



**PRASAR BHARATI
DIRECTORATE GENERAL: ALL INDIA RADIO
(PLANNING & DEVELOPMENT UNIT)**

**SPECIFICATION DOCUMENT FOR MEDIUM FREQUENCY
ANTENNA OF ALL INDIA RADIO**

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SUMMARY OF CONTENTS

1. SECTION I : Detailed technical and general specifications (Page 2-7)
2. SECTION II : Appendix for Technical data to be submitted by tenderer (Page 8-9)
3. SECTION III : Specification for painting of mast (Page 10)
4. SECTION IV : Schedule of Requirements (Page 11-12)

SUMMARY:

These specifications give details of various technical parameters, accessories and spares required for a Self Radiating Triangular Lattice Structure Guyed Mast for MF Antenna.

Section I, II & III are generic specifications whereas Section-IV is for a particular place wherein the frequency of operation, height, power and other special technical requirements along with spares as well as optional items required for self radiation mast have been indicated.

The requirement is for a **60 meter** high, vertical, self radiating, series fed mast, capable of radiating 20kW Carrier power + 150% Modulation in MF band at Kavarati (Lakshadweep) as indicated in Section-IV.

N.B: 1. The tenderer should go through all the sections of the specifications carefully and could confirm clause by clause compliance to all sections clearly. Tenders without clause by clause compliance are liable to be objected.

2. The tenderer should also indicate the list of items offered as per schedule of requirements of Section-IV, without cost details to assess the completeness of offer against AIR's requirements in the Technical bid details.

(R.K.SAINI)
Dy. DIRECTOR ENGG. (TD)

SECTION – I

DETAILED TECHNICAL SPECIFICATIONS FOR MEDIUM FREQUENCY ANTENNA

I. INTRODUCTION:

This specification covers the design, fabrication, supply and erection of self Radio activity Triangular structure for use as medium frequency antenna with broadcast transmitter, operating in MF Band.

II. ELECTRICAL CHARACTERISTICS:

- i) Frequency Range : 531 - 1602 KHz.
- ii) Polarisation : vertical
- iii) Height of Antenna : As given in the schedule of requirements.
- iv) Power handling capacity : As given in the schedule of requirements.
- v) Feeding arrangement : The antenna should be suitable for being series fed at the base, the power being fed between the base of the antenna and ground.
- vi) Input Impedance : The input impedance at the feeding point should have a flat characteristic within 10 KHz at any operating frequency in the range specified in (i) above. (An impedance curve for the entire frequency range will be supplied by tenderer).

III. MECHANICAL DESIGN:

1. General:

The structure shall be designed to withstand the mechanical / electrical stresses encountered in the Transportation, installation, operation and maintenance of the mast even under the worst wind and Ice loading conditions detailed in this specification. The antenna shall be provided with ladders or steps to enable persons to go up in complete safety, rest platforms at the top and intermediate levels and Aviation obstruction lights as required under the regulations.

2. Type of structure:

The antenna structure shall be a guyed, lattice faced, steel structure of uniform triangular cross section throughout its height.

A typical antenna of this type is shown in the attached drawing No. TF-8832 Mod. 1.

3. DESIGN DATA:

(a) Wind and Ice Loading:

The antenna structure shall be designed taking into account wind loading as below:

i) Basic wind pressure may be taken as per IS:875-1987 with latest amendments, taking into consideration the importance of structure as it is to provide uninterrupted broadcast during all season and will be designed for use anywhere in India. For the purpose of design calculations, therefore, basic wind pressure has to be taken as that of coastal areas in India.

ii) The overall wind forces may be computed using the coefficient as given in BIS = CP-3, Chapter V, Para 2 with latest amendments.

(b) Material and type of construction:

Tower members shall be of standard structural steel (open hearth) conforming to IS-226-1969 (with latest amendments).

(c) Design

Design, fabrication and other details shall be in accordance with IS-806-1962 (with its latest amendments).

(d) Galvanizing:

To prevent corrosion, all steel members, accessories and hardware shall be galvanized after fabrication by the "Hot Dip Method" and shall conform to IS-4759-1968 with latest amendments. The fastener shall be galvanized as per IS-5388-69. The galvanizing shall be tested as per test procedure laid down in the relevant IS specification with latest amendments.

