



All India Radio



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

**SPECIFICATION DOCUMENT FOR 10 KW SOLID STATE AMPLITUDE MODULATED
MEDIUM WAVE TRANSMITTER**

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SUMMARY OF CONTENTS:

1. Section I : General conditions of Tender/contract (P.No. 2-7)
2. Section II : Specifications of the Design Features of the equipment (P.No.8-20)
3. Section III : Technical specification of Transmitter Equipment and Accessories (P.No.21-27)
4. Section IV : Schedule of requirements (P.No.28-30)
5. Annexure-I : Guidelines for ATP of the transmitters and Accessories (P.No.31-33)

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

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

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

SECTION - I
GENERAL CONDITIONS OF TENDER / CONTRACT

1.0 GENERAL SCOPE

These specifications cover the Design and Supply of 10 kW fully Solid-state AM- M.W. DRM compatible transmitter and its accessories required by All India Radio.

1.1: Broad scope of supplies/ services:

(a) Items to be included:

- (i) 10 kW Solid State MW Transmitter .
- (ii) Automatic voltage regulator
- (iii) Dummy load.
- (iv) Antenna/Dummy load RF change over switch.
- (v) 1-5/8" 50 ohm R.F.coaxial cable along with accessories including end connectors
- (vi) Antenna tuning unit
- (vii) Facility for Extended / Remote Control & monitoring facility (OPTIONAL)
- (viii) Programme input equipments with wired up Rack.
- (ix) Installation materials for the above & manuals for above equipments

(b) Items not to be included:

The following works/services will be carried out by All India Radio. These are not to be quoted by the tenderer.

- (i) Construction of necessary buildings, including all works and materials connected there with (i.e. masonry, foundations, cable trenches etc.) as per the details/ dimensions furnished by the transmitter supplier.
- (ii) Electric (mains) supply Cable connection upto main Power Supply Distribution of Tx..
- (iii) All furniture and fittings, which are not forming part of the transmitter equipment.
- (iv) Installation of Transmitter equipment.
- (v) All works connected with the mast/antenna.

1.2 LANGUAGE AND SYSTEM OF MEASURES:

All information supplied by the tenderer and all markings, notes, designations on the drawings and associated write-ups etc. shall be in the "English" language.

All dimensions and units on drawings and all references to weights, measures and quantities shall be in "Metric" Units.

1.3. DOCUMENTS TO BE SUPPLIED ALONGWITH TENDER:

The tender and associated information shall be submitted in duplicate.
Following information shall be furnished to enable AIR to adjudge the full merit of the offer.

- 1.3.1. Compliance statement on each and every clause of these specifications (in the order in which they appear in these specifications) indicating clearly whether or not the equipment and accessories offered conforms to these specifications.

Tenders without clause by clause compliance to these specifications is liable to be rejected.

- 1.3.2. All documents like pamphlets, data sheets, write-ups, drawings, block schematic etc. for the transmitter, accessories and auxiliaries etc. in support of compliance statement will be furnished in printed form.
- 1.3.3. Descriptive functional information giving complete details and salient features of the transmitter.
- 1.3.4. Detailed typical layout plan clearly indicating dimensions for main transmitting equipment and its accessories like power supply equipment.
- 1.3.5. An overall schematic of the transmitter circuitry, including the power supply distribution.
- 1.3.6. A comprehensive schedule of materials offered along with quantity of each item.
- 1.3.7. Details of the internal test procedures/standards followed for quality control of the equipment offered and to supply a copy of ISO 9001-2000 certificate .
- 1.3.8. A general undertaking to accept / furnish the guarantees, which will be required to be complied by the contractor as listed under Clause 1.10. of Section- I.
- 1.3.9. A supply record giving the names of the customers, countries, locations, year of supply at site, type and other details of the similar type of 10 kW transmitter supplied by the tenderer during last five years.
- 1.3.10 A complete set of performance figures taken on the similar type and make transmitter (at full as well as reduced power specified under Section-III) offered by the manufacturer to be furnished along with the tender.
- 1.3.11 Any other information, which the tenderer feels relevant to his offer.

1.4 DOCUMENTS TO BE SUPPLIED AFTER PLACEMENT OF ORDER/ ACCEPTANCE OF TENDER :

- 1.4.1 The following documents in duplicate in hard copies as well as CD form for approval shall be supplied within two months of the date of acceptance of the tender to the Director Engineering (Transmitter Design Section), P&D Unit, DG: AIR, New Delhi-110 001.
 - a) Detailed procedure along with drawings in plan, elevation, section and photographs, for the assembly/ installation of the transmitting equipment. (Installation Manual and drawings)
 - b) Detailed procedural steps required for various adjustments, settings along with schematic and drawings of the transmitter circuits and all the ancillary equipments, as deemed essential for the testing and commissioning (Testing and Commissioning Manual) .
 - c) Draft "Inspection and Acceptance Test Procedure" (ATP) as per guidelines given in Annexure-I for approval by AIR. This ATP after mutual acceptance will form the basis for final Inspection and testing at works as part of pre-dispatch inspection.
- 1.4.2 One set each of the above mentioned documents after updating as per approval of AIR shall be supplied to the Director Engineering (Transmitter Design), P&D Unit, DG: AIR, New Delhi-110 001 and concerned Zonal Chief Engineer (Project), and to Installations Officer at site (Total 3 sets per transmitter.)
- 1.4.3 Above requirement shall not be linked to supply schedule of Equipments.

1.5 DOCUMENTS TO PRECEDE DISPATCH OF TRANSMITTER AND OTHER SUB SYSTEMS :

The following documents shall be supplied, one month prior to the dispatch of equipment. One set of these shall be sent to Director Engineering (TD), P&D Unit, Akashvani Bhavan, New Delhi, one set each to the respective Zonal Chief Engineer and one set to the consignee.

- a) Detailed list of equipment under dispatch vis-a-vis reference of supply order.
- b) Drawings showing location of various components indicating their part numbers in the various units/sub assemblies.

1.6 DOCUMENTS TO BE SUPPLIED ALONG WITH THE TRANSMITTER AND OTHER SUB-SYSTEMS:

- 1.6.1 Along with each equipment following documents shall be supplied.
- i. Technical Manuals covering detailed circuit descriptions, schematic/circuit drawings for operation & maintenance, in printed form as well as CD form.
 - ii. Technical Manuals for fault location and Troubleshooting of all the main as well as ancillary equipment in printed form as well as CD form.
- 1.6.2
- i. Test Reports of each sub-system of transmitter and ancillary equipment and the measurements conducted during Pre dispatch Inspection of these equipment at the manufacturer's works shall form a part of these manuals.
 - ii. These manuals shall include Data-Sheets on various Semi-conductors, Active Devices, Electrical Switch gear etc. used in the equipment supplied.
- 1.6.3 Three sets each of the above [one set for Transmitter Design Section, one set for Maintenance Wing and one set for STI(T)] shall be packed separately and supplied to the Director Engineering (TD) P&D Unit, Directorate General, All India Radio, New Delhi. One set each shall be supplied to Zonal Chief Engineer (Projects), Zonal Chief Engineer (Maintenance), and two set each shall be supplied to the consignee. (Total 7 sets per transmitter.)

1.7 DELIVERY OF EQUIPMENT:

The delivery of the entire equipment (at AIR's transmitter site) shall be completed within 6 (six) months from the date of acceptance of Tender by AIR.

1.8 PACKING & MARKING DETAILS :

Please refer to the relevant para in the booklet "Instruction to bidders"

1.9 INSURANCE AGAINST WAR AND MARINE RISK:

Please refer to Commercial terms for transportation by Sea and Land upto site.

1.10 COMPLETENESS OF SUPPLIES, QUALITY & WORKMANSHIP OF MATERIAL USED, WARRANTY AND GUARANTEE:

An undertaking to accept the following terms and conditions along with those contained in para 8, P-49 of "Instruction to bidders" (with the exception of para 8.2.2) shall be submitted along with tender :-

1.10.1 _Correctness, completeness shortages and damages of stores:

- (a) The stores will be complete in every respect with mountings, fittings, fixtures and standard accessories which are normally supplied even though not specifically mentioned in these specifications. The Contractor shall not be eligible for any additional payment in respect of such mounting, fitting and fixtures and accessories which are needed for safe and efficient operation of the equipment. The Contractor shall be responsible for the completeness of the equipment and for efficient working of the same at site.
- (b) The Contractor shall arrange to replenish/repair all the items reported as shortage/ damages free of cost to AIR and send the same to the ultimate consignee at the earliest, but not later than a period of one month from the date of receipt of such intimation from AIR. Payments for freight, insurance and other incidentals for such items shall be made by the Contractor. AIR shall not pay anything extra on this account.

1.10.2 Free replacement of components:

The Contractor shall furnish guarantee to make good, at his own expense, any component which becomes defective within 18 months from the date of receipt of last consignment at site or 12 months from the date of commissioning of the equipment at site, whichever is later.

