

P R A S A R B H A R A T I
DIRECTORATE GENERAL: ALL INDIA RADIO
P & D UNIT: NEW DELHI-110 001

SPECIFICATION DOCUMENT FOR 1000 kW
SOLID STATE AMPLITUDE MODULATED- DRM MEDIUM WAVE TRANSMITTER
FOR ALL INDIA RADIO, SPT, RAJKOT& CHINSURAH

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GENERAL

This Specification document is for supply of 1000 KW MW transmitter along with associated Equipments as defined in schedule of requirements in Section- IV at SPT, Rajkot for replacing existing old 2x500 KW MW transmitter operating into a 4 element DA system in directional or in omni directional mode and at SPT, Chinsurah (Mogra) for replacing existing old 2x500 KW MW transmitter operating at two frequencies into 3 feeder Lines System in directional or omni-directional mode with 2 element as well as 4 element array.

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Instructions:

1. The tenderer should go through all the sections of these specifications carefully and submit clause-by-clause compliance of all the sections clearly.
2. The tenderer should indicate the list of items offered as per schedule of requirements, (Section –IV) without cost details in technical bid, to assess the completeness of offer against AIR's requirements. In addition a block schematic, to avoid any ambiguity as well as to assess at a glance completeness of offer, facilitating identification of various items with make incorporating all the items of the system, is also required to be enclosed.

(JITENDRA ARORA)
Dy. Director (Engineering)

SECTION - I
GENERAL CONDITIONS OF TENDER / CONTRACT

1.0 GENERAL SCOPE

These specifications cover the Design and Supply of 1000 kW fully Solid-state AM- DRM, M.W. transmitters and its accessories required by All India Radio.

1.1: Broad scope of supplies/ services:

(a) Items to be included:

- (i) 1000 kW Solid State Transmitter consisting of N numbers of Power Blocks. (N= 2 to 5)
- (ii) Power Block Switching system, Drive Rack and Master Control.
- (iii) Dummy load.
- (iv) Power Supply Distribution Panel.
- (v) Power Block Combining unit.
- (vi) L- Network (60-120 ohms) for Branching Hut.
- (vii) a. Over Head Screened (Duct) Feeder / rigid line.
(For interconnection between various Power Blocks, Transmitter Combining Unit & D/L inside Transmitter Building)
- b. 60 ohms overhead duct feeder / rigid lines (Inside Transmitter Building up to feed out Assembly)
- (viii) Feed out assembly at Transmitter building for connection to Feeder Line.
- (ix) Lead-In & Lead-out wall mounted Bowl insulator assembly in branching hut for Rajkot only.
- (x) Antenna tuning unit with Lead-In and Lead-Out Bowl wall mounted Insulator assemblies for Rajkot only.
- (xi) Extended / Remote Control & monitoring facilities fully wired-up.
- (xii) Programme input equipments with wired up Rack.
- (xiii) Installation materials for the above.
- (xiv) Technical manuals for Transmitter proper and accessories.

(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 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 60 Ohms over-head feeder lines external to Transmitter Building.
- (vi) All works connected with the mast/antenna.
- (vii) Copper sheets for inner shielding of Feeder / Branching Huts.

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 each block, controls and software. Wherever appropriate block diagrams and photographs showing interior and exterior views of the main equipments .
- 1.3.4. Detailed typical layout plan clearly indicating dimensions for main transmitting equipment and its accessories like power supply equipment, cooling system and other ancillaries.
- 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. (a)The details of the internal test procedures/standards followed for quality control of the equipment offered. (b) ISO 9001-2000 certificate (c) Experience in design & manufacturing of solid state transmitter .
- 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 1000 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-despatch 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 PROPER 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 Bhawan, 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/ Photographs 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 PROPER 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 12 (Twelve) 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, WARRANTEE 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 and 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 and high value) 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 extra 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 deputing at least two (2) 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 labour 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 10 (Ten) 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 AIR site:

In case the testing and commissioning of the transmitters is awarded to the contractor, he will train a group of 10 AIR engineers free of cost to AIR, for a period of 4 weeks after the testing and commissioning of the transmitter equipment at AIR site. The training will be imparted for operation, maintenance and trouble shooting of the equipment. The Training will also include practical demonstration of circuits, fault finding, circuit tracing, major part replacements and also for the use of the various test and measuring equipment, jigs and tools etc. This is required to be done with a view to develop necessary skills for efficient operation and maintenance of the equipment by AIR staff. Training charges, if any, for the trainer, materials and logistics shall be quoted in the tender separately.

(The expenditure towards to & fro Journey, lodging, boarding & DA for the trainees as per Govt. of India norms shall be borne by AIR.)

1.12.2 At Manufacturer's Works: (OPTIONAL)

- (a) The contractor shall be required to train Six (6) AIR Engineers. for a period of 4 (four) weeks 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 I 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:

- (a) 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.
- (b) In case the testing and commissioning of the equipment at AIR site is awarded to contractor, all test and measuring instruments, special tools and any consumables required for the purpose shall be provided by the supplier, without any extra charge or liability to AIR.

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 1000 kW MW Transmitter:

Type & Configuration: Fully solid state, using state of art, field proven technology with MOSFETs. Full carrier power of 1000 kW will be configured in not more than 5 power blocks having individual control unit, a Combiner Unit for all Power blocks, Master control unit, monitoring unit and a common drive Unit. Transmitter at Rajkot shall be operating on a single Carrier frequency whereas at Chinsurah, it will operate on two carrier frequencies.

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) In order to have a reliable Broadcast service with minimum interruptions, adequate redundancy shall be provided in the equipment. 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/liquid 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 labelled liberally for easy identification.
- g) Electrical Wiring : The size and insulations of the various wires/cables used in the equipment shall be of adequate rating having 1.5 factor of safety. 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 Combining Unit, Speech Rack or on operator's table with following provisions:

- (a) RF frequency shall be generated by DDS (Direct Digital Synthesis) for having spectral purity in AM band. Both the DDS RF source should be fully interchangeable.
- (b) Single RF Source shall be capable to drive all the power blocks simultaneously irrespective of numbers of active power blocks in combined mode.
- (c) RF source should have independent control for adjusting phase and amplitude to compensate for variation in physical length of cables.
- (d) In case of Chinsurah transmitter it shall have provision for selecting desired RF carrier frequency out of the two carrier frequencies
- (e) 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.
- (f) Automatic as well as manual change over arrangement shall be provided for selecting the healthy RF Source.
- (g) Provision for visual indication of active RF source shall be provided.
- (h) A BNC socket, (50 Ohms) for monitoring of carrier frequency shall be provided.
- (i) A 50 Ohm BNC Socket also shall be provided for connecting an external RF source / synthesizer.
- (j) UPS is required to be provided for RF source & its switching unit.
- (k) Drive rack can be part of combining unit and same should be specifically indicated in tender. Alternately it should be feasible to install it in standard EIA rack or on operator table.
- (l) Location and a schematic to assess all the above provisions shall have to be supplied with tender.

