument cables.
- Electrical cable entry at instrument control room.
- Directions and orientation of F&G instruments.
- Tray support arrangements are shown at tanks and vessels.
- Cable trench fouling with civil/piping supports is checked.
- Tray crossovers on pipe racks are modelled
- Process tube routing in critical area is modelled
- Close drain requirement is properly modeled which is in piping scope
- Any drain pit requirement for flow instrument
- Condensate/seal pots are modeled wherever required as per hook-up drawing
- Air manifold or air header to be modeled as per project philosophy

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- Volume bottle supports are modeled
- Instrument installation on vibrating pipes
- Instrument installation comparing with wind direction for H2S area e.g. local ESD/test /reset push button stations
- ESD/reset push button locations
- Constructability for trenches and u/g pipe sleeves
- Availability of clear space for removable of instruments e.g. Pitot tubes and flow probes.
- Extra supports are provided for big size valves by piping
- Crane access or davit requirement for instrument drops from higher platforms.
- Tank gauge dial size is quite big enough with respect to the tank height to view the gauge from grade.
- Installation of float and tape gauges are modelled
- Accessibility for tank instruments is checked.
- Requirement of fireproofing for inline instruments is checked.
- Air coolers cable tray routes are modelled.
- Underground conduit requirements for local instruments are modelled.
- Mobile trolley/stool requirements for inaccessible instruments is checked.
- Sounders and Beacons orientations and their supports height.
- Remote mounted Instruments & Junction boxes are not installed in access ways.
- Instruments power JB, IS JB & NIS JB are modelled and shown with different colors
- Local panels' cable entry is modelled as per vendor data.
- Cable route markers for trenches are modeled.
- Built-up trenches width and depth is modelled.
- Line of sight detector height and beam is checked
- Panels marshalling rooms showing escape routes is modelled
- Contractor to submit previous model review recommendations/comments closeout sheets for the company review, before proceeding to the next stage i.e. 60 or 90% review.