

DEP SPECIFICATION

PLANT MODEL CONSTRUCTION AND REVIEW

DEP 30.10.05.11-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations related to the BDEP (Define) and Execute (detailed engineering) phase of projects for:

- 3D-CAD models.
- 3D-CAD visualisation and use of 3D-CAD features.
- Model review sessions.

Level of detail for the Define Phase is described in (4), 3D-CAD Model. The quality of the model content shall be communicated to the Principal (i.e. content model based on preliminary information, piping based on "dummy/standard" specifications, etc.).

Visualisation tools other than 3D-CAD tools (e.g. virtual reality) are not covered by this DEP. The use of such tools is subject to the agreement of the Principal.

This is a revision of the DEP of the same number dated January 2005; a summary of the main changes is given in (1.5).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

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

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Abbreviations

Term	Definition
3D-CAD	Three Dimensional Computer Aided Design
BDEP	Basic Design Engineering Phase
CAD	Computer Aided Design
HFE	Human Factors Engineer
HSE	Health Safety Environment
HVAC	Heating Ventilating Air Conditioning
PFS	Process Flow Scheme
PEFS	Process Engineering Flow Scheme
TA	Technical Authority
VCA	Valve Criticality Analysis

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2005. The following are the main, non-editorial changes.

Change
Scope of block model changed to scope of 3D block model.
Scope of model review re-defined.
Notice period extended.
Team composition updated.
Checking method updated.
Model colour codes changed.
Write-up and references to physical block models are deleted.
Method of informing the Principal before the formal review by the Contractor on completeness and quality of the model has been updated.
Archiving procedure updated.
Descriptions of completeness of model at 30 %, 60 % and 90 % stages are increased.
Checklist for the model review has been extended.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://swwww.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. GENERAL

In the course of the Define stage of a project, the construction of a 3D-CAD block model may be useful depending on the type, size and complexity of the plant.

In the early phase of a project, the 3D modelling tool may be used for locating the buildings, main equipment and the main pipe routings.

As part of BDEP (Define) Phase, a 3D-CAD block model should be constructed.

As part of the Execute Phase (detail engineering) a 3D-CAD model shall be constructed.

A 3D-CAD system is a design tool for the Contractor and an integral part of the design and engineering process. The visualisation used for the 3D-CAD "model review" is only one of the features of a 3D-CAD system.

The 3D-CAD model reviews are performed by the Contractor at 3 stages during the design.

The 3D-CAD system also provides a clash free design for all engineering disciplines involved, all the construction drawings and can assist in controlling the construction materials (through listings per unit, rack or class).

The model provides a visual check on safety, operability, accessibility, maintainability and facilitates the engineering and erection of the units (erection path can be implemented in the model). It may also be used for the training of operators (including safety training) and for the planning of efficient maintenance schedules, to assist construction work (e.g. handling of heavy or large equipment) and commissioning planning.

3 MODEL REVIEWS

3.1 GENERAL

The Contractor shall perform formal 30 %, 60 % and 90 % model reviews to check that the arrangements meet the Principal's requirements.

The purpose of a 30 % model review in the Execute Phase, is to freeze the basic plot layout and to reach agreement on the proposed design to enable the Contractor to proceed into detail design. Where plot layout is critical, and as such affects feasibility, it is required to be executed as part of the BDEP (Define) Phase of the project.

The purpose of the 60 % model review in the Execute Phase, is to confirm the design is in-line with the PEFS, Supplier data and all other design relevant documentation. After the review the Contractor should be able to finalise the deliverables for construction.

The purpose of the 90 % model review in the Execute Phase, is to confirm on the comments from the 60 % and to finalise on the total design of the model.

These reviews should be undertaken in detail, checking each unit for safety routes, operability, maintainability, accessibility and constructability and checking each system in the unit using the PEFS to make item-by-item checks.

The modifications initiated during previous model reviews shall be implemented before the next official model review.

The Contractor shall perform in-house model checks prior to the formal model reviews. The results of these in-house reviews shall be documented. Any changes which impact the results from prior reviews shall be brought forward to the Principal at start of the formal review-

All items as listed for the relevant 30 %, 60 % and 90 % model reviews shall be part of the 3D model. Any deviation from the lists shall be reported by the Contractor to the Principal, well in advance of the formal 3D model review.

Any necessary changes shall be agreed upon and immediately recorded and shall be marked with reference numbers and model pictures to allow proper follow up and to avoid misunderstanding.

From each formal 3D-CAD model review, an electronic copy of the presented model shall be saved by the Contractor and handed over to the Principal (if required).

When the Contractor, during the BDEP (Define) Phase, constructs a 3D-CAD block model, model reviews have to be held to check that the arrangements meet the Principal's requirements. See (5): BDEP Define phase.

3.2 TOOLS

A 3D-CAD model presentation for a group of people should be performed using a large screen having a high resolution. Point-to-point distance measurements shall be possible on request, to be able to verify compliance to clearance and access requirements or approve slight deviations. Main computer manipulations, such as switching to another process unit should not take more than 2 minutes. Reference items, mobile cranes, bundle pulling equipment, etc. and an operator of the same scale as the model under review, shall be available. The model operator's dimensions shall be conform to the the workspace design requirements of DEP 30.00.60.20-Gen. Deviations or "cultural calibration" can be done on regional level and approved by the appropriate HFE TA.

