

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

**SPECIFICATION DOCUMENT FOR SUPPLY, TESTING & COMMISSIONING OF
500 KW AM-DRM SHORT WAVE TRANSMITTER**

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SUMMARY OF CONTENTS:

1. Section I : General conditions of Tender/contract (P. No. 2-9)
2. Section II : Specifications of the Design Features of the equipment (P.No.10-21)
3. Section III : Technical specification of Transmitter
Equipment and Accessories (P.No.22-27)
4. Section IV : Schedule of requirements (P.No.28-29)
5. Annexure-I: Guidelines for ATP of the transmitter, Associated
Equipments and Accessories (P.No.30-32)

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

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

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CO. ENGG. (TD/SW)

SECTION - I
GENERAL CONDITIONS OF TENDER / CONTRACT

1.0 GENERAL SCOPE

The scope of the tender covers the design, supply, testing and commissioning of 500 KW AM-DRM Short Wave transmitter along with all its associated equipments and installation material at AIR site. The transmitter shall have AM/DRM/Simulcast broadcast capabilities. The essential requirements of the tender are:

- i) The transmitter shall be capable of being operated in AM/DRM/simulcast mode and the change-over from one mode to another shall be effected by a press of button/soft key/touch screen.
- ii) All the components and sub-assemblies of the transmitter shall be assembled by the Transmitter Manufacturer in his factory.
- iii) All the associated equipments and installation materials should be complete in all respects and fully sourced from their respective O.E.Ms and they shall be supplied along with the transmitter as per the schedule of supply mentioned in the Section IV of this document.
- iv) The transmitter shall be fully integrated with all its associated equipments as per the AIR specifications by the transmitter manufacturer in his factory.
- v) An acceptance test shall be carried out by AIR on the transmitter, fully integrated with all its associated equipments in the transmitter manufacturer's works, before the ordered equipments are dispatched to AIR.
- vi) Optional items, such as spares, etc shall be tested and discrete components ordered as spares shall be physically inspected during the pre-dispatch acceptance test in the transmitter manufacturer's works and
- (vii) The installation, testing and commissioning Manuals along with Operation, Servicing and Trouble-shooting Manuals of the transmitter as well as associated equipments and accessories shall be supplied by the tenderer/OEM of the equipment.

1.1 BROAD SCOPE OF SUPPLIES/ SERVICES:

(a) Items to be included:

- (i) 500kW AM-DRM SW Transmitter along with DRM Equipments.
- (ii) Dummy load.
- (iii) Extended / Remote Control & monitoring facility (OPTIONAL).
- (iv) Installation materials for the above.
- (v) Technical Manuals for above equipments.
- (vi) Testing and Commissioning of the transmitter along with it's associated equipments.
- (vii) Power supply distribution panel.
- (viii) Factory acceptance test as per ATP approved by AIR
- (ix) Customer acceptance test of the transmitters after installation of transmitter at site **Doddaballapur (Bangalore/India)**
- (x) Optional items such as spares, etc.

(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/ Modification of Transmitter 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 up to main Power Supply Distribution of Transmitter.
- (iii) All furniture and fittings, which do not form part of the transmitter equipment.
- (iv) Installation of Transmitter equipment at AIR site.
- (v) Feeder lines.
- (vi) Provision and laying of R.F. Grounding by copper strips inside and projecting outside the Transmitter building Ground plane & A.C. Power Earthing outside the Transmitter building

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 "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 (quoting the para number in the order in which they appear in these specifications) indicating clearly whether or not the equipment and accessories offered conforms to these specifications.

Tender 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, associated equipment and accessories etc. in support of compliance statement will be furnished in printed form.

1.3.3. Descriptive functional information giving complete details and salient features of the transmitter.

1.3.4. Detailed typical layout plan clearly indicating dimensions for main transmitting equipment, associated equipments like stand-alone AHU, Dummy load, HV/LV panels etc. and installation material like ducts of the air-cooling system etc.

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 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.

