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Guidance on Industry Standard for Cooling Towers

GIS 26-201

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 26-201. This Guidance on Industry Standard (GIS) is based on parts of heritage documents from the merged BP companies as follows:

Amoco

A FE-CTWR-00-P Fabricated Equipment—Cooling Towers—Procurement Specification.

ARCO

ES-90 Engineering Standard 90, Induced Draft Water Cooling Tower.

PTA

PTA FE-CTWR-00-P Fabricated Equipment—Cooling Towers—Procurement Specification.

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1. Scope

This GIS provides guidance on industry standard for the design, materials selection, fabrication, inspection, testing, preparation for shipment, erection, documentation, and performance testing for both crossflow and counterflow induced draft, water cooling towers.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GP 06-62	Guidance on Practice for Painting of On-shore Facilities.
GIS 12-201	Guidance on Industry Standard for IEC Low Voltage Induction Motors.
GIS 12-202	Guidance on Industry Standard for Low Voltage Induction Motors (IEEE 841).
GP 12-25	Guidance on Practice for Earthing / Grounding.
GP 12-30	Lighting and Small Power.
GP 14-01	Guidance on Practice for Noise Control.
GP 30-25	Guidance on Practice for Field Instruments General.
GP 30-35	Guidance on Practice for Control Valves and Pressure Regulators.
GIS 60-501	Guidance on Practice for Chemical Dosing

American Gear Manufacturer's Association (AGMA)

AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives.
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American Petroleum Institute (API)

API Spec 15LR	Specification for Low Pressure Fiberglass Pipe.
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American Society of Civil Engineers (ASCE)

ASCE 7-88	Minimum Design Loads for Buildings and Other Structures.
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American Society of Mechanical Engineers (ASME)

ASME B31.3	Process Piping.
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American Society for Testing and Materials (ASTM)

ASTM A385	Standard Practices for providing High-quality Zinc (Hot Dip).
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ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D2466	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D3841	Standard Specification for Glass Fiber Reinforced Resin Panels.
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials.

American Wood Preserver's Association (AWPA)

AWPA STD-C1 2.214 All Timber Products - Preservative Treatment by Pressure Process.

Occupational Safety and Health Administration (OSHA)

OSHA 29 CFR, Part 1910, Occupational Safety and Health Standards.

West Coast Lumber Inspection Bureau (WCLIB)

WCLIB Number 17 Standard Grading and Dressing Rules for West Coast Lumber.

Cooling Tower Institute (CTI)

ATC-105	Acceptance Test Code.
ATC-128	Measurement of Sound from Water Cooling Towers.
STD-111	Gear Speed Reducers.
STD-114	Design of Cooling Towers with Douglas Fir Lumber.
STD-119	Standard Specifications, Timber Connection Specification.
STD-131	Fiberglass Reinforced Plastic Panels.
STD-134	Plywood for Use in Water-Cooling Towers.
STD-136	Polyvinyl Chloride Materials used for Film Fill, Louvers and Drift Eliminators.
STD-137	Fiberglass Structural Products.
WMS-112	Pressure Preservative Treatment of Lumber.

National Electrical Manufacturers Association (NEMA)

NEMA 250 Standards for Electrical Enclosures.

National Fire Protection Association (NFPA)

NFPA 214	Water Cooling Tower.
NFPA 780	Lightning Protection Code.

3. Symbol and abbreviations

For the purpose of this GIS, the following symbols and abbreviations apply:

CPVC Chlorinated Polyvinyl Chloride.



FRP	Fibreglass Reinforced Plastic.
PVC	Polyvinyl Chloride.
SUS	Saybolt Universal Seconds.

