

TECHNICAL SPECIFICATION FOR SELF-SUPPORTING STEEL MICROWAVE TOWERS

The following sections contain Generic Requirement for Light weight Microwave tower for use in ONGC Communication Network. The towers shall be four legged with a square base. The tower shall be able to support a maximum of four parabolic microwave solid dish antennas of 3m dia.

Technical specifications for self supporting communication tower are as under:

1.0 GENERAL:

1.0.1 Bidder shall **furnish along with technical bid, all relevant technical information to substantiate that the offered tower complies with the give specifications.**

1.0.2 The tower and accessories must be warranted to be free from defects in material and workmanship for lifetime on all manufactured items (applicable to steel structural elements).

1.0.3 The towers shall be designed and constructed/ erected to be suitable for the described antenna loading, weather conditions, soil conditions and conform to the given certifications.

1.0.4 All tower elements shall be angular and hot dip galvanized after fabrication.

1.0.5 All tower accessories like antenna mounts, platforms, cable trays, safety climbing ladder etc. should also be hot dip galvanized.

1.0.6 Nuts, Bolts & Washers:

All fasteners, plain washer, all Nuts, Bolts & Washers should be Hot Dip Galvanized as per applicable relevant standards.

1.0.7 The tower shall be erected such that one leg is directed towards true north.

1.0.8 The foundation of the tower shall be designed based on the soil testing reports and foundation design shall also be approved by registered and Govt. approved structural Engineer.

1.0.9 Tower shall be four legged, angular, square self supporting.

1.1 The following specifications are the minimum requirements for self supporting towers (and accessories) from 30m to 100m height.

The specifications cover the design, fabrication, supply and erection of self supporting steel Microwave tower and accessories complete with foundation work, earthing devices, pipe of suitable size and length for mounting antennae, Solid State Aviation Obstruction Lights with cabling, ladders for climbing, Cable Racks for supporting cables and platforms.

- 1.1.1 Tower members shall be of structural steel conforming to IS: 8500, IS 226, IS 2062 and IS: 7215 or latest IS as applicable with latest amendments.
- 1.1.2 All steel used shall be galvanized, conforming to relevant IS specification i.e. IS 2629 for tower members IS 5358 for fasteners and IS 1573 for washers with latest amendments. Spray galvanizing may be permitted whenever hot dip galvanization is not possible.
- 1.1.3 Assembly of tower members and other structures on tower shall be by means of nuts and bolts with locking nuts. Riveting and welding may be done if the design demands and it shall conform to relevant IS specifications with latest amendments. Minimum thickness of the members should not be less than 6 mm.
- 1.1.4 The quality of steel used for nuts, bolts, washers etc. should conform to IS No. 6639/ 72 and mechanical properties as per IS 1367 with latest amendments. Dimensionally, it shall conform to IS 1363 with latest amendments. The heads being forged out of solid, truly concentric with the shank and shall be perfectly straight. All bolts shall have hexagonal heads and nuts. The bolts shall be treated with standard threads to take the full depth of the nut. All nuts shall fit hand tight to the bolts. No appreciable fillet shall exist at the point where shank of the bolt connects to the head. Lock nuts and washers shall be provided to all bolts and nuts. The tender shall include sufficient spare bolts and nuts to compensate for loss in the field during erection. The cost of bolts and nuts shall be included in the cost of tower.
- 1.1.5 The overall force co-efficient for wind load on tower shall be taken from IS: 875/ 1987 (with latest amendments) Indian Standard for Self-Supporting Steel Towers. For calculating the solidity ratio actual obstruction area of tower shall be considered. Separate Wind obstructing areas shall be taken for ladder, cable rack and platforms etc.
- 1.1.6 The basic dynamic wind pressure at different heights for different zones shall be taken from the Indian Standard Code with latest amendments mentioned above.
- 1.1.7 The basic wind velocity for the site is to be taken from the revised BIS Code No. IS 875/1987 with latest amendments.
- 1.1.8 The permissible stresses in the various structural members of tower shall be adopted from the relevant clauses of IS 800 amended up to date.

1.1.9 Loading effect due to antenna and various accessories as indicated at elsewhere in the document will be taken into consideration.

1.1.10 Loading effect of seismic forces as per IS 1893 (with latest amendments) and cyclonic winds and conditions of frost etc. if any, may also be taken into consideration.

