

DEP SPECIFICATION

WATER INJECTION IN DOWNSTREAM HYDROPROCESSING UNITS FOR CORROSION CONTROL

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(DEP Circular 17/12 has been incorporated)

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for design of continuous water injection systems in hydroprocessing units. Water injection may be for water wash of components from a vapour stream, quenching, or as a carrier for chemical additives such as neutralizers.

Water injection systems for downstream process units other than hydroprocessing units are excluded from the scope of this DEP.

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

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 refineries, chemical plants, and gas plants. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should 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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Annular flow	A flow regime for gas-liquid mixtures in which the liquid is primarily flowing in a continuous film on the pipe wall
Quill	a tube, a perforated pipe, or similar element protruding some distance into a flow. A quill may or may not have a spray nozzle on the end

Term	Definition
	into a flow. A quill may or may not have a spray nozzle on the end.
Receiving stream	Process stream into which the water is injected
Spray nozzle	Device for atomizing a liquid stream for dispersion into a gas or mixed phase stream. Nozzles may generate full cone or hollow cone sprays.
Static mixer	In-line, motionless mixing device which operates by splitting a recombining a stream multiple times in a short distance.
Stratified flow	A flow regime for gas-liquid mixtures in which the liquid flows along the bottom of a horizontal pipe.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets.

1.5 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://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.6 DUAL UNITS

**Amended per
Circular 17/12**

Dual units have been incorporated throughout this DEP.

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. WATER WASH INJECTION DESIGN

2.1 GENERAL

- a) A process model shall be used to determine the following design criteria. The model shall be verified by a process engineer of the Principal with specialist knowledge in wash water system design and documented in the equipment files.
- Quantity of injected water is such that a minimum of 25% of the injected water remains in the liquid water phase after equilibrium flash in the most severe case. More liquid water may be required if the stream must go through multiple downstream flow splits.
 - Concentration of halides (sum of HCl and HF) in the vapor portion of the reactor effluent stream before the wash water is injected, if present.
 - Concentration of NH₄HS in the sour water that exits the separator that is immediately downstream of the cooler.
- b) Design of injection systems should take startup, shutdown, turndown, and off-design operation conditions into consideration.

2.2 HALIDE CONCENTRATION CASES FOR WATER WASH – DESIGN CLASSES

2.2.1 Low Halide

Halide concentration should be considered low if the sum of HCl and HF concentrations is less than 3 ppmv in the effluent vapor immediately upstream of water wash.

2.2.2 High Halide

Halide concentration should be considered high if the sum of HCl and HF concentrations is equal to, or greater than, 3 ppmv in the effluent vapor immediately upstream of water wash.

2.3 WATER INJECTOR

2.3.1 General

Water injectors used in both halide concentration cases shall have the following features:

- a) Water injector SHALL [PS] consist of a quill with an attached spray nozzle.
- b) Injector shall be able to be removed for inspection and cleaning when the process is not in operation.
- c) The mechanical integrity of the quill SHALL [PS] be analyzed for flow induced vibration. The results of the analysis, shall be documented in the equipment files.
- d) Injector should be self-draining.
- e) Spray nozzle SHALL [PS] be attached to quill so that it does not break off or fall off during operation. Attachment method can be a fully welded connection or a tack welded connection for threaded spray nozzles.
- f) Quill and spray nozzle material SHALL [PS] meet or exceed that of the effluent line. Quill and spray nozzle SHALL [PS] be of the same or compatible material. Acceptable materials are Alloy 20Cb3, Alloy 825, Alloy 625, or Alloy C-276.

2.3.2 Spray Nozzle

Spray nozzle used in both halide concentration cases shall have the following features:

- a) Nozzle shall be a full cone spray centrifugal swirl nozzle with internal vanes. If there is a static mixer following the spray nozzle, a vaneless full cone nozzle is permitted. External spiral or hollow cone nozzles shall not be used.
- b) Spray angle shall be between 60 and 120 degrees.