1.10.3. Materials & workmanship:

- i. Should any defect be noticed in the design, material and / or workmanship of any equipment, within a period of 18 months from the date of receipt of last consignment at site or within a period of 12 months from the date of commissioning of the equipment, whichever is later, it shall be replaced by the supplier free of cost, freight and insurance paid, to the ultimate consignee. All India Radio shall inform the supplier about any defects noticed. On receipt of such intimation, the supplier shall investigate the cause of defects and submit a report within 14 days and arrange rectification/replacement / modification of the defective equipment at AIR site without any cost to All India Radio. All such rectifications / replacements modification of the defective equipment based on report shall be done immediately, within a period not exceeding one month from the date of receipt of information by the supplier at no cost to AIR. If the supplier fails to take proper corrective action to repair/ replace the defective item/items satisfactorily within the period of one month as stated above, All India Radio shall be free to take such corrective action as may be deemed necessary, after giving notice to the supplier, at the risk and cost of the supplier. This supercedes para 8.2.2. of "instruction to bidders"
- ii. The supplier / manufacturer shall submit an undertaking for supply of spare parts, for a period of ten years from date of commissioning.
- iii. The manufacturer of transmitter shall ensure that components used (like VVC, transducers, semiconductors, MOSFETS) as well as critical items, are available from more than one source. The information on various sources will be supplied along with the tender.
- iv. If at any stage during next 10 years from the date of commissioning, the manufacturer stops production of this model of transmitter or any of the spare parts, the supplier is required to submit an undertaking for giving an adequate advance notice to AIR so that the latter can procure, if necessary, the balance of the life time requirements of these spare parts and the critical items.
- v. The Contractor shall insure his men while working at AIR site, against any accidental injury death etc. Similarly the equipment, instruments, tools etc., belonging to the Tenderer shall be insured against damage, loss, theft etc. AIR will not be responsible in any way for the safety and security of the Contractor's Men and equipment etc.
- vi. The supplier shall ensure safety of AIR's Inspectors/ Trainees, while on Inspection and Training (vide paras 1.11 and 1.12 of Section-I of these specifications) at the manufacturer's works, against any accidental injury, accidents, death etc, at no cost to AIR.
- vii. In case the equipment falls short of the guaranteed performance level, All India Radio will be free to either reject the equipment completely or impose penalty on the supplier so as to recover the cost of the deficiency. However this does not entitle the supplier to deliberately supply substandard equipment or conceal the defects of the equipment supplied by the supplier.

1.11 INSPECTION/ ACCEPTANCE:

1.11.1 Pre-dispatch Inspection / Acceptance Tests at manufacturer's Works:

- a) AIR will carryout the inspection of the equipment ordered at Manufacturer's works, by AIR Engineers, as per mutually agreed Acceptance Test Procedure (ATP). The various tests to be performed and the measurements to be done will be to check the conformity of the equipment offered to these specifications and the various conditions of the A/T.
- b) The transmitter equipment with its accessories offered for inspection shall be tested at Station frequency (frequencies) by AIR as per the ATP.
- c) The contractor shall give at least 8 (eight) weeks notice, to AIR to carry-out the inspection, before the consignment is ready for dispatch.
- d) The manufacturer shall put up the transmitter equipment on the test bench, at his premises, before AIR's Representatives and shall provide, without any extra charge, than that indicated in 1.11.1 (g), the power supply, consumable materials, tools, testing instruments and labor etc. as considered necessary for the tests to be carried out, at the manufacturer's/ contractor's premises
- e) The equipment shall be tested at the Mains Input Voltage and frequency specified against the various equipment in Section - III.
- f) The inspection and testing period for each transmitter (along with accessories) at the manufacturer's works shall be of 5 (Five) working days.
- g) The tenderer shall furnish the testing charges, if any, levied by the manufacturer / tenderer (The expenditure towards To & fro Air Journey, lodging, boarding & DA of the inspecting Officers as per Govt. of India norms shall be borne by AIR).

1.11.2 Inspection/Acceptance Tests at AIR site (In India):

AIR will carry-out the following inspections/tests at AIR site, in India.

- a) Physical inspection, after receipt of the equipment at AIR site, for reporting any shortages or damages for free replacements / repairs by the manufacturer/contractor.
- b) Testing of equipment after its' installation and commissioning as per mutually agreed ATP to confirm the performance of the equipment to Contract specifications, before finally taking-over/accepting the equipment.
- c) If any component fails or found defective on receipt at site as well during the installation/testing/commissioning these will be supplied free of cost to AIR site by the manufacturer / contractor. The Contractor will be bound to make free replacements even if the transmitter is commissioned by AIR as per the testing / commissioning procedure specified by the contractor/ manufacturer.
- d) After installation of the equipment at AIR site, in case the performance of the equipment is not achieved as per these specification, the Contractor will be bound to send his representative to solve the problem at no extra cost to AIR.
- e) A heat run test for a continuous period of 24 hours with rated carrier power and modulation as per the ATP shall be done keeping in view the modulation capability specified in the specifications and as per the claims made by the tenderer. Should this test get interrupted for any reason connected with the failure of any component or power failure, for a period exceeding 20 minutes a further period of 24 hours must be commenced. In essence, AIR has to be satisfied that the equipment supplied is capable of operating continuously for a period of 24 hours.
- f) Any other tests which may be found necessary to prove the performance of the equipment as a result of the preceding tests or as a result of the inspection by the inspecting authority.

1.12 TRAINING OF AIR ENGINEERS:

1.12.1 At Manufacturer's Works: (OPTIONAL)

- (a) The contractor shall be required to train Four (4) AIR Engineers. for a period of 1 week at

manufacturer's works to enable them to become acquainted with all particulars in respect of erection, testing/ commissioning, operation, maintenance, trouble shooting of the complete transmitter equipment . This training shall be imparted on same type of transmitter including accessories.

- (b) The training programme will be structured so as to cover theory of operation of transmitter, installation, maintenance, practical demonstrations of circuits, maintenance demonstrations, fault finding, testing, commissioning, operation, circuit tracing exercises and major part replacements.
- (c) The tenderer shall quote separately for the Training charges, if any, levied by the manufacturer / tenderer in the tender. (The expenditure towards to & fro Air Journey, lodging, boarding & DA for the trainees as per Govt. of India norms shall be borne by AIR.)

1.13 INSTALLATION, TESTING AND COMMISSIONING:

The transmitter equipment will be installed by All India Radio in accordance with the instructions, drawings and other details supplied by the manufacturer . All India Radio shall have the option to carry-out the testing, commissioning and the acceptance tests on the transmitter equipment at site themselves or to entrust the same to the contractor. If the testing/commissioning is done by the contractor, the terms for the same will have to be mutually agreed upon in advance. Testing/commissioning charges shall be quoted separately and will also include the various terms and conditions stipulated by the contractor for the testing / commissioning work along with the time period required for this work.

1.14 AFTER-SALES SUPPORT:

The Manufacturer/contractor shall guarantee for the after-sales support for all the equipment offered under the contract for a minimum period of 10 years, after commissioning of the equipment.

The details of the type of after-sales support and list of the various after-sales support centers in India and elsewhere shall be indicated in the tender.

SECTION - II DESIGN FEATURES OF THE EQUIPMENT

2.0 10 kW MW Transmitter:

Type & Configuration: Fully solid state, field proven technology with MOSFETs delivering full carrier power of 10 kW. MW transmitter shall operate on single frequency.

2.1 Design Features

2.1.1 General:

- a) The architecture of the Transmitter should be simple and all the devices ergonomically placed for fatigue- less operation, ease in identification of components, adequate accessibility for maintenance / repair/ replacement.
- b) The transmitter shall be capable of continuous operation (24x7 Hrs).
- c) The transmitter will be in modular design with plug in modules for easy and quick replacement.
- d) The design shall be optimized to minimize the MTTR and maximize the MTBF. (Typical figures to be given)
- e) The operating sequences will be designed in logical steps with proper annunciated and prompted steps for convenience of the operator.
- f) Supervisory, monitoring and fault diagnostic system should be user friendly & placed ergonomically for the ease in troubleshooting.
- g) An efficient air cooling system shall be provided to dissipate the heat generated wherever required for ensuring safe operation and long life of the transmitter components.
- h) The transmitter shall conform to latest standards for Electrical Safety, Electromagnetic compatibility and Interference.
- i) Drawings: Station wiring drawing showing electrical interconnection between each system of transmitter plant shall be part of manual.
- j) Manual: For each equipment system of transmitter plant manuals shall be provided. This will include manual for operation, maintenance, troubleshooting, Installation, adjustment, testing and commissioning

2.1.2 Constructional Features:

- a) Various components and sub-assemblies of the transmitter shall be housed in a rugged mechanical enclosure to withstand impacts, vibrations or abrasions encountered during the transportation, installation, and maintenance of the equipment.
- b) Proper arrangements shall be provided for fixing/grouting of the enclosures/components. The mounting arrangements for the various components / sub- assemblies shall be designed taking care of their weight and to withstand transit / transportation hazards.
- c) The Layout of the components shall be as per technical standards to have sufficient space for carrying out the repair and maintenance in the field.
- d) The material used shall be non- inflammable and fire proof / retardant.
- e) The various metal parts shall be painted to prevent rusting or corrosion. The transmitter panels shall be painted in non-glossy, mat finish color.
- f) The various assemblies and components shall be labeled liberally for easy identification.
- g) Electrical Wiring : Various wires/cables switches etc. used in the equipment shall be as per international standard. Their termination shall be done as per the standard practice used for

Broadcast equipment. The various cables and terminations will be ferule numbered with cross-reference in circuit diagrams / drawings for ease in identification. Provision for cable entry shall be kept from top as well as bottom. All the wiring shall be routed through cable troughs duly harnessed and fastened. Suitable provision for preventing the entry of rodents through left over Cable entry routes is to be made.

- h) Size: The size of the equipment will be optimized for economy in space required for installation and convenience of maintenance. Typical equipment layout drawings showing the shape and size of the various equipment in plan and elevation shall be enclosed with the offer.
- i) Weight : The weight of the equipment shall be optimized to have the required ruggedness and ease in handling. The weight of various equipment shall be specified in the tender.