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

2.1.3.3 RF POWER AMPLIFIER BLOCK: Each power block with a number of RF PA modules shall be capable of delivering 10% higher output than it's rated power with 100 % modulation at nominal supply voltage.

- (a) Design Criteria of P.A. Modules : The transmitter power block shall have multiple R.F. P.A Modules of identical design and completely interchangeable to deliver rated output power from each power block. 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
 - iv. Excessive Load Currents/Short Circuits/ Sparks
 - v. Lightning/Static
 - vi. Power Fold back as per VSWR indicated in Section-III shall be provided.
- (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 fitted in the each Power Block of the transmitter & Nos. of power blocks required for 1000 KW carrier power with 10% overrating at 100% modulation.
 - ii) Minimum No. of P.A. Modules in each power block required for 100% Modulation at rated carrier power .
 - iii) Maximum number of module 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 with 0% and 100 % modulation.
 - vi) Details of protection devices provided against failures of the PA modules, which should include item mentioned in Para 2.1.3.3(c) above.
 - vii) The safety margins adopted in the design criteria of the PA modules.
 - viii) The 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 orders.
 - xiii) Average life of RF Modules.
 - xiv) Efficiency of RF Module.

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

- (a) Combiner: The mechanical assembly of block 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 due to switching in/out spikes 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/ arcing
 - c) Lightning
 - d) High voltage discharge / Static
- (f) Dual Carrier Frequency Operation: Provision for automatic / manual selection with manual override of tuning of Filters, output matching and all Frequency dependent stages shall be made for the Chinsurah Transmitter.
- (g) 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 analog input signal.
- (b) Detailed description of modulation technique, the year of its introduction & a list giving quantity of transmitters of 1000 kW and higher power using the same modulation technique sold world-wide during last 5 yrs shall be furnished . The list will include the addresses of customers 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) Dynamic Carrier Control (DCC): The transmitter shall be having built-in arrangement for operation in DCC mode having 3 different suitable curves upto 3/6 dB selectable as per ITU-R.
- (d) DRM Mode : The transmitter shall be having built-in arrangement for DRM operation having simulcast facility also as per DRM standard. No change or addition of components should be required for DRM operation. DRM Operation will be tested during factory inspection. .

2.1.5 Power Supply :

AIR will extend 11 kV (Phase to Phase) 3 phase 50 Hz power supply connection for feeding to entire transmitter equipment system at the input of main panel of the transmitter plant, 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 it's all accessories shall be derived from this main connection by supplier by providing step down transformers & distribution panels. It should be possible to operate the Transmitter up to $\pm 10\%$ of rated supply to sustain a satisfactory broadcast service.

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 11 KV, (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 Switch (Vacuum Circuit breaker (VCB), Oil circuit breaker (OCB)/ 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 colors) shall be mounted on the front panel of the transmitter to isolate the Mains Isolator switch of 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.
- e. The Power Supply switchgears should have been used in similar transmitter. The make / rating is to be specified in the offer. A block schematic of Power Supply distribution shall be enclosed with tender.

2.1.6 TRANSMITTER CONTROL SYSTEM:

2.1.6.1 Power Block (PB) Control System: PB 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. The power block control system shall have provision for local as well as Operation from Master Control. .

i) Switching Sequence & Interlocking: The "Switching-ON" and "Switching-OFF" of the transmitter will be interlocked to ensure only the desired operational sequence for the safety of the equipment and operating personnel. The transmitter output power shall also be interlocked with the switching matrix, dummy load and combining unit.

ii) Control and Indications : The following minimum indications on the status of the transmitter will be provided in the Local 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) Alarms
- g) Oscillator status

All faults shall be supplemented with resettable 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.

2.1.6.2 MASTER CONTROL SYSTEM:

A Master Control system shall be provided on the Operator table for controlling all the Power Blocks and Combined operations. The Master Control System in addition to having all the required facilities of Control system of Power block shall over ride the Local control system of all Power Blocks operating in Combined mode. It shall control the functioning of Combiner unit, various switching arrangements, dummy load and to release RF drive and input audio signal to all Power Blocks,

In the event of failure maintenance of any power block, this master control system will release the power block to be controlled by its own control system. The other healthy power blocks at this instant should remain under the control of master control system.

i. General Provisions required :

- a. Start /Stop of entire transmitter system including release of RF drive & audio signal.
- b. Manual/ Auto mode for selecting best possible operational service.
- c. Real time Display of ON -air transmitter configuration.
- d. Auto isolation of defective unit (Power Block) for connecting to dummy load or in standby mode.
- e. Facility for extended Remote operation through PC. (Optional)
- f. Provision to prevent transferring of subsequent defective Units (Power Block) to Dummy load in case of auto transferring, if already one unit has been transferred to it. The subsequent unit in such case should be removed from combiner and Switched OFF for maintenance or brought to standby mode.
- g. Should have an emergency –OFF button for complete shut down in case of major fault.
- h. Master control system should have provision for a mimic diagram for displaying the current operational chain/ mode including status of various switching devices.

ii. Metering / monitoring/ indication facilities for all Important Parameters : All the requisite provision for smooth operation of transmitter in combined mode by providing adequate metering/ monitoring/ indications of visual parameters shall be provided as in local mode for individual power block and combined operation. Aural and visual warning for overloads/ faults wherever appropriate shall also be provided.

iii. Logging/ Print out : Necessary facilities for generating log book of various events and data of important parameters shall be provided for history of events for normal operation, feedback and troubleshooting purposes.

iv. Interlocking : Master control system shall be having interlocking between each power block, switching matrix, combining unit, Dummy load & Antenna. The interlock shall be provided for the cooling system also. The interlock will switch OFF the unit with failed interlock indication in case it was delivering RF power or would prevent switching ON the RF power, in the following cases-

- a) The R.F. Connection between the Antenna, Combiner and individual power block is not through.
- b) The cooling system of the combiner is not functioning properly.
- c) Overloads./ High VSWR.
- d) Arching/ high static/high surges.

v. Control for Switching System for Power Blocks and Combiner output:

Control for following switching arrangements shall be provided:

- a. Combined power of all healthy power blocks on Antenna or Dummy load
- b. Single power block on Antenna or Dummy load to sustain broadcast service.
- c. Transferring of defective Power Block from Standby mode to Dummy load for repair/ testing.