(e) Guys:

The triangular antenna structure shall be guyed in three planes, 120 degrees apart and at suitable levels. The top most guy level shall be one or two sections below the top of the mast. The mast must have minimum three guy level points. The guys shall be of stainless steel wire of appropriate size and grade and shall be chosen with adequate factor of safety. The guy ropes shall conform to IS-2266/1970 and IS-3326/1966 (with latest amendments). The guys shall be designed in such a way so that the initial tension in the guys should not be more than 15 percent of the breaking strength of the guys under still air conditions. 1st Insulator / Insulators of adequate rating should be connected as near as possible to the point of attachment of each guy to the tower. The guys shall be broken up (electrically) by the insertion of slip in type insulators of sufficient electrical and mechanical strength. The next insulator on each guy shall not be more than 15 meters away and the spacing between the succeeding insulators shall not be more than 24 meters.

The guys shall be prefabricated to enable easy assembly at site. Provision shall be available to adjust at site, the total length of each guy to take care of relative variations in the ground level at the mast base and guy anchor points to the extent of 3 meters.

Provision shall be made for adjustment of the tension of each guy. The tensioning device shall form an integral part of the guy attachment assembly at the anchor end. The guy attachment at the anchor block shall also include arrangements for easy and accurate measurements of the guy tensions.

(f) Cable connection:

Ferruling/sleeving or socketing used in each guy section including the straining

screw should be designed to withstand atleast 80% breaking load strength of main guy rope. Suitable locking arrangement also is to be made to avoid the slipping of sleeving/socketing and guy straining screw under storm conditions by providing U-clamps as backup measures in addition to ferruling/ socketing. If felt necessary, a sample breaking load test for a guy section may be taken in the presence of AIR inspector.

(g) Ladder and Rest Platform:

There shall be an interior ladder surrounded by a cage of about 70 cms diameter for the personnel to climb the structure with safety. Rungs of ladder shall be clear of any obstruction to the climber's toe etc and shall be equally spaced not more than 22.5 cms apart. However, in the case of masts having heights up to 60 M, an outside ladder can be accepted provided a fool proof safety climbing system is incorporated. The rest platform with hand-rails of sufficient size & 750mm high shall be provided at the top of the mast and at other intermediate levels at suitable heights.

IV. INSULATOR RATING:

As required under clause II(v) of this specification, the antenna is to be fed at the base. For this purpose, the base of antenna is to be suitably insulated from the ground. This is to be achieved by interposing an insulator of adequate electrical as well as mechanical strength between the antenna base and the base foundation block. The base insulator or insulators shall be capable of withstanding the electrical stresses as given in the schedule of requirements. In addition, it shall also withstand voltage stress that may be built up due to lightning and other static charges. The electrical rating of the base insulator / insulators shall be chosen to have a margin of safety of 2.5. Not withstanding the rating imposed by the above conditions, the base insulator shall have a wet flash over rating of not less than 90KV at 50 Hz. The insulators shall also have as low capacitance as possible and low loss ratings at 1 MHz.

A carbon spark ball gap arrangement shall be provided across the base insulator for it's safety in the event of lightening/ thunder storms etc.

Mechanically the base insulator shall be strong enough to withstand the loadings imposed by the antenna structure under worst conditions. A margin of safety of 3 may be taken while choosing mechanical rating of insulator.

Guy Insulators shall be rated - electrically and mechanically with factors of safety as 2.5 and 3 respectively. Damage to guy insulators due to lightning and other electrical disturbances and consequent interruption in transmitter operation are to be prevented by means of suitable devices such as RF chokes connected across the insulators. These devices should be so designed as to offer an easy leakage path for the unwanted electrical disturbances but at the same time not impairing the efficiency of insulators at the operating frequency of the transmitter. These devices shall be provided in the top two guys. For masts up to 60 mtr. height, these will be provided only for the top most guy.

V. AVIATION OBSTRUCTION LIGHTING:

The antenna structure shall be provided with beacon lights, aviation obstruction light fittings at the top of the mast and at intermediate levels respectively as per latest civil aviation rules. The lights shall be of solid state devices in conformity with international standards.

The intermediate lights should be spaced as equally as practicable between the top

obstruction light and the mast base level. In no case the spacing shall be more than 45 metres. The first intermediate light may be provided at the height of 45 meters from the ground. The obstruction lights shall be fixed lights, red in colour, having an intensity sufficient to ensure that it is conspicuous, considering the intensity of the adjacent lights and the general level of illumination against which they would normally be viewed. In no case shall the intensity be less than 10 candles of red light.

Rest platforms with hand rails shall be provided at the levels where aviation obstruction lights are fixed to have easy access to these lights. The supply should include all necessary cables, water tight conduits of appropriate size from the bottom of the tower to the lights and other accessories.