2.1.3 R.F. SECTION : RF Section shall consist of three stages namely RF source, driver/ buffer/ distribution amplifier and Power amplifier consisting of multiple RF modules followed by combiner, Filter & matching network.

2.1.3.1 R.F. Source:_ The RF Drive Unit having two independent RF sources shall be suitably located in transmitter cubicle having following provisions:

- (a) RF frequency shall be generated by DDS (Direct Digital Synthesis) for having spectral purity in AM band. Both the RF sources should be fully interchangeable.
- (b) Each source shall be self-contained in all respects including arrangement for varying the frequency to a few cycles in field for having stability as per Section - III.
- (c) Automatic as well as manual change over arrangement shall be provided for selecting the healthy RF Source.
- (d) Provision for visual indication of active RF source shall be provided.
- (e) A BNC socket, (50 Ohms) for monitoring of carrier frequency shall be provided.
- (f) A 50 Ohm BNC Socket also shall be provided for connecting an external RF source / synthesizer.

2.1.3.2 R.F. Buffer/Driver/ Distribution Amplifiers:_ This unit shall be self-contained having 100% redundancy, and broadband with no frequency selective components for splitting the RF feed to PA Modules. The tenderer shall furnish complete details with schematic diagram to assess the specified provision.

2.1.3.3 Design Criteria of P.A. Modules : The transmitter power block shall have multiple R.F. P.A Modules of identical design and completely interchangeable and capable of delivering 10% higher output than it's rated power with 100 % modulation at nominal supply voltage. PA modules shall be wired in suitable combination for plug-in connection/disconnection for ease in maintenance. The P.A. Modules shall be based on MOSFETs with adequate safety margins to work under extreme ambient conditions in tropical regions as specified under Section – III. PA Module shall be broad band (in MF band) without any tuning elements / frequency dependent components.

(b) Arrangement of P.A. Modules: A number of R.F. PA Modules shall be wired in series/parallel, combinations to provide required rated power output. Detailed configuration of RF modules in each power Block along with the type of combiner used shall be given.

(c) Protection of P.A/Modules : Effective and adequate arrangements will be provided for protection of P.A. modules against the risk of failure due to:

- i. Excessive Heating;
- ii. Voltage Surges/Spikes.
- iii. Load Mismatch/High VSWRs with automatic power fold back as specified in Section III
- iv. Excessive Load Currents/Short Circuits/ Sparks

- v. Lightning/Static
- (d) Isolation of defective PA modules: Arrangements shall be provided for isolation of the defective PA modules to prevent deterioration of technical performance of the transmitter.
- (e) Information to be submitted with the tender :
- i) Total no. of P.A. Modules used in the transmitter required for 10 KW carrier power with 10% overrating at 100% modulation.
 - ii) Minimum No. of P.A. Modules required for 100% Modulation at rated carrier power .
 - iii) Maximum number of modules which can fail without affecting the broadcast service
 - iv) Whether any balancing in corresponding section of PA module for a defective module in other section is required to maintain technical performance? If so details to be provided .
 - v) Peak & Average power output of each PA module at full carrier power with 0% and 100 % modulation.
 - vi) Details of protection devices provided against failure of PA modules, which should include item mentioned in Para 2.1.3.3(c) above.
 - vii) Safety margins adopted in the design criteria of the PA modules.
 - viii) Circuit Diagram of the P.A Module.
 - ix) Make, model and details of supplier for MOSFETs (At least two sources).
 - x) Make, model & source of other special devices used in P.A.
 - xi) Type and details of the arrangements provided for isolation of defective modules.
 - xii) Five most critical components in descending order.
 - xiii) Average life of RF Module.
 - xiv) Efficiency of RF Module.

2.1.3.4 P.A. Combiner / Output Network and Filter:

- (a) Combiner: The mechanical assembly of combiner will be designed for plugged connection/disconnection of PA modules for ease in maintenance. Details of sub/ main combiner are required to be submitted.
- (b) Output Filter: A low pass filter to remove the spikes due to switching in/out of the P.A. Modules shall be provided in the output network.
- (c) Harmonic filter : Necessary tuned circuit / circuits for filtering out unwanted harmonics and undesired spectral components below the limits specified in Section- III shall be provided in output circuit. Details of filter is to be indicated.
- (d) Output Impedance Matching Network : Details of Matching network to obtain an output impedance of the transmitter specified in Section-III as well as isolation from load side disturbances like very high continuous VSWR resulting from any fault in Transmission line, ATU, Mast etc. shall be provided.
- (e) Output Network Protection : The output network of the transmitter should incorporate UV arc sensors, spark gaps and required VSWR detecting devices for effective protection against :
 - a) High VSWR / Load mismatch (Instantaneous & Long term).
 - b) Sparking/ flash over/ arching
 - c) Lightning
 - d) High voltage discharge / Static
- (f) Frequency Dependent Components: A complete list of additional components, along with circuit / schematic diagrams, required in the post PA stages for change of frequency over the MF band specified in Section-III are to be submitted. AIR will have the option to purchase these kits.

2.1.4 Modulation Technique:

- (a) Amplitude Modulation shall be generated with digital techniques i.e. PA Modules will be switched ON/OFF in proportion to amplitude of analog input signal.
- (b) Detailed description of modulation technique, the year of its introduction & a list giving numbers of transmitters of 10 kW and higher power using the same modulation technique supplied world-wide during last 5 yrs shall be furnished. The list will include postal address of customers, e-mail & telephone no. and year of delivery. The tenderer shall furnish the details of audio chain and the principle and system of modulation employed, with schematic/block diagram etc.
- (c) **DRM Compatibility** : The Transmitter shall be compatible of Digital broadcasting having simulcast facility as per DRM standard. To make transmitter DRM operational, the additional items required are to be indicated. The quote for this is to be indicated in schedule of requirements section-IV as optional item.

2.1.5 Power Supply :

AIR will extend 400 volts (Phase to Phase) 3 phase 50 Hz power supply connection for feeding to entire transmitter equipment system at the mains input, for normal operation of the transmitter with the power supply variations specified under Section-III. All main and sub power supply required for operation of transmitter and its all accessories shall be derived from this main connection by supplier by providing step down transformers & distribution panel.

Power supply system (main & sub) shall be regulated and capable to withstand various overloads including transients encountered during the operation of the transmitter without undue heating of any power supply components as specified in Section-III.

a) Power supply equipments : As there will be a 400 volts, (phase to phase) 3 phase, 50 Hz mains input provided by AIR for transmitter equipments as specified under Section-III any step down or step up transformers and the associated distribution and control switch gear along with necessary protective circuits required for any section and also for any accessory of the transmitter equipment (under scope of the supply of this Tender) shall be supplied by the tenderer as a part of Transmitter power supply equipment.

b) Mains isolation switch : A suitably rated Air Circuit Breaker (ACB) or equivalent will be provided for isolation of mains input to the transmitter.

c) Emergency off : A Push Button (Red in color) shall be mounted on the front panel of the transmitter to isolate the Mains supply to the Transmitter in case of any Emergency.

d) Transient Protection: Metal Oxide Varistors (MOVs) or similar fast acting devices will be provided at the input of Power Supply system of the Transmitter and all sub system to protect the equipment from voltage surges/transients encountered on the mains input line as specified under Section-III.

2.1.6 TRANSMITTER CONTROL SYSTEM:

The Transmitter control system will be designed using user friendly digital control techniques. Control system shall be having self diagnostic, supervising & monitoring facilities along with visual display as well as re-settable aural alarm.

i) Switching Sequence & Interlocking: The "Switching-ON" and "Switching-OFF" of the transmitter will be interlocked to ensure the desired operational sequence for the safety of the equipment and operating personnel. The transmitter output power shall also be interlocked with dummy load and Antenna change over switch.

ii) Control and Indications : Following visual indications on the status of the transmitter will be provided in the Local and Remote mode (Tx. Front Panel):

- a) Transmitter-on/off
- b) Power level

- c) Local/remote mode of operation
- d) Forward Power, Reverse Power
- e) Fault
- f) Oscillator status

All faults shall be supplemented with reset-able audible alarm.

iii) Fault Diagnostics: Indications as required and procedures will be provided for fault diagnostics in the various circuits of the transmitter up to module level.

iv) Metering: Necessary metering will be provided to have a close monitoring of the following vital operating parameters of the transmitter (in 'Local' and 'Remote').

- a) Mains input voltage
- b) Stage DC Voltages
- c) Stage DC load currents
- d) Audio input level /percentage modulation.
- e) Forward RF power
- f) Reverse RF power
- g) Transmission hours.

2.1.7 Protection of equipment and operating personnel:

i) Safety of operating personnel: Adequate and fool-proof arrangements shall be provided for protection of the operating personnel against hazards of any nature involved in operation and maintenance of the equipment covered under this specification as per IEC 215.

ii) The Operating Personnel shall be protected against following hazards by providing suitable interlocking through door key inter-locks, ground hooks or mechanical locks having electrical loops etc. (to be confirmed for provision by enclosing a schematic indicating type of device)

- a) Against high RF voltages;
- b) High voltage Power Supplies;
- c) Energy storing components requiring discharge time
- d) Access to moving machinery, hot / live components.

iii) Protection of components: The Equipment and its various components will be protected by providing suitable devices like UV detectors, arc gaps corona rings (to be confirmed for provision indicating type of device and their locations) against the following:

- a) Electrical Flash over ;
- b) Deep Voltage fluctuations/transients;
- c) Lightning on or near the Antenna
- d) Fire due to sparking etc.