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 followings 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 appreciable 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) Lightening on or near the Antenna
 - d) Fire due to sparking etc.

Output RF circuit of Power Block shall be provided with a protective device in order to provide by pass/ ground lightning strokes propagations 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 liberally
- vi. Earth terminals: for connecting client's earth to the transmitter shall be provided at all 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 Cooling System:

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

- a. An air/liquid cooling system or combination of both shall be provided to take away the heat generated at any component of the equipment for ensuring a safe operation and long life of the transmitter components.
- b. In case of liquid cooled transmitter, the liquid to air heat exchanger shall be outdoor type. If it is indoor type it should be specifically indicated in the tender.
- c. 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.
- d. The cooling fans / Blower shall be designed for acoustic noise as specified in Section-III to minimize the fatigue to the operator.
- e. 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.
- f. Flow/ temperature detectors and protective devices for fans : The operation of fans and pumps

should be monitored by measuring airflow & temperature. Protective devices should be provided to foldback 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. All supports and anti vibration duct hangers shall be of standard quality and high grades.

(iii) Liquid Cooling System :

Water circulating pumps, pressure equalizing chamber, water reservoir, heat exchanger etc. shall be of reputed make for water cooling circuits. De-ionizer (on- line type) shall be part of liquid cooling system with its own monitoring unit. The liquid cooling system shall be complete in all respect with water flow switches, meters, pressure gauge, temperature gauge with status monitoring and interlocking features. Suitable rating water pump for meeting the total liquid cooling requirements of all Power Blocks in feed line from water reservoir to water cooling circuit for feeding the water at required pressure shall be part of supply. A standby pump set also shall be part of standard supply.

(iv) Following data shall be supplied with tender.

- a. Detailed schematic of cooling system indicating number and capacity of the cooling fans / pumps used
- b. Total amount of heat generated by the transmitter equipment and ancillaries including D/L to be extracted by Water System, & Air System shall be specified separately.
- c. Details of size and filtering efficiency of the filters may be furnished in the tender.
- d. The amount of heat load (in KW/ Kcal per hour) to be taken away by the air in CFM in case of closed loop operation of conditioned air and in case of open circuit by outside ambient air shall be specified, clearly.
- e. In case of built-in air ventilation units/ Fans, which suck air from Tr. Hall and require a duct for letting out hot air , whether a Standby duplicated fan in the opening at the end of duct for letting IN/OUT the air is required. If yes then it has to be included in the offer including all the filters to be fixed in the wall along with motorized weather proof louvers and necessary control panel.

2.1.9 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 screened (duct) overhead feeder.
- 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. **POWER BLOCK COMBINER (1000 KW)**

- a. Type: The Combining unit shall be a self-contained single cabinet unit capable of combining the output of multi-unit power blocks into a single output of 1000 kW. Combiner at Rajkot will be for 1071 KHz but for Chinsurah it will be for dual carrier frequency operation of 594 KHz & 1134 KHz. So the combiner at Chinsurah should have pre-select setting for dual frequency operation.
- b. Configuration: The Combiner will be realized with reactive components and shall be designed to allow all operations as per para 2.1.6.2 (v).
- c. Performance: The combined output should maintain all the Performance parameters as specified in Section-III. The unit shall have its own cooling system/heat exchanger, if any, required for it.
- d. Combining Principle: It should use minimum no. of components. Provision to dissipate unbalance power if any in normal mode and in reduced power condition shall be made. Consequent cooling requirement to be taken care of, to avoid failure of dissipater, if any.
- e. Reduced Power Block operation Capability: The combiner, shall be designed to allow on-air servicing of an individual power block while the rest of the system remains ON-AIR. The system should allow operation with even one healthy power block to sustain broadcast service. It should also have an internal resistive reject load to dissipate any power imbalance if design so warrants.
- f. Isolation: To maintain the full performance and efficiency of each power block, Combiner should provide minimum 30 dB of isolation between input ports and between input ports to output port.
- g. Input & Output Matching:
 - (i) The input impedance of the combiner shall be matched as per number of healthy power blocks delivering the power to it for an output Impedance as in Section-III.
 - (ii) The combiner shall be provided with tuning control and loading facilities for fine adjustment of system to ensure the proper matching of the combined power into Antenna at any time. This facility shall be provided for input side also to ensure proper load impedance to each power block under all conditions.
- h. RF Input and Output Connection : The RF input & output connections at the combiner shall be for a screened (duct) overhead feeder or rigid line.
- i. Electrical /Thermal Protection: The combiner shall be provided with UV detectors, spark gaps/ gas filled discharging devices and VSWR measurement for protection against-
 - i. High VSWR
 - ii. Lightning
 - iii. Failure of Ventilation
 - iv. Excessive power dissipation across unbalance resistor, if any.
 - v. UV detector RF arcs/flash over
- j. Metering/Monitoring Facilities:
 - (i) Provision for metering facilities for direct read out of input RF power for each power block and combined output power including reverse/ reflected power. Direct readout of feeder current on output side also shall be provided. The facility of metering shall also be made

- available On master control console
- (ii) Provision of an AM detector for demodulated audio on XLR connector for aural audio monitoring through the programme/ speech input rack.
 - (iii) Provision for RF Sample on output side in BNC connector for feeding to Station Modulation monitor and CRO for performance parameter measurements and visual monitoring of modulated Carrier in combined power.
- k. Mechanical Construction : The combining Unit components shall be housed in a cabinet having provision for grouting on the floor. It shall be rugged in construction with proper protection against mechanical impacts. The cabinet shall be provided with a protection paint coating to prevent rusting, corrosion etc. This should be painted in color similar to power Blocks.
- l. Cooling/Ventilation system: The Combiner shall have independent cooling system for its various components including reject load, if the design warrants for it. The ventilation / Cooling system shall be suitably interlocked to prevent damage to components.
- m. Electrical input: The combiner Unit shall work on mains input voltage specified under Section - III.
The tenderer will clearly indicate the following:
- i. Principle of combining, circuit diagram and salient features.
 - ii. Type of cooling with schematic.
 - iii. In case it uses unbalance power absorbing resistor then it's maximum rating and time allowed for maximum unbalance power dissipation indicating the amplitude of power without damage to resistor.
 - iv. Indicate the arrangement provided for removing the source of unbalance power after lapse of predetermined time.
 - v. Type of resistor and its source of supply.
 - vi. Degree of isolation between input ports and each input ports to Output Port.
 - vii. Control circuit schematic.

