

DEP SPECIFICATION

TELECOMMUNICATIONS TOWERS AND GUYED MASTS

DEP 32.71.00.14-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design, fabrication and erection of telecommunication towers and guyed masts.

Design requirements for steel structures in general are covered in DEP 34.28.00.31-Gen. and DEP 34.00.01.30-Gen., and those for offshore structures are covered in DEP 37.19.00.30-Gen.

Towers or guyed masts normally form a part of total telecommunications network, so this DEP should therefore be read in conjunction with DEP 32.71.00.10-Gen. and DEP 32.71.00.12-Gen.

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 authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil refineries, chemical plants, gas plants, exploration and production facilities and supply/distribution installations. 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 include an agent, or a 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

Term	Definition
Structure	Guyed mast or self-supporting tower.
Guyed Mast	Tall thin vertical structure that receives support from guy lines.
Tower	Tall structure that can stand alone on the ground or on larger structure or device. Towers are distinguished from guyed mast by their lack of guy lines.
Waveguide	Structure that guides waves, such as electromagnetic waves or sound waves. The most common type is a hollow conductive metal in rectangular or cylindrical pipe form used to carry high frequency radio waves, particularly microwaves.

1.3.3 Abbreviations

Term	Definition
MWL	Mean Water Level
NOTAMs	Notices to Airmen
ICAO	International Civil Aviation Organization
TIA	Telecommunications Industry Association

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 in this DEP are listed in (10).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2013. The following are the main, non–editorial changes.

Section/Clause	Change
7,2	Removed DEP 70.48.11.30-Gen.
10	Removed DEP 70.48.11.30-Gen.
10	Removed DEP 32.71.00.13
10	Removed DEP 32.71.00.11
10	Renamed DEP 32.71.00.10 to Onshore Telecoms
10	Renamed DEP 32.71.00.12 to Telecommunications for Offshore Facilities
B.3.6	Removed DEP 70.48.11.30-Gen.
B.3.7	Removed DEP 70.48.11.30-Gen.

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.
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. DESIGN AND ENGINEERING

2.1 GENERAL

1. The design of a steel structure shall take into account not only the properties of the materials of construction and the calculated stresses for the members, but also prevailing conditions of the local environment, requirements at the site, construction details, methods of erection and fabrication, and their effect on cost in order to achieve a safe and economic design.

2.2 DESIGN REQUIREMENTS

2.2.1 General

1. The design shall comply with DEP 34.00.01.30-Gen., DEP 34.28.00.31-Gen., and one of the following codes:
 - a. TIA 222
 - b. EN 1991-1-4 and EN 1993-3-1.
2. A single standard should be applied to the entire facility when towers, guyed-masts or tall slender structures form a part of a larger structural system (e.g., an offshore facility).
3. To allow for possible additional future mountings, all new towers should be designed with reserve structural capacity. In the absence of an estimate for this future capacity, the unity check of primary structural members may be limited to 0.8.

2.3 DESIGN LOADS AND CRITERIA

2.3.1 Load Combinations

1. The load combinations, partial safety factors and load combination factors for the structure and the foundation shall be in accordance with all of the following:
 - a. Applicable design codes and standards for loads
 - b. Any other probable and realistic combination of loads
 - c. DEP 34.00.01.30-Gen

2.3.2 Gravity loads

1. Gravity loads shall include the weight of the structure together with fixtures, fasteners, appurtenances, mounted equipment and accessories. Gravity loads shall also include imposed loads, such as loads on platforms and railings, and other maintenance related loads.

2.3.3 Ice or snow loads

1. Ice and snow loads shall be considered, where applicable, in combination with gravity loads and wind loads. For example, the Telecommunications Industry Association (TIA) recommends increase in the ice thickness with increase in wind speed.

2.3.4 Thermal loads

1. Thermal loads should be considered, where applicable, in combination with gravity loads. Thermal loads shall be either due to environmental temperatures or due to the influence of mounted equipment, whichever is the more stringent condition.

2.3.5 Initial guy tensions

1. Initial guy tensions in guyed masts shall be considered as permanent forces if environmental loads on the structure are less than the initial guy tensions.

2.3.6 Wind

1. Wind forces shall be considered on the portion of the structure exposed above ground or above mean water level (MWL), as well as on any mountings such as equipment, facilities, radomes, troposcatter dishes, cable trays, ladders, etc.
2. Wind load should be calculated in line with the codes specified in DEP 34.00.01.30-Gen.
3. Unless all aspects of wind actions are addressed within the project specific basis of design, wind actions shall be taken in accordance with the rules given in TIA 222. Deviations may be stated and agreed upon, where applicable.