Output RF circuit of the transmitter shall be provided with a protective device in order to by - pass/ ground the lightning strokes entering through feeder line .

iv. EM/ RF Radiations :The radiation shall be within the safe limits prescribed under the relevant standards to avoid risk to operating personnel.

v. Earthing Rods: Earthing rods wherever required shall be provided.

vi. Earth terminals: for connecting client's earth to the transmitter shall be provided at appropriate locations as per standard practice.

The above details along with the schematic and location of the various provisions made for protection of equipment and operating personnel shall be indicated with tender.

2.1.8 Extended/Remote control (Optional) Facility for an Extended/ wired Remote control & monitoring system having facility for remote ON/OFF , reduced power operation and monitoring of vital parameters, Percentage modulation Meters, logging facility shall be provided.

2.1.9 Cooling System:

(i) Main Features of cooling / Heat extracting arrangement:

- a. An air cooling system shall be provided to take away the heat generated in the equipment for ensuring a safe operation and long life of the transmitter components.
- b. The air-cooling system shall be designed for both closed and opened (fresh air) circuit operation in conjunction with client's Air-conditioning plant. The tenderer shall include the fans (duplicated), motorized louvers (for closed and open circuit operation), Air ducts and Air Handling Units (AHU), Air Filters/ weatherproof louvers etc. in the offer.
- c. The cooling fans / Blower shall be designed for acoustic noise as specified in Section-III to minimize the fatigue to the operator.
- d. **Dust filters:** Fine filters of washable and re-usable type of sufficient surface area shall be provided at the cooling air inlet to the transmitter. Details, size and filtering efficiency of the filters may be furnished in the tender for tropical environments.
- e. **Flow/ temperature detectors and protective devices for fans :** The operation of fans should be monitored by measuring airflow & temperature. Protective devices should be provided to fold back the Power of the transmitter upto a safe operating level in case of insufficient / deficient cooling.

(ii) Air cooling System features:

- a. The capacity and static pressure of blower should be as per ventilation requirement of the transmitter. The blower shall be statically & dynamically balanced.
- b. Air filters shall be of synthetic material , non woven washable type with efficiency 90 % down to 10 microns, .
- c. The duct shall be fabricated with standard rust proof sheets suitable with joining collars and smooth bend.
- d. Requisite supports and anti- vibration duct hangers shall be provided.

(iii) Following data shall be supplied with tender.

- a. Detailed schematic of cooling system indicating number and capacity of the cooling fans used .
- b. Total amount of heat generated by the transmitter equipment and ancillaries including D/L to be extracted by Air System shall be specified separately.
- c. Details of size and filtering efficiency of the filters may be furnished in the tender.

2.1.10 Input/output connections from Transmitter Cabinet:

The transmitter cubicle shall be designed for connection of the R.F. output from top and for power supply, audio control & other monitoring cables from top as well as bottom of the cubicle through overhead mounted cable trays/ underground trenches as per site suitability.

The following Input / Output Connections will be provided:

i) Input connections:

- a) Mains input through suitable industry standard connectors with suitable termination.
- b) Audio input shall be through suitable industry standard connectors.
- c) Remote control connections: The remote control command connections shall be through suitable terminal blocks / standard connectors.

The mating connectors shall be supplied along with the equipment.

ii) **Output connections :**

- a) RF output: RF output shall be terminated suitably for connecting to 1-5/8", 50 ohm RF coaxial cable.
- b) RF o/p for performance measurement: One sample RF output shall be provided by terminating in a BNC connector with output level of 5 to 15 volt RMS, suitable for connecting modulation monitor of standard make which shall be used for performance measurement purposes.
- c) De-modulated output: A demodulated output by providing a suitable detector unit shall be provided/ terminated in a BNC connector with a level of 1 volt RMS for aural monitoring.

2.2 AUTOMATIC VOLTAGE REGULATOR (AVR):

The AVR shall be Servo controlled type with individual phase sensing and control for regulating unbalanced incoming voltage. The AVR shall be housed in a rugged enclosure to withstand the transit hazards and to provide mechanical protection to the sensitive parts and will be provided with wheels for ease of movement. The enclosure shall be designed for indoor operation. An efficient natural cooling arrangement ensuring long life for the AVR shall be provided so that the AVR works without getting unduly heated. The AVR shall be painted in the standard equipment color.

i) The input/output connections shall be provided in covered boxes with cable glands for cable entry from overhead trays/underground trench.

ii) A 4 pole ACB / MCCB of adequate capacity having adjustable over-current and magnetic release and with tripping facility from emergency OFF of the transmitter shall be provided as Mains Isolation Switch to the AVR.

iii) An arrangement to By-pass the AVR shall be provided.

iii) Meters shall be provided for measuring the following:-

- a) Input voltage
- b) Output voltage
- c) Input/Output current

iv) Electrical protection : AVR shall be protected against over loads of both prolonged and short duration including transient's from power supply line.

2.3 DUMMY LOAD:

2.3.1 **Type**: Dummy load shall be of standard make closed circuit air cooled or water - cooled resistance type. All the accessories like Heat Exchanger, Pump, Flow meter, Blower Unit, motor controlled automatic flow control etc. shall be included in the offer.

2.3.2 **RF Input Impedance & connection type**: Impedance shall be as indicated in Section-III. The termination arrangement will be as per internal feeder system.

2.3.3 **RF Power Measurement**: Direct reading type RF Power measurement shall be provided either by electrical method or by Calorimetric method with digital display.

2.3.4 **Electrical/Thermal Protection**: The dummy load shall be protected against over heating, electrical overloads. Necessary protection shall also be provided for any over loads occurring in any component of the dummy load.

- 2.3.5 Mechanical construction: Dummy load enclosure shall be constructed out of sheet metal work with a frame work. The dummy load shall be grouted on the floor. The body of the dummy load shall be provided with a protection paint coating to prevent rusting, corrosion etc.
- 2.3.6 Electrical input : The dummy load shall work on mains input voltage specified under Section - III.
- 2.3.7 Interlocking: In addition to it's internal interlocking, the dummy load shall be interlocked with the transmitter. The interlock connection shall switch-off the transmitter R.F. Power automatically (in case the transmitter is delivering R.F. Power) or would prevent switching-on of transmitter RF power (in case the transmitter is not delivering R.F. Power) for the following conditions of the Dummy load:
 - a. The R.F. Connection between the Dummy Load and the transmitter is not through.
 - b. The Dummy Load impedance is outside the permissible variation.
 - c. The cooling system of the Dummy Load is not functioning properly.
 - d. There are any overloads or abnormal working conditions of the dummy load.

2.4 RF CHANGE OVER SWITCH:

It shall be manually operated motorized switch for 50 Ohms RF Coaxial cable. For connecting the output of 10 KW Transmitter and existing standby transmitter to either antenna during normal transmission or to dummy load for testing the transmitter. The switch shall provide the necessary R.F. isolation between the input and output ports and also between two output ports.

The switch shall be housed in a suitable rugged enclosure with proper isolation of live terminals / points. It shall be suitable for overhead mounting but operateable from the ground level with suitable indication provided/extended at the operating point to clearly indicate the position of the switch.. The details of mounting arrangements shall be included in the installation manuals of the transmitter. The enclosure shall be painted/ treated to prevent rusting/corrosion, in a color to match the transmitter equipment.

- i. Interlocking connections shall be provided from the antenna change over switch, wired into the transmitter controls, so as to ensure that the transmitter RF power can be switched on only when the transmitter is connected either to the antenna or to the dummy load.
- ii. The switch shall be adequately rated for the power handling capacity mentioned under Section-III.
- iii. The switch shall be designed to present a very low VSWR as mentioned under Section-III.

2.5 **ANTENNA TUNING UNIT (ATU):** All the components shall be housed in a metal enclosure. The enclosure shall be provided with terminals for earthing. The metal enclosure shall be painted to prevent rusting / corrosion, in same colour as the Transmitter. Suitable natural ventilation arrangement shall be provided for the ATU, to prevent undue heating of the components. The various components of the ATU shall be mounted with proper insulation.

- i) The input & output impedances of the ATU shall be as specified in Section - III.
- ii) The input connections shall be through R.F connectors suitable for 50ohm R.F. coaxial cable mounted on the enclosure. The output connection will be through Bowl insulators mounted on side wall of the ATU enclosure along with required terminals for earthing.
- iii) Meters shall be provided for measuring the Feeder RF current and the Antenna RF current. The meters shall be provided with suitable shorting switches. It will be possible to read the meters with the ATU enclosure door closed and with the transmitter on. Arrangement shall be provided for remote indication of the antenna current at the transmitter end through underground cables running between the ATU and the transmitter.
- iv) Static leak coil of adequate rating shall be provided for discharging the lightning current safely to the

ground. Size of the conductor and dimensions of the coil may be furnished.

v) Adjustable spark gaps shall be provided at the input as well as output points of the ATU. Necessary voltage break-down strength characteristics of the spark gaps shall be included in the technical literature on erection of equipment supplied with the transmitter.

2.6 Feeder Outlet:

The bowl insulators assembly shall be complete in all respect including mounting Plates etc.

- a) For transmitter Building Outlet : It shall be designed for mounting on a wall opening, and shall be suitable for termination of 50 Ohms, coaxial cable inside the building and 50 Ohms coaxial cable outside the building. Alongwith live terminals this shall be having provision for grounds terminal.
- b) Feeder Hut Inlet : It shall be mounted in a wall opening , suitable for termination of 50 ohm coaxial cable outside the ATU . Alongwith live terminal this shall be having provision for ground terminal.
- c) Feeder Hut Outlet: It shall be mounted in a wall opening suitable for termination of a copper pipe connection to self radiating mast.