It should be possible to save snapshots and to indicate on the overall picture (e.g. projected in the corner of the screen) where the review detail is located.

The full model presentation should be given in a darkened room with sufficient dimmed light to enable drawings to be read and notes to be made without interfering with the presentation. The review must be held in a room that is fit for purpose (enough space and good view on the 3D model). A sufficient number of pointers should be available to point to items shown on the screen and to improve the efficiency of discussions.

The following information shall be available in clear legible prints for all participants:

- a) Process Flow Schemes (30 %);
- b) Process Engineering Flow Schemes (60 %, 30 % as far as available);
- c) Plot Plan;
- d) Equipment arrangements;
- e) Line List + Critical Line List (through computer access to project documentation system during review);
- f) Individual equipment information, data sheets (on request);
- g) Civil structural drawings (on request);
- h) Stress calculations (on request);
- i) Piping studies (through computer access to a dedicated electronic folder during review);
- j) Material (equipment) handling studies;
- k) Fire safety studies;
- l) HSE reviews;
- m) Listing of agreed standards;
- n) Level of completeness of model (Clash report) and quality of catalogues.

3.3 TEAM COMPOSITION

A team leader from the Contractor shall be appointed who is fully familiar with the project, the model and the 3D-CAD system capabilities. The team leader shall guide the team through the model with the assistance of the system operator. The team leader shall be responsible for the efficiency of the review process, the adequate reporting of comments made and the subsequent follow-up.

The efficiency of the model review largely depends on the experience and knowledge of the system operator and secretary. Both the system operator and secretary shall be fluent in the project language, and should understand the technical terms used within the industry. The system operator should be heavily involved in the design of (the area of) the model under review. He is familiar with the technical content of the model and can clarify the design to the team members when necessary. A secretary shall be available to take meeting notes, and throughout the full review, take down any comments without discussion,

To prevent specialist sub-meetings during a model review, which distract the attention of other team members, teams should not be larger than 10 members excluding the contractor specialists. If a larger number of people is necessary for a model review separate teams should be formed of members with a common interest in the subject(s) under review. Each team shall then review the model independently, and at the end of the review the team leader shall plenary discuss any conflicting recommendations made by each individual team.

The composition of the review team depends on the progress of the model.

3.4. HANDLING OF COMMENTS

The 3D Model Review Minutes shall encompass all the comments made in the session, state the actions to be taken, the responsibilities and time frame of implementation

After every review (30 %, 60 %, 90 %), the Principal team shall decide if the level of completion of the model is in line with the requirements defined in (6.2) and (6.3). Shortcomings in the degree of completion shall be highlighted and, after correction, checked in the next review, or in an additional review depending on the degree of incompleteness and the project schedule.

Comments on the model shall be electronically tagged during the review. The 3D-CAD tools should have sequence reference facilities to describe the comments given by the review team. The text of each reference shall be complete and unambiguous and include a "snapshot" to avoid confusion in a later stage of the review process. Electronic tag files shall be archived as a permanent record of review comments. A Log List shall be applied for the Review Sessions in order to keep record for all comments.

The team leader shall co-ordinate the tag handling process. The tagged items shall be reviewed by the Contractor within 2 weeks and a record shall be produced showing which tag items will be implemented or rejected, with reasoning. The relevant specialist or technical authority as appropriate shall be consulted, and the other team members shall be informed, before a tag item is deleted or significantly changed.

The Contractor may proceed when deviations or non compliances are agreed and approved by the appropriate TA present in the 3D model review. However audit trail for deviation/ derogation register shall be followed up by the Shell project team.

Before the next review starts, all agreed tag items shall be implemented in the 3D-CAD model.

4. 3D-CAD MODEL

4.1 GENERAL

The 3D-CAD model is a collection of graphical data which describes the facilities of a plant or offshore installation for design and visualisation purposes.

The 3D-CAD model can be accessed via a 3D-CAD system. The graphical data is an integral part of an engineering database supporting the design process.

The 3D-CAD engineering database enables the integration and consistency of the different design stages and the different subjects, such as piping, foundations, tablespots, steel structures, equipment, instrumentation, electrical equipment, buildings and Heating, Ventilation and Air Conditioning (HVAC) equipment into one 3D-model.

Typical deliverables of a 3D-CAD system include:

- a) Detailed engineering drawings such as plan and elevation drawings for piping, structural, civil, instrumentation and electrical;
- b) Plot plans;
- c) Plot elevation drawings;
- d) Piping isometrics;
- e) Vessel trim isometrics;
- f) Commissioning system drawings;
- g) Material Take-off (Bills of Material);
- h) Reports such as line lists, instrument data, interference checks (clash reports) and valve data.

Each discipline should create their design within the 3D model, only then an interference free design can be ensured.

