

2.8 Patent & copyright :

The tendered shall hold the purchaser and his employees safe, harmless and immune from any liability that may arise out of infringements of patents and copyright associated with design, fabrication, erection tower construction work and its accessories.

2.9 The performance specification and basis of design are detailed in subsequent paras. All deviation from these specifications should be clearly brought out in a separate annexure to tender. The tendered shall be deemed to comply with specifications in that aspect which do not figure specifically in the deviations from specification. In this light a compliance statement in the format as described in para 16(i) shall be submitted.

3.0 Design, calculation and drawings.

3.1 The specifications indicated herein are only to guide the tendered about the requirements of the purchaser. Detailed design of the tower from all aspects shall be got worked out by the tendered, keeping in view the effects of local meteorological conditions like wind velocity, seism city, temperature, codal provisions and as per good engineering practice to ensure the safety of the tower. Tender shall consult Wind & seismic zones as per latest BIS codes. The only Indian codes are only acceptable. The **Basic Wind Speed Zone of 44m/sec** is to be considered for design of tower.

3.2. The design of the tower shall be based on recognized principles of structural design Engineering, Conforming to Indian codal provisions and standard practices.

3.3. **Along with bid**, The tenderer shall furnish complete information about tower with his tender so that its full merit may be judged with respect to the requirements of the specifications. For this purpose the tenderer shall submit along with his tender, the following documents, without which tender is liable to be rejection. The following information must be attached with the offer. This is mandatory requirement.

- (i) A tower profile drawing showing all the facilities and requirements as specified in these specifications should be attached with offer. These drawings should show following along with any other information features of design & construction deemed necessary.
- (a) Main dimensions of tower profile including panel sizes (width & height), base width, bracing system in elevation, plan, hip etc.
- (b) Antenna arrangement of Band II & III, UHF and MW dishes in elevation and plan section with tower leg section.
- (c) Details of various platforms with typical handrail.
- (d) Arrangement of ladder, cable rack & cables through out tower including in antenna portion with plan section & elevation and member sizes.
- (e) Main structural member, sizes of leg, bracings including horizontal.
- (f) Arrangement of aviation obstruction lights, earthing, lightning arrestor. Etc.
- (g) Method of attachment of tower with foundation i.e. base detail.



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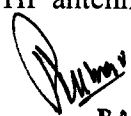
दूरदर्शन मध्यम विद्युत प्रसारण, नई दिल्ली
DGS: Telecom, Secy, New Delhi



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- (ii) Detail information concerning design parameters such as loads due to wind effect as per IS:875-1987 and seismic effect as per IS:1893 – 2002, dead loads, antenna loads, loads combination considered, design philosophy along with other information and shall contain.
- (a) Wind speed zone, terrain category, topographic factor etc.
- (b) Seismic zones factor, importance factor, response reduction factor etc.
- (c) Antaeen loads due to band II & III, UHF and MW dishes.
- (d) Load combination considered.
- (e) Design criteria, analytical model & philosophy.
- (iii) The preliminary design calculation of tower structure and its members, analytical model, load calculation due to wind, dead & seismic for tower structure, ladder, cable rack with cable etc. Design, forces, stresses & deflection in the main tower structure due to critical loading condition with various formulas used, reaction at base for design of foundation & any other information deemed necessary to show that tower design meets fully requirement of specification and safety norms & codal provisions.
- (a) Typical dead, wind load calculation of wind obstruction area, solidity ratio, force coefficient, wind pressure supported by formulas & references due to
- 1) Main tower structure for 5-6 pannels including bottom & Band II & III zone etc.
 - 2) Ladder, cable rack with cables for Band II & III antenna zone & below.
 - 3) Platforms with hand rails and other accessories.
 - 4) Antenna & MW dishes.
- (b) Typical panel wise dead & wind loads in table form for Band II & III zone and bottom 50% panels consisting of panel number & elevation wind load due to tower structure, ladder, cable rack, with cable and antenna loads including MW dishes, platform with hand rail and final panel wise loads considered for design of tower.
- (c) Typical design load calculation with method due to seismic effect.
- (d) Design forces compression / tension due to critical load combination, design of main members panel wise i.e. leg, bracing diagonal & horizontal with section adopted capacity members based on length, slenderness ratio, allowable stress with reference & formula.
- (e) Deflection at top of tower including UHF antenna system and reaction at base in most critical load combination.

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- (f) Typical design of connection with method & codal references.
- (iv) Detail information about material used in tower structure & accessories such as quality of steel, fasteners with reference to relevant BIS codes.
- (v) The preliminary design of foundation based on soil data specified in Doordarshan specification with system drawing consisting of soil data used, design of foundation, having bearing, stability check in uplift, overturning, sliding, band etc. F.O.S adopted & reference with formulas.
- (vi) Details of aviation light, type model, battery back up, sun switch etc, earthing, lightning arrestor arrangement power cable details with drawing catalogue and other information.
- (vii) Detail of paint, paint schedule with numbers of coats etc with source and manufacturers catalogue and other information.
- (viii) Detail of activity wise bar / pert chart with delivery schedule.
- (ix) Details of weight of tower structure, fasteners & foundation quantity.
- (x) Details of past work experience of similar work min 2 nos. executed towers with completion certificates, scope of works and clients addresses, telephone & fax numbers.

3.4 After award of contract. (The main works which must be done by the tenderer)

The successful tenderer shall supply within two month from the date of the award of work the following documents to the purchaser for review:-

- (i) General arrangement drawing showing antenna arrangements, tower profile including main dimensions (elevations, panel sizes, width & height), bracing system in plan, hip & elevation, platform with hand rails, arrangement of ladder, cable rack with cable throughout the tower with plan section details, facilities provided on the tower i.e. detail of aviation light with type, lightning arrestors, earthing system, telephone line and service connections and showing all the requirements as per specification. Further in a table form details of all the antenna & facilities shall also be part of this drawing for guide line detail requirement given in para 3.(i) of Doordarshan specification shall also be considered but not limited to.
- (ii) Based on the general arrangement design drawing showing all main dimension and size of section of tower with elevation at different levels, panel sizes, bracing system of elevation, hip, plan, platform with hand rails, connection details of tower members, ladder, cable rack throughout the tower with sections, antenna fixtures etc. showing complete detail of tower from design point of view including base detail connection of legs with foundation and UHF & MW antenna fixing details. The design drawing shall show all



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the details specified in para 3.8(i) except facilities like A.O. L, Antenna earthing & power etc.