1.1.11 FOUNDATIONS

- a) Bidder is advised to inspect the tower site and acquaint himself with the local terrain & site conditions soil conditions, nature of sub soil, water table and its seasonal variations etc. and make such local enquiries, as may be necessary for any data required by him, before quoting if required. No extra charges for leveling and retaining walls etc., shall be payable by the ONGC in addition to the cost quoted in the tender.
- b) The successful Bidder shall carry out soil tests through a reputed firm of experts, to the satisfaction of the ONGC. Soil samples should be got tested in a recognized laboratory. In case the Bidder carries out the tests himself, authorized representative of the ONGC has to be associated with such borings. Samplings and testing. When a test boring is conducted complete test observations will have to be recorded and furnished to ONGC.
- c) The cement, sand and concrete used shall be best grade and the concrete shall preferably be mixed in a mechanical mixer in the standard ratio 1:2:4. The foundation shall be watered and cured for at least 14 days and the erection of the tower shall be commenced only after the foundations are thoroughly cured.

1.1.12 VERTICALITY, DEFLECTION & TWIST UNDER STILL AIR CONDITIONS:

- a) The tower shall be vertical after erection and no straining shall be permitted to achieve this. This erection tolerance of verticality shall be within 25 mm every 9100 mm. Deflection in any particular section beyond the above limit is not permissible.
- b) The angular twist shall not exceed +/- 0.5 degree from the normal plans of tower face.
- c) **UNDER MAXIMUM WIND LOAD CONDITIONS:**

The average slope of the axis of the antenna support column shall not depart from the vertical by more than 1 deg. under maximum wind load conditions. The successful Bidder will have to satisfy that verticality is maintained at not more than 1 deg. at the maximum wind load conditions.

- d) The angular twist shall not exceed +/- 1 degree from the normal plane of the tower face.
- e) The following additional technical parameters/ specifications are to be considered for design of tower:

- i. **DEAD WEIGHT:**

- Dead weight of the tower plus ODU & antennae proposed in this tender plus provision of two additional antennae (parabolic grid @2.5m diam.) in future, wind load and resistivity against earthquake etc.

- ii. **WIND SPEED:**

- Operational = 180km/ hr minimum
 - Survival = 225km/ hr

1.1.13 **PROTECTION AGAINST LIGHTNING:**

The tower shall be provided with a suitable designed complete system of lightning protection in accordance with the provision of IS-2309-1969 with latest amendments including necessary earthing based on the specific resistivity of the soil and sub-soil water level. The lightning protective system shall be got approved, before execution.

1.1.14 **PAINTING:**

- a) The tower shall be given two or more coats of paint in addition to primer coats after erection. The tower shall be painted to have equal alternate bands of international orange and white colours with top and bottom bands painted in orange as per civil aviation regulations.
- b) The paints used in painting shall be in accordance with IS-2074/ 62, 2932 & 2933/ 75 or latest IS with latest amendments. Before applying coats of primer, the surface shall be given a coat of Pickling agent so as to avoid the flaking of painting. The Bidder should furnish the details about the pickling intended to be applied.

1.1.15 **EARTHING:**

- a) All the tower legs shall be grounded properly, following the standard practice of earthing of such structures in level ground and mountainous regions.

- b) The tower earthing shall be done as per the relevant standards and standard industry practices. The earth resistance of the tower shall be less than 2 ohm.
- c) Necessary provision for earthing surge suppressors, LAN extenders etc. shall be made on top i.e. at antennae locations and below near the base of tower from where the cable tray leaves tower for the equipment room.

1.1.16 FACILITIES ON TOWER:

a) PLATFORM

- i) Provision of platform for access to microwave dish antennae and cable at different levels be made. 1.5 meter high handrails would be provided at each level with expanded metal net for additional safety. Platform flooring will consist of chequered plate conforming to IS 3502 and shall be designed as to take stationary and moving load of 4 persons plus equipment weighing about 100 Kg. At each platform "Toe-plates" has a form of protection against accidental dislodging of small tools, are to be provided.
- ii) An internal ladder of width not less than 300 mm starting from about 2M level of the tower from the ground and going up to the top with openings at all the platforms shall be provided. The ladder shall be hinged type for safety of the climbing personnel. The ladder shall be provided with fall prevention safety system for ensuring safety against free fall of climbing personnel. A light weight ladder of portable type and of adequate length shall be provided to be used between the ground and the permanent ladder. It shall be made of aluminum. The face on which the ladder is to be provided shall be intimated before the commencement of erection of tower.
- iii) **Working platforms:**
 - a. 30m Tower= 1 No. on top
 - b. 45m Tower= 1 No. on top with 1No. Rest Platform at 30m
 - c. 60m Tower= 2 Nos. (1 No. at 45m and 1No. on top) with 1No. Rest Platform at 30m
 - d. 80m Tower= 3 Nos. (1 No. at 45m and 1No. at 60m and 1No. on top) with 1No. Rest Platform at 30m
 - e. 100m Tower= 4 Nos. (1 No. at 45m, 1 No. at 60m, 1No. at 80m and 1No. on top) with 1No. Rest Platform at 30m and 45m

b) LADDERS

Rungs of the ladder shall be clear of any obstructions to the climber, equally spaced by a distance of not less than 250 mm.

