

DEP SPECIFICATION

PROCESS ENGINEERING AND SAFEGUARDING PRACTICES (PRENSAP)

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DESIGN AND ENGINEERING PRACTICE



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These views are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where deemed appropriate DEPs are based on, or reference international, regional, national and industry standards.

The objective is to set the standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to Shell companies for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.

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All administrative queries should be directed to the DEP Administrator in Shell GSI.

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PART I INTRODUCTION

1 GENERAL

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for process engineering safeguarding. The objective of this DEP is to provide safeguarding practices that should be incorporated during project design work, in order to achieve a design that is safe to operate.

In most cases, safeguarding requirements and guidelines for design and construction of facilities and installations are provided in other DEPs that are referenced in this DEP. The intention is not to repeat these requirements in this DEP, but rather to reference the applicable DEP when it exists. Therefore, requirements that are stated in this DEP generally are requirements that are not included in other DEPs.

During project execution, the project is required to demonstrate that risks are controlled to ALARP with regard to people, assets, the environment, and the reputation of the Principal.

This DEP addresses a number of different process engineering safeguarding topics in (Part II). Requirements and recommendations are specified under each topic, as well as references to other DEPs that are applicable to each topic.

This DEP supersedes the Process Engineering & Safeguarding Practices Manual (PRENSAP) Report GS.10.500067.

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 authorisation 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, 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
ALARP	As Low As Reasonably Practicable
EFD	Engineering Flow Diagram
HEMP	Hazard and Effect Management Process
HAZOP	Hazard and Operability (assessment)
LOPA	Layers of Protection Analysis
MOC	Management of Change
P&ID	Piping and Instrumentation Diagram
PEFS	Process Engineering Flow Scheme
PFD	Process Flow Diagram
PHA	Process Hazard Analysis
PSA	Process Safety Assessment
QRA	Quantitative Risk Assessment

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 within each Section in (Part III).

1.5 SUMMARY OF MAIN CHANGES

This is a new DEP.

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.

2. INTENDED USE

This DEP is primarily a guidance document that is intended to be used during the design development of a project. It provides supplemental information on certain requirements in other DEPs and is applicable to Process Engineers as well as other discipline engineers. It has been developed based on the experience of the Process Technical Safety and other Engineering Technology groups and represents a point of reference for what is expected in the field.

Where the referenced DEP or regulatory requirements are more stringent than this DEP, regulatory requirements followed by the referenced DEP requirements shall take precedence over this DEP. In some cases, the referenced DEPs contain DEM 1 requirements that are Group mandatory under the HSE Control Framework.

Additionally, there are sections that cover content that cannot be found in other DEPs.

This DEP is applicable across all Shell businesses.

PART II ELEMENTS OF PROCESS ENGINEERING SAFEGUARDING

1. PROCESS SAFETY RISK MANAGEMENT

The Hazard & Effect Management Process (HEMP) should be applied during the various phases of a Project to assess and manage the risks associated with process hazards.

Reference: Project Standard 01 - HSSE & SP Management.

The actual hazard identification and risk analysis is a major part of this work process and can be done in a number of different ways. The following are a few examples of methodologies that may be applied:

- HAZOP
- PHA
- PSA
- Bowtie analysis
- Quantitative Risk Assessment (QRA)

The risk assessment should identify and address the risk of process hazards for People, Assets, Environment and Reputation.

NOTE: For Shell projects, the Group Risk Assessment & Management Guide should be used. Refer to the HSE Control Framework.

When HEMP is applied, the output of the structured work process shall be documented in the project design HSSE Case.

All process safety risks that are identified shall be managed prior to commissioning by either:

- Eliminating the hazard, or
- Controlling the hazard (i.e., mitigating to ALARP)

For risks that are not eliminated, the remaining risk shall be verified to be As Low as Reasonably Practicable (ALARP) based on the risk acceptance criteria of the Principal, and if applicable, local regulations.