4. General considerations

- a. Design and specification of cooling towers shall include: structure, mechanical equipment, electrical equipment, instrumentation, and ancillary equipment necessary to provide a complete unit.
- b. Thermal design shall comply with conditions set forth in the data sheets.
- c. Completed work of Vendor and sub-vendors, shall conform to local rules and regulations that apply.
- d. Cooling tower shall be designed and constructed for minimum service life of 20 years, and components affecting each cell for minimum 1 year uninterrupted operation.
- e. One set of special tools required for tower maintenance, including alignment equipment for motor and gear unit, shall be supplied.
- f. Unless otherwise specified, anchored columns shall extend 0,3 m (1 ft) below basin curb. Bidders shall include a price addition for columns extending to basin floor.
- g. Towers containing fewer than two cells shall be subject to BP approval.
- h. Location and size of bracing to minimize tower sagging, warping, or vibrating shall be subject to BP approval.
- i. Retention time at total operating rated flow shall be 30 minutes unless specified otherwise. Basin depth shall be subject to BP approval.

Cooling tower basin design shall be subject to cooling water pump vendor's review and recommendation.

- j. Specification of the following shall be subject to BP approval:
 1. Lightning protection system.
 2. Fire protection system.
- k. As a minimum, cooling tower shall be supplied with:
 1. Thermal design.
 2. Mechanical design.
 3. Tower fill with supports.
 4. Drift eliminators.
 5. Fan deck.



6. Fan stacks with access doors and sight ports.
7. Fan drives (motors or turbines).
8. Access platforms, stairways, and ladders to monitor and maintain tower and mechanical equipment.
9. Hot water distribution systems.
10. Support structure.
11. Air inlet louvers and supports for crossflow towers.
- l. Equipment arrangement shall provide access for operation and maintenance.
- m. Equipment arrangement, including piping and auxiliaries, shall be subject to BP approval.
- n. Others shall perform the following work:
 1. Piping, including gaskets and bolting, external to tower inlet flange.
 2. Motor starters and disconnects and motor control cabinet shall be supplied by others and located remote from cooling tower.
 3. Fire system piping upstream of trip and deluge valves.
 4. Building and construction permits.
 5. Foundation and basin, including anchor bolts etc.
 6. Blowdown and chemical feed equipment for control of corrosion, scale and fouling per GIS 60-501.
 7. Cooling tower thermal performance test.

5. Process

- a. The Vendor shall furnish curves showing performance of cooling tower over a considerable range of atmospheric wet bulb temperatures for various heat loads and water quantities according to data sheets.
- b. As a minimum the cooling tower shall meet all criteria in the CTI Acceptance Test Code ATC-105, unless otherwise specified.
- c. The tower shall be capable of meeting the design process conditions as specified on the data sheet with crosswinds from any direction.
- d. The cooling tower data sheet shall indicate the anticipated characteristics of the cooling water.



6. Structural

6.1. Design loads

- a. Structural design load values shall be provided by the Vendor.
- b. Dead loads shall be based on wet operation load of the tower, including applicable fan thrust loads.
- c. Design wind loads and other design loads on tower shall conform to CTI STD-114 and ASCE 7-88.
- d. Wind load shall be based on 180 km/h (110 mph) minimum, regardless of other code requirements. Seismic and wind loads shall not be applied concurrently.
- e. Live loads shall meet the following requirements:
 1. Stairs and walkways: 4,8 kPa (100 psf).
 2. Snow or other distribution load: 1,9 kPa (40 psf).
 3. Ice load on louvers, if applicable: 1,4 kPa (30 psf) distributed, 23 kg (50 lb) point load.
 4. Fan deck shall be designed to carry:
 - a) Minimum of 2,9 kPa (60 psf) live load, 450 kg (1 000 lb) point load.
 - b) Concentrated loads from fan motor, gear reducer, and other mechanical equipment.
 - c) Distributed loads, including those resulting from tower erection, operation, and maintenance.
- f. Guardrail shall be capable of withstanding a 113 kg (250 lb) (horizontal at top rail) load from any direction.
- g. Counterflow tower fill shall withstand live load of 1,2 kPa (25 psf) plus 1,2 kPa (25 psf) static load from ice formation, if specified for installation in a climate where icing can occur.
- h. Drift eliminators in a counterflow tower shall be capable of supporting a distributed load of 50 psf, provided load does not exceed 113 kg (250 lb) per bay.