2.3 POWER BLOCK & COMBINED POWER ROUTING/SWITCHING MATRIX:

- (a) A suitable routing/ system for Power blocks and combined power for connecting either to dummy load, antenna or to ground system, to be controlled by Master Control system shall be provided.
- (b) The various switching/routing provision required for Rajkot Transmitter are as:
 - (i) To route a power block to dummy load for maintenance/ repair/ trouble shooting or to combiner for adding to radiating power. The router shall have provision for grounding other open terminal under various conditions.
 - (ii) To route the combined output power of all healthy power blocks (max. 1000 KW rating) either to dummy load or to antenna for testing or trouble shooting/transmitting respectively.
- (c) The various switching/routing provision required for Chinsurah Transmitter are as:
 - (i) To route a power block to dummy load for maintenance/ repair/ trouble shoot or to combiner for adding to radiating power. The router shall be having provision for grounding other open terminal under various conditions.
 - (ii) To route the combined output power of all healthy power blocks to either to dummy load or to antenna through any one of three Feeder line system depending upon the carrier Frequency selection.
- (d) This switching arrangement shall be rated suitably as per system requirement.
- (e) The switching arrangement shall be housed in suitable enclosure having interlocking and , earthing arrangement.

2.4 DUMMY LOAD:

- 2.4.1 Type: Dummy load shall be of standard make closed circuit soda water circulation type or water - cooled resistance type. All the accessories like Heat Exchanger, Pump, Soda water storage tank, Flow meter, Blower Unit, motor controlled automatic flow control etc. shall be included in the offer. Preheating arrangement from AC mains to bring the soda water Temperature to the operating temperature level to have nominal operating input impedance shall be provided. Soda water type or water cooled resistance type load shall be for indoor use. However, the water to air heat exchanger shall be outdoor type of efficient & low noise design.
- 2.4.2 RF Input Impedance & connection type: Impedance shall be as indicated in Section-III. The termination arrangement will be as per internal feeder system.
- 2.4.3 RF Power Measurement: Direct reading type RF Power measurement shall be provided either by electrical method or by Calorimetric method with digital display.
- 2.4.4 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.
- 2.4.5 Mechanical construction: The dummy load shall be grouted on the floor. It shall be rugged in construction with proper protection against mechanical impacts. The body of the dummy load shall be provided with a protection paint coating to prevent rusting, corrosion etc.
- 2.4.6 Electrical input : The dummy load shall work on mains input voltage specified under Section - III.
- 2.4.7 Interlocking: In addition to it's internal interlocking, the dummy load shall be interlocked with power block as well as for combined power. 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:
- The R.F. Connection between the Dummy Load and the transmitter combining unit is not through.
 - The Dummy Load impedance is outside the permissible variation.
 - The cooling system of the Dummy Load is not functioning properly.
 - There are any overloads or abnormal working conditions of the dummy load.

2.5 IMPEDANCE TRANSFORMATION NETWORK (For Rajkot Transmitter only) :

The salient features of the Impedance Transformation Network shall be :

- 2.5.1 This Network shall be located in branching hut for transforming the 60 ohms impedance of incoming feeder line to 120 ohms for feeding 1000 kW power to either M1 or M2 through their 120 ohm feeder line for Omni directional pattern. This network shall be switched into circuit for single mast operation
- 2.5.2 It will be a self contained, single cabinet and Network will be realized with inductors and capacitors. The components of Impedance transformation network shall be designed for adequate bandwidth, amplitude and phase linearity to allow AM DSB and DRM operation.
- 2.5.3 Input/ output connections : It shall have One input port and One Output Port each rated for 1000 KW output, for connecting feed -out bowl insulators assembly leading to 28 wire 60 ohms feeder line input and 28 wire 120 ohms at output.
- 2.5.4 The design of the network shall be such that no forced ventilation is required.
- 2.5.5 Power handling capacity : As mentioned under Section-III.
- 2.5.6 Mounting & Safety switch The network shall be floor mounted fully enclosed. It shall be inaccessible to operator in ON condition with an interlocked access door. All other safety requirement as needed in a RF networks are to be taken.

2.6 SWITCHING MATRIX IN BRANCHING HUT: (For Rajkot only)

2.6.1 The Branching hut shall house impedance transformation network and various switching control system for following modes:

- a. Full power (1000 KW) to M1 ; M2, M3 & M4 to be earthed for omni pattern.
- b. Full power (1000 KW) to M2 ; M1, M3, & M4 to be earthed for omni pattern .
- c. Half Power (equal) to each M1 & M2 (500 KW each) in phase and grounding of M3 & M4 for directional pattern through respective phasing element installed in their respective hut.
The switching devices of masts shall be housed in respective feeder huts. Switching device for impedance transforming network or paralleling of 120Ω feeder lines going to M₁ & M₂ shall be housed in branching hut.

2.6.2 Switching Control Arrangement:

- (a) Provision shall be made for distributing power by paralleling two feeder lines going to M1 and M2 in branching hut and switching of ATU components in all the four feeder huts in directional mode from branching hut in local (manual) mode and in remote mode from control Engineer's desk in transmitter hall.
- (b) Provision for grounding mast M1, M3, M4 or M2, M3, M4 mast as per command from branching hut or remotely from transmitter hall for omni direction mode either from M2 or M1 mode respectively.

2.6.3 Mechanical construction:

- a. Mounting: The unit shall be supplied in the form of floor mounted components/ assemblies to be supported on post insulators inside a shielded hut located in the center of four element DA system. A metal frame guard netting enclosure shall be provided to prevent accidental contact of operating personnel with the live points.
- b. Control panel for local, operation for various mode in a sheet metal cabinet shall be grouted on the floor in the branching hut.

2.6.4 Ventilation: Low noise axial blower/ fans of adequate capacity with automatic gravity shut off louvers and air exhaust hoods with anti insect mesh shall be provided for sufficient cooling and longer life of branching component.

2.7 ANTENNA TUNING UNIT (ATU): (Only For Rajkot)

The unit shall be supplied in the form of floor mounted components/assemblies supported on post insulators inside a shielded hut near the antenna base. A guard net groutable on the floor to deny access to operator when Tx. is running, also shall be provided.

2.7.1 Input/output impedance : As specified in Section - III.

2.7.2 Input/output connections : Shall be through bowl insulators mounted on the plates to be fixed in the walls openings of the ATU hut having provision for connection of the earthed limb of the feeder at the inlet side.

2.7.3 Metering :

(a) Meters for measuring the Feeder and Antenna currents with suitable shorting switches shall be provided. It will be possible to read the meters with the ATU enclosure door closed and with the transmitter on.

(b) Arrangement shall be provided in the ATU with the help of Detector Unit for remote indication of the antenna current, detected audio from ATU at the transmitter end through client's underground cables running between the ATU and the transmitter for M1 and M2 hut only.