VI. ANTENNA LIGHTING TRANSFORMERS:

The antenna lighting circuit shall be connected to 230 V, 50 Hz mains supply through a well designed isolation circuit which shall provide perfect isolation of the power mains circuit from the Radio Frequency voltages of the antenna lighting circuit. The isolation circuit may take the form of toroidal transformers with low coupling (Austin transformer shown in attached drawing TF-8832 Mod.I) or filter circuits with chokes and capacitors of adequate rating. The supply against this tender should include either of these and in the case of the transformer, it shall be water proof, outdoor type, complete with mounting brackets, insulators if any, and lightning arrestor. The transformer primary shall have tappings for 5 percent and 10 % voltage variations from the normal 230 volts and the transformer and its fittings shall add negligible capacitance between the antenna base and the earth.

VII. FOUNDATIONS:

The casting of concrete foundations for the Antenna structure, guy anchors and isolation transformer will be done by the tenderer to suit the site requirements at each place. These foundations will be 750 mm (minimum) above the natural ground level. The supplies will include galvanised guy anchor assemblies, foundations bolts, re-enforcement etc., and the necessary material including cement etc. for casting of the foundations.

The tenderer shall conduct the necessary soil testing for designing the foundations for installation of the tower and guy anchors at each place. However, for the purpose of estimate the following typical values of the soil bearing parameters may be considered:

Bearing Pressure	:	8.2 metric tons/Sq.m
Earth Weight	:	1450 Kg/cubic meter
Angle of repose of soil	:	30 degrees
Concrete	:	2200 Kg/cubic meter

N.B : For a reduction of every 0.5 MT/sq.m in soil bearing capacity, additional amount required will be quoted.

The mast base and the isolation transformer foundations will be covered with 1.6mm thick copper sheets of electrical grade on the top and all sides of the foundation upto a depth of 1 foot below the natural ground level.

These sheets will be securely fastened to the foundation. The joints will be over lapping up to at least 1 inch and brazed continuously. The copper sheets, fixing and brazing material required for this work will be supplied by the tenderer.

VIII. ERECTION:

The complete erection of the antenna structure will be done by the tenderer. The tenderer shall, however, supply complete instructions with drawings for the assembly, erection procedure, adjustments of the antenna structure.

IX. GUARANTEE

(a) The tenderer shall certify and guarantee that the design, material used and fabrication of the antenna structure and accessories has been done to ensure the capacity of the antenna to withstand the electrical and mechanical stresses with margin of safety specified in this specification encountered under the conditions detailed in the specifications. The structure design details of the mast shall be approved by any of Govt of India structural Institute/IIT/IISc. For this purpose, a dynamic analysis is required to be performed against actual or standardized wind spectra and the successful tenderer shall provide the structural fitness certificate of the mast design within 3 months from the date of the acceptance of the tender.

(b) The tenderer shall ensure that the fabrication of the members of the antenna is done with such precision so that the main leg members of the antenna structure shall remain vertical within two minutes of the arc subtended at the base of structure. The twist of the mast members will not exceed 1/2 degree.

(c) The tenderer shall guarantee the safety of the antenna structure under the specified conditions of electrical operation and wind pressure for a period of one year from the date of the taking over, of the antenna system.

(d) In the event of structural or electrical failure of any component / part of the antenna structure within the guarantee period specified above, on account of manufacturing defects, the tenderer shall undertake to replace the component / parts which have failed and those which were damaged as a result thereof, free of cost and bear the expenditure to be incurred for re-erection of the tower.

X. DRAWING AND TECHNICAL INFORMATION:

(a) A drawing showing the general arrangement of the antenna offered along with the technical information shall be submitted along with the tender in the proforma given in Appendix. This will include the leaflet showing technical and physical details of base and guy insulators.

(b) The successful tenderer shall submit four sets of the following within two months of the date of acceptance of his tender.

1. Layout plan along with action plan erection bar chart
2. Foundation design data and drawings for the antenna base and guy anchor foundations based on soil data given in Para - VII above.
3. Complete instructions with drawings for the assembly erection and adjustments of the antenna structure.

XI. SPARES:

(a) The tenderer should quote separately for the spares such as mast base insulator, guy insulators, RF chokes, light fittings and Austin transformer etc.

(b) The tenderer should quote separately for the kit comprising of Jig and fixture, Hydraulic Jacks etc required for the replacement of mast base insulator.

