

DEP SPECIFICATION

BULK SEPARATION AND OIL TREATMENT FACILITIES

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for crude bulk separation and oil treatment facilities. It provides guidance for suitable integrated system line-ups for various types of crudes (i.e., condensate, light, medium and heavy) in both onshore and offshore environments.

The scope of the DEP excludes the following subjects:

- De-oiling and produced water treatment – Information on this can be found in DEP 39.01.40.31-Gen.
- Gas compression and treatment – An exception to this is providing guidance on the operating pressures and number of stages in a multi-stage separation process, which is influenced directly by the gas compression ratio.
- Downhole bulk separation – This technology is not included in this DEP as it had not passed a development release at the time of publication.
- Subsea bulk separation and dehydration – At time of publication no Shell development releases had been made on subsea bulk separation and oil treatment and therefore the topic is excluded from this DEP.
- Processing of produced fluids from chemical EOR developments, containing surfactants, polymers and other EOR chemicals.
- Bulk separation and oil treatment of extra heavy crude.

This is a revision of the DEP of the same number dated February 2015; 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 authorized 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, 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.

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

1.3.2 Specific definitions

Term	Definition
Dispersion	Systems in which particles are dispersed in a continuous phase of a different composition (or state). Particles in this context can be liquid, solid or gas.
Emulsion	Dispersions of two or more liquids which are immiscible, which can be stable or unstable.
Free water	Water that is not taken up by the emulsion. Separation of the free water phase occurs relatively quickly.
Dehydration	Removal of water from bulk crude oil.
Deep dehydration	Dehydration of the bulk crude oil to a stringent specification, e.g. <0.5% BS&W.
Desalting	Process of removing salt from the crude.
Extra heavy oil	Crude with a density higher than water (API < 10°).

1.3.3 Abbreviations

Term	Definition
MOC	Management of Change
DEP	Design and Engineering Practice
ADE	Asphaltenes Deposition Envelope
ADT	Asphaltenes Dispersancy Test
ARN	tetra-protic naphthenic (acid)
BS&W	Basic Sediment and Water
FWKO	Free Water Knock Out
GSI	Global Solutions International, Inc.
PVT	Pressure, Volume, Temperature
o/w	oil in water
RVP	Reid Vapour Pressure
SARA	Saturates Aromatics Resins Asphaltenes
TBP	True Boiling Point
TVP	True Vapour Pressure
w/o	water-in-oil
API	American Petroleum Institute
GOR	Gas to Oil Ratio
TAN	total acid number
ASTM	American Society for Testing and Materials
EOR	Enhanced Oil Recovery
IOR	Improved Oil Recovery
RAM	Reliability, Availability and Maintenance
ppmv	parts per million by volume
CAPEX	Capital Expense

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 (7).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a minor revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced shall/should.

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://swwww.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. BULK SEPARATION AND OIL TREATMENT DESIGN BASIS

2.1 BACKGROUND

Crude bulk separation and treatment usually requires some form of gravity separation of the crude, combined with addition of heat, chemical and electrostatic treatment.

2.2 GENERAL

1. The design of the process system shall be determined with consideration of the feed stream factors, the product specification and the expandability and field life cycle.
2. The potential variation in feed stream factors shall be assessed to determine the governing feed stream factors for the process system design.

2.3 FEED STREAM FACTORS

2.3.1 General

1. Feed stream factors shall be recorded in the project Basis for Design.

2.3.2 Production forecast

1. The production forecast(s) shall address the impact of reservoir parameter uncertainties.
The production forecast (oil, gas, and water with associated qualities, temperatures, pressures, etc.) for a reservoir, or field, is dependent on specific reservoir parameters that, at the onset of a design, are uncertain. The uncertainties associated with these parameters could result in large variations in the expected production forecast.
2. The production forecast(s) shall address the impact of the selected recovery mechanism.
The production forecast for a reservoir/field represents an annual average production.
3. The field specific RAM study should determine the system design flow rates for the bulk separation and oil treatment.
4. A design margin (or surge factor, S) should be included on the fluid flowrate, which provides an allowance for surging and uncertainties in the basic data.
Guidance on surge factors is provided in DEP 31.22.05.12-Gen.
5. The surge factor used shall be confirmed by the Principal.

2.3.3 Operating conditions

1. The feed stream pressure, temperature and associated uncertainty ranges shall be determined.

The feed stream temperature is affected by cooling of the well fluids in the well, flow lines, pipelines, etc. The feed stream temperature depends on:

- *variation in well flowing tubing head temperature with changing well fluid flow composition;*
- *variation in well flowing tubing head temperature with changing well flow rate;*
- *heat loss in gathering system;*
- *cooling of well fluids due to pressure drop.*

The feed stream pressure is dependent on:

- *variation in feed stream composition;*
- *variation in feed stream pressure as a result of flow rate changes;*
- *implementation of artificial lift.*

2. The process system design has to take into account the impact of start-up following a prolonged shutdown on the feed stream temperature.
3. The feed pressure shall be set following an integrated assessment by the Production Technologist, the Flow Assurance Engineer and the Concept Engineer.

2.3.4 Characteristics

2.3.4.1 Hydrocarbon phase

1. The hydrocarbon phase (oil and gas) shall be characterised by means of a quality assured PVT analysis, including transport properties and composition.
2. The Production Chemistry discipline shall assure the sampling, analysis and interpretation of the PVT analysis.

The potential variation as a result of the chosen recovery scheme has to be taken into account in the characterisation of the hydrocarbon phase.

The uncertainty associated with key hydrocarbon phase characteristics has to be considered.

3. Hydrocarbon characterisation should be defined by standard TBP or ASTM distillation test methods. Data from these test methods should be used to generate pseudo-components to represent heavier fractions of the oil, also to generate derived properties such as volume average boiling point or Neilson 'K' value.
4. Fluid type shall be defined by API ranges as shown in Table 1.

Table 1 API for various crude types

API Definition	Gravity
Condensate	>44
Light Oil	31 – 44
Medium Oil	22 – 31
Heavy Oil	10 – 22
Extra Heavy Oil	6 – 10

5. The addition of diluent to heavy crudes to reduce fluid viscosity should be considered if available and the project scope allows for its addition.

2.3.4.2 Wax

1. The cloud and pour point of the crude should be determined as part of the hydrocarbon phase characterisation.
2. The temperature of the process fluid should be maintained above its cloud point to prevent wax deposition built-up on the inside surface of pipelines and equipment.
3. If wax deposition is expected in the process system, the Production Chemist/Flow Assurance Engineer should be consulted to quantify its effect on the process system.
4. Wax deposition mitigation and/or controlled wax deposition shall be considered.
5. The wax control strategy shall be decided upon by the Principal, based on lifecycle cost and risk evaluation.