

DEP SPECIFICATION

**ABOVEGROUND VERTICAL STORAGE TANKS  
(AMENDMENTS/SUPPLEMENTS TO API STANDARD 650)**

DEP 34.51.01.33-Gen.

February 2012

DESIGN AND ENGINEERING PRACTICE

**DEM1**



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## PART I INTRODUCTION

### 1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and construction of above ground vertical tanks intended for storage of hydrocarbon products, and is based on API Standard 650 – Welded Tanks for Oil Storage, Eleventh Edition, June 2007; incorporating Addendum 1: Nov 2008 and Addendum 2: Nov 2009.

Part III of this DEP amends, supplements and deletes various clauses of API Standard 650 and follows the clause numbering of API Standard 650 for ease of reference. All clauses of API Standard 650 that are not modified by this DEP remain valid as written.

This DEP is intended for use globally. Users of the DEP are advised to exercise due care and sound engineering judgement to ensure that application of the DEP results in compliance with all relevant local jurisdictional and legislative requirements.

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 February 2011; 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. Application in other facilities may also apply.

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. The Principal may undertake all or part of the duties of 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 **Purchaser** is the term used in API Standard 650. For the purposes of this DEP, the term Purchaser shall be understood to mean the Principal.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The word **SHALL [PS]** indicates a Process Safety requirement.

The word **shall** indicate a mandatory requirement.

The word **should** indicate a recommended requirement.

### 1.3.2 Abbreviations

| Term       | Definition            |
|------------|-----------------------|
| <b>SME</b> | Subject Matter Expert |

### 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 (Part IV).

### 1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2011. There have been major revisions made to the DEP and it is impractical to list all of the changes here.

The following new SHALL [PS] statements have been added to this DEP:

|          |         |                                                                                     |
|----------|---------|-------------------------------------------------------------------------------------|
| Part III | 5.2.6.1 | All tanks SHALL [PS] be designed to safeguard against tank overfill.                |
| Part III | 5.8.5   | All tanks SHALL [PS] be designed for venting under normal and emergency conditions. |

### 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 ACTION REQUIRED BY PURCHASER/PRINCIPAL

The API Std 650 document uses a bullet (•) at the beginning of a paragraph to indicate that there is an expressed decision or action required of the Purchaser/Principal. The Purchaser/Principal's responsibility is not limited to these decisions or actions alone. When such decisions and actions are taken, they are to be specified in documents such as requisitions, change orders, data sheets, and drawings.

Within Part III of this DEP, the use of the bullet notation is shown to be consistent with API Std 650.

### 1.8 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.

## PART II GENERAL REQUIREMENTS

### 2.1 GENERAL

Part III of this DEP is written as amendments and supplements to API Standard 650, Eleventh Edition, June 2007; incorporating Addendum 1: Nov 2008 and Addendum 2: Nov 2009. Wherever reference is made to API Standard 650, it shall be understood to mean API Standard 650, Eleventh Edition, June 2007; incorporating Addendum 1: Nov 2008 and Addendum 2: Nov 2009 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of API Standard 650 has been used throughout Part III of this DEP.

Clauses in API Standard 650, which are not referenced in this DEP, shall remain valid as written.

If a discrepancy is noted between this DEP and API Standard 650, the subject under consideration shall be brought to the attention of the Principal, who shall initiate a technical review by the Principal's SME – Storage, and deliver a resolution.

### 2.2 SELECTION

The following list provides some of the considerations that should be taken into account for the selection of storage tanks in hydrocarbon service. These include but are not necessarily limited to,

- a) Product Properties (e.g., vapour pressure, specific gravity, flash point, viscosity, etc.)
- b) Evaporation Losses
- c) Pumping Losses
- d) Climatic and Environmental Considerations
- e) Ground Conditions
- f) Local Legislative Regulations
- g) Working Capacity
- h) Economics

### 2.3 VOLATILE EMISSIONS

To minimize volatile emissions, selection of aboveground storage tanks shall be based on jurisdictional air quality regulations where the tank is located. Where local regulations for emissions control are unavailable, the following guidelines shall be followed:

- a) The true vapour pressure for hydrocarbons stored in fixed roof tanks without an internal floating roof shall not exceed 10.34 kPa (1.5 psi) gauge.
- b) Products with true vapour pressure greater than 10.34 kPa (1.5 psi) gauge, but not exceeding 86 kPa (12.5 psi) gauge shall be stored in floating roof tanks.
- c) Products with true vapour pressure greater than 86.0 kPa (12.5 psi) gauge shall be stored in tanks with vapour recovery systems, low-pressure refrigerated storage tanks, or in pressurised storage vessels.
- d) Tanks under 4,000 L (25.2 bbls) volume and 4.0 m (13 ft) diameter storing products between 10.34 kPa and 76 kPa TVP, may use pressure vacuum vents in lieu of an internal floating roof.