XII. DELIVERY PERIOD:

All the erection works including measurements and handing over shall be completed with in 9 months of acceptance of tender.

XIII. PRE- DISPATCH INSPECTION:

Pre dispatch inspection of stores by giving an advance notice of three weeks shall have to be got done by representative of DG:AIR , P&D Unit or resident inspector if any assigned for such purpose at the premises of manufacturer.

XIV: PAYMENT TERMS:

As per commercial terms.

XV: INSURANCE

The entire store will be comprehensively insured including during transit, for free delivery at site, till the mast is erected and handed over to the consignee.

SECTION-II

APPENDIX

TECHNICAL INFORMATION TO BE SUPPLIED ALONG WITH THE TENDER

1. ANTENNA STRUCTURE :

- a. A drawing showing the general arrangement of the antenna structure offered.
- b. Dimension of the Cross-section of the antenna structure.
- c. Wind load adopted for the mast.

2. Guy ropes:

- (a) Type and specification reference.
- (b) Sizes of various guy ropes.
- (c) Maximum calculated working stress for each guy at the design load.
- (d) Calculated ultimate breaking strength of each guy rope (as modified by a factor depending on the type of connections).
- (e) Proof testing load for each guy wire

3. Base Insulator:

- (a) Make/Manufacturer's name
- (b) Type number with sketch
- (c) Working load (as per design of antenna structure)
- (d) Proof testing load
- (e) Breaking load
- (f) Wet flash over voltage at 50 Hz.(without & with rain shield)
- (g) Wet flash over voltage at 1 MHz.(without & with rain shield).
- (h) Capacitance. of base insulator with & without Austin transformer
- (i) Calculated Base and characteristic Impedance of mast.
- (j) Calculated Base Voltage across insulator under normal working condition.

4. Guy break up insulators:

- (a) No. and type of insulators in the chain near the tower attachment point.
- (b) Spacing of the insulators in each guy.

- (c) Type and make of guy insulators.
 - (d) Breaking load
 - (e) Wet flash over voltage of each insulator at 50 Hz.
 - (f) Wet flash over voltage of each insulator at 1 MHz.
 - (g) Capacitance of Insulator.
 - (h) Distribution of voltage across guy insulators for each guy length.
5. Guy insulator protective device type proposed to be used & if RF chokes then its details & inductance including the antiresonance impedance at carrier frequency.
 6. Antenna lighting transformer/filter circuit details with KVA ratings and it's capacitance/inductance values.
 7. Details of aviation lights.
 8. Wiring diagram of mast lighting.
 9. Details of mast climbing arrangement including the safety arrangements with drawings.
 10. Details of kit for replacement of mast base insulator.

SECTION III
SPECIFICATION FOR PAINTING OF A GALVANISED MAST

Painting is a accepted method of protection against corrosion, wear, decay and other factors which affect the durability of the structures. In addition, painting of the masts according to a specific colour scheme is obligatory as per "International Civil Aviation Regulations", which are reproduced as follows:

" The towers shall be painted in alternate bands of International Orange and White paints. The bands shall be perpendicular to the longest dimension and have a width of approximately 1/7 th of the longest dimension for towers of height upto 210 meters and 1/9th of the longest dimension for towers of height between 210 meters and 270 meters OR 30 meters (100 ft.) whichever is less. The Orange and White paints shall be of equal width terminating with Orange bands at both top and bottom."

The painting shall be done in the following sequence.

A) Preparation of Surface:

All dust, dirt, grease, rust add scale, if any, should be thoroughly removed. Degreasing is an essential preliminary for removing dirt and grease. Solutions of soap, or other detergents should be used. After the dirt has been removed, the work should be thoroughly rinsed off with plenty of clean water.

B) Pre-treatment by Etching:

After degreasing and cleaning, when the work is absolutely dried, the surface is to be prepared for receiving the paint by etching. For this purpose, a priming coat of wash/etch primer should be given. The etch primer shall be of a reputed make and of a composition specifically used for zinc surfaces.

C) Priming under Coat:

After the above coat is dried, but without too much delay, a coat of zinc chromate primer should be applied. The priming coat should be allowed to dry for a minimum period of 72 hours before application of the next coat.

D) Final coats of paints:

The finishing coats of high quality exterior class paint shall be applied. The first coat shall be allowed to dry for at least 48 hours before the second coat is applied. The paints, primers and thinner used must be of best quality and shall conform to the following specifications.