2.7 PROGRAMME INPUT EQUIPMENT RACK:

2.7.1 GENERAL :

- (i) A dual mono channel Pre Wired Programme Input Equipment Rack is required to process the programme (analogue audio signal) received from various sources like studio center via Telephone lines or VHF/ Studio Transmitter Link / rebroadcast from satellite receiver, tone from generator before feeding to the transmitter power blocks to the required nominal level with professional quality through audio processor.
- (ii) It shall be a standard 19" Rack conforming to professional standards of sound broadcasting for mounting equipment and accessories as per configuration indicated later.
- (iii) It shall have the facility for monitoring of programme through a Monitoring Amplifier with rack mounted as well as external speakers.
- (iv) Six Nos. of Audio Input signals shall be given to the Rack viz. Prog-1, Prog-2, EM.ST., RN, Rx and OSC. The required input shall be selected using a suitable Program Selector Switch, mounted on the Selector Switch Panel . The selected input shall be applied to the Audio Processor and then to the Distribution Amplifier. One of the four outputs of the Distribution Amplifier shall be fed to the transmitter. All the four outputs shall be monitored using VU / Program Monitor & a Monitoring Amplifier.
- (v) RF Samples from the Transmitter shall be given to the RF Patch panel mounted at the rear side of the rack. The RF Sample shall be monitored using the CRO. From the RF patch panel, signal shall also be fed to the AM Modulation Monitor. The demodulated audio signal can be monitored using VU/ Program Monitor & a Monitoring Amplifier. The signal to be monitored shall be selected using a 12-way Selector Switch mounted on the Audio Patch Panel. Programme and monitoring chain shall be brought to an Audio Patch Panel consisting of 48 jacks (24 in each row).
- (vi) Necessary repeat coils, tag blocks, terminal strips, BNC connectors etc as per requirement shall be provided in the rack for all inputs.
- (vii) Facility to measure/ monitor levels at various points in the programme chain with a VU(PPM) meter and a selector switch shall be provided in the rack.

2.7.2 Mechanical:

- (i) **Construction Details** : The rack shall be constructed from aluminum extrusions of suitable size fastened to form framework properly reinforced with stiffeners, suitably welded. The front site of the rack shall be open for mounting equipments. The rear side of the rack shall be provided with a

single leaf, hinged removable type door and handle with latching arrangement . The sides should be covered with panels which can be screwed to the frames. These panels should be reinforced with stiffeners. The Racks shall have holes for grouting bolts on the bottom plate. The thickness of the sheet used for sides of the rack and door shall be 1.6mm and 1.3mm respectively. The overall dimensions of the rack shall be 2120 \pm 5mm (H) x 645 \pm 5 mm (W) x 685 \pm 5mm(D).

- (ii) **Mounting Arrangement** : Panel mounting rails with pre-drilled and tapped holes corresponding to metric thread 'M-S' are to be provided at the front. Suitable mounting arrangement is to be made at the top and the bottom of the frames for mounting the rails at different intervals. Pre-drilled holes shall be such that it shall be possible to mount any standard equipment of width 483mm and height 1U to 42U. Necessary equipment support angle to relieve strain on holding screws wherever required shall be provided. Any equipment which is not of standard 19" width shall be provided with rack mount kit.
- (iii) **Style/Strips or Trims** : To render sleek look style, strips/trims are to be provided on the front side which will cover the drilled and holes on the mounting rails.
- (iv) **Ventilation Arrangement** : Louvers are to be provided throughout the length of rear door of the rack. provision is required to be made for mounting a cooling fan of about 100 CFM at the top.
- (v) **Finish of the Rack** : The inside and outside of the rack shall be spray painted with dark admiral grey (Color No.632 of IS-5 as amended up to date) after necessary anti rust treatment.

2.7.3 Jack Field/ Audio patch Panel :

- a. Standard Jacks of robust construction and positive action shall be used. Input and output of all the equipments and the programme lines shall be brought to the Jack Field. Few jack points shall be used as check points without disrupting the signal flow & few to be left as spares for the tie lines, parallel points and for future use. The jack strip panels shall be on openable front sides without strain on connector and wiring. Jacks shall be of "Switch craft" make or equivalent.
- b. Jack construction: The jacks shall have preferably a nickel plated brass frame, with nickel-silver springs and gold-silver/ Palladium contacts. The jacks shall be mounted on 20mm centers. The Jacks shall be as per DIN specifications.
- c. Contact arrangement : Each jack shall be a five point jack, providing a break circuit (on both wires) and an isolated earthing lug.
- d. Indicating strip: A paper-strip covered with transparent plastic shall be provided above the row of jacks for labeling purposes.

2.7.4 Programme Meter (PPM / VU)

The Program Meter shall be a dual VU meter or peak programme indicator in the form of Bar graph Display with LEDs or both. The signal fed at the input connectors shall be processed, levels compared and displayed on the Bar graph. This unit shall work independently in any configuration for signal monitoring without loading the source. There shall be provision for selecting VU or Peak response using a front panel switch.

2.7.5 Loud Speaker Panel

The Loud Speaker Panel shall have two loud speakers of 6" size, one for each channel. The output from the Monitoring Amplifier will be fed to the loudspeakers.. The loudspeakers shall be of reputed make.

2.7.6 Repeat Coil:

- (i) A Line to line audio transformer shall be provided for isolating balanced and unbalanced circuits.
- (ii) **Primary & Secondary Impedances** : The primary secondary windings shall consist of two exactly identical sections which can be connected in series for 600 ohms operation or in parallel for 150 ohms operation.
- (iii) **Hum reduction** : The shielding and design of the windings shall be such that the hum level

picked up by the unit, when placed in normal magnetic field inside equipment racks is better than -75dBm, as measured across either winding, both secondary and primary being terminated by 600ohms.

2.7.7 Stereo Monitoring Amplifier :

- (i) The amplifier shall be able to deliver an output of 20 W RMS with both channels driven at 1kHz. at nominal input level. The amplifier shall be capable of continuous operation without degradation in performance.
- (ii) The amplifier should have protection against open circuit, full short circuit, ultrasonic frequencies, RF pick up, excessive heat sink temp. and for loudspeaker against DC & low frequencies.
- (iii) It should be switch-able to stereo and dual mono operation mode. Necessary function switches such as volume/gain control, low and high frequency filters should be available on front panel. These controls shall be rugged and reliable.
- (iv) All necessary accessories like power cord and mating connectors shall be supplied along with the units.

2.7.8 Stereo Distribution Amplifier:

The distribution amplifier shall have one stereo input and six stereo out put channel. The amplifier shall be capable of continuous operation without degradation in performance. The amplifier should have protection against open circuit, full short circuit, ultrasonic frequencies and RF pick up. All standard accessories including mating connectors shall be supplied.

2.7.9 Space for Equipment : Space/ slot for mounting of additional equipments like Tone Generator etc shall also be provided.

2.7.10 Rack Wiring : All the wiring in the rack shall be carried out with Mil standard approved PTFE insulated, shielded, twin core, audio cables of standard make in PVC cable duct.

- (i) The wiring for all the equipment shall be routed through terminal blocks which shall be suitably located for easy accessibility. All the wiring on the terminal block shall be suitably marked. The wiring bunches shall be neatly laid and clamped to the body of the rack.
- (ii) The low level audio lines shall be suitably isolated from high level audio lines in order to avoid interference.
- (iii) Power supply wirings shall pass through separate conduits and shall be segregated suitably from the audio wiring in order to avoid noise and hum pick up.

2.7.11 Other Accessories:

- (i) A lamp to illuminate when the door is opened shall be provided on one of the side at top.
- (ii) Arrangement may be made for mounting tag-blocks/terminal strips at a height of 450mm from the bottom at the rear side.
- (iii) PVC channels may be provided at the front as well as the rear for routing cables.
- (iv) Necessary shelves/hooks shall be provided for keeping patch cords & headphones.
- (v) Suitable arrangement is to be made for fixing AIR Monogram on the top frame on the front side as shown in the drawing.
- (vi) A 1U blank space shall be provided for fixing a tone generator.
- (vii) Blank panels of 1U height wherever required for proper gap between equipment are to be provided suitably.

2.7.12 Power Supply:

- (i) A single phase 50 Hz., 230 V Mains Panel to distribute power supply with indication lamp and MCB to the various equipment, mounted on front side bottom in the rack shall be provided.

- (ii) RFI Filter to protect against electrical & EM disturbances shall be provided for protection in the mains supply. A Distribution panel with suitable rating fuses for over current protection for each outlet shall be provided at the output of this filter.
- (iii) Power supply to all the equipment/circuits in the rack shall be distributed from this panel along the height of rack at each equipment level. A spare 5A,3 Pin power socket shall also be provided.

2.7.13 Earthing :

All the equipment in the Rack shall be properly earthed. The earth circuits of the power supply and audio circuits shall be kept separate and brought out on suitable terminals for earthing.

2.9.14 Shielding:

The Rack shall be installed in the transmitter Hall. Necessary precautions shall be taken to shield the equipment and wiring from high level R.F. field, to deliver specified performance of programme input rack input with transmitter on full power. Door leaf shall be connected with flexible braided wire to rack body.

2.9.15 Configuration/layout of equipment:

The rack shall be having following configuration in ascending order starting from top to bottom with necessary blank panels in between.