- 2.7.4 Static leak coil : Static leak coil of adequate rating shall be provided for discharging the lightning current safely to the ground.
- 2.7.5 Spark gaps : 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.
- 2.7.6 Earthing / Isolation arrangements : Necessary earthing & isolation arrangements shall be made for isolating input and Output side as well as to groundings of Controls.
- 2.7.7 ATU Design : The ATU components shall be designed for rated power as in section III. The components shall be designed for standard bandwidth required for AM - DRM and Simulcast operation.
- 2.7.8 Mode Switching for DA Pattern : Provision for mode switching devices as per para 2.6..1(a), (b), (c) in case of directional and grounding of masts M2,M3,M4 or M1,M3,M4 as per the configuration in case of omni-directional pattern through Branching hut, in local mode and from control engineer desk in remote mode shall be made.
- 2.7.9. An inductor (with capacitance for fine tuning) for providing required phasing to reflector masts (M3 & M4) to obtain desired directional Radiation Pattern (Annexure II) to be mounted on floor shall be supplied.

2.7.10 Mechanical construction :

- (a) Mounting: The unit shall be supplied in the form of floor mounted components/assemblies supported on post insulators inside a shielded hut near the antenna base.
- (b) Ventilation: Low noise axial blower fans of adequate capacity with automatic gravity shut off louvers and air exhaust hoods with anti insect mesh shall be provided for sufficient cooling and longer life of ATU component.

2.8 Feeder Outlet :

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

- 2.8.1 Design for transmitter Building Outlet : To be mounted in a wall opening, suitable for termination of an overhead screened(duct), 60 Ohms, unbalanced feeder inside the building and an overhead 28 wire, 60 Ohms unbalanced feeder outside the building. Alongwith live terminals this shall be having provision for ground terminal.

2.8.2 Design for Branching Hut : (For Rajkot only)

- (a) Branching hut Inlet to be mounted in a wall opening , suitable for termination of an overhead 28 wire, unbalanced 60 ohms feeder coming from transmitter building . Alongwith live terminal this shall be having provision for ground terminal also.
- (b) Branching hut Outlet- There shall be two outlets ; rated for full power of 1000 kW each, to be mounted in the wall openings suitable for termination of 28 wire 120 ohms unbalanced feeder line on outside and a pipe connection from inside, for connecting branched output with the provision of extended ground terminal on the bowl plate.

2.8.3 Design for feeder hut : (For Rajkot only)

- (a) Feeder Hut Inlet : To be mounted in a wall opening , suitable for termination of an overhead 28 wire, unbalanced 120 ohms feeder line outside the ATU. Along with live terminal this shall be having provision for ground terminal also
- (b) Feeder Hut Outlet : To be mounted in a wall opening suitable for termination of a pipe connection to self radiating mast.

2.9 PROGRAMME INPUT EQUIPMENT RACK:

2.9.1 GENERAL :

- (i) A dual mono channel Pre Wired Programme Input Equipment Rack is required to process the programmes (analogue audio signal) received from various sources like studio center via Telephone lines (Non-exchange) 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 programmes 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. PROG1-IN, PROG2-IN, EM.ST.OUT, RN.OUT, RX-OUT and OSC-IN. 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 can 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.

2.9.2 Mechanical:

- (i) Construction Details : The rack shall be sturdily constructed from aluminum extrusions of suitable size fastened to form framework properly reinforced with stiffeners, suitably welded. The front side 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 relive 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 admiralty grey (Color No.632 of IS-5 as amended up to date) after necessary anti rust treatment.

2.9.3 Jack Field/ Audio path 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 open able on 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 nickle plated brass frame, with nickle-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 labelling purposes.

2.9.4 Programme Meter (PPM / VU)

The Program Meter shall preferably be a dual VU meter or 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.

2.9.5 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.

2.9.6 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.

2.9.7 Stereo Monitoring Amplifier :

- (i) The amplifier shall be able to deliver an output of 20 W RMS and 100 W P MPO 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 switchable 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.

2.9.8 Stereo Distribution Amplifier:

The distribution amplifier shall have one stereo input and four 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.

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

2.9.10 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 like Beldon, Canare, Tecnic etc. 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.

2.9.11 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 shall be provided by keeping patch cords & headphones.
- (v) Suitable arrangement is to be made for mounting 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.

2.9.12 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.

2.9.13 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.

2.10 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 calibrator checks 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% .
8. Fully solid state & NRSC compliant

2.11 Cathode Ray Oscilloscope

The Digital Phosphor Oscilloscopes 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, automatic anomaly detection.

2.12 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 and highly reliable for working round-the-clock, 365 days a year and based on field-proven design using modern technology. The necessary factory presets should allow choosing true presence & impact for announcer sports or news/talk and telephone voices. Music programme should have real bass, with punch & warmth. 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

2.13 Frequency Synthesizer : (Optional)

- (i) Design: The frequency synthesizer shall be suitable for providing adequate and stable excitation to the transmitter as an external R.F. Source as per Technical Specifications in Section - III.
- (ii) Frequency Selection: Either by frequency selection decade knobs or push button keypad.
- (iii) Frequency Display: Digital Display.
- (iv) Output level: Continuously variable with Analogue / Digital display for
- (v) Stability : For meeting broadcast standard for using as standby source for carrier frequency.
- (i) Mounting: 19" Standard Rack

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 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 M.

- N.B:**
1. Full Technical performance of the various equipment as per these specifications shall be guaranteed at AIR sites with Ambient conditions specified above.
 2. De-rating above certain MSL, if any, is to be clearly specified.
 3. The performance figures are applicable for Power Block & Combined output operating with antenna as well as Dummy load.

3.2. 1000 kW MW Transmitter Unit:

| S. No. | Parameters | Specifications |
|--------|---|---|
| 3.2.1 | Type of Emission | AM Double side Band, DRM (all modes) |
| 3.2.2 | R.F. Range | 531 - 1602 kHz. (Carrier Frequency specified in the Schedule of Requirement). |
| 3.2.3 | Carrier Frequency Stability | Within ± 10 Hz at site conditions or as per the latest ITU-R Radio Regulations in force at the time of delivery of the Transmitter equipment; whichever is better. |
| 3.2.4 | Carrier Output Power (at the output of Combiner) | 1000 kW (Nominal) The transmitter system will be capable of 1100 kW carrier power operation with 100 % Peak modulation, at the specified A.C. Mains input. |
| 3.2.5 | Reduced power operation | There will be a provision for operating the transmitter on reduced carrier power upto level of single power block. There will be a total of at least 3 preset power levels in each power block. : 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. |
| 3.2.6 | Spurious and Harmonic Radiation | As per the ITU-R Radio Regulation in force at the time of delivery of the equipment. (At present as per ITU-R, the total harmonic content should be 60dB below carrier and should not exceed 50mW.) |
| 3.2.7 | Carrier Level Shift | ≤ 1 % from 0 to 100% modulation at 1 kHz. (Mains voltage variation excluded) |
| 3.2.8 | Noise Level | ≤ -60 dB (Un-weighted) w.r.t. full R.F. level at 100% modulation with 1 KHz tone . |
| 3.2.9 | R.F. Impedance | a) Each Power Blocks output } b) Combiner Input each part } 60 Ohm (unbalanced) c) Combiner output } |
| 3.2.10 | Load mismatch / VSWR withstand Capacity | 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 |