- (iii) Detail design, calculation of complete tower, accessories including load calculation (panel wise) for dead, wind, seismic effect, including wind obstruction area, force coefficient, wind pressure, seismic factor etc. The design shall also include loading conditions considered analytical model, computer model and information required as specified in the para 3.3 (ii) & (iii) of Doordarshan specification and any other technical information deemed necessary to illustrate that tower design meets fully the requirement of this specification, safety norms and codal provisions .
- (iv) Detail design and drawing of foundation based on soil data & tower design loads consisting of bearing, stability check in uplift, overturning, sliding, band etc. F.O.S. adopted & as per safety norms and codal provisions.
- (v) Tendered shall submit a detailed report alongwith dynamic analysis of tower and certificate testifying the soundness and safety of design of tower at his own cost from one of the following institutions
 - (a) Indian institute of Technology at Chennai, Delhi, Mumbai, Kanpur, Roorkee.
 - (b) Indian institute of Science Bangalore.
 - (c) Structural Engineering Research Center, Chennai.
- (vi) A detailed Soil investigation report, duly Certified by a Govt. agency.
- (vii) Details drawing of earthing, power cable rout, lightening arrestors etc.
- (viii) Tenderer shall also submit with in two months after submission of soundness certificate from the above institution. Three sets of all documents and drawing including following, but not a limit to.
 - (a) General arrangement drawing with all details and facilities provided on tower.
 - (b) Design drawing, earthing system & power system & lightening arrestors.
 - (c) Detailed design calculation of tower and foundation and accessories..
 - (d) Details structural drawing indicating section size, length of member, sizes of guests, joint details, indicating cutting and bending details, details relevant of fabrication with material and bolt lists etc. complete in all respect.
 - (e) All the detail drawing of tower accessories & foundation.
- (ix) Tenderer shall also submit after erection of tower one complete set of "as made" drawing along with original tracing/microfilm/CD of all the documents and detail drawings alongwith a detailed completion report in bound form for the reference and record of the purchaser.

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4. Design of tower and foundation.

Tower loading details due to antenna and cables etc.

Tower structure and foundation shall be designed based on loading due to antennas, RF cables, M/W dishes, power supply cables, vertical cable racks, ladders etc and load due to tower body and in accordance with design latest BIS design codes.


4.1. Loading on tower and antenna aperture details, RF cables, and M/W dishes are given below.

Type of Aperture	: Size of Aperture : (a) Length (b) CrossSection	: (a) Net Weight of Antenna.	(b) Wind load of antenna System at 216 km/h
(i) Band II (FM) (Present/Future requirement as indicated in para 1.1 of specs.)	(a) 18000 mm (b) 2500 mm	(a) 3500 kg (b) 6500 kg	(without support structure) (without support structure)
(ii) Band III (Present/Future requirement as indicated in para 1.1 of specs.)	(a) 20000 mm (b) 1200 mm	(a) 4800 kg (b) 7300 kg	(without support structure) (without support structure)
(iii) UHF Band IV/V. (Present requirement as indicated para 1.1 of specs.)	(a) 20000 mm (b) 640 mm	(a) 4700 kg (b) 7000 kg	(with support structure) (with support structure)
ref.cl. 4.1.2			
(iv) Microwave dish of 2 m. dia. (Present requirement)	(a) - (b) -	(a) 150 kg (b) -	(each dish) (To be calculated by tenderer)

Note- The Band IV/V antenna shall be supplied alongwith support structure(Spine). Therefore tower is to be erected upto Band-III aperture i.e.150m only but is to be designed to take the load of Band IV/V antenna with support structure as per above details.

4.1.2 Wind load given in 4.1 shall be modified considering tower location, wind zone, basic wind speed, terrain category and height of antenna mounting. The above weight and wind load does no includes weight and wind load due to the antenna supporting ladders on which antennas of Band II and Band III will be mounted.

4.1.3. As indicated in the following paragraphs the No. of R.F cables, in addition to power supply and the aviation light cables, to be installed on tower as below. Wind loading due to these (RF feeder cables) may also be taken into consideration. In addition of power supply cables


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for power points, AOL etc, the RF feeder cables which shall be mounted are given below. The wind-load of these cables is to be taken for design of tower.

Sr.No	Size & length of RF cables	No. of cables	Remarks
1.	115 mm outer dia RF cable,150 M approx.	2	All cables are to be
2.	80 mm outer dia RF cable ,150 M approx.	4	laid on the horizontal
3.	40 mm outer dia RF cable ,150 M approx.	2	feeder rack and are to
4.	Power supply cable for 15A & 5A power points.	1	be fixed by clamps with 1 M interval.
5.	Vertical rack		Size as per drawing no.TVT-5094/R3
6.	Climbing access ladder on tower		

40 mm dia RF cable net wt.	1.0 kg/m
80 mm dia RF cable net wt.	4.0 kg/m
115mm dia RF cable net wt.	5.5 kg/m

Please see tower profile drawing No. TVT-7562 with this spec.

- 4.2** The wind loading on tower body, platform, ladder, cable rack and cable shall be calculated as per wind loading code IS:875/Part-3-1987 (with latest amendments). The special care should be taken while calculating the wind load on tower and appurtenances, considering proper probability factor(risk coefficient), terrain category, wind zone (Basic wind zone) as may be applicable based on tower site location, and specified in the BIS code.
- 4.2.1** The tower shall be designed considering probability factor based on mean probable Design life of tower structure as 100 years.
- 4.2.2** The minimum terrain category to be considered for designing the tower shall be 2 and for the tower sites on hill, coastal areas etc. terrain category 1 irrespective of the tower site location.
- 4.2.3** Topography factor shall be considered for designing the tower depending on site condition, type of hill and range and cliff and escarpment as per BIS code IS:875-1987.
- 4.3** Loading effect of seismic forces as per I.S.1893/2002 shall be taken into account while designing the tower.
- 4.4** The tower shall be checked while designing for dynamic effect of wind and seismic forces as per codal provision of IS:875/part 3-1987 and 1893/2002 respectively alongwith static effect.
- 4.5** Wind load and seismic forces shall be assumed not to act simultaneously. The tenderer should spell out clearly in their offer various loads e.g. wind load, seismic force, antenna load etc. design procedures so that the same may be scrutinized by the Purchaser.