- (i) Monitoring speakers
- (ii) VU meter/ PPM with selector switch
- (iii) RF patch panel (on rear of rack)
- (iv) CRO for monitoring AM wave with rack mount kit :
- (v) Modulation monitor :
- (vi) Audio patch panel with programme selector switch, monitoring selector switch and attenuator (rotary fader) for programme fed to transmitter for reserve gain.
- (vii) Jack fields
- (viii) Tone generator (to be supplied by AIR separately)
- (ix) Audio processor
- (x) Audio distribution amplifier
- (xi) Monitoring amplifier
- (xii) Power supply distribution panel (front bottom).

The Tenderer shall prepare schematic drawing including level diagram & layout of equipment in the offered Rack and submit along with tender.

2.8 Modulation Monitor:

The Equipment is to be used for measuring the modulation & carrier deviation level of A.M. broadcast transmitters in MW & SW range. The equipment shall be simple in operation requiring no tuning. The instrument shall have efficient R.F. screening so that it can be operated in high R.F. field. It should be precise, compact, fully solid state & rugged. It shall conform to international broadcasting measuring equipment standards in all respects.

The equipment shall have :

1. It shall have modulation level and carrier deviation measurement.
2. Broadband demodulator for providing accurate proof of performance measurements on AM transmitter.
3. Built in calibration for the accuracy of modulation reading.
4. Isolated out puts for modulation and carrier level alarms.
5. Remote out puts for all modulation indication as well as the carrier level.
6. Separate negative and positive peak modulation indications.
7. Peak modulation indicator, range up to 125% for positive modulation with suitable incremental step above 50% .

2.9 Cathode Ray Oscilloscope

The Digital Phosphor Oscilloscope shall be rugged and portable with user-friendly front panels for various types of measurements quickly and precisely. It shall provide facilities for commonly used automatic Measurements, auto set features, Cursor measurements, etc..

2.10 Audio Processor :

The audio processor shall be a part of the analogue audio input chain to AM Transmitters. The equipment should be capable of processing sound in digital domain for producing very bright, clear and punchy sound providing balance between optimum loudness & high quality with substantial improvement in both speech/spoken words and music quality for high modulation and simultaneously offering protection to transmitter also. The equipment should be fully solid state, self-contained, compact, easy to set up, simple to use, efficient for working round-the-clock, 365 days a year and based on field-proven design. The equipment should have:

- (a) A multi-band processor with compressor & limiter function for optimum loudness & high quality
- (b) Built in digital processing having A/D & D/A conversion with minimum of 18 bit resolution.
- (c) Provision for receiver equalization at low, mid and high frequencies
- (d) Provision for final clipper for protection against peak over modulation
- (e) Provision for transmitter equalization
- (f) Front panel controls/metering
- (g) By pass mode (Features which remain in chain to be indicated by tenderer)
- (h) Should be upgradable to digital input/output in future and select automatically any of the three standard sampling rates of 32, 44.1 and 48 Khz

SECTION - III

TECHNICAL SPECIFICATIONS OF TRANSMITTER EQUIPMENT AND ACCESSORIES

3.1 Ambient Conditions:

The equipment covered by these specifications shall be required to work at various AIR sites under the Ambient Conditions as follows:

- a) Ambient Temperature : 0 to 50°C
- b) Humidity : 0 to 95% Non-condensing.
- c) Altitude : 0 to 1000 Mt.

3.2 10 kW MW Transmitter :

<u>S. No.</u>	<u>Parameters</u>	<u>Specifications</u>
3.2.1	Type of Emission	A3E (Double side Band, full Carrier B'casting)
3.2.2	R.F. Range	531 - 1602 kHz. (Actual Carrier Freq. Shall be specified at the time of placement of order).
3.2.3	Carrier Frequency stability	Within ± 10 Hz as per the latest ITU-R Radio Regulations in force of the time of Delivery of the Transmitter equipment, whichever is better.
3.2.3	Carrier Output Power	10Kw+10% overrating with 100% modulation, at the A.C. Mains input specified under para 3.2.22.
3.2.4	Reduced power operation	up to 2.5 kW carrier power with at least 3 preset power levels. <u>N.B. :</u> The performance figures of the transmitter shall be as specified in this section even at the reduced levels. Typical figures to be enclosed with the Tender.
3.2.5	Spurious and Harmonic Radiation	As per the latest Radio Regulation in force at the time of delivery of the equipment. Please specify the figures. As per ITU-R the harmonic contents should be 60 dB below the rated carrier power at fundamental frequency.
3.2.6	Carrier Level Shift	$\leq 1\%$ from 0 to 100% modulation

		at 1 kHz (Mains voltage variation excluded)
3.2.7	Noise Level below Carrier	$\geq -60\text{dB}$ (Un-weighted) w.r.t. full R.F. level at 100% modulation with 1 KHz tone.
3.28	Output R.F. Impedance	50 Ohms (Unbalanced)
3.2.9	Load mismatch / VSWR withstand Capacity	<ol style="list-style-type: none"> 1. Full rated R.F. output upto a VSWR of 1:1.25. (Continuously at least 12 hrs.) 2. Reduced R.F. output (within safe limits) for VSWR from 1:1.25 to 1:1.5. 3. At VSWR greater than 1:1.5 <ol style="list-style-type: none"> i. The transmitter should make three attempts of switching ON before switching OFF permanently. ii. For switching-on the transmitter again, Manual Intervention shall be required. <p>NB : R.F. output vs. VSWR relationship for equipment offered would be specified by the tenderer.</p>
3.2.10	Type of Modulation	Amplitude modulation. The modulation pattern will be seen on CRO for proof of fidelity of modulation for Triangular / Saw-tooth / Square / Rectangular wave forms.
3.2.11	Modulation capability	Continuous 70% Sine Wave Tone modulation 30 Hz to 10kHz.
3.2.12	Peak Modulation capability	Up to 110% positive peak programme modulation at nominal carrier power for 1 minute.
3.2.13	Modulation Linearity	Within ± 0.5 dB w.r.t 70% modulation at 1 kHz
3.2.14	Audio input level	0 dBu (Nominal for 100% modulation, adjustable from -10 to +10 dBu in steps of 1 dB.
3.2.15	Audio Input Overload Protection	The Audio Input level will be protected upto 10dB higher level over the nominal audio level required for 100% modulation without tripping transmitter.
3.2.16	Audio input impedance	600 Ohms (balanced)
3.2.17	Audio Frequency Response	± 1.0 dB from 30 Hz to 10 kHz w.r.t 70% modulation at 1kHz.
3.2.18	Total Audio Harmonic Distortion	$\leq 1.0\%$ from 30 to 95% modulation between 30 Hz to 10 kHz
3.2.19	Inter Modulation Distortion	$\leq 1.0\%$ at 60/7000 Hz. 4:1 at 95% modulation as per SMPTE standards.

3.2.20	Square Wave Overshoot without filter	$\leq 1\%$ at 400 Hz 80% modulation
3.2.21	Square Wave Tilt	$\leq 2\%$ at 40 Hz 80% modulation.
3.2.22	A.C. Mains input	<ol style="list-style-type: none"> 1. 400 V $\pm 10\%$, 3 phase, 50 Hz ± 2 Hz, for the Transmitter(without AVR). 2. An AVR of rating specified under para - 3.3 of this section will be included to meet the A.C. mains input voltage variations at site conditions. 3. The various loads within the transmitter shall be evenly distributed on the three phases of AC mains. The load unbalance between the three phases at the Mains Input of the transmitter shall not exceed $\pm 5\%$.
3.2.23	Power Factor	≥ 0.95 excluding the AVR.
3.2.24	Overall Efficiency	$\geq 80\%$ (including AVR and all the ancillary equipment of the transmitter) from 0 to 100% modulation. <u>NB : Calculation to be enclosed</u>
3.2.25	Acoustic Noise due to rotating machinery	≤ 65 dB A at 1.5 meters from the Transmitter panel.
3.2.26	Transmitter protection	MOVs or any other fast acting device will be provided on AC input line to prevent damage to any component of the transmitter and AVR against voltage transients of at least up to 1000 volts on AC Mains Input.

3.3 AUTOMATIC VOLTAGE REGULATOR (AVR) :

S. No.	Parameters	Specifications
3.3.1	Capacity	50 kVA
3.3.2	Input voltage	320 V A C to 480 V , 3 phase, 50 Hz ± 2 Hz
3.3.3	Output voltage	400 V A C $\pm 1\%$ 3 phase 50 Hz ± 2 Hz

3.4 DUMMY LOAD:

S. No.	Parameters	Specifications
3.4.1	Capacity	20 KW r.m.s.
3.4.2	Input Impedance	50 Ohms $\pm 2\%$
3.4.3	Frequency Range	531 – 1602 kHz
3.4.4	Mains Input supply for system	400 V A C $\pm 10\%$ 3 phase/230V, 1 ϕ , 50 Hz ± 2 Hz

3.5 RF/ ANTENNA CHANGE OVER SWITCH:

S. No.	Parameters	Specifications
3.5.1	R.F. Power Handling Capacity	20 kW
3.5.2	Switch Impedance	50 Ohm \pm 2%
3.5.3	Mismatch/VSWR due to switch	< 1.05
3.5.4	Frequency range	531 – 1602 kHz
3.5.5	Mains Input for motor and Status/Indications etc.	230 VAC + 10%, 1 Phase/ 400 V, 3phase, 50 Hz \pm 2 Hz
3.5.6	R.F. Isolation between ports	More than 40 dB

3.6 **ANTENNA TUNNING UNIT (ATU)**

S. No.	Parameters	Specifications
3.6.1	Power Handling Capacity	10 kW carrier + 150% Modulation
3.6.2	Frequency range	531 – 1602 kHz
3.6.3	Input impedance	50 Ohms unbalanced
3.6.4	Output Impedance	(a) <u>To be designed to match Antenna Impedance of</u> Resistance: 30 to 900 Ohms Reactance : +j 500 to -j 500 Ohms (b) To be supplied for impedance at Carrier Frequency of 1152 KHz with \pm 50% variation in resistive and reactive component- Impedance value shall be given after placement of order.
3.7	RF Cable (Actual length will be mentioned in the purchase order.)	1-5/8" Foam dielectric, RF cable along with accessories to handle RF power(10 kW+150% modulation) having connection of suitable type and size on both ends. Loss \leq .09dB/100mtr.