| | | |
|--------|--|--|
| | | <p>1:1.25 to 1:1.5. ;</p> <p>3. At VSWR greater than 1:1.5</p> <p>i. The transmitter should trip-off for a predetermined period, after three attempts of switching on automatically.</p> <p>ii. After the predetermined period, the transmitter should make an attempt to switch-on automatically. In case the high VSWR still exists, the transmitter should switch-off automatically.</p> <p>iii. For switching-on the transmitter again, Manual Intervention shall be required.</p> <p><i>R.F. output vs. VSWR relation for equipment offered would be specified by the tenderer.</i></p> |
| 3.2.11 | Type of Modulation | <p>Amplitude modulation generated with digital techniques.</p> <p>The modulated waveform for Sine, Triangular/Saw Tooth, Square/Rectangular, will be seen on CRO for proof of fidelity of modulation. For DRM mode ETSI standards would apply.</p> |
| 3.2.12 | Modulation capability | Continuous 70% Sine Wave Tone modulation 50 Hz to 10kHz. |
| 3.2.13 | Peak Modulation capability | Up to 110% positive peak programme modulation at nominal carrier power for 1 minute from 50 Hz to 10 kHz. |
| 3.2.14 | Modulation Linearity | Within ± 0.5 dB w.r.t 70% modulation from 50 Hz to 10 kHz |
| 3.2.15 | Audio input level | 0 dBu (Nominal for 100% modulation, adjustable from -10 to +10 dBu in steps of 1 dB. |
| 3.2.16 | Audio Input Overload Protection | The Audio Input level will be protected upto 10dB higher level over the nominal audio level required for 100% modulation. |
| 3.2.17 | Audio input impedance | 600 Ohms (balanced) |
| 3.2.18 | Audio Frequency Response | ± 1.0 dB from 50 Hz to 10 kHz w.r.t 70% modulation at 1kHz. |
| 3.2.19 | Total Harmonic Distortion | ≤ 1.0 % from 30% to 95% modulation between 50 Hz to 10 kHz |
| 3.2.20 | Inter Modulation Distortion | ≤ 1.0 % at 60/7000 Hz. 4:1 at 95%. Modulation as per SMPTE standards. |
| 3.2.21 | Square Wave Overshoot without filter | $\leq 1\%$ at 400 Hz. 80% modulation |
| 3.2.22 | Square Wave Tilt | $\leq 2\%$ at 40 Hz 80% modulation. |
| 3.2.23 | Modes of operation | <p>NORMAL:</p> <p>1) DSB without DCC (AM)</p> <p>2) With DCC upto 3/6 dB carrier reduction</p> <p>DRM:</p> <p>i. DRM Simulcast with Analogue transmission.</p> <p>ii. DRM mode only</p> |
| 3.2.24 | Performance parameters for DCC mode of operation | Technical performance in DCC mode will be within the parameters specified for nominal AM mode (without DCC). Please enclose typical figures. |
| 3.2.25 | A.C. Mains input | 11 KV (Phase to Phase) $\pm 5\%$, 3 phase, 50 Hz ± 2 Hz 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 $\pm 5\%$. |
| 3.2.26 | Power Factor | > 0.9 |
| 3.2.27 | Overall Efficiency | $> 80\%$ (including all the ancillary equipment of the transmitter) from 0 to 100% modulation. (Efficiency calculation to be enclosed) |
| 3.2.28 | Acoustic Noise due to rotating machinery | < 70 dB A at 1.5 meters from the Transmitter panel. |

3.3 Combining Unit

| S. No. | Parameters | Specifications |
|--------|--|---|
| 3.3.1 | Carrier Power capacity | 1000 kW + 110 % modulation |
| 3.3.2 | Input Impedance | 60 ohms $\pm 2\%$ |
| 3.3.3 | No. of Inputs | As per offer of power blocks/units |
| 3.3.3 | Isolation between input Ports | ≥ 30 dB |
| 3.3.4 | Isolation between various input ports to Output Port | ≥ 30 dB |
| 3.3.5 | Frequency range | 531-1602 kHz |
| 3.3.6 | Output power (RF-Carrier) | 1000 KW (Nominal) |
| 3.3.7 | Output Impedance | 60 ohms. |
| 3.3.8 | Performance Parameters at combined output | As per individual power block units |
| 3.3.9 | Modulation capability | As per individual power block units |
| 3.3.10 | Mains Input | 400 V (Phase to Phase) AC $\pm 5\%$ 3 Phase, 50Hz ± 2 Hz |

3.4 DUMMY LOAD:

| S. No. | Parameters | Specifications |
|--------|-----------------|---|
| 3.4.1 | Capacity | 1000 KW Carrier + 110 % modulation |
| 3.4.2 | Input Impedance | 60 ohms $\pm 2\%$ |
| 3.4.3 | Frequency Range | 531 – 1602 kHz |
| 3.4.4 | Mains Input | 400 V (Phase to Phase) A C $\pm 5\%$ 3 phase, 50 Hz ± 2 Hz |

3.5 IMPEDANCE TRANSFORMATION NETWORK (for Branching hut)

| S. No. | Parameters | Specifications |
|--------|------------------------------|--|
| 3.5.1 | R.F. Power Handling Capacity | 1000 kW + 110 % Modulation |
| 3.5.2 | Impedance | a) INPUT : 60 ohms $\pm 2\%$ b) OUTPUT : 120 ohms $\pm 2\%$ |
| 3.5.3 | Mismatch/VSWR due to switch | ≤ 1.05 |
| 3.5.4 | Frequency range | 531 – 1602 kHz |

3.6 ANTENNA TUNNING UNIT (ATU)

| S. No. | Parameters | Specifications |
|--------|-------------------------|--|
| 3.6.1 | Power Handling Capacity | (a) For Fed mast M1 and M2 : 1000 kW carrier + 110% Modulation (For ATU's of M1 & M2) (b) For Passive Mast M3 and M4: Phasing element to withstand induced voltage and to provide a phase of $+106^\circ \pm 15\%$ (For ATU's of M3 & M4) |
| 3.6.2 | Frequency range | 531 – 1602 kHz |
| 3.6.3 | Input impedance | 120 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 1071 KHz with $\pm 50\%$ variation in resistive and reactive component (refer Annexure-III) |