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4.6 DESIGN CRITERIA FOR TOWER

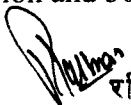
- 4.6.1 Tower shall be designed for antenna loads, loads due to tower body and appurtenances for various critical loading conditions and combinations so as to obtain maximum and minimum critical loads in the tower members. Tower shall be analyzed for static and dynamic loads produced by wind load, self weight and seismic forces as other critical load as may be deemed required.
- 4.6.2 The tower structures and accessories shall be designed as per allowable stress method and as per provisions of IS:800-1984 for various internal and external forces in members.
- 4.6.3 Allowable stresses in the tower structure members, accessories and fastener shall be as per IS:800-1984 and its provisions, no increase in allowable stress shall be allowed for any load combination.
- 4.6.4 The R.C.C foundation, tie beams etc, shall be designed and constructed in accordance with IS : 11233-1985, IS:456:2000 and other application codes. The minimum grade of concrete used shall be M-20.
- 4.6.5 All bracing and redundant member of the tower which are horizontal or inclined up to 15 degree from horizontal shall be designed to with stand an ultimate vertical load off 1500 N considered acting at center, independent of all other loads. The redundant and connection shall also be designed for 2.5% of minimum axial load of connecting members.
- 4.6.6 The platform structure and chequered plate flooring shall be designed as to take stationary and moving load of 4 persons plus equipment weighing 100 Kg independent of all others loads. The handrail members shall be designed for 75 kg load acting horizontally. Height of the hand rail must be 1.5 m on each platform.
- 4.6.7 Where erection stresses combined with other stressed could produce critical combination in any member, same shall brought within permissible stress limit while designing the tower.
- 4.6.8 Members subjected to fluctuations off stresses are liable to suffer from fatigue failure, effect of same shall also be considered while designing the tower members and in accordance with codal provisions.
- 4.6.9 The minimum thickness and size of tower structural members shall not be less than specified below.

(a) Main structural members like leg, Bracing etc –6mm.

(b) Secondary structural members like handrail, ladder –5mm.

(c) Minimum section of angle L45x45x5.

- 4.6.10 Joints shall be designed as to avoid eccentricity as far as possible; the thickness of the gusset plates required to transmit stress shall be 2 mm more than of member connected.
- 4.6.11 The maximum deflection of the axis of tower shall be not more than 1/100 from the vertical under maximum wind and other critical loading condition including dynamic effect.
- 4.6.12 The maximum slenderness ratio L/r for main and secondary members shall be limited to 180 in compression and 300 in tension.


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4.7 Foundations of tower:

Tenderer is advised to inspect the tower site and acquaint himself with the local soil conditions, nature of sub-soil , water table and its seasonal variations, area contours etc, and to make such local enquiries, as may be necessary for any data required by him before quoting his rates for foundation of the tower.

- 4.7.1 The successful tenderer shall carry out soil tests through a reputed firm of experts, to the satisfaction of the purchaser. Soil samples should be got tested in a Govt. recognized laboratory. In case the tenderer carries out the test himself, authorized representative of the purchaser, has to be associated with such borings, sampling and testing. When a test boring is conducted complete test observations will have to be recorded and furnished to the purchaser. The tenderer shall also quote rate on the basis of 8.2m.tones per sqm. Safe bearing capacity of soil at 4m depth.

The following variation clause in cost of foundation depending on the bearing capacity of soil obtained by soil investigation shall be applicable.

- (i) Normal soil bearing pressure of 8.2MT per Sq.M. at a depth of 4 M has been considered. If the soil properties vary during final design, the cost of foundation will increase by 5.5% for every 0.55 MT per Sq.M decrease in bearing pressure upto a minimum of 5.45 MT per Sq.M bearing capacity. Similarly, the foundation cost will decrease by 5.5% for every 0.55 MT per Sq.M increase in the bearing pressure up to a minimum of 10.95 MT per Sq.M. No other variation in the cost of foundation will be permissible due to any reason whatsoever.

However tenderer shall visit the site and may conduct preliminary soil test, if he so desires to ascertain the soil details. It may be noted that no extra cost will be paid to tenderer in any circumstances for change of soil and foundation type and quantity increase based on the soil investigation report or any other reason after award of work except as per above (i).

- 4.7.2 It may be noted that no extra cost will be paid to tenderer in any circumstances for change of soil and foundation type and quantity increase based on the soil investigation report after award of work except above (i) and (ii).
- 4.7.3 The soil-investigation report by a State/Central Govt. agency or if the investigation has done by private agency, the soil-investigation report is to be got certified by a Govt. agency and submitted to the purchaser for review.
- 4.7.4 In case of rock anchorage type foundation same shall be designed as per IS: 10270-1982.
- 4.7.5 The cement sand and concrete used shall be the best grade and the concrete shall be mixed in a mechanical mixer .The foundation shall be watered and cured for at least 14 days before the erection of the tower shall be commenced only after the foundations are thoroughly cured.



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4.8 Verticality and Maximum Deflection of Tower.

4.8.1 The tower shall be vertical after erection and no straining shall be permitted to achieve this. The erection tolerance of vertically shall be within 25mm every 9100mm, subject to over all verticality of tower with in 50 mm after erection of full height of tower and stage wise corrective action shall be taken to achieve the above.

4.8.1.1 The successful tenderer will have to satisfy the purchaser that verticality of tower is maintained within 50 mm after achieving and erecting full height of tower at site on two adjacent faces.

4.8.2 . The successful tenderer will have to satisfy the purchaser the verticality is maintained with in 50mm after erection of the tower at site. The verticality of the tower shall be measured and report shall be provided by tenderer after completion of work.

4.8.3 The maximum deflection of the axis of tower shall not be more than 1/100 from vertical at various levels including top, under maximum wind and other critical loading condition while designing.

5.0 Experience and Resource:

The tenderer is required to submit details of his previous experience in similar type of work i.e design, fabrication, supply of self-supporting TV/AIR or any other towers 100m height, capacity of their plant and their organizational set up for undertaking such works. Tenderer must have erected at least two towers of similar capacity in past. The name and address of the purchaser for whom towers have been erected must be provided with supporting documents. This is an essential requirement.

6.0 Date of completion:

The complete turnkey tower project shall be completed as early as possible but not latter than 15 months from date of L.O.I . However, activity wise time schedule including the period of delivery of materials at site and the time required for completion of erection of the tower shall be specified clearly in the tender. Early completion of work is an important consideration in the award of work.


7.0 Technical Specification

7.1 Materials

7.1.1 Tower steel section.

All tower member shall be out of structural steel confirming to IS-2062 Class A or B. However steel confirming to IS:8500 for medium and high strength steel can also be used, but same will be identified separately using colour code to avoid mix up with mild steel and use of steel confirming to IS:8500 shall be got approved from purchaser prior to its use.