IS : 2074 - 1962 (Revised up to date) - Ready mixed paint ,redoxide zinc chrome priming.

IS : 2932 - 1964 (Revised up to date) - Enamel synthetic, exterior type.

IS : 1745 -1961 (Revised up to date) – Petroleum Hydrocarbon solvents (thinner).

The correct shade for International Orange corresponds to "592 - International Orange" as per IS : 5 - 1961 (Revised up to date).

SECTION-IV

**SCHEDULE OF REQUIREMENTS FOR VERTICAL MAST FOR 10kW MW
TRANSMITTER AT AIR, SPT, KAVARATI (Lakshadweep)**

PART-1 : DETAILS & SITE PARTICULARS:

- | | | |
|----|-----------------------------|---|
| 1. | Power | 20kW (Plus modulation up to 150%) |
| 2. | Freq. Of operation | 1152 KHz |
| 3. | Mast Height | 60M |
| 4. | Height above mean sea level | 1.1M |
| 5. | Site coordinates | 10Degree -34'-00" N
72Degree-38'-00" E |

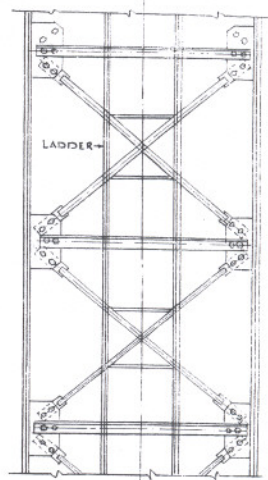
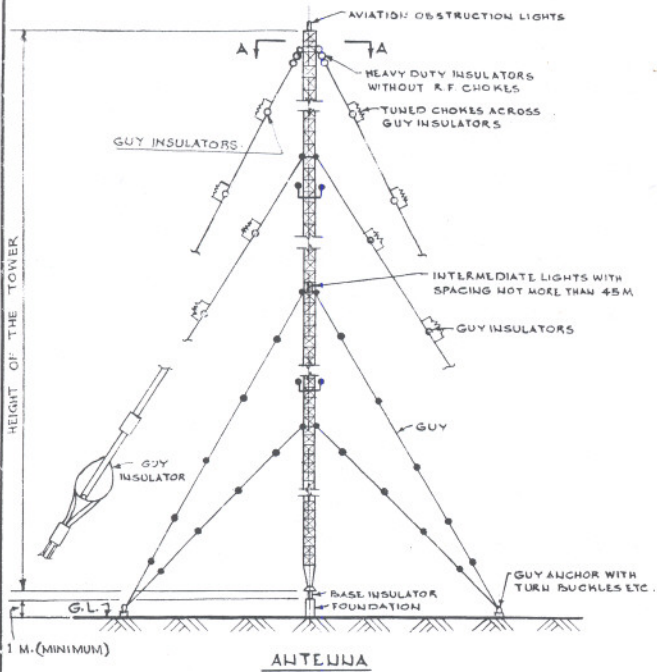
PART-II ; SHEDULE OF REQUIREMENTS :

S. No.	Item Description	Qty.
(A)	SUPPLY PORTION material/stores	
1	a) Design, Fabrication, Galvanizing, Supply of mast structure with Climbing arrangement, b) Guy ropes including fasteners, thimbles, Pin washer etc. c) Isolation transformer, AOL (Solid State), Cables, Conduit pipes, Junction boxes, Sunswitch,. d) RF Chokes (Nos. to be indicated by tenderer) e) 1.6mm copper sheet covering for mast and isolation transformer foundation for RF Earthing of radials.	1 Lot 1 Lot 1 Lot 1 Lot 1 Lot
2	Design, Supply, Integration of base insulators & Guy insulators	1 Lot
3	Manuals incorporating all the drawings giving description, erection procedure & maintenance of mast including procedure for measuring twist, verticality & guy tension	4 sets
	NOTE:- The Supply shall include all the items which might have not been specifically mentioned above but are requisite & essential for mast on ready to use basis	
(B)	SERVICES/WORKS	
1	Design & casting of concrete foundation for Mast base, Guy anchor and Austin transformer including all raw materials, labour, site clearance etc and covering of base and Austin transformer foundation block with 1.6mm copper sheet.	1 job
2	Erection of Mast including fixing of Guy strain Insulators, Egg Insulators, Checking	1 job

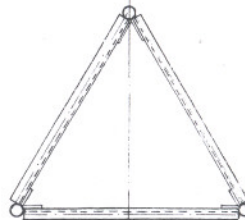
	of vertically, Guy tension etc.	
3	Painting of triangular mast including supply of paints	1 job
4	Additional charges for reduction of every 0.5 MT/sqm in soil bearing capacity of casting of Mast base, guy anchor, Isolation transformer foundation	1 job
(C)	OPTIONAL ITEMS	
	1. RF Chokes	2 Nos.
	2. AOL (Solid state lamps)	1 set
	3. Guy Insulator	2 Nos.
	4. Base insulator	1 No.
	5. Jig for replacement of Mast-Base insulator .	1 set
	6. Safety-kit for Mast climbing.	1 set
	7. Shunt type tension dynmometer	1 No.