3.7 PROGRAMME INPUT EQUIPMENT RACK:

| S. No. | Parameters | Specifications |
|--------|-------------------------------|--|
| 3.7.1 | Wired Rack | The Rack shall be designed to shield the equipment and wiring from high level R.F. field, to deliver specified performance with transmitter on full power. |
| a | Nominal input level / Range | 0 dBu; -10dBu to +10dBu (Selectable) |
| b | Nominal output level | + 0 dBu Range : -10dBu to +10dBu. |
| c | Frequency Response | ± 0.5 dB (20 Hz. to 15 kHz.) |
| 3.7.2 | Programme / VU Meter | |
| a | Measurement Range | -40dB to -10dB in 3dB steps -10dB to +20dB in 1dB steps |
| b | No. of Display LED | 40 in 3 colors per channel |
| c | Input Impedance | >10 k ohms |
| d | Tolerance | + 1LED(0.5dB) |
| 3.7.3 | Audio Patch Panel/ JACK FIELD | |
| a | No. of Jack | 48 in two rows (24 in one row) |
| b | Contact Resistance | <0.015ohm |
| c | Insulation resistance | > 100 Mega Ohms between GND & contact |
| d | Working Voltage | 100V DC |
| 3.7.4 | Repeat Coil | |
| a | Frequency Response | ± 0.5 dB (20 Hz to 15 kHz) |
| 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. |
| 3.7.5 | 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 | + 0.5dB (20 Hz to 15 kHz (All Filters By -Passed) |
| (iii) | Total Harmonic Distortion at 1 kHz | < 0.2% at rated outputs. |
| (iv) | SNR with input Shorted & at rated output (unweighted rms.) | ≥100 dB |
| (v) | Power Supply | 230V AC 50 Hz + 10% |
| 3.7.6 | 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 | 0 dbu, + 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 15 KHz |
| c | T.H.D | ≤ 0.3% max. 30 Hz to 15 KHz |
| d | Inter channel cross talk | > 65 dB 20 Hz to 15 KHz |
| e | Operating Voltage/ VA | Single phase : 230 V + 10% , 50 Hz+2Hz. |
| 3.7.7 | AUDIO PROCESSOR | |
| (a) | Frequency response | < + 0.5 dB (High pass 50-100 Hz, low pass 4.5 – 3.5 kHz). |
| (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 | Suitable for 4.5 KHz. & 9.5 KHz. cut off |
| (i) | High pass filter | 50 Hz - 100 Hz |

| | | |
|-------|-------------------------------------|--|
| (j) | Audio Input Level | -20dBu to + 20 dBu |
| (k) | Audio Input Impedance | 600Ω 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 output | 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 |
| (p) | Connector (Power) | IEC, EMI-suppressed, Detachable 3-wire power cord supplied |
| (r) | Safety Standards | ETL listed to UL standards CE. |
| 3.7.8 | 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 | ± 2% at 100% modulation with Sinusoidal signal. |
| f. | Carrier Level Deviation Meter Range | ± 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 ± 10%, 50 Hz ± 4% |
| q | Physical Dimension | Standard 19" rack mounting |
| 3.7.9 | 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 Rate | 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 |

3.8 Frequency Synthesizer: (Optional)

| S. No. | Parameters | Specifications |
|--------|----------------------|--|
| a. | R.F. Frequency Range | 100 KHz to 30 MHz |
| b. | Frequency Resolution | 1 Hz. |
| c . | Frequency Stability | Better than 1×10^{-7} |
| d. | R.F. Output level | 5 V TTL compatible (variable from 0 to maximum) |
| e. | Output impedance | 50 Ohms, unbalanced. |

SECTION - IV
SCHEDULE OF REQUIREMENTS

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. The Tenderers are required to indicate their offered system in the format of enclosed system sketch as per Annexure-V.
- iii. Indenter reserves the right to choose & decide the quantity of Equipments at the time of finalization of Tender.
- iv. 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.

4.0 MAIN ITEMS:

| S. No. | Equipment | Quantity For Rajkot | Quantity For Chinsurah |
|--------|---|---------------------|------------------------|
| 4.1 | Transmitter Equipment | | |
| 4.1.1 | Solid state 1000 kW MW AM – DRM Transmitter with built in DCC and all accessories (to be indicated as per section II and III) tuned to Station frequency (frequencies) and consisting of following: | 1 Set | 1 set |
| (a) | Power Blocks: (N) numbers with arrangement for RF drive from Driver Rack: N= no. of Power blocks (N= 2 to 5) | | |
| (b) | Air Ventilation Units for Power Blocks. Please refer to Para 2.1.8 (i) and (ii) of Section-II. | | |
| (c) | Liquid Cooling System for all Power Blocks with standby pump . Please refer to Para 2.1.8 (iii). | | |
| (d) | Air ducts, motorized close/open loop arrangements for fixing to AHU & weather proof Louvers for fixing on wall opening for inlet and outlet | | |
| (e) | Power Block power distribution Panel (if any) | | |
| (f) | Power Block MV/ LV Transformer (if any) | | |
| (g) | Control Units (Built-in) for Power Blocks | | |
| (h) | Self contained RF Drive Unit with Standby Unit for Combined operation Station Frequency: Rajkot : 1071 KHz, Chinsurah : 594 / 1134 KHz | | |
| (i) | DRM system (Built-in) in each Power Block | | |
| (j) | Master Control Unit for combined operation with mimic diagram and arrangement for audio signal distribution to power blocks. | | |
| (k) | 1000 kW Combiner with cooling system and necessary control and protection circuitry. | | |
| 4.1.2 | Mains Power Supply Distribution Panel for complete system | 1 No. | 1 No. |
| 4.1.3 | Dummy Load (1650 kW RF Power) suitable for Sl.No.4.1 with heat exchanger and Control Panel (Water cooled resistance type or Soda Water type) | 1 No. | 1 No. |
| 4.1.4 | RF Switching Matrix for Power Blocks, Combining Unit, Dummy load/ Feeder lines. | 1 set/ system | 1 set/ system |