7.1.1.1 (a) (i) Steel shall procured exclusively from the main producers like SAIL/TISCO/RINL(VSP).


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- (ii) The main members in-legs, bracing etc, shall not be less than 6mm thick.
 - (iii) The secondary members, like hand-rails, ladders etc. shall not be less than 5mm thick.
- (b) Steel less than 6mm thick can be procured form the re-rollers other than main producers provided :-
- (i) These are not available from main steel producers.
 - (ii) Re-rolled of structural steel sections can be from the billets of tested quality and from main producers.
 - (iii) Re-rolled section shall be duly confirm to IS:2062 and relevant inspection and testing codes.

7.1.2 Fastner: Bolts, nuts and washers:

The tower members and other structures of components shall be connected/assembled by means of nuts and bolts with locking nuts or spring washer. In case of riveting and welding is employed for connection of tower members, same shall be got approved from purchaser prior to its user.

- 7.1.2.1 The quality of steel used for nuts, bolts, washers etc. should confirm to mechanical properties as per IS:1367/79 and dimension to IS:6639 –1972 . The heads being forged out of solid, truly concentric and square with the shank and shall be perfectly straight. All bolts shall have hexagonal heads and nuts. The bolts shall be threaded with standard threads to take the full depth of the nut. All nuts shall fit 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.
- 7.1.2.2 The bolts shall be 16/20/24 mm dia etc and minimum property class 5.6 as specified in IS; 1367 part III-1979 and matching nut property class as specified in IS; 1367 (part VI)-1980.
- 7.1.2.3 All bolts shall be threaded to take the full depth of the nuts and to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point, where the shank of the bolt connects to the head.
- 7.1.2.4 Flat and tapered washers shall be provided wherever necessary, spring washers shall be provided for insertion under all nuts. These washers shall be steel electro galvanized, positive lock type and 3.5 mm in thickness for 16 mm dia bolts and 4.5 mm for 24 mm bolts.
- 7.1.2.5 To obviate bending stress in bolts or to reduce to minimum no bolt shall be connect aggregate thickness of more than three times diameter.
- 7.1.2.6 Nuts should be double chamfered as per the requirement of IS:1363 part III-1984. It should be ensured by the manufacturer that nuts should be not the over tapped beyond 0.4 mm over size on effective diameter for size up to M16.
- 7.1.2.7 Bolts upto M16 and having length upto 10times the diameter of the bolts should be manufactured by cold forging and thread rolling process to obtain good & reliable mechanical properties and effective dimensional control.




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- 7.1.2.8 The shear, bearing & tension strength shall be in accordance with IS:800 the bolts nuts shall be procured from reputed manufacturers such and G.K.W, UNBRACO, TVS etc.
- 7.1.2.9 All the bolts and nuts shall be galvanized by high temperature hot-dip galvanizing at temperature at 530 °C accordance with IS:1367 part XIII-1982 . The galvanizing coating should be uniform and its value should be between 80 to 115micron to be checked on random sample basis on the threaded portion as well. Thickness of galvanizing coating shall also be according to environmental condition at tower site considering life to tower as 100 years and as per BIS codes. The washers spring washers shall be electro galvanized as per Grade 4 IS: 1573-1986. The galvanized coating shall be checked by metallographic method.

7.2 Fabrication & work man ship:

The work shall be carried out in thoroughly reliable and workman like fashion in order to ensure satisfactory assembly and erection, inter changeability of similar members, accuracy of dimension, position and alignment of holes etc.

7.2.1 The fabrication of various components of the tower shall be in accordance with the approved drawings.

7.2.2 The fabrication of tower components shall confirm to IS:800-1984 except wherein after modification.

7.2.3 All steel section shall be reasonably straight and if required carefully straightened and trued by pressure and not by hammering.

7.2.4 Cutting of members may be effected by shearing, cropping, sawing. Gas cutting by mechanically controlled torch may be permitted provided special care is taken to leave sufficient metal to remove flame hardened material by grinding or machining

7.2.5 Drilling and punching.

7.2.5.1 Holes for bolts shall be drilled or punched with jig, but drilled holes shall be preferred. Punching may be adopted for thickness up to 5 mm. Tolerances regarding punched holes are as follows.

- (a) Holes must be perfectly circular and no tolerance in this respect will be permissible.
- (b) The max. Allowable difference in diameter of the holes on the two sides of plates or angles shall be 0.8 mm i.e the allowable tow per in punched holes should not exceed 0.8 on diameter.

7.2.5.2 Drilled & punched holes must be square with the plates or angles and have their wall parallel.

7.2.5.3 Holes on both side of the bend line in a bent member shall be drilled after bending



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7.2.6 The mild steel section up to 75x75x6 may be bent by cold process upto bend angle 10° and all other angle sections and bend angles shall be bent by hot process

7.2.6.1 The formation of bends by the "cut & weld" method unless specified in drawings is not permitted without prior approval of the engineer.

7.2.7 No angle member shall have two leg flanges brought together by closing the angle.

7.2.8 Welding

7.2.8.1 Welding if any shall be carried out be carried out in accordance with IS:816 IS:1024 and IS:9595-1980 as appropriate.

7.2.8.2 Butt welding shall be carried out either by submerged arc or shielded arc welding.

7.2.8.3 Pre-heating and post heating shall be employed as may be necessary for welding members.

7.2.8.4 For welding of any particular type of joint, welder shall give evidence, acceptable to purchaser of having satisfactorily completed appropriate tests as described in relevant codes.

7.2.9 Tolerance

7.2.9.1 fabrication tolerances shall not exceed those specified in Is:7215 as applicable to group B structures.

7.2.9.2 Deviation from straightness of any member shall not exceed $0.001L$ subject to maximum 10 mm, where L is the unbraced length.

7.2.9.3 The error in squareness of the hole shall not exceed more than 0.05 mm thickness of member drilled.

7.2.9.4 Tolerance of holes to hole distance shall be within ± 1 mm

7.2.9.5 Tolerance on the overall length of a member shall be within ± 2 mm

7.2.9.6 Tolerance on back mark shall be within ± 1 mm.

7.2.10 Each Piece of steel work shall be distinctly marked before delivery in accordance with marking diagram and shall bear such and other marks as well to facilitate erection.

7.2.11 steel work shall be temporarily shop erected complete or part if required, so that accuracy of it may be checked before dispatch.