c) SOLID STATE AVIATION, OBSTRUCTION LIGHTS & POWER CABLES

- i. Solid state aviation obstruction lights fittings equipped with appropriate colour prismatic globes shall be provided as per latest Civil Aviation Regulations with latest amendments for marking and lighting of obstacles. The globes and their housings shall be strong, weather proof and of approved manufacture. Each globe shall house a solid state

lighting arrangement to yield specified illumination. The tower lighting drawing shall be got approved from the ONGC.

- ii. Power supply cable for the Solid state aviation obstruction lights and power sockets shall conform to latest IS with latest amendment. These cables shall be terminated in TP&N MCB of suitable rating in a suitable metal box at the tower base including the earthing etc.
- iii. Distribution of supply to Solid state aviation obstruction lights shall be through 4 way weather proof junction boxes. The power sockets with switches shall be of suitable rating. All these shall be suitably mounted.
- iv. The Bidder shall provide temporary solid state aviation obstruction lights during erection of tower as soon as the tower reaches height of 40 meters or the minimum heights to be lighted as prescribed in Civil Aviation regulations with latest amendments.
- v. One no. of 4 core, 6.0sq.m Aluminum conductor (Stranded), PVC Insulated, PVC sheathed weather proof armoured cable shall be provided and laid with weather proof service outlets at each platforms terminated in a 15 ampere socket and switch for power supply for miscellaneous purpose. This cable shall be terminated in Control Room/ Transmitter Hall near the tower.
- vi. The cables shall be laid under ground up to tower base as per standard practice (where cable tray is not feasible from equipment room to tower) and from tower base these cables shall be taken on tower on the vertical cable rack.

d) CABLE RUN-WAY AND ANTENNA SUPPORTING LADDERS

- i. The vertical cable rack for support of RF feeder cables starting from the base of the tower and going up to the tower top shall be provided.

- ii. This cable rack shall be routed along the tower face or leg and should be just behind the climbing ladder or be a part of this for easy accessibility. The cable rack shall carry all the RF feeder cables as well as Solid State aviation obstruction lights, service cable etc. It should be provided with necessary arrangements for fixing the cable clamps.

e) Microwave Dish Antenna Fixtures :

Two (2) Nos. of antenna mounting structure shall be provided at each working platform. The direction of these mounts shall be finalized after engineering site survey. Provision for mounting these fixtures at other platforms is also to be made.

1.2 PNEUMATIC/ TELESCOPIC MAST (25 M):

Pneumatic Telescopic Mast shall be as per standard and shall conform to following specifications:

- i. The Pneumatic Telescopic Mast shall be made of concentric metallic tubes of different diameters, telescoped into one another.
- ii. Mast shall be light weight.
- iii. The mast shall be consisting of various small sections which can be extended or retracted slowly and smoothly.
- iv. Each section shall have one set of locking arrangement
- v. Sufficient steel guy ropes shall be provided to withstand the mast firmly at wind velocity of 120 KM per hour.
- vi. The mast shall be operated with air pressure from standard foot operated pump and motorized or any other source of compressed air.
- vii. Once the mast is erected and anchored whether partly or fully, it should remain permanently extended without maintaining the air pressure.
- viii. Partly or fully extended range of mast shall be capable of carrying a head load of 15 Kg (Antenna plus ODU).
- ix. Partly or fully extended the mast can be rotated for orientation of antenna towards base station antenna.

- x. Rotating handle shall be fitted to the top side of the bottom section to enable the orientation of antenna in required direction.
- xi. Sufficient foot rest shall be provided to enable a person climb when the mast is extended or retracted.

1.3 Masts

Guyed Mast shall be as per standard and shall conform to following specifications:

- a) Design approval of Central Structural Research Institute (CSRI) Chennai or TEC (BSNL), Structural Engineering Research Centre, Ghaziabad
- b) Foundation work for the towers shall be as per OEM's recommendations of mast's manufacturer
- c) Hot dipped galvanized structural steel construction
- d) All bolted construction with angle design
- e) Triangular Cross Section
- f) Steel Angle Cross Bracing
- g) Standard 10 feet Sections (Minimum) with 22" face
- h) Standard Painted Finish
- i) Supported by Guying Cables
- j) Foundation of the mast shall be stress free
- k) With full structural safety
- l) With following accessories :
 - i. High Intensity Aviation Lights
 - ii. Lightning arresters
 - iii. Grounding
 - iv. Cable Tray

v. working platform

vi. Guying Cables