

DEP SPECIFICATION

# STEAM INJECTION SYSTEMS FOR SAFEGUARDING THERMAL CRACKING UNITS

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DESIGN AND ENGINEERING PRACTICE

DEM1



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## 1. INTRODUCTION

### 1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and engineering of the steam injection facilities in thermal cracking units, for safeguarding their integrity and operation. The purpose of the steam injection system is to protect the furnace tubes from coking up during an emergency situation, e.g. in the event of unexpected feed failure. After initiation, the steam-out operation should therefore be fast, reliable and automated.

This DEP explains the principles of the steam-out system but it does not cover furnace control systems except where certain control features are necessary for the operation of the steam-out system.

The steam injection facilities consist of:

- Automated steam-out facilities for the radiant section coils of both residue and distillate cracking furnaces.
- Barrier-steam injection into furnace outlet lines in units with a soaker, in order to minimize backflow of soaker contents into the furnace if a tube rupture takes place.
- Steam injection upstream and downstream of relief valves, in order to ensure that the relief valves are fully reliable.

This DEP shall be used for all new designs and applied to existing installations if modifications are required. Some design details may need modification to suit the requirements of individual installations.

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

This is a revision of the DEP of the same number dated January 2010; see (1.5) regarding the changes.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil refining. 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                                                                                                                                                                      |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Delegated Technical Authority</b> | A <b>Delegated Technical Authority</b> is a person who has received delegated authority to approve Derogations from the Process Safety requirements from the Head of Shell P&T. |
| <b>Derogation</b>                    | A <b>Derogation</b> is an authorised variance or exemption from a Process Safety requirement, with specified conditions.                                                        |

### 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 (5).

### 1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. The following are the main, non-editorial changes.

| Old section | New section | Change                                                                                                                     |
|-------------|-------------|----------------------------------------------------------------------------------------------------------------------------|
| 1.6         |             | Addition of section "PROCESS SAFETY REQUIREMENTS" and implementation of "Segregation of Requirements in DEM1 listed DEPs". |
| 2.2.2       |             | Change of operating philosophy for the drain on the steam-out system. Flagging of HSE risk (H <sub>2</sub> S release).     |
| 2.3 and 2.4 |             | Merging of sections for heater without back-pressure controller and with back-pressure controller.                         |

### 1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at [standards@shell.com](mailto: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.

### 1.7 DUAL UNITS

**Amended per  
Circular 57/11**

**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. AUTOMATED STEAM-OUT SYSTEM

### 2.1 PRINCIPLE OF OPERATION

After manual initiation, a number of switches and control valves are activated in a controlled sequence by an electrical/pneumatic automatic system as follows:

- Activation of Emergency Shutdown system that involves
  - o Shut down of feed control valves
  - o Trip of the furnace feed pump (then the low-flow trip device cuts out fuel supply to the burners)
  - o Opening of back-pressure control valve if present in the furnace or soaker outlet
  - o Trip of the boiler feed water injection pump.
- Close of bleeder valve to prevent steam going to the distillation column.
- After a delay to allow the above actions to be taken, a double block and bleed control valve set are opened to admit dry, medium-pressure steam to the inlet of each coil.

The steam valve opening is preset but can be monitored and, if necessary, adjusted from the control room. This steam flushes the tube contents into a vessel (the cyclone, soaker or column) downstream of the furnace. The furnace effluent can be pumped out of the thermal cracker by the bottoms pump of the cyclone or column through the residue rundown system.

If a soaker is installed downstream of a residue cracking furnace, its contents can be pumped out from the soaker bottom to the column bottoms pump via a separate pump-out line.

Provisions are made to operate the system even in the event of failure of mains electricity or instrument air, albeit with some manual intervention. Most of the equipment of the system will be used during routine shutdowns and steam-air decoking.

In case of loss of feed flow, if the feed pump can be restarted within about 5-10 minutes (for a coil cracker) or 10-20 minutes (for a soaker cracker) there is no need to use the system at all. If the pump remains out of action for longer periods, the steam-out system shall be initiated.

The same basic type of system may be used for all types of thermal cracking furnaces.

### 2.2 GENERAL FEATURES

For letters/numbers used in the text, see Appendices 1 and 2.

#### 2.2.1 Steam supply

Steam for injection shall be taken from the normal refinery medium-pressure main, usually at about 18 bar (ga) (260 psig). Alternatively, high-pressure steam may be used instead. The steam supply pressure is independent of the inlet pressure of the furnace. To avoid surges in downstream equipment, it is most important that this steam is dry upon injection.