- Note:-**
1. The tenderer shall furnish the cost details of each of the above items separately under the commercial Bid.
 2. The tenderer should visit the site before submitting the tender for realistic offer. A certificate alongwith report duly signed by station authority and tenderer representative in this regard is to be enclosed with the tender. Station authority are requested to coordinate the representative of tenderer as and when approached for site visit. To establish authencity of representative, a photocopy of receipt of tender purchase document may be checked.

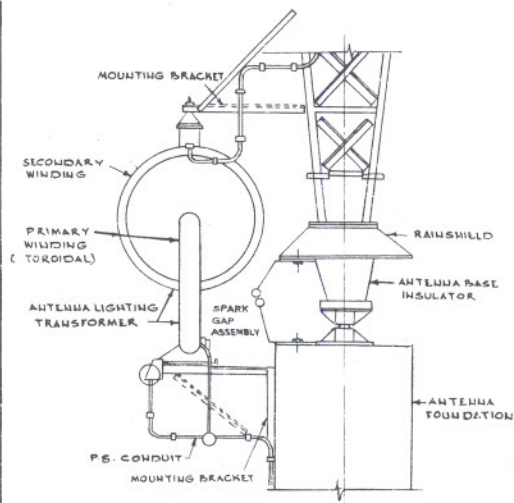
RNC	DATE	ZONE	BRIEF RECORD	INITIALS
1.	26.6.76		NOTE REG. PROTECTION OF GUY INSULATOR ADDED	



LATTICED FACE



SECTION A-A



DRG No. - TF 8832

SCALE:- N.T.S.

TRACED BY:- T. U. GROVER

J.C.R.

ANTENNA LIGHTING TRANSFORMER

THIS TRANSFORMER CONSISTS OF RING TYPE WINDINGS WITH A LARGE AIR GAP BETWEEN PRIMARY AND SECONDARY RINGS. THESE WINDINGS ARE FULLY ENCLOSED. THE CAPACITANCE BETWEEN THE TWO RINGS IS A FEW MICRO-MICRO FARAD ONLY AND IS INDEPENDENT OF WEATHER CONDITIONS. PRIMARY RING IS ATTACHED TO THE BASE OR FOUNDATION OF THE TOWER AND THE SECONDARY IS SUPPORTED THROUGH SUITABLE MOUNTINGS ATTACHED TO THE TOP AT THE TOP OF THE INSULATOR.

TRANSFORMER RATINGS

PRIMARY VOLTAGE = 230 V AC 50 C/S WITH $\pm 5\%$ $\eta \pm 10\%$
 SECONDARY VOLTAGE = 250 V, POWER RATING = 2 KW.

PROTECTION OF GUY INSULATORS

THE DAMAGE TO GUY INSULATORS DUE TO LIGHTNING AND OTHER ELECTRICAL DISTURBANCES AND CONSEQUENT INTERRUPTED TRANSMITTER OPERATION ARE TO BE PREVENTED BY MEANS OF SUITABLE DEVICES CONNECTED ACROSS THE INSULATORS. THESE DEVICES SHOULD BE DESIGNED SO AS TO AFFORD AN EASY LEAKAGE PATH FOR UNWANTED ELECTRICAL DISTURBANCES BUT AT THE SAME TIME NOT DETRACTING FROM THE EFFICIENCY OF THE INSULATOR FOR THE OPERATING FREQUENCY OF TRANSMITTER. THESE DEVICES MAY BE PROVIDED AT TOP LEVEL GUYS ALONE WHEN NO. OF GUY LEVELS ARE UP TO THREE. FOR MORE THAN THREE LEVEL GUYED MASTS THESE DEVICES SHOULD BE PROVIDED ON THE TWO TOP-MOST LEVELS.

A.I.R.
 P. S. D. U. H. T.
 DRG. NO. TF-8832 M