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7.3 Galvanizing

7.3.1 All steel tower members shall be hot dip galvanized after fabrication is completed. The galvanizing to the tower members shall conform to IS:2629 and IS:4759 1996 and in case of spray galvanized confirming to IS:5905 & IS:6585. The spray galvanizing shall be permitted for welded box section members.

7.3.1.1 The thickness of galvanizing shall be generally 85 microns (610g/m^2) in accordance with IS:4759 hot dip and incase spray galvanizing 150 microns as per IS:5905:1989 however higher coating shall be employed if tower site's environmental & pollution condition warranted so , In accordance with Table 1 of IS:4759 for hot dip galvanizing and table 1 of IS:5905 –1989 for spray galvanizing.

7.3.1.2 All galvanized members shall with stand test as per IS:2633-1986 & IS:3203 –1982.

7.3.1.3 All material prior to galvanizing shall be free form oil, grease or any substance which may adversely effect the quality of galvanizing.

7.3.1.4 Excessively thick or brittle coating due to high levels of silicon or phosphorus in steel, which may result in an increased risk of coating damage and / or other features that make the final product non-fit-for- purpose, shall be rejected.

7.3.1.5 The preparation for galvanizing and galvanizing it self shall not adversely affect the mechanical properties of the coated materials.

7.3.2 All fasteners shall be galvanized in accordance with IS:1367 part XIII and IS: 5358-1969

7.3.3 Spring washers shall be electro galvanized as per Grad 4 of IS: 1573 1978.

7.4 Inspection and tests.

7.4.1 All standard tests, including quality control tests, in accordance with appropriate Indian(BIS) /international standard shall be carried out unless otherwise specified herein.

7.4.2 In addition to the provisions of clause regarding inspection following shall also apply.

- (a) Contractor shall keep the purchaser informed in advance about time of starting and progress of manufacture and fabrication of various tower parts, so that it can be inspected.
- (b) The acceptance of any part or items shall in no way relieve contractor / tenderer of any part of his responsibility for meeting all the requirement of the specification.



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Dist: Deoria, Uttar Pradesh, India



Tower Specification
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7.4.3 The purchaser or his representative shall have free access at all reasonable times to those parts of contractor's works, where fabrication work is carried out for satisfying him self that fabrication is being done accordance with specification

7.4.4 Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch.

7.4.5 The correct grade and quality of steel shall be used by contractor. The contractor shall made available to manufacturer's test certificate. However inspector may at his discretion get material tested at approved laboratory to ascertain the quality of steel and other material used, for which cost shall be born by contractor.

7.4.6 Any member of the structure found not to comply with the approved drawings, shall be liable for rejection. No member once rejected shall be resubmitted for inspection except incase, where inspector considers that the defect can be rectified.

7.4.7 All welding shall be subjected to a non-destructive testing as per BIS code requirement and cost should be born by contractor.

7.4.8 All gouges, templates, jigs, fixtures, instruments necessary for inspection and testing shall be supplied by contractor to purchaser.

7.4.9 To ensure effective in-process quality control, it is essential that the manufacturer should have all testing facilitates for tests like, weight of zinc coating, tensile & shear strength, non-destructive testing of welds etc in house or tie up. The manufacturer should have proper quality assurance system in line with requirement of this specification and IS:4000

7.5 PAINT & PAINTING

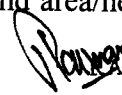
7.5.1 The lattice steel portion of tower shall be painted after erection usually until unless Cl . 7.6.4, as per given paint schedule.

- (a) One coat of etch primer conforming to IS: 5666-1970
- (b) One coat of zinc chromate primer conforming to IS:104
- (c) Final Two coats of synthetic enamel conforming to IS:2932 (color, international orange & white.)

7.5.2 The final coats of paint on tower shall be painted with synthetic enamel to have alternate band of international orange and white colors with top and bottom bands painted in international orange as per civil aviation regulation. The width of the orange band shall be double width of the white band.

7.5.3 The paints used in painting shall be of best quality from reputed paint manufacturer such as British , Asian, Burger, Asian, Shalimar paints in accordance with relevant BIS:codes.

7.5.4 All care should be taken in painting the tower, if tower sites environmental & pollution condition(such as near sea cost/desert / snow-bound area/heavy rainy area etc.) warants special


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paint shall be applied on tower at no extra cost irrespective of paints mentioned in clause 7.6.1. The Drawing No. TVT.4840/R1, shall be referred for painting & aviation light.

8.0 Soil investigation & foundation work.

8.1 Soil investigation

8.1.1 Contractor shall undertake soil investigation at tower location as approved by purchaser. At least four bore hole of Min 20 m deep shall be drilled at center of foundation base or near by for soil investigation.

8.1.2 Test on soils should be conducted in accordance with relevant parts of IS: 2720. Position and Fluctuation of water table should be ascertained reference may be made to IS: 1892 –1979 and IS:2131 – 1972 for guidance regarding investigations and collection of data.

8.2 Foundation:

Foundation shall be constructed as per approved drawing of foundation and in accordance with IS:456-2000 and other applicable provisions of BIS code and practices.

8.2.1 Material:

8.2.1.1 All material used in production of concrete including all ad mixture shall be in accordance with IS: 456 –2000 . The cement concrete used for foundation shall be of grade M-20 corresponding to 1:1 ½ :3 nominal mix ratio with 20 mm coarse aggregate for pedestal (chimney) portion and 40 mm coarse aggregate for pyramid or slab portion .

8.2.1.2 (a) The Portland cement used in concreted shall confirm to IS:269 –1967.

(b) The Puzzolena cement used in concrete shall confirm to IS;1489 –1976.

8.2.1.3 Concrete aggregates shall conform to IS:383 –1970.

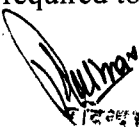
8.2.1.4 Reinforcement shall conform to IS: 432 –1966 for M.S bars and hard drawn steel wires to IS: 1139 –1966 and IS: 1786 –1966 for deformed and cold twisted bars respectively.

8.2.2 All properties of concrete regarding its strength under compression, tension, shear punching and bond etc. as well as workmanship will confirm to IS:456-2000.

8.2.3 The water used for mixing the concrete shall be fresh, clean and free from oil, acids and alkalies, organic materials or other deleterious substances, potable water is generally preferred.

8.2.4 All reinforcement shall be clean and free from loose mill scales, dust. loose rust, and coats of paints ,oil or others coating , which may destroy or reduce bond.

