

DEP SPECIFICATION

HAZARD AND OPERABILITY (HAZOP) STUDY

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and provides recommendations for Hazard and Operability Study (HAZOP). This DEP includes guidance for responsible persons and for HAZOP execution.

A project requires Process Safety Review. HAZOP is one of the review methods that can be selected.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This DEP is a revision of the same number dated February 2016; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

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, Shell/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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Accountable	The person accountable for a task who has the ultimate duty to ensure it is completed to the required quality.
Authorised Person	The party that initiates the HAZOP study. This refers to the Technical Authority typically from the Technical Safety Engineering Discipline (or business equivalent competent person) or the equivalent in the Contractor organization.
Barrier	A Barrier is a measure that prevents a top event from occurring or reduces the extent of a consequence as per Shell's risk management through Hazards & Effects Management Process (HEMP) and Bow-tie. Within HAZOP the word safeguard is also used to define a measure that prevents an event from occurring.
Chairperson	The party that is accountable for execution of the HAZOP study. This role is also known as the Facilitator.
HAZOP Close-out Co-ordinator	The party responsible for handling the close-out of HAZOP actions, typically the Process Engineer. For some projects with low technology components, this could be the Project Engineer or may be the same person as the HAZOP Co-ordinator.
HAZOP Co-ordinator	The party responsible for scheduling and organising the execution of HAZOP studies to meet the project needs; typically the Technical Safety Engineer or Process Engineer for the Project. For some projects with low technology components, this could be the Project Engineer or Process Engineer or Discipline Engineer.
HAZOP Team (Team)	Experienced professionals from multiple disciplines that are responsible for identifying hazards and operational risks through a systematic and structured review of process drawings and/or procedures.
Recorder/Scribe	Person whose role is to record and document the HAZOP step, statement and actions. The HAZOP recorder/scribe is typically filled by support staff within the Technical Safety Engineering or Process Engineering discipline.
Sponsor	The party that provides necessary resources for initiating the HAZOP study. This may be the Project Manager, Asset Manager, Well Manager, Front End Development Manager or Operations Manager.
Technical Authority	The competent person designated by the Principal as a decision authority for a specified technical discipline. Designation of technical authority follows the structure established by the DCAF (Discipline Controls and Assurance Framework) process used in major projects.

1.3.3 Abbreviations

Term	Definition
ALARP	As Low As Reasonably Practicable
EPC	Engineering, Procurement and Construction
FEDM	Front End Development Manager
FEED	Front End Engineering and Design
GIP	Group Investment Proposal
HAZOP	Hazard and Operability Study
IDM	Investment Decision Manual
IPF	Instrumented Protective Function
LFI	Learning From Incidents
MOC	Management of Change
P&ID	Process and Instrumentation Diagram(s) (or Drawing(s)) (Same as PEFS)
PACO	Process Automation, Control and Optimisation
PCN	Proposal to Commence Negotiations
PEFS	Process Engineering Flow Schemes (Same as P&ID)
PFD	Process Flow Diagram
PFS	Process Flow Scheme
PRENSAP	Process Engineering and Safeguarding Practices (DEP 01.00.02.13-Gen.)
PSBR	Process Safety Basic Requirements
RAM	Shell Risk Assessment Matrix
RHA	Reactive Hazards Assessment
SIL	Safety Integrity Level
TA	Technical Authority
TSE	Technical Safety Engineering
ToR	Terms of Reference
UEFS	Utility Engineering Flow Schemes

Term	Definition
UFS	Utility Flow Schemes

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (6).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2016. The only changes are to DEP cross-references to reflect changes in the DEP library in 2017

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

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.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. HAZOP PROCESS

2.1 OVERVIEW

HAZOP is a review method to identify and assess risks based on guide words leading to scenario development.

The HAZOP is aligned with Hazard Identification for the project and Assessment per Risk Assessment Matrix to identify scenarios and manage risks to ALARP in accordance with the Shell HSSE & SP Control Framework.

The HAZOP study breaks the design into small process sections (nodes), and each node is successively examined by the multi-disciplinary team in a systematic and structured way to identify potential deviations from the design intent.

The study is facilitated by a qualified Chairperson/Facilitator using a core set of “guide words” and a series of parameters to initiate thinking, elicit ideas and discussions to identify potential deviations from safe and operable design intent. This is followed by an examination of possible causes of deviation and an assessment of the consequences of such deviation.

The HAZOP Study is supported by specialists from various engineering disciplines that represent the multi-disciplinary team.

The HAZOP methodology is equally applicable to major green-field developments, brown field projects, small unit modifications or operating procedures.

To be effective, HAZOP requires an approach that is unbiased and open minded. This is achieved through the application of a structured method, with independent facilitation and contribution of knowledgeable participants.

1. HAZOP study SHALL [PS] be applied to all processes with hazards, including marine and utility systems.

HAZOP should not be restricted to just the hydrocarbon processing systems, but should be applied to any system with process hazards.

2. Contractors may have their own HAZOP procedures and the Authorised Person shall align the Contractor's method so that the requirements in this DEP are applied when executing HAZOP on the project.

The mandatory elements of this DEP take precedence over the Contractor's procedures.

2.2 HAZOP PROCESS

2.2.1 HAZOP Analysis

HAZOP should be in accordance with one of the following industry guidelines:

- a. IEC 61882 - HAZOP and Operability Studies (HAZOP studies) – Application Guide;
- b. American Institute of Chemical Engineers "Guidelines for Hazard Evaluation Procedures";
- c. A Guide to Hazard and Operability Studies. Chemical Industries Association, London, UK.

The HAZOP analysis process is typically executed in four (4) phases:

- a. *Phase A: Definition*
- b. *Phase B: Preparation*
- c. *Phase C: Examination*
- d. *Phase D: Documentation and Follow-Up*

The following subsections supplement the HAZOP guidelines (2.1).

2.2.2 Phase A: Definition

The study is be initiated by the Authorised Person, accountable to the Sponsor.

1. The Authorised Person shall identify the HAZOP study scope in order to focus effort, including defining the following:
 - a. study boundaries;
 - b. process interfaces;
 - c. assumptions for performing the assessment.
2. The HAZOP study scope shall include systems outside the project scope when those outside systems can influence the pressure, temperature and composition of the project process systems.
3. HAZOP shall be executed by a cross-functional team comprised of knowledgeable specialists from various disciplines with appropriate skills and experience as (4.3).
4. The scope of the HAZOP study SHALL [PS] include verification of the applicable Process Safety Basic Requirements (DEM2) per HSSE & SP Control Framework.