

DEP SPECIFICATION

DESIGN OF COOLING TOWER WATER SYSTEM

DEP 34.74.00.10-Gen.

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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 of industrial type open recirculating cooling tower based cooling water systems. Specific requirements for cooling towers are covered in General Functional Specification, GFS 31.86.50.01-Gen.

This DEP is applicable to cooling water systems intended for use in oil, gas and chemical plants. This DEP is applicable to both Greenfield as well as Brownfield projects. Additional scope w.r.t integration in Brownfield projects are not covered in this DEP and will be covered as part of project specifications.

Packaged Cooling towers intended for Building air conditioning applications 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.

This is a revision of the DEP of the same number dated February 2013; 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. 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.

1.3.2 Abbreviations

Term	Definition
GRP	Glass Reinforced Plastic
GRVE	Glass Reinforced Vinyl Ester
HDG	Hot Dip Galvanised
HFE	Human Factor Engineering
NPSH	Net Positive Suction Head
OEM	Original Equipment Manufacturer
PFHE	Plate Frame Heat Exchanger
PFS	Process Flow scheme
PS	Process Safety
PSFS	Process safeguarding Flow Scheme
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RO	Reverse Osmosis
RCC	Reinforced Cement Concrete
TSS	Total Suspended Solids
VFD	Variable Frequency Drive
WBT	Wet Bulb Temperature

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 full revision of the DEP of the same number dated February 2013.

The scope of the DEP has been modified to include cooling water system related requirements and to remove cooling tower related requirements that are covered in GFS 31.86.50.01-Gen.

As the scope now includes system aspects, a number of DEM1 process safety requirements have been added.

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.
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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. GENERAL REQUIREMENTS

2.1 GENERAL

This DEP is generally written for Design Class 2 or Design Class 3 facilities, as summarised in DEP 00.00.07.91-Gen., with options identified according to design class where appropriate.

1. When projects choose not to implement the design class practice, options set forth within this DEP based on design class shall default to the Design Class 2 selection unless otherwise directed by the Principal.
2. The design of the cooling system shall meet the design on-stream availability of the refinery, chemical complex, or LNG complex throughout the plant lifetime.
3. The Contractor shall estimate the cooling requirements in early project phases and verify these estimates when final cooling data becomes available.

Cooling requirements for rotating equipment and other consumers may become known only in a later project phase after the equipment is purchased.

- a. The estimated cooling requirements shall identify service, minimum/typical/maximum volumetric requirements, duty and temperature ranges for all the cooling water users, for both present and future demand envisaged.
 - b. Requirement for side stream filter back wash (if required) shall be included in the total cooling water demand.
4. The Contractor shall be responsible for the final design incorporating the cooling duties of all consumers.
 5. Equipment sparing for the cooling tower, pumping and chemical treatment systems should be in accordance with the project premise and selected design class.
 6. Cooling tower design shall include Legionella mitigation as per CTI specification on Legionellosis-WTB-148.

Design should be based on industry best practise to minimise the risk of bacterial/Legionella growth in the system.

2.2 SEGREGATION OF CONSUMERS

1. In case of multiple consumers, the process consumers in flammable hydrocarbon and very-toxic service should preferably be served by a dedicated cooling tower in order to segregate cooling from that for non-hazardous users.
 - a. Refer to DEP 01.00.01.30-Gen. for definition of very-toxic service.

Very-toxic includes all type of toxic including very toxic –environment, very toxic-acute and very toxic-chronic.
2. Unless otherwise specified, the cooling tower for the process consumers in flammable hydrocarbon and very-toxic service should be located in the same area as the consumers.
 - a. Refer to DEP 80.00.10.10-Gen. or DEP 80.00.10.13-Gen., as applicable, for area classification.
3. If cooling water consumers are in flammable hydrocarbon or very-toxic service, online hydrocarbon and/or toxic gas detection facilities SHALL [PS] be provided at the cooling water return line.
 - a. Refer to DEP 32.30.20.11-Gen. for gas detection systems.
4. Sampling facility shall be provided to detect leak of hydrocarbon/toxic substance at every heat exchangers (having hydrocarbon or toxic fluid on other side) cooling water outlet.

2.3 COOLING TOWER REQUIREMENTS

1. For requirements and recommendation for cooling tower, refer to General Functional Specification (GFS) of cooling tower, GFS 31.86.50.01-Gen.
 - a. Contractor shall provide the process and mechanical definition for the cooling tower package based on this DEP.
 - b. The cooling tower Supplier shall provide the complete design and guarantee of the cooling tower as per GFS 31.86.50.01-Gen.
2. Decisions related to the design class performance categories for cooling towers should be made by the Contractor, subject to the approval of Principal, in the project "Define" phase and detailed in project scope defining documentation (e.g., equipment BDEP (Basic Design Engineering Package), cooling tower data sheet (EDRS), and project specific specifications).
3. Because of Legionella concerns, the tower SHALL [PS] not be sited within 15 m (50 ft.) of a building air-intake to the surrounding residential community.
4. The cooling tower drift loss SHALL [PS] be limited to 0.001 % of the water circulation to control airborne aerosol generation to reduce Legionella risk.

3. DESIGN

3.1 CIRCULATING WATER FLOW RATE

1. The design circulating water flow rate shall be based on the requirements of the process facilities and utility systems served by the cooling water tower plus the margin as per the selected design class as per DEP 00.00.07.91-Gen.
2. The design shall size the cooling water circulating pumps, drivers and piping to allow full operation of the cooling water system when the exchangers are "clean" as well as "fouled".
3. The design circulating water flow rate shall be based on the final process design of the heat exchangers.

3.2 DESIGN WET BULB TEMPERATURE

1. The design ambient wet bulb temperature (WBT) shall be based on geographical location and localised plant influence.
2. WBT data should be taken at the proposed tower site to compare against data taken simultaneously at the nearest source of base WBT data. The difference between the data indicates the appropriate correction for plant influence.

The correlation is best when the source of base data and the tower site experience similar weather conditions, usually requiring relatively close proximity.

3. Tower design shall use a base ambient WBT that is equalled or exceeded 1 % of the time per annum for design class 3.
 - c. Towers that service design class 1 and 2 facilities may allow use of base WBT equalled or exceeded 2 % of the time per annum.
 - d. Other exceedance of base ambient WBT shall be subject to the approval of the Principal.
4. The design inlet WBT shall be the design base ambient WBT plus an allowance that accounts for recirculation of humid air from the fan discharge to the tower air inlet.
 - a. To minimise recirculation, refer to DEP 80.00.10.11-Gen. for the location of the cooling tower.
 - b. Hot air recirculation shall be assessed including the following considerations:
 - i. wind direction and velocity;