The Contractor has to inform the Principal before the formal 30 % 3D model review, which individual disciplines (e.g. piping, structural, civil, electrical, etc.) are creating their designs in the 3D-CAD model and which deliverables each discipline extracts from the 3D-CAD model.

4.2 SAFETY, OPERATIONAL AND MAINTENANCE ASPECTS

The 3D-CAD system shall be structured in such a way that all disciplines involved can check whether sound design and engineering criteria have been met with respect to safety, operability and maintenance and facilitate the engineering and erection of the plant.

This shall include accessibility for maintenance, operations and fire fighting, location of valves, constructability, process instrumentation, routing of the piping adequate for the process, location of emergency shut-down stations, proper and safe location of vents and drains, engine exhausts, accommodation air intakes, location of fire protection and fire-fighting equipment, access egress and escape routes.

4.3 AT THE CONSTRUCTION SITE

A 3D-CAD review system should be made available at site, to provide information during construction for aspects such as transport and erection of equipment, the routing of piping, positioning of structural steel, platforms, cable trenches, trunking and channels.

During the construction of the process unit the pre-defined free areas (e.g. maintenance space, escape routes) in the 3D-CAD model shall remain free from items that are not presented in the 3D-model, though are constructed in the field (e.g. small bore piping, tubing, secondary cable trenches, tracing.)

Contractor has to check the availability of "free space" in the 3D model, prior to field route piping, instruments or electrical trenches.

4.4 INSTRUCTION

The 3D-CAD model may be used for training and instruction of plant operators, construction staff, maintenance staff and emergency response organisation.

4.5 FEATURES WITH 3D-CAD TECHNOLOGY

The required features shall be agreed between the Principal and the Contractor before the set-up of the 3D-CAD system and engineering database is started.

The 3D-CAD system should be programmed to provide reports regarding situations where certain criteria are not met. This approach can substantially improve the efficiency of the model review. Only the differences to the criteria need to be checked during the model review.

The application of 3D-CAD technology allows:

- a) Definition of classified 3D-shapes (soft boxes) to indicate free volumes in order to:
 - Check for the absence of unwanted equipment in certain area classification zones;
 - Check headroom available;
 - Check accessibility for inline instruments;
 - Check absence of tripping hazards;
 - Check absence of obstructions in access and escape routes;
 - Check correct location of valve handwheels;
 - Check for reach and clearance for activities;
 - Check vertical access for lifting and cranes.
- b) Identification of deviations from normal engineering practices;
- c) Modelling of foundations and underground systems;
- d) Combining a 3D-CAD model with a 3D scanned model from the existing situation at the site;
- e) Review of proposed material handling strategies and equipment design.

4.6 REQUIREMENTS

Where practical, the colours used in the 3D-CAD model shall be in accordance with (Appendix I). The 3D-CAD design lead engineer is to advise if specific colour coding is achievable. The Principal shall approve alternative colour convention.

Colour coding shall also be used to indicate the status of equipment, valves and piping during the various model reviews (i.e. built according to final information or indicative only).

Category I Criticality ratings of valves to be colour coded as indicated in DEP 30.00.60.13-Gen.

The 3D-CAD model shall be set up such that images of items can be presented separately (e.g. when only steel structures are shown and all other items are suppressed).

For complex areas, separate review files of floors or smaller units should be set up to make detail review possible.

5. BDEP (DEFINE PHASE)

5.1 3D-CAD – BLOCK MODEL GENERAL

A block model means that the representation of the equipment as shown is for visualisation purpose only because of the absence of more detailed information on the items.

The project specific specifications for modelling the individual components are usually not yet created in the 3D system at this phase in a project.

The 3D-CAD block model may be used for evaluating different lay-out options and to establish the location of main equipment and the main pipe routings, taking into account the required safety distances and accessibility for construction, operation and maintenance. After approval of the layout by the Principal, it can be used as a basis for preparing a more detailed (initial) plot plan drawing.

When a 3D-CAD block model has been made it should be used as the basis on which further 3D-CAD modelling will be developed.

5.2 CONSTRUCTION

In a 3D-CAD block model, the equipment, buildings etc. shall be modelled in a simplified way.

All different types of components modelled, shall have their own colour coding (see Appendix I).

Plant layout studies and piping studies form the basis of the model. These studies will also establish pipe track widths, structures, etc. The routing of main electrical and instrument cable trenches and access ways / roads should be shown.

5.3 3D-CAD BLOCK MODEL SCOPE

5.3.1 Introduction

A block model should be set up during the Define Phase for one process unit or for multiple process units inclusive or exclusive of the neighbouring facilities, buildings and structures.

Separation distances of the process and utility facilities shall conform to DEP 80.00.10.11-Gen. and DEP 80.00.10.12-Gen.

A 3D-CAD block model should include the items as given below.

5.3.2 3D-CAD block model Scope of the overall site

3D-CAD block model Scope of the overall site
Process/utility units
Buildings (e.g. control room, administration or workshop, etc.)
Interceptors
Effluent treatment facilities
Flare-stack area.
Jetties and marine facilities
Pump stations
Roads
Storage tanks and tank farms
LNG/LPG storage facilities
Blending plants.