

DEP SPECIFICATION

COOLING WATER TOWERS – SELECTION, DESIGN, FABRICATION AND ERECTION

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DESIGN AND ENGINEERING PRACTICE



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All administrative queries should be directed to the DEP Administrator in Shell GSI.

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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the selection, application, design, fabrication and erection of cooling water towers.

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 word **should** indicates a recommendation.

1.3.2 Specific definitions

The basis for cooling tower nomenclature shall be CTI Bulletin BUL-109.

1.3.3 Abbreviations

Term	Definition
CTI	Cooling Technology Institute
FRP	fiber reinforced plastic
MOE	modulus of elasticity
TSS	total suspended solids
WBT	wet bulb temperature

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 (7).

1.5 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.
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://www.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.

1.6 SUMMARY OF MAIN CHANGES

This is a new 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.

2. GENERAL INFORMATION

The basic expectation is that the Contractor will provide the process and mechanical definition for the application, with the Manufacturer providing the complete design and guarantee.

Decisions related to the design class performance categories for cooling towers are intended to be made by the 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, project specific specifications, etc. This DEP is generally written for Design Class 2/3 facilities, with options identified basis design class where appropriate. When projects opt not to implement the design class practice, options set forth within this DEP based on design class shall default to Design Class 3 section unless otherwise directed by the Principal.

2.1 REQUIREMENTS

Cooling tower shall be designed, fabricated, and erected in accordance with the following standards:

CTI Design Manual	Standard
Acceptance test code for water cooling towers	ATC-105
Nomenclature for industrial water cooling towers	BUL-109
Gear speed reducers	STD-111
Pressure preservative treatment of lumber	STD-112
Design of cooling towers with douglas fir lumber	ESG-114
Bid form (factory assembled)	Ptg-118 SF/FA
Bid form (field erected)	Ptg-118 SF/FE
Timber connection specifications	STD-119
Fibreglass reinforced plastic panels	STE-131
Plywood for use in cooling towers	STD-134
Thermoplastic materials used for film fill, splash fill, louvers and drift eliminators	STD-136
Fibreglass pultruded structural products for use in cooling towers	STD-137
Standard for publication of custom cooling tower thermal performance test results	STD-202
CTI fastener material guidelines	ESG-144
Structural design of FRP components	ESG-152
Low clog fill – New approaches	TP01-02

Cooling tower shall conform to the local occupational safety and health regulations.

2.2 HIERARCHY

In case of conflict between documents relating to an order, the following hierarchy shall apply:

- a. the Purchase Order
- b. the data sheets and drawings

- c. the project specification
- d. this DEP

2.3 SUPPLIER PROPOSAL

Supplier technical proposal shall include the following information:

- a. Completed CTI Bid Form STD-118 SF/FE or STD-118 SF/FA.
- b. Dimensional outline drawings (plan and elevation views), including the dimensional requirements of the basin and individual cell dimensions with heights of the rain and spray zones identified.
- c. Longitudinal and transverse frame elevation drawings (showing proposed column, girt, and bracing sizes), typical connection details, and connection details of the hot water distribution header.
- d. Completed data Sheet DEP 31.10.00.94-Gen for normal and maximum fan pitch.
- e. Completed standard gear box data sheet.
- f. Completed DEP motor data sheets.
- g. Complete data on fill: Type (manufacturer, model number, geometrical description, and wetted fill density as used in the structural design calculations), height, width, clearances, splash, and wetted area, as well as the total tower splash and wetted areas, length, width, and height of total fill section of the tower.
- h. Complete description and dimensioned sketch of water distribution nozzles.
- i. Air velocity and pressure drop through fill, inlet, drift eliminators, and velocity recovery stack.
- j. Arrangement of driver, shaft, and gear speed reducer.
- k. Fan and hub design details.
- l. Fan stack entrance, throat and exit diameters, and height.
- m. Fan performance curves with the operating point clearly marked. Curves shall include the effects of design fan tip clearance and the operating environment of the fans.
- n. Drive and gear box efficiency.
- o. Pressure drop in water distribution header and water distribution system for each cell.
- p. Recirculation allowance applied to ambient wet bulb temperature if inlet wet bulb is not specified by the Contractor.
- q. Predicted tower performance curves.

Proposal shall state the entering air wet bulb temperature as corrected for recirculation. A preselection meeting may be held at which the supplier is to justify the assumed recirculation, considering tower type and orientation, adjacent structures, wind direction and velocity during the four hottest months, fan stack height and exit velocity, etc.

Proposal shall include a detailed description of any exceptions to the specified requirements. If there are no exceptions, the proposal shall include a statement to this effect.

2.4 APPROVAL DOCUMENTATION

Successful Supplier shall submit the following documentation to the Contractor for review and approval prior to starting fabrication:

- a. Foundation plan showing:
 - Maximum vertical and horizontal loads (gravity and lateral loads-wind/seismic) at each column support based on the specified load

combinations.