NOTE: For Shell projects, reference is made to the HSSE Control Framework for risk reduction and ALARP requirements and Project Standard 01 HSSE & SP Management.

Risk may be estimated qualitatively, semi-quantitatively, e.g., using a Layer of Protection Analysis (LOPA), or quantitatively using QRA methodology and compared with applicable Business risk tolerance and ALARP criteria.

Detailed guidance on risk tolerance and ALARP criteria is considered outside the scope of this DEP. Reference is made to the Shell Group or individual business unit HSSE and SP Business standards and practices and/or to external regulations and literature.

2. FLOW DIAGRAMS AND ENGINEERING FLOW SCHEMES

Requirements for preparation of process flow schemes and process engineering flow schemes are covered in DEP 01.00.02.11-Gen.

Simple flow diagrams/charts should be included to convey thoughts/expectations in Investment/Project Proposals and Technical Maturation Plans.

As these conceptual plans evolve to project status, preliminary Engineering Flow Diagrams (EFD), also called Process Flow Diagrams (PFDs) or Process Flow Schemes (PFS), are developed during SELECT phase and used as a basis for equipment design, layout, risk assessment, and other discipline purposes.

During the DEFINE phase of the Project, the EFDs are further defined with Engineering Flow Schemes (EFS), also called Process Engineering Flow Schemes (PEFs) or Process

and Instrumentation Diagrams (P&IDs). EFS shall be defined to a level that process flow lines including major piping components and instrumentation and all equipment are clearly shown. These drawings become the basis for construction.

Additionally, during DEFINE phase, relief device scenarios and instrumented protective function (IPF) requirements are developed. This information is captured in the Safeguarding Memorandum (SGM). As a supplement to the text in the SGM, a Process Safety Flow Schematic is developed. Requirements for preparation of safeguarding memoranda and process safeguarding flow schemes are covered in DEP 01.00.02.12-Gen. This flow schematic identifies the major pieces of equipment and the location of the safeguarding elements.

Once the formal safety review such as Hazard and Operability assessment (HAZOP) has been completed, the drawings are "frozen". This becomes the point that the Management of Change (MOC) process as described in the HSSE & SP Management System HSSE & SP Management System Manual of Control Framework is invoked.

NOTE: For smaller projects, another risk assessment tool may be substituted for the HAZOP. In such cases, MOC should be invoked upon completion of the risk assessment.

For further information on the requirements for Projects, refer to standardised integrated Project Management Systems.

Equipment symbols and piping identification are provided in the following DEPs:

DEP Standard Dwgs S02.001 and S02.002	Mechanical symbols
DEP 32.10.03.10-Gen.	Instrumentation symbols and identification on process engineering flow schemes
DEP Standard Dwg S37.000	Instrument installation (symbols)
DEP 31.10.03.10-Gen	Symbols and identification system - Mechanical

3. PRESSURE VESSELS (INCLUDING REACTORS AND COLUMNS)

Requirements for unfired pressure vessels are covered in DEP 31.22.00.31-Gen. and the pressure vessel Code applicable in that country.

Definitions for design temperature, design pressure and toxicity of substances are covered in DEP 01.00.01.30-Gen.

Requirements for design of pressure relief, flare and vent systems are covered in DEP 80.45.10.10-Gen. Requirements for protection of equipment against overpressure and underpressure are covered in DEP 80.45.10.11-Gen. In addition, local regulatory requirements may apply.

Where vessels are vapour filled or where there are significant amounts of LPGs, emergency depressuring facilities may be required as specified in DEP 80.45.10.11-Gen. and DEP 80.45.10.12-Gen. High-rate depressuring systems shall be designed in accordance with DEP 80.45.10.12-Gen. with a preference for the normally energized (NE) mode. For the purpose of sizing depressuring systems, each unit area shall be divided into probable fire areas.

Requirements for low point drain valves and high point vents are covered in DEP 31.38.01.11-Gen. All vessels shall have a low point drain valve and high point vent valve.