6.2. Materials

6.2.1. General

- a. Specifications shall be provided for materials that are treated.

Typically only the wood is treated.
- b. Materials containing asbestos shall not be used.



- c. Plastic products exposed to sunlight shall be resistant to ultraviolet radiation deterioration.
- d. Plastic products shall have flame spread rating of 25 or less in accordance with ASTM E84.
- e. Carbon steel materials shall be galvanized in accordance with ASTM A385.
- f. Any reference to stainless steel shall mean AISI 300 grade.

6.2.2. Plastic materials

CPVC shall be used in lieu of PVC if there is a possibility of exposing material to temperatures above 63°C (145°F).

6.2.3. Lumber

- a. Structural lumber shall be Douglas fir per CTI STD-114, and conform to WCLIB grading rules. Boxed heart lumber shall not be used.
- b. All four sides of lumber shall be surface planed.
- c. After all fabrication steps of cutting to size, drilling holes, etc. has been finalized, but prior to tower assembly, all lumber for construction of the tower shall be pressure treated in accordance with CTI WMS-112.
- d. Treatment shall be in accordance with CTI MS-112. If specified retention cannot be met after repeated exposure to chemical, lumber may be accepted if it can be demonstrated that the material has been treated to rejection in accordance with AWPA STD C1-2.214.
- e. Lumber shall be certified as to the retention and to the pre-treatment moisture content.
- f. If requested by BP, a treated sample from each charge shall be supplied for penetration measurement by dye or other means.
- g. Areas of lumber cut or drilled after pressure treating shall be soaked for at least 10 minutes in a leach resistant wood preservative.
- h. Structural lumber shall be inspected and graded after fabrication, but prior to preservative treatment or shipment to treater.
- i. Samples may be tested for moisture content prior to treatment and for penetration after treatment.

6.3. Framework

- a. The cooling tower structure shall either be treated Douglas fir or fibreglass structural shapes. Douglas fir joints shall be connected using through bolted joint connectors that comply with CTI STD-19.
- b. Structural Douglas fir framework members shall conform to CTI STD-114.
- c. Framework joints shall:
 - 1. Be fitted without notching.



2. Have FRP, type 304 stainless steel, or silicon bronze connecting hardware.
- d. Critical framing joints shall be made with structural shear plates.

6.4. Columns

- a. Splicing of wood members shall conform to CTI STD-119.
- b. Structural columns shall extend to basin slab, piers, or perimeter shelves.
- c. Minimum nominal sizes of wood structural members shall be:
 1. Columns and diagonal bracing: 100 mm by 100 mm (4 in by 4 in).
 2. Ties: 50 mm by 100 mm (2 in by 4 in).
 3. Fan deck joists: 50 mm by 150 mm (2 in by 6 in).
 4. Fill support joists: 50 mm by 150 mm (2 in by 6 in).
- d. Minimum nominal size of fibreglass structural components shall be:
 1. Columns 75 mm by 75 mm (3 in by 3 in) box section with 6,4 mm (1/4 in) minimum wall thickness.

The strength of the fibreglass structure diminishes in cooling tower services with water temperature exceeding 50°C (120°F). Structural calculations shall take this into consideration.

6.5. Basin

- a. Basin curb for counterflow towers without inlet louvers shall be 1,2 m (4 ft) from perimeter column centreline.
- b. Unanchored columns shall be field cut for extension to basin floor.
- c. Cross-flow towers shall have hot water basins.
- d. Hot water basin shall be treated tongue & groove Douglas fir plywood a minimum of 25 mm (1 in) thick and sealed with mastic.
- e. Basin wall height shall prevent overflow at maximum flow rates.
- f. Bottom of basin shall be sloped 1% toward pump suction location.
- g. Overflow line shall be DN 150 (NPS 6), minimum.
- h. Overflow line shall be sized to handle full tower makeup rate.
- i. Hoist for pump suction screen shall be provided, with provisions to move the lifted screen to a wash down area.

6.6. Tower casing

- a. Tower casing shall not carry structural loads.