- Size and location of columns, and/or bolt settings and details.
- b. Maintenance and erection loads.
- c. Recommended cold water basin arrangement.
- d. Detail drawings of the hot water distribution system, including details of the distribution piping supports, anchors, or guides.
- e. Overall dimensions and elevations of all assemblies and subassemblies, including all clearances that must be maintained.
- f. Location and details of all connections to equipment.
- g. Fill dimensions and arrangement details, including the wetted fill density as used in the structural design calculations.
- h. Stairway, platform, and ladder details and locations. Information shall include the design live loads for stairways and platforms.
- i. Recommended orientation and clearances for the tower to minimize recirculation or interference.
- j. Drawings of structural framing (plan and elevation of longitudinal and transverse bent lines), structural connections and joints, fill and fill supports, casing, walls, mechanical equipment, and water distribution system.
- k. Drawings shall have sufficient detail to allow complete review of structural analysis and design.
- l. Drawings of the hot water distribution system shall have sufficient detail to allow complete review of the mechanical design, including design of supports, anchors, or guides.
- m. Drawings showing plan layouts for platforms and stairs shall have a note indicating the allowable live load for stairs and all areas of the platforms.
- n. Load or stress diagrams for wind, seismic, and gravity loading for structural components
- o. Complete set of structural calculations that include, but are not limited to, the following:
 - p. Lateral frame analysis and design (transverse and longitudinal)
 - q. Gravity load design
 - r. Dynamic loading/vibration study
 - s. Connection designs (consistent with analyses result)
 - t. Distribution header support, anchor, and guide details (including an assessment of thermal movement and pressure thrust loads)
 - u. Calculations shall indicate the strength reduction factors, service factors, and deflection limits.
 - v. Fan performance curves showing air flow, pressure, efficiency, and horsepower as a function of fan pitch. Design points shall be identified on the curves.
 - w. Tower performance curves, including the detailed data set to allow analysis of the cooling tower's thermal performance by an independent CTI certified testing agency if thermal performance testing is specified. Details of all required and recommended spare parts.
- x. Inspection and test plan documents.

Approval of documentation by the Contractor shall not relieve the Supplier of the responsibility to meet the requirements of the purchase order.

2.5 FINAL DOCUMENTATION

The following final documentation shall be provided after final mechanical acceptance of the tower:

- a. Operation and maintenance manuals.
- b. Recommended spare parts lists.
- c. Gear reducer cross-sectional drawing showing all parts and referenced to a parts list.
- d. Set of shop fabrication and erection drawings that include fully specified materials.
- e. Mechanical, structural, and thermal design calculations.
- f. Set of final as-built drawings including transverse bent line structural drawings, longitudinal bent line structural drawings, drawings of all connection details, plan view, elevation view, fill support details, and hot water distribution piping details.
- g. As-built CTI STD-118 SF/FE or 118 SF/FA.
- h. Results of minimum mechanical property tests of FRP pultrusions.
- i. Timber material test results that include degree of testing, member moisture content, and MOE test results.
- j. Certificate of grade and pressure preservative treating records for all timber.

2.6 GUARANTEE

Supplier shall guarantee that the tower capacity determined in accordance with ATC-105 shall not be less than 100 % of the specified capacity without exceeding the quoted fan power and pumping head. The Manufacturer shall bear the burden of including an appropriate test "tolerance" in their thermal rating.

If the results of the performance test indicate that the tower does not meet the capacity requirements, modifications shall be made to the tower as required to make the tower meet the requirements.

- a. Tower shall be retested by a CTI certified tester after modification.
- b. Above procedure shall be repeated as required until a successful performance test is achieved.
- c. Principal reserves the right to schedule the modifications based on the associated plant operation, i.e., work may be restricted to one cell at a time.

Supplier shall warrant and guarantee all materials, equipment, and workmanship for a period of one year after the tower is placed in service or for a period of 18 months after mechanical acceptance of the tower by the Principal.

Cooling tower structural FRP components shall be guaranteed to be free of UV and chemical degradation for a minimum of ten (10) years after erection. The FRP casing shall have a guaranteed service life of a minimum of ten (10) years after erection. Minor visible degradation of the casing which does not affect the structural integrity or function of the casing is permitted within the guarantee period.

Tower thermal performance guarantee shall extend through the second summer following final mechanical acceptance to permit testing with a full thermal load.

Supplier shall guarantee that the vibration readings taken per (5) of this DEP shall not exceed the values identified as region(s) B or the values for blade pass on the fan cylinder in the following figures of Chapter 10 of Cooling Tower Manual depending on tower construction:

- a. Figure 1a for steel, factory-assembled cooling towers.
- b. Figure 1b for wood-framed, field-erected cooling towers.
- c. Figure 1d for FRP-framed, field-erected cooling towers.