| | | | |
|--------|--|-------------------------|-------------------------|
| 4.1.5 | Over-Head rigid line between Power blocks, Combiner unit and Dummy load as per design of the transmitter (inside transmitter building). | 1 lot | 1 lot |
| 4.1.6 | Overhead 60 Ohms duct Feeder with out-let Bowl Insulator assembly with mounting plate in the transmitter building (Per mtr. rate to be quoted for actual Quantity) | 1 set (Min 10 mtr.) | 1 set (Min 10 mtr.) |
| 4.1.7 | Impedance Transformation Network in Branching Hut 60 ohm to 120 ohms with lead-in and lead-out bowl insulators. | 1 set | ----- |
| 4.1.8 | Switching unit MATRIX for various radiation pattern modes having control Panel for local and remote facility in branching hut. | 1 set | ----- |
| 4.1.9 | Antenna Tuning Unit (ATU)) with lead IN and lead OUT bowl insulator assembly with mounting plate for following ratings as below. | | |
| (a) | 1000 kW (Carrier Power) for M1 and M2 with remote /local mode switching unit arrangement for various modes.{ ref. para 3.6.1 (a)} | 2 set | ----- |
| (b) | Phasing Element for Passive Mast M3 and M4 with remote /local mode switching unit arrangement for various modes. { ref. para 3.6.1 (b) } | 2 set | ----- |
| 4.1.10 | Extended/Remote control & monitoring facilities for master control unit. | 1 set | 1 set |
| 4.1.11 | Remote Control for Branching hut Impedance Network & ATU for various modes of operation in transmitter hall. | 1 Set | ----- |
| 4.1.12 | Complete installation material for all the above items (S.I. No. 4.1.1 to 4.1.11) including the cables etc. for the entire system including the extender cards. (Details to be enclosed) | 1 set. | 1 set. |
| 4.2 | Wired-up Programme Input Rack with equipment and comprising of following : | 1 set | 1 set |
| a | Wired Rack with Programme Meter (PPM/VU) as well as selector switch, Audio Patch Panel, R.F. Patch Panel, Monitoring speakers, Programme Selector Switch, Selector Switch for Monitoring, Cooling fan, Repeat Coils, High Impedance Headphone & Power Supply panel with mains switch, mains filter, MCBs for distribution along with the following Equipments: | 1 No. | 1 No. |
| b | Distribution Amplifier | 1 No. | 1 No. |
| c | Monitoring Amplifier (20W) | 1 No. | 1 No. |
| d | Audio processor | 2 Nos. | 2 Nos. |
| e | Modulation Monitor | 2 Nos. | 2 Nos. |
| f | CRO | 1 No. | 1 No. |
| 4.3 | Installation, Testing and commissioning manuals for the Transmitter and all associated Equipment. (soft copy on CD as well as hard copy) (Please refer Para 1.4.2 of Section - I) | 3 sets | 3 sets |
| 4.4 | Operation and maintenance manuals for Transmitter and all associated Equipment (Please refer Para 1.6 of Section - I) | 7 sets | 7 sets |
| 4.5 | Charges for factory inspection/Acceptance tests for 10 working days by 2 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 | 1 lot |
| 4.6 | Charges for training of 10 AIR Engineers for 4 weeks at site in India (Please refer Para 1.12.2 Section-I) | 1 lot | 1 lot |
| 4.7 | Additional Cards for Master Control system (List to be enclosed) | 1 set of each type card | 1 set of each type card |

| | | | |
|------|---|------------------------|------------------------|
| 4.8 | Additional Card for Power Block Control System including supervisory monitoring and display unit. (list to be enclosed) | 1 set of all type card | 1 set of all type card |
| 4.9 | Additional PA modules for power blocks. | 10 Nos. | 10 nos. |
| 4.10 | Additional Ventilation Unit for one Power Block. | 1 set | 1 set |
| 4.11 | Any other Equipment required for the completeness of 1000 kW MW transmitter system (To be indicated with details) | 1 set | 1 set |

5.0 OPTIONAL ITEMS :

| S. No | Item | Quantity For Rajkot | Quantity For Chinsurah |
|-------|--|---------------------|------------------------|
| 5.1 | Charges for Testing & commissioning of Equipment system at AIR site in India. (Please refer Para 1.13 of Section-I) | 1 lot | 1 lot |
| 5.2 | Provision for current & phase meter with phasing loop on mast for 1000 kW (Carrier Power rating) in M1 and M2 Feeder Hut | 2 sets | ----- |
| 5.3 | Provision for current & phase meter with phasing loop on Passive mast in M3 and M4 Feeder Hut | 2 sets | ----- |
| 5.4 | Charges for training of 6 AIR engineers for 4 (four) weeks at manufacturer's works. (Please refer Para 1.12 of Section - I) | 1 lot | 1 lot |
| 5.5 | Frequency change kits to cover the entire frequency band from 531 to 1602 kHz for complete transmitter. The frequency range for each set of kits will be clearly stated by the tenderer. | One Full set | One Full set |
| 5.6 | Frequency Synthesizer | 1 No. | 1 No. |
| 5.7 | Tentative/ Suggestive List of Maintenance Spares | | |
| 5.7.1 | Spares for the Transmitter Each set comprise of the following: | | |
| i. | P.A. Modules | 10 nos. | 10 nos. |
| ii. | PCBs for all the pre P.A. R.F. stages from crystal oscillator upto P.A. | 1 No. each | 1 No. each |
| iii. | PCBs for all the Audio processing, modulation and encoding stages. | 1 No. each | 1 No. each |
| 5.7.2 | Discrete components like power transistors (MOSFETs), main I.C 's, Semi conductors & other special components. | 1 set. | 1 set. |
| 5.7.3 | Spares for all switching systems | 1 set. | 1 set. |
| 5.7.4 | Spares for the dummy load | 1 set. | 1 set. |
| 5.7.5 | Spares for Combiner Unit | 1 set. | 1 set. |
| 5.7.6 | Spares for Transformation Network | 1 set | 1 set |
| 5.7.7 | Spares for the ATU | 1 set. | 1 set. |
| 5.7.8 | Other items of spares recommended by the tenderer N.B.: <i>The manufacturer / contractor shall specify the recommended quantity of each item of major and minor spares, required for maintenance of the equipment for 2 years, along with their prices. AIR will decide upon the quantity of spares under optional to be purchased after the transmitter equipment system on lowest cost basis is decided.</i> | 1 set. | 1 set. |

ANNEXURE – I

GUIDELINES FOR 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 by 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.
- 1.4 All test data including any failed or partially accomplished tests shall be recorded and supplied with the transmitter for future reference.

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

AIR's inspectors shall carry out 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 its workmanship is of high quality.
- b) Standard Manufacturing Practice: The various standard practices recommended 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 equipment 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 10% (with AVR), 3 phase / 230 V AC (Nominal) \pm 5%, 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, if quantity ordered is more than one.
- 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 7.2 (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.
- f) 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 (in case the testing and commissioning of the equipment is ordered by AIR on the contractor).