3.8 **PROGRAMME INPUT EQUIPMENT RACK:**

S. No.	Parameters	Specifications
3.8.1	Wired Rack	
	Normal input level	-20dBu to +5dBu across 150ohm/600 ohms (Selectable)
	Normal output level	+10 dBm across 600 ohms through an attenuator for wiring (< \pm 1.0 dB with chain including Repeat Coil)
	Frequency Response	+0.5 dB (20 Hz. to 20 kHz.)
	Inter-channel cross-talk	Better than 60 dB
3.8.2	Programme/ VU Meter	
	a) Measurement Range	-40dB to -10dB in 3dB steps -10dB to +20dB in 1dB steps
	b) No. of Display LEDs	40 in 3 colors per channel

	Input Impedance	>10k ohms
	c) Tolerance	+ 1LED(0.5dB)
	d) Power Supply:	230V + 10%, 50Hz + 2Hz
3.8.3	<u>Audio Patch Panel/ JACK FIELD</u>	
	a) No. of Jacks	48 in two rows (24 in one row)
	b) Contact Resistance	<0.015ohm
	c) Insulation resistance	> 100 M Ohms between GND & contact
	d) Working Voltage	100V DC
	e) Dimensions	3U (Height), 19"
3.8.4	Repeat Coil	
	a) Frequency Response	$\pm 0.5\text{dB}$ (30 to 15000Hz)
	b) Maximum Level	27dBm for negligible wave form distortion over the entire frequency range.
	c) Unbalanced D.C.	Nil in primary or secondary
	d) Insertion Loss	Less than 1dB over the stipulated frequency range.
3.8.5	MONITORING AMPLIFIER (DUAL MONO/ STEREO)	
	a) INPUT	
	(i) No. of Inputs	One Stereo pair on X.L.R.
	(ii) Input level	-10dbu to + 10dbu. Nom. 0 dBu
	(iii) Input impedance	>10K Ohms (Balanced).
	(iv) CMRR (20 Hz-20kHz)	>60 db.
	b) OUTPUT	
	(i) Power Output	20W per channel in 8 Ohm 30W per channel in 4 Ohm
	(ii) Frequency Response	$\pm 0.5\text{db}$ 20 Hz to 20 kHz (Filters by Pass)
	(iii) Total Harmonic Distortion at 1 kHz	$\leq 0.2\%$ at rated outputs.
	(iv) Signal to noise ratio at rated output (unweighted rms.)	≥ 100 dB
	(v) Power Supply	230V AC $\pm 10\%$ 50 Hz $\pm 2\text{Hz}$
	(vi) Level difference between the channels.	< 0.5 db.
	(vii) Inter-channel X- talk	$\geq 50\text{db}$.
3.8.6	STEREO AUDIO DISTRIBUTION AMPLIFIER (DUAL MONO/ STEREO)	
	a) INPUT	
	i) Input level	0 dbu nominal + 20 dbu Maximum
	ii) Input impedance	≥ 5 K Ohms (Balanced)
	b) OUTPUT	
	i) Output level	0dbu to + 20 dbu maximum into 600 Ohms
	ii) Output impedance	< 50 Ohms (Balanced)
	iii) Gain control	± 6 db (Min.)

	iv) Frequency response	± 0.5 db 20 Hz to 15 KHz
	v) Signal to Noise ratio	> 75 dB w.r.t. to nominal output
	vi) No. of outputs	Six Stereo/ Twelve Mono
	vii) Inter channel level difference	≤ 0.5 db 20 Hz to 20 KHz
	b) T.H.D	$\leq 0.02\%$ nominal
		$\leq 0.3\%$ max. 30 Hz to 20 KHz
	c) IMD	$\leq 0.1\%$
	d) Inter channel cross talk	> 65 db 20 Hz to 20 KHz
	e) Operating Voltage	230 V $\pm 10\%$, 50 Hz ± 2 Hz
3.8.7	AUDIO PROCESSOR	
(a)	Frequency response	< ± 0.5 dB
(b)	Signal to Noise Ratio	≥ 75 dB reference to 100% modulation 50 Hz to 15 kHz.
(c)	Total Harmonic Distortion	< 0.25% at 100% modulation 50 Hz to 10 KHz
(d)	Gain	- 15 dB to + 15 dB (Test Mode)
(e)	Sine wave Tone	Programmable 30 Hz to 10 kHz 0 – 95% Modulation (Test mode)
(f)	Square wave Tone	Programme link 63 Hz to 1 kHz 0 – 50% Modulation (Test mode)
	Audio Input/ Output (Analog)	
(g)	No. of input channels	Dual, mono/stereo
(h)	Low pass filter	4.5 KHz. & 9.0 KHz.
(i)	High pass filter	50 Hz to 100 Hz in suitable steps
(j)	Audio Input Level	-20dBu to + 20 dBu
(k)	Audio Input Impedance	600 Ω balanced or bridging mode, jumper selectable
(l)	Sensitivity	-20dBu to +20dBu selectable with adjustable control on front panel software
(m)	Maximum input level	20dBu
(n)	No. of outputs	2 Monaural/ (independently variable)
(o)	Audio Output Level	0 to +20 dBu into load impedance of 600 ohms balanced
(p)	Maximum out put level	+20 dBu
(q)	Operating voltage	230 V $\pm 10\%$, 50 Hz ± 2 Hz,
3.8.8	Modulation Monitor	
a	R.F. Frequency Range	500 KHz to 40 MHz in 1 kHz. Increments.
b	R.F.Input	5 Vrms
c	R.F. Input Impedance	50 Ohms (Unbalanced).
d.	Modulation Meter Range	0 to 130% with dB scale
e.	Modulation Accuracy	$\pm 2\%$ at 100% modulation with Sinusoidal signal.
f.	Carrier Level Deviation Meter Range	$\pm 30\%$

g.	Carrier Level (Loss) Alarm	Alarm with a 30% drop from nominal carrier level
h.	Peak flasher Indicator levels	Adjustable upto to 130% for +ve peak.
i.	Peak Modulation Accuracy	+ 2% at 98% modulation
j.	Audio Test Output (i) (ii)	5 Vrms, rear panel BNC connector (Unbal.) 0 dBm (0.775 Vrms), 600 Ω (balanced)
k.	Audio Frequency Response	+ 0.5 dB, 20 Hz to 15 kHz.;
l	Total Harmonic Distortion(AF)	< 0.25% Max. at 99% modulation.
m	Signal to Noise Ratio	Better than 75 dB
n	Transient Response	Overshoot < 1%
o	Protection against RF Interference	The equipment shall be provided with adequate shielding against RF/ EMI interference
p	Power Requirements	230V \pm 10%, 50 Hz \pm 4%
q	Physical Dimension	Standard 19" rack mounting
3.8.9	Cathode Ray Oscilloscope	
a	Real Time Bandwidth	DC-300 MHz. Simultaneously on all channels
b	No. of channels	Two with external channel
c	Sample Rate (Max)	2.5 GS/s on all channels
d	Record Length	10000 points per channel
e	Vertical Resolution	9 Bits
f	Vertical sensitivity	1 mV to 10 Volts
g	Time Base Range	2 ns to 10 sec per division
h	Time Base Accuracy	20 ppm
i	Waveform Capture Rat	3500 wave forms/sec.
j	Sweep Mode	Auto, Normal and Single Sequence
k	Max. Input Voltage	150 V CAT I
l	Input Coupling	AC, DC & Ground
m	Triggering	Edge, Video, logic, Pulse (width or Glitch) Alternate
n	Analysis Modes	Peak Detect, Average, sample, Single Sequence, DPO, Wave alert, Envelop
o	Measurements	25 Automatic Measurements, Time & Voltage Cursors, Math (Add, Subtract, Divide, Multiply) FFT
p	Display	Color LCD
q	Interpolation	Sin x/x
r	Format	Y-T and X-Y
t	Accessories	One 1X/10X Switchable probes per channel, Power Cord, Manual, Calibration Certificates

SECTION - IV

(SCHEDULE OF REQUIREMENTS / PRICES)

AIR requires the following equipment / services as per technical specifications detailed under Sections I, II & III. The present requirement is for Kavarathi (Lakshdweep & Minicoy groups of islands. The tenderer shall quote price of each item separately with necessary break-up details keeping in view the following:

- i. Make & Model of each item, to be indicated.
- ii. Indenter reserves the right to choose & decide the quantity of Equipments at the time of finalization of Tender.
- iii. All items mentioned in Sl.No.4 (Main item) will be taken in to consideration for ranking purpose where as all items mentioned in Sl.No.5 (Optional items), will not be taken in to consideration for ranking purpose. However the tenderer must quote for all the items under main and optional items.

