

DEP SPECIFICATION

METALLIC MATERIALS - PREVENTION OF BRITTLE FRACTURE IN NEW ASSETS

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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 selection and application of steels in order to prevent brittle fracture at low temperature, and is applicable to new assets.

This DEP applies irrespective of the contained fluids and covers low temperatures caused both by climate and by the process operating envelope. In addition, specific requirements are included for equipment containing liquefied gas.

Guidelines are provided for steel selection on the basis of the Lower Design Temperature for:

- a. unfired pressure vessels;
- b. piping, piping components and valves (including control valves);
- c. pressure safety relief valves;
- d. rotating equipment;
- e. pipeline and subsea equipment.

This DEP is not applicable to:

- a. fired heaters;
- b. vertical atmospheric storage tanks;
- c. steel structures.

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

This DEP is a revision of the same number dated February 2016; 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 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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

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



1.3.2 Specific definitions

Term	Definition
Adiabatic Flash Temperature (AFT)	The lowest temperature a fluid reaches, when a given quantity of a mixture is adiabatically depressurised to atmospheric pressure.
Atmospheric Boiling Point (ABP)	The temperature of the liquid when the vapour pressure at the top of the liquid surface equals atmospheric pressure at sea level (i.e., 1 atmosphere).
Auto-Refrigeration	Cooling by evaporation or boiling of liquefied gas. In the latter case, the MMT is the adiabatic flash temperature (AFT) or the atmospheric boiling point (ABP) of the fluid, unless vacuum conditions can cause boiling below these temperatures.
Critical Exposure Temperature (CET)	The lowest process or atmospheric temperature at which equipment metal will be exposed to a given stress. The CET may be a single temperature at an operating pressure, or an envelope of temperatures and pressures/stresses. CET is equivalent to the MMT when exposure temperature is not referenced to coincident pressures or stresses.
General Membrane Stress	The tensile component of the general primary stress resulting from sustained loadings, such as internal and external pressure, static head, weight and wind loading. The general membrane stress is averaged over the thickness of the structure, and it determines the elastic stored energy in the wall of the equipment. In design or assessment of piping systems for resistance to brittle fracture, stresses due to thermal expansion or contraction contribute to the general membrane stress.
Liquefied Gas	A fluid which is gaseous at ambient temperature and atmospheric pressure, but is maintained in a liquid state by means of pressure or refrigeration, or a combination of the two.
Lower Design Temperature (LDT)	The lowest temperature at which equipment may be subjected to its design pressure; LDT is further described in (3.2).
Lowest Ambient Temperature (LAT)	The lowest one day mean ambient temperature (sometimes referred to as LODMAT) based on statistical analysis of the meteorological data for a specific geographic site over a 20 year or longer timeframe. The meteorological data should include temperature measurements at least once per hour, and should be from a location that is representative of the climate conditions that are expected at the actual installation site.
Lowest Anticipated Service Temperature (LAST)	The lowest anticipated service temperature for steady-state operating conditions. This term is used for design of subsea equipment.
Minimum Allowable Temperature (MAT)	The lowest metal temperature allowed for a given material, at a specified thickness, based on its brittle fracture resistance. MAT can be a single temperature, in which case it is the same as the LDT when associated with the design pressure. It can alternatively be an envelope of allowable temperatures as a function of pressure or stress.