### 2.4 SPECIALITY PRODUCTS

The provisions under this DEP are applicable to all aboveground vertical storage tanks that are intended for hydro carbon service.

Where tanks are intended for storage of speciality products such as liquid sulphur or bitumen, the tank designer/specifier is advised to account for additional requirements defined in the Sulphur Recovery Unit (SRU) Design Manual or the Bitumen Facilities Design Guide (BFDG) or any other relevant design guidelines that may be stipulated by the Principal.

The tank designer/specifier shall carefully consider all relevant product specific process requirements to ensure a safe and fit for purpose design.

## 2.5 TANK APPURTENANCES

### 2.5.1 DESIGN

#### 2.5.1.1 General

The Manufacturer/Supplier shall design the required fixtures and appurtenances to fulfil the service requirements specified by the Principal. Where applicable, human factors engineering aspects defined in DEP 30.00.60.20-Gen. shall be considered in the design of tank fixtures and appurtenances.

#### 2.5.1.2 Inlet and outlet nozzles

Inlet and outlet nozzles shall be sized based on the maximum product inflow and outflow rates.

If it is required to locate the inlet nozzle on the roof of the tank or at an elevation within the upper shell courses, a vertical down comer (slotted pipe flow diverter) shall be installed to prevent product splashing into the tank. A collar shall be provided over the down comer to minimize product spraying into the tank. The down comer shall be designed to break vacuum and prevent siphoning out tank contents.

The down comer shall terminate approximately 300 mm (12 in) above the tank bottom or the internal heating coils where these are installed in a heated tank. Careful attention shall be paid to ensure heating coils located directly below the down comer are adequately protected from the impact of the incoming product flow streams.

An impingement plate shall be installed over the tank bottom directly below the down comer. The impingement plate shall be at least 6 mm ( $\frac{1}{4}$  in) thick and seal welded to the tank bottom.

#### 2.5.1.3 Inlet diffuser

Where an inlet diffuser is specified, the diffuser shall be designed to ensure a flow velocity of less than or equal to 1 m/s (3 ft/s).

#### 2.5.1.4 Floating suction

Floating suctions should be installed to address product quality assurance requirements (e.g., aviation grade fuels).

Proprietary designs by specialist floating suction vendors are preferred.

#### 2.5.1.5 Tank bottom sumps

Tank bottom sumps shall be provided as follows:

| Tank Diameter                                     | Floor Profile | No. of Bottom Sumps |
|---------------------------------------------------|---------------|---------------------|
| $D \leq 7.3$ m (24 ft)                            | Cone Up       | 1                   |
| $D > 7.3$ m (24 ft),<br>but $\leq 21.3$ m (70 ft) | Cone Up       | 2                   |
| $D > 21.3$ m (70 feet)                            | Cone Up       | 3 or Greater        |
| All Diameters                                     | Cone Down     | 1                   |

Additional sumps shall be provided if directed by the Principal.

#### 2.5.1.6 Water draw off

Minimum pipe size for the water draw off shall be DN 50 (NPS 2).

The minimum clearance between the bottom of the sump and end of the draw off pipe shall be one (1) pipe diameter.

For cold weather locations where freezing temperatures are experienced, an equalization valve system shall be installed to flush any freezing of the exterior section of the water draw off.

#### 2.5.1.7 Shell nozzles

The number and sizes of shell nozzles shall be governed by the process requirements for the individual tanks.

If directed by the Principal, additional nozzles shall be installed to fulfil future operational requirements for the tank.

#### 2.5.1.8 Thermowell connection

The thermowell connection should be located on the bottom shell course at a height of 900 mm (36 in) above the tank floor level.

The thermowell nozzle shall be minimum 40 mm (1-½ in) diameter with ASME B16.5 Class 300 slip-on raised face flange.

#### 2.5.1.9 Shell manways

Shell manways shall be provided as follows:

| Tank Diameter                                 | No. and Size of Shell Manways |
|-----------------------------------------------|-------------------------------|
| $D \leq 6.0$ m (20 ft)                        | 1 - 610 mm ( 24 in)           |
| $D > 6.0$ m (20 ft) but $\leq 21.3$ m (70 ft) | 2 - 610 mm ( 24 in)           |
| $D > 21.3$ m (70 ft)                          | 3 - 610 mm ( 24 in)           |

Additional or larger diameter manways shall be provided if directed by the Principal.

Unless dictated by process requirements, shell manways shall be located peripherally in close proximity to each water draw off sump to facilitate ease of pump out during tank cleaning.

Consideration should be given to locating at least one shell manway in line with the prevailing wind direction for the location to facilitate natural air circulation through the tank during tank gas freeing.