8.2.5 Contractor shall supply, fabricate and place reinforcement to shapes and dimensions as indicated or as required to carry out the intent of drawing and specification.


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8.2.6 WORKMANSHIP.

All workmanship for foundation work shall be in accordance with specification approved drawings and IS: 456 –2000.

8.2.6.1.1 Contractor shall carryout excavation in all kind of soils, while excavating excavation shall be adequately supported or formed to ensure stability of the sides and prevents any damage to the surrounding ground or structures.

8.2.6.1.2 Excavation material suitable for re-use as backfill shall be stored within the site working area.

8.2.6.1.3 For excavation in cohesive soil the final 150mm above foundation bottom level shall only be removed immediately prior to placing to M10 concrete pad.

8.2.6.1.4 Contractor shall not permit water accumulation in excavated pit until & unless agreed by engineer in charge.

8.2.6.2.1 The contractor shall carry out concrete trial mix using representative materials shall be carried out under full scale condition using contractor's proposed method subject to approval .The testing shall be carried out accordance with IS: 456 –2000 . Min three test cubes shall be tested.

8.2.6.2.2 The aggregated and cement shall be proportioned by meas of efficient weigh batching machines. The machine shall be maintained & cleaned periodically.

8.2.6.2.3 The concrete shall be mixed in batches, in concreted mixtures, which shall comply to IS Codes.

8.2.6.2.4 The contractor shall carry out slump or other workability tests as required during concreting of work, in order to related the degree of workability of the mix to the values obtained during the trial mix.

8.2.6.3 All formwork shall be accurately constructed to produce the correct foundation shape and shall be sufficiently strong to withstand pressure arising from concrete during placement and compaction.

8.2.6.4 Reinforcement bar shall be bent and fixed in accordance with procedure specified in IS: 2502. The high strength deformed steel bars should not be re-bent, straightened without approval of Engineer- in – charge. All the reinforcement should be placed and maintained in the position as shown in the drawing by providing proper block, spacers, supporting bar.

8.2.6.5 The concreted shall be place in layer maintaining proper cover of reinforcement, which shall be compacted by vibrators or other approved means.

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8.2.6.6 The curing & protection shall start immediately after compaction of the concrete and shall ensure adequate protection.

8.2.6.7 Backfilling shall be compacted in 300mm layers to achieve a bulk density of 1.7 m³

8.2.6.8 As soon as possible contract shall clear the site from all surplus soil and other materials.

8.2.6.9 Inspection and testing concrete work shall be accordance to provisions of IS: 456- 2000.

8.2.6.10 in case of rock anchorage type foundation workmanship & other requirements shall be in accordance with IS:10270-1982.

9.0 Facilities on tower:

9.1 Platform.

9.1.1 Provision of platform for access to the antennas, aviation lights and cables at different levels shall be made as indicated in drawing referred above. 1.5 m high handrail with expanded metal shall be provided around the platform for safety. Platform shall have suitable thickness chequered plate flooring but not less than 6mm shall be designed as to take stationary and moving load of 4 person plus equipment about 100kg.

9.2. Ladders for Climbing:

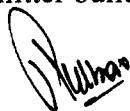
9.2.1. An internal ladder of width not less than 300 mm starting from the ground level and going upto the top with openings at all the platforms shall be provided. The ladder shall be suitably hooped for safety of the climbing personnel. The location of climbing ladder should be near to the vertical cable rack and it should be located in center or on one of the faces of tower or at corner.

9.2.2. Rungs of the ladder shall be clear of any obstructions to the climber, equally spaced by a distance of not more than 254 mm.

9.3. Cable Rack:

9.3.1. The vertical cable rack for support of RF feeder cables starting from the base of the tower and going up to be junction box position, shall be routed along the tower face as per rack drawing No TVT-5094/R3.

9.3.2. Horizontal feeder cable rack to support antenna R.F cables on ground from tower base to the transmitter hall shall also be fabricated by the tower-contractor. The cable rack shall be as per details in drawing No.TVT-5094/R3.The tenderer shall quote on the basis of unit length rates for the rack. Exact level and the route and length of horizontal rack shall be decided at site as per actual length of the cables. The horizontal cable rack is to be covered by Galvanized iron-sheets as per Drawing No.TVT-5094/R3.The correct length of horizontal cable-racks shall be as per actual R.F feeder cable supplied and as per actual routing decided at site between tower base and the transmitter building.



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DB: Deordarshan, New Delhi



9.4 Protection against Lightning & Earthing

9.4.1 Principles of protection :

The fundamental principle for the protection of tower against lightning is to provide a conducting path between the general mass of earth and the atmosphere above the building by which a lightning discharge may enter the earth without producing dangerous potential differences in or near the building and also without passing through a non-conducting parts of the building, for example, parts which are made of wood, brick, tile, stone or concrete. Damage to the building may be caused by the thermal and mechanical forces generated in such non conducting parts by the discharge, where as metal parts the heat and mechanical forces due to the lightning discharge have negligible effect provided the metal part has sufficient cross sectional area.

Comprehensiveness of the lightning protective system depends on the prevalence of lightning in the locality, the frequency and extent of occupancy, of building and nature of the soil, other things being equal, the more elaborate the protective system the more complete the protection will be provided.

9.4.2 Materials and dimension :

The materials for the lightning conductors, down conductors earth termination network etc. of the protective system shall be reliably resistant to corrosion or be adequately protected against corrosion, following materials are recommended.

- i) Copper: When solid or standard copper wire or flat copper strip are used, they shall be of grade, ordinarily required for commercial electric work, generally designated as being of 98% conductivity when annealed. They shall conform to the relevant Indian Standard Specification.
- ii) Galvanized Steel : Where steel is used it shall be thoroughly protected against corrosion by a zinc coating which will satisfactorily with stand the following test :

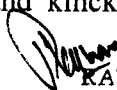
A test piece should be dipped seven times, each time for a duration of one minute, in a solution consisting of two parts of copper sulphate in five parts of water. The test piece shall after each dipping be carefully rinsed in water and where shall not be formed any continuous coating of copper. The zinc shall be so strong and plastic that it does not crack or break when the test piece is mounted on a cylinder of 50mm diameter.

The minimum sizes of conductors shall be 20mm x 3mm for use above ground and 30 mm x 6mm for use below ground.