2.3.7 Dynamic effects

1. The structural integrity of the telecom tower should be demonstrated against the impact of dynamic wind loading (vortex shredding), in accordance with the selected design code.

2.3.8 Earthquake

1. The structure shall be designed and/or checked for applicable earthquake loads.

2.3.9 Antenna and tower mounts

1. Antenna and tower mounts should be analysed as part of the structural review.

2.4 TYPES OF CONSTRUCTION

Guyed masts are normally made from triangular formation in plan, whilst self-supporting towers may be either triangular or square formations. Square towers are preferred since the four faces allow more flexibility in mounting directional antennas such as parabolic dishes.

Towers with tubular members are sometimes used, particularly in offshore applications, where their rigidity allows a single lift installation. Tubulars may be subject to internal corrosion.

1. The difficulty and cost of inspection and correction during the lifetime of the tower should be considered when the design concept is selected.
2. The Contractor should indicate the safe head load and provide back-up engineering and design calculations to support this. Depending on foreseeable future requirements, sufficient spare capacity for additional loading should be included. These documents should be retained by the Principal in the structure's log.
3. Flare or vent stacks should not be used as telecommunication towers because of the following:
 - a. Access to antennas, in case of faults, requires shut-down of the facility.
 - b. Damage to antennas, due to heat and corrosive fumes, is highly probable.
 - c. Any telecommunication building in the vicinity of the flare stack may be at risk from liquid hydrocarbon carry-over.
4. However, if no viable alternatives exist, especially for offshore locations, a specialist study shall be performed if there is a requirement to use a flare tower as a telecommunication tower.
 - a. The type of flare tower shall be taken into consideration in order to ensure no significant effect to the telecom equipment installed on the tower.
 - b. To reduce the possibility of maintaining the equipment, the usage of active equipment outdoors shall be minimized.
5. Rig derricks should not be used as telecommunication towers. However, if no viable alternatives exist, a specialist study shall be performed to ascertain whether they can indeed be used for this purpose.

3. TOWER AND MAST FOUNDATIONS

3.1 GENERAL

Towers and masts are subject to overturning moments, base shear induced by environmental actions and weight eccentricities.

1. Foundations shall be suitably designed to resist base shear and overturning moments.
2. The foundation design shall take into account the soil conditions and soil properties, gravity loads and corresponding eccentricities, base shear and overturning moments as provided by the telecom tower Supplier.

3.2 ONSHORE

For self-supporting towers onshore, different types of foundations are used, including the following:

- *Gravity block, where the dead weight of a large concrete block resists the overturning moment. It can thus be used in most soil types.*
 - *Pad and chimney, where the weight of an underground concrete pad is enhanced with backfilled rock and soil.*
 - *Concrete raft, which may be subsurface (where the weight of the concrete is increased by backfilling over the whole area under the tower) or on the surface.*
 - *Rock anchors, where chains are grouted into predrilled holes in the rock and then tensioned. A drilling rig is required for this, and its mobilisation costs may not be economically justified unless several towers are to be built simultaneously.*
 - *Piled foundations, where soil conditions are poor. These may be also used in swamps and shallow water.*
1. Soil tests shall be carried out at the exact intended location of the proposed tower, since the choice of foundation and its design depend substantially on the soil type. Refer to DEP 34.11.00.10-Gen. for soil investigations.
 2. The soil should be analysed to determine the presence of any corrosive chemicals, so that any necessary measures to prevent or mitigate chemical attack on the foundations can be taken.
 3. The water table should be determined, allowing for seasonal level variations.
 4. Earth resistivity should be measured to allow economic design of the earthing (lightning/electrical grounding). Refer to DEP 63.10.08.11-Gen. and to DEP 33.64.10.33-Gen., where applicable.
 5. Tower Suppliers normally provide a range of suitable foundation drawings and specifications based on standard soil conditions and these may need to be modified according to local conditions. Refer to DEP 34.11.00.12-Gen. and to DEP 34.19.20.31-Gen. for detailed information on foundations.
 6. For guyed masts, the foundation of the base shall be designed to resist the weight of the mast and the compression force produced by the weight and tension of the guy wires.
 - a. The guy-wires shall be designed to resist the overturning moment.
 - b. The guy anchors shall either be simple gravity blocks or shaped concrete set at depth, using the surrounding soil to resist drag and pull-out forces.

3.3 OFFSHORE

1. For the design of Offshore Telecom Towers refer to DEP 37.19.00.12-Gen.