S. No.	Equipment	Quantity
4.0	Transmitter Equipment Each set comprise of the following :	1 Set
4.1	Solid state 10 kW MW AM Transmitter and all accessories tuned to 1152 kHz (Kavaratti is an island surrounded by sea all around and having more than 90% humidity and salinity in air. Care is required to design the electronic/mechanical system of Tr. suitable for such environmental conditions)	1 No.
4.2	Automatic voltage regulator (AVR) as per specification Section-III para-3.3	1 No.
4.3	Dummy Load as per specification Section-III para—3.4	1 No.
4.4	4 port RF changeover switch (Antenna/Dummy load)/ Standby Tr. as per specification Section-III para—3.5	1 No.
4.5	(a) 1-5/8" Foam dielectric, 50 ohm R.F. coaxial cable complete with RF Connectors at both ends and other cable accessories. (b) Per mtr. cost also to be quoted for variation in quantity at the time of placing order.	2 lengths 100 mtr each
4.6	RF Coaxial cable terminating assembly at the transmitter building as per para 2.6 (a) of section-11	1 set.
4.7	Feeder hut lead IN plate with necessary connectors suitable for 50 ohms coaxial cable and lead OUT bowl insulator assembly with mounting plate as per as per para 2.6 (b&c) of Section-11	1 set
4.8	Wired-up Programme Input Rack comprising of	1 set

	followings:	
	Wired Rack with Programme Meter (PPM/VU) as well as selector switch, Audio Patch Panel, R.F. Patch Panel, Monitoring Loudspeaker, Prog. Selector Switch, Selector Switch for Monitoring, Cooling fan, Repeat Coils, High Impedance Headphone & Power Supply panel with mains switch, mains filter, MCBs for distribution Alongwith the following Equipments:	1 No.
4.8.1	Distribution Amplifier	1 No.
4.8.2	Monitoring Amplifier (20W)	1 No.
4.8.3	Audio processor	1 No.
4.8.4	Modulation Monitor	1 No.
4.8.5	Cathode Ray Oscilloscope	1 No.
4.9	Complete installation material for all the above items (Sl. No. 4.1 to 4.10) including the cables etc. for the entire system including the extender cards.(List to be given)	1 set.
4.10	Charges for factory inspection/Acceptance tests by AIR engineers including charges , if any, for arranging the power supply at 50 Hz for testing the equipment. (Please refer para 1.11 of Section-I)	1 lot
4.11	Delivery of the entire equipment at the respective AIR site including custom clearance and Insurance etc.	1 Set
4.12	Installation Testing and commissioning manuals for the Transmitter and all associated Equipment . (Please refer para 1.4 of Section - I)	3 sets
4.13	Operation, maintenance manuals and trouble shooting for Transmitter and all associated Equipment (Please refer para 1.6 of Section - I)	7 sets
5.0	<u>Optional items</u>	
5.1	Extended/Remote control & monitoring facilities as per para 2.1.8 of Section II.	1 No.
5.2	Spares for the Transmitter Each set comprise of the following:	1 Set
5.2.1	P.A. Modules	To be specified later
5.2.2	PCBs for all the pre P.A. R.F. stages from crystal oscillator upto P.A.	1 No. each

5.2.3	PCBs for all the Audio processing and modulation encoding stages.	1 No. each
5.2.4	Power supply transformers	1 No. each
5.2.5	Cooling Fans (if mounted inside transmitter cabinet)	2 Nos
5.2.6	Control circuit PCBs	2 No
5.2.7	Discrete components like power transistors (MOSFETs), main I.C 's , Semi conductors & other special components.	1 set.
5.2.8	Spares for the AVR	1 set.
5.2.9	Spares for the dummy load	1 set.
5.2.10	Spares for R.F change over switch	1 set.
5.2.11	Other items of spares recommended by the tenderer <u>N.B.:</u> <i>The manufacturer / contractor shall specify recommended quantity of each item of major and minor spares required for maintenance of the equipment for 2 years, with their prices. AIR will decide upon the quantity of spares to be purchased.</i>	1 set.
5.3	Charges (with breakup details of items) for making Tx compatible in DRM simulcast mode.	1 set
5.4	Frequency change kits for R.F.Stages <u>N.B.:</u> The frequency range for each set of kits will be clearly stated by the tenderer.	Full set to cover the entire frequency band from 531 to 1602 kHz.

ANNEXURE - I

(ACCEPTANCE TEST PROCEDURE FOR THE TRANSMITTER AND ACCESSORIES)

1. General :-

1.1 The Transmitter Equipment and the various accessories ordered shall be accepted only after inspection and testing by All India Radio as per the "Acceptance Test Procedure" detailed in this Annexure.

1.2 The manufacturer/contractor shall put up the equipment for Inspection / Testing and Acceptance of the Inspectors deputed by All India Radio, only after being satisfied themselves first that the equipment offered meets the stipulated standards and specifications.

1.3 The contractor shall dispatch the equipment to AIR only after it has passed the various tests as per this ATP and certified to be acceptable (vide para-4 below) by the Inspectors of AIR.

2. Inspection/Testing of Equipment at Manufacturer's Works:

AIR's inspectors shall carryout the following tests at the manufacturer's works:-

2.1 Physical/Visual Inspection:

A physical/visual inspection of the equipment offered shall be carried-out to ascertain the following:

a) **Quality of Material:** The material used in the manufacture of the equipment and it's workmanship is of high quality.

b) **Standard Manufacturing Practice:** The various standard practices used for manufacture of high quality broadcast equipment have been adopted in manufacture of the equipment.

c) **Quality checks during manufacture:** The certificates issued by the manufacturers of the various items/sub assemblies on the quality checks done during manufacture will be put up by the contractor for perusal/scrutiny of the AIR inspectors.

d) **Identification / Labeling of Sub-Assemblies:** All the sub-assemblies have been identified and all the wiring have been labeled with corresponding numbers / references in the Erection / Technical Manuals.

e) **Conformation to AIR Specifications:** The various provisions in the equipment offered conform to Sections - I, II & III of AIR specifications.

2.2 Control-circuit protection and interlocking:

a) **Control circuit:** The control circuits of the transmitter will be tested for proper switching-on and switching-off sequences. The various indications during the switching-on and switching-off process shall be checked against those specified in the Technical/Operation Manual.

b) **Protection and Overloads:** The settings of the various protective and over load circuits/devices will be checked against those specified in the technical manual and their operation will be checked by suitable simulations.

c) **Interlocking:** The various interlockings for the safe and sequential operation of the transmitter will be checked as specified in the Technical Manual. The interlocking of the transmitter with the antenna changeover switch, dummy load and ATU / Antenna will also be checked for proper operation.

d) **Protective / Control Circuits of the Auxiliary Equipment:**

The protective, over load and interlocking circuits of the various auxiliary equipments like AVR, Dummy Load and Antenna Change over switch and ATU etc. will be checked for proper operation.

2.3 Performance tests on the equipment:

All the equipment ordered shall be tested against the technical specifications stipulated under Section-III of these specifications or the technical parameters of the equipment claimed by the contractor whichever are better.

The equipment shall be tested at the Mains Input specified for the various equipment under Section - III i.e. 400 V AC \pm 20% (with AVR), 3 phase / 230 V AC (Nominal) \pm 10%, 1 phase; 50 Hz \pm 2Hz.

The methodology adopted for testing the equipment shall be as follows:-

a) Out of the equipment offered for inspection / testing by AIR inspectors at the manufacturer's works, one of the transmitters (selected at random) along with the complete set of its auxiliary equipment like Dummy Load etc. shall be tested as per ATP.

b) After successful testing of the technical performance of the transmitter as specified under para 2.3 (a) above, Heat run test for 24 hours shall be conducted on the transmitter as per para 1.11.2.3 (e) of Section-I of these specifications.

c) Any other tests which may be found necessary to prove the performance of the equipment as a result of the preceding tests or as a result of the inspection by the inspecting authority as per para 7.2(f) of Section - I of these specifications.

d) Remaining sets of Transmitters and their accessories, shall be tested only at station frequency, for the various technical parameters (including DCC) specified under Section-III of these specifications.

e) The remaining equipment (not covered under para 2.3 (a) to 2.3 (c)) like ATU etc. shall be tested to check their performance as per the technical parameters specified under Section - III of these specifications or the technical parameters claimed by the contractor whichever are better.

e) **Testing of Spares:**

All the Sub assemblies / amplifiers / oscillators and PCBs etc, ordered as spares shall be tested in circuit and performance of the equipment shall be checked against the

specifications. The various discrete components, ordered as spares, shall be checked physically / visually.

3. Testing of equipment at AIR site:

After installation of the various equipment at the respective AIR sites, tests shall be carried out as per paras 2.3 to 2.3(e) above except that these equipment shall be tested only at the assigned station frequency at the particular AIR site.

4. Documentation of Inspection / Tests Results at manufacturers works:

The results of the various tests conducted at the manufacturer's works as per para 2 above shall be documented neatly and signed by the AIR's inspectors and contractor's authorized representatives.

Three sets of these signed documents shall be handed over by the contractor to the AIR's inspector. The certificates mentioned under para 2.1 (c) above shall be attached along with the results of the Inspection / Tests Report.

5. Seal of inspection:

AIR's inspector will affix a seal of inspection on each equipment which has passed the Acceptance Tests at the manufacturer's works. The equipment shall be shipped only after the inspection and acceptance of the same by the AIR's inspector.

6. Documentation of Inspection/Test Results at AIR site:

The results of the various tests conducted at AIR site, as per para 3 above shall also be documented neatly and signed by AIR's representatives and the contractors representative (incase the testing and commissioning of the equipment is ordered by AIR on the contractor).