9.4.3 Design consideration :

The vertical air termination of the lightning arrester need not have more than one point and should be projected at least 30cm. above the top, of the object, the down conductor should run outside the building preferably along one corner. The down conductor should follow the most direct path avoiding sharp bends, upturns, and kincks. Each down conductor shall be




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provided with a testing point but inaccessible for interference. No connection other than one direct to an earth electrode, shall be made below the testing point.

9.4.3.1 The tower shall be provided with suitable complete system of lightning protection in accordance with provision of IS: 2309-1989 and approved drawings, considering necessary earthing based on the specific resistibility of the soil and sub-soil water level and other relevant provision state their off.

9.4.3.2 Tower structure shall be provided lightning arrester for protection against lightning as per IS: 2309-1989

9.4.4 The comprehensiveness of lightning protection system depends on the prevalence of lightning in the locality, its frequency, and extent of occupancy nature of soil etc, the tower shall be provided protection considering these facts.

9.4.5 The material for lightning conductors, down conductors earth terminals network etc. of the protective system shall be reliable resistant to corrosion or be adequately protected against corrosion. The material recommended are copper – solid standard copper wire strip or galvanized steel.

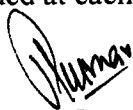
9.4.6 All tower legs shall be connected to ground properly as per standard practice of earthing of such structures in the ground properly as per standard parties of earthing of such structures in plain areas and mountainous regions. Each down conductor should have independent earth termination. All earth termination shall be interconnected. Earth electrodes shall be constructed and installed in accordance with IS: 3043-1987. Four nos. of lightning arrestors at four corners interconnected by G.I strip shall be provided.

9.4.7 TESTING:

9.4.7.1 The earth resistance value obtained for whole of lighting protective system should not exceed one ohm. In case it exceeds one ohms the same should be reduced by providing additional earth electrodes.

9.5 ELECTRICAL REQUIREMENT FOR TV TOWER:

- a. Provision of aviation obstruction lights and hazard beacon lights is to be made on tower as per ICAO norm and DG:Doordarshan Drawing No. TVT-4840/R2. AOL shall be approve by D.G Doordarshan.
- b. Provision of two nos. of twin core weather proof magneto wire with socket arrangement is to be made at every platform.
- c. One no. of 10 sq. mm. three core PVC (weather proof) 600 V rating cable with weather proof service out lets, with (5 Amp. and 15 Amp. socket) is to be provided at each platform.



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- d. Provision of Automatic sun-switch is to be made for operating the Aviation lights.
- e. Tower should be provided with lighting arrestors to give protection against lightening for this purpose I.S. 2309-1989 should be strictly followed. Earth electrodes should be and installed in accordance with IS 3045-1966(with latest amendments)
- f. A detailed completion report of tower with all drawings of facilities provided is to be submitted by the tenderer to the Zonal Office/Station/ Directorate for reference and record after its completion.

9.6 Aviation obstruction lights (A.O.L):

9.6.1 LED based Aviation obstruction lights should be provided. The globes and their housings shall be strong, weather proof and of approved manufacturer. The LED based Aviation obstruction lights shall be provided and installed as per drg. No. TVT 4840/R2. Tender may be quoted separately for the provision of Beacon light. Necessary Foreign Exchange if required, for the import of the beacon light, has to be arranged by the tenderer himself. There shall be 2 lights located diagonally at each level, except the top level. AOLs are to be as per drg. No. TVT-4840/R2 and detailed instructions provided for electrical works on tower. The aviation obstruction lighting arrangement shall be as per latest International Civil Aviation Organization rules.

9.6.2 Power supply load of the aviation lights shall be evenly distributed on all the three phases, in order to ensure that with failure of the single phase all the lamps at each level do not go off. The power supply cable for the lights shall confirm to IS:1554 (Part-I) of 1976 or the power supply cables for the aviation lights shall be liberally rated and shall confirm to the latest Indian standard specifications.

9.6.3 The contractor shall provide temporary aviation obstruction lights during erection of tower as soon as the tower reaches 45 meters.

9.6.4 The 'ON' and 'OFF' switches and power supply control panel of Aviation Lights shall be provided in the power supply metering room of the transmitter building.

9.6.5 A "SUN Switch" is required to be provided for aviation lights so that these are "ON" automatically if sufficient sunlight is not available around tower. In no case sun-switch is to be installed inside a room or covered space.

9.6.6 The details of Power Supply arrangements for aviation lights shall be provided with the tender bid.

9.6.7 The power supply arrangement shall be provided with battery back up system (operate on 24 volt D.C.).

10 Addition items of works

10.1 Mounting of Antenna system:



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DG: Dourgasman, New Delhi

10.1.1. After the erection of the tower, the tenderer shall also mount UHF antenna (Band IV/V only), 2 nos. 115mm dia styro-flex cables, junction boxes etc, on tower as per details, which will be provided later. The UHF antenna along with support spine will be supplied by purchaser, and same shall be mounted on the support interface provided on the tower above Band III aperture at top of the tower. The top of the tower must have the interface as per the drawing supplied later on so that Band IV/V antenna could be fixed on top of the tower.

10.1.2. The tenderer shall supply aviation obstruction light and mount the same on the tower as per requirement of civil aviation regulation and specified in tender specification and drawing.

10.1.3. For the sake of completeness of works, the tenderer may have to undertake minor/major items of works that may become necessary in mounting of antenna system hereto mentioned.

10.2 Service connection:

10.2.1 Similarly one number of 10 Sq.mm 3 core PVC weather proof cable of 600 volts rating shall be provided with weather proof service outlets at each platform terminated in a 15 A socket and switch. At the base the cable shall extend to the transmitter hall.

The above provision of cables is in addition to the cables for aviation obstruction lights. The cables shall conform to relevant IS Specifications.

11.0 PURCHASERS SUPPLY.

The purchaser shall supply to successful tenderer following:

(a)The drawing of bottom portion of the antenna support structure Band (IV/V) for designing suitable support interface structure.

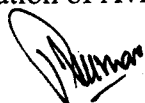
(b)The location of the tower at the site VIS-À-VIS the transmitter building will be marked out by the purchaser. L.O.P. Drawing No. TVT – 7563.

(c)UHF Band IV/V antenna along with support spine to be mounted on top of the tower above Band III antenna aperture.

12. Schedule of requirements :

Design, supply, fabrication and erection of 150M television tower as specified above complete with following main works:-

- i) Foundation & soil testing.
- ii) Earthing of tower (Earth resistance one ohm)
- iii) Platforms with railings.
- iv) Internal ladders for climbing from ground to top of the tower.
- v) Vertical cables rack on tower.
- vi) Horizontal cable rack as per actual site conditions between transmitter building and tower.
- vii) Aviation obstruction lights including Beacon light and sun-switch. Arrangement for operation of Aviation obstruction lights on battery back up system in case of AC Mains



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Asstt. Engineer



failure is to be provided by tenderer.

- viii) Mounting of UHF Band IV/V antenna with spine is present requirement.
- ix) Supply and installation of power supply cables and service connection cables as per D.D specs.
- x) Painting of Tower as per I.C.A.O norms.
- xi) Hauling and fixing up of Main RF Feeder cables for UHF Band IV antenna.

13. Inspection :


The tenderer shall state in his tender, the place of manufacture, testing and inspecting of the various materials included in the specifications, to enable Purchaser or his representative or such other inspecting authority that may be designated to carry out inspection and test as he may desire. The tenderer shall provide all the necessary facilities for the purpose, such of the stores as are to be inspected during manufacturing have to be certified by Purchaser or an authorized representative before the finished materials are packed and forwarded to the destination. All the Civil works will be inspected by the representative of the purchaser.

14. Guarantee :

- i) The tenderer shall guarantee to replace free of charge any material or part thereof that may develop defects within one year of handing over the tower.
- ii) The tenderer shall guarantee the stability, safety, durability and satisfactory mechanical behavior of the tower structure under the all conditions of specified loading and complete system and part their off including allied system such as lightening arrestors, aviation obstruction lights etc. The guarantee shall hold good for a period of two years from the date of completion of erection of the tower, or one year after the erection of the television antenna. The operation period of the guarantee being the one is to lapse earlier.

15. COMPLETION OF TOWER :

- a. The tower is to be jointly inspected at site by the representatives of Zonal Office and Doordarshan Directorate when it is completed in all respect including the works of painting, aviation light etc.
- b. The verticality of the tower is to be verified by the inspector at site during this inspection as per the specification. The arrangements of equipment for checking the verticality is to be arranged by the tower erector.
- c. The Earth-resistance of the tower is also to be verified by the inspector at site.
- d. All debris, extra-material and items etc. which are brought/created during construction work at site are to be removed/cleared by the tower tenderer.
- e. The Aviation -Lights on the tower should function as per Doordarshan specs.


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- f. The orientation of the tower base is to be got confirmed from Doordarshan Directorate before taking up the foundation work at site. The site lay out plan is to be obtained from the Doordarshan Directorate.

16. GENERAL INSTRUCTIONS FOR THE TENDERER :

The tender should attach with his offer, the following documents:-

- a. The detailed tower profile drawing showing various requirements and facilities of Doordarshan tower which are specified in these specification should be submitted, Refer also cl. 3.3(i).
- b. A detailed drawing showing all electrical facilities on tower is also to be attached.
- c. The main parameters for designing of tower are to be provided in the offer including loads, wind speed terrain category allowable stress etc. as to judge the offer with respect to specification, refer also cl 3.3(ii) to(vi) .
- d. Maximum horizontal and vertical reaction in the tower legs, material used with specification, foundation type to be adopted etc. and any other relevant information shall be attached with tender.
- e. The list of self-supporting TV towers of similar heights which have been erected in past by the tenderer is also to be provided.
- f. The tenderer should have completed design, supply, fabrication erection of at least two such high tower in past to qualify for bidding of TV towers. Otherwise tender may be rejected, refer also cl. 5.0.
- g. The tender documents with all relevant drawings, statements past record etc. are to be submitted.
- h. The detail information required in cl.3.3,4.1,4.2 to 4.8,5.0,6.0,7.1,7.6,9.0,9.6,10.1&10.2 shall be supplied without which tender may be rejected without assigning any reasons.
- i. Para by para compliance statement in the table form as per the format given below for all the paras given above must be attached with the offer duly signed by the tenderer on each page of compliance statement. Mere signing of D.D specification sheets shall not be treated as compliance statement.

If it is not possible to provided full information in the prescribed format Column, the information may be provided in Annexures and Annexure No. may be written in format column. All relevant drawings must be attached with offer and drawing No. may be written in the compliance statement column.

The compliance statement from the tower erector should be in the following format:-

Para No, of D.D. spec	Details of information, its references mentioning Annexure nos. & drawing nos etc. where the required information is provided should be mentioned.	Remarks:- for compliance or deviation
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17. List of Drawings.

1. TVT - 7562
2. TVT - 4840/R2
3. TVT - 5094/R3
4. TVT - 7563



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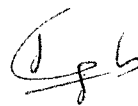
RAVINDER KUMAR

सहायक अभियन्ता

Amrta Engineering


दूरदर्शन, महाविद्यालय, नई दिल्ली

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SUGGESTIVE BILL OF MATERIALS / LIST OF DELIVERABLES
(UNPRICED) FOR MAHBOOBNAGAR (AP)

Sl. No.	Description of Item	Unit	Weight in MT	
1 (a)	Design, Supply, Fabrication, Hot Dip Galvanisation, Primer painting with one coat of etch primer & one coat of yellow primer. The tower is provided with accessories like ladder, platforms, vertical cable rack, provision for mounting micro-wave dishes and AOL, AE as per Doordarshan drawing. Provision for mounting Band-IV / V UHF antenna including supply of anchor bolts and templates for casting foundation. MS MT			
1(b)	Transportation of tower materials to the erection site including loading, unloading and stacking.			
2	Supply of Electrical accessories such as Aviation obstruction lights, Sun switch and battery backup system. AOL cables, Power & Telephone Cables with clamps, Earthing materials like Copper plate and Copper strip etc.			
3	Supply of Hot dip galvanized MS Fasteners of class 5.6/6.8 & HSS Fasteners of class 8.8			
4	Any other item to complete the system			
4(a)	Design approval from IIT, detailing and documentation.			
4(b)	Soil testing.			
	TOTAL SUPPLY ITEMS			
	SERVICES			
5	Casting of Open foundation designed for SBC-8.2MT/ Sq.m, including Site survey & soil investigation. (a) Excavation volume (b) Concrete volume (c) Weight of steel reinforcement (d) Others			
6	Installation of towers as per drawings along with fixing of accessories (AOL with cable, lightning arrestors, Power & Telephone cables along vertical cable rack and routing them up to the building), Earthing etc. A.O.L. make-model and technical specifications with data sheet.			
7	Amount of paint and painting of tower with 2 coats of final paint in white and red/ orange bands as per Doordarshan's requirement.			


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