- 1.3.8. A supply record giving the names of the broadcasting organizations, countries, locations, year of supply at site, type and other details of the similar type of 500 KW SW transmitter supplied by the tenderer.
- 1.3.9 A complete set of performance figures taken on the similar type and make transmitter for: (i) AM DSB at full as well as reduced power (ii) Pure DRM at full DRM power, MER measurement and spectrum mask as per ETSI standard. (iii) AM DSB and DRM in SCS/MCS mode, MER measurement and spectrum mask as per ETSI Standard, as specified under Section-III, offered by the manufacturer to be furnished along with the tender.
- 1.3.10 Any other information, which the tenderer feels relevant to his offer.

1.4 DOCUMENTS TO BE SUPPLIED AFTER PLACEMENT OF ORDER:

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

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

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

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

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

- 1.6.1 Along with each equipment following documents shall be supplied.

- i. Technical Manuals covering detailed circuit descriptions, schematic/circuit drawings for operation & maintenance, in printed as well as electronic format.
- ii. Technical Manuals for fault location and Troubleshooting of the Transmitter as well as auxiliary equipments and accessories in printed as well as electronic format.

1.6.2 i. Test Reports of each sub-system of transmitter and associated equipments and the measurements conducted during Pre-dispatch Inspection of these equipments at the transmitter manufacturer's works shall form a part of these Manuals.

- ii. These Manuals shall include manufacturer's part numbers with generic description of semiconductors, tubes and active devices. These Manuals shall include data sheet on various 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 Staff Training Institute (Tech.) i. e. 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 sets shall be supplied to the consignee. (Total 7 sets per transmitter.)

1.7 DELIVERY OF EQUIPMENT:

(A) Supply of Equipment:

The delivery of the entire equipment at AIR's transmitter site shall be completed within **9 (Nine) months** from the date of placement of order in case of FOR destination quotes in Indian Rupee. In case of FOB quote, the delivery of the entire equipment shall be completed within **9 (Nine) months from the date of opening of letter of credit.**

(B) Testing and Commissioning of the Transmitter

- i) The testing and commissioning of the Transmitters shall be completed within one month of the handing over of the transmitters to the OEM after the installation of the transmitters at the AIR site is completed by AIR.
- (iii) The Contractor/O.E.M. 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.

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 up to site.

1.10 COMPLETENESS OF SUPPLIES, WARRANTEE AND GUARANTEE, QUALITY & WORKMANSHIP OF MATERIAL USED AND AVAILABILITY OF MAJOR & CRITICAL SPARES,:

An undertaking to accept the following terms and conditions along with those contained in para 8, P-49 of the Booklet "Instruction to bidders" with the exception of para 8.2.2 of the Annexure II (General terms and conditions), 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 and completeness of the system at the AIR 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 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 Warrantee and Guarantee/ quality & workmanship of material used:

Should any component become defective or 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 earlier, 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 supersedes para 8.2.2. of the Annexure II (General Terms and Conditions) of the "Instruction to bidders"

1.10.3 Availability of spares:

- (a) The supplier / manufacturer shall submit an undertaking for supply of spare parts, for a period of ten years from date of commissioning.
- (b) The manufacturer of transmitter shall ensure that transmitting tubes, MOSFETS, semiconductors, capacitors, transducers etc. as well as other critical items of spares, can be easily procured by AIR whenever such need arises and shall make available the information, in his tender, about the firms/agencies where from these items can be procured.
- (c) 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 spare parts and critical items.
- (d) 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 Firm.

1.11 INSPECTION/ ACCEPTANCE:

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

- a) AIR will depute 2(two) Engineers and carry out the inspection of the Transmitter on a set of SW frequencies, fully integrated with all its associated equipments like Dummy load, Air-Ventilation Unit, etc, by the Transmitter Manufacturer at his works, as per Acceptance Test Procedure (ATP) approved by AIR. 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. Rate for Pre-dispatch Inspection for five (05) working days per transmitter shall be quoted by tenderer in his price bid.
- b) The contractor shall give at least 8 (eight) weeks notice to AIR to carry-out the inspection, before the consignment is ready for inspection.
- c) The transmitter manufacturer shall put up the transmitter along with its associated equipments on the test bench, at his works, before AIR inspectors and shall provide, without any extra charge, other 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 transmitter manufacturer's premises.
- d) The equipment shall be tested at the Mains Input Voltage and frequency specified against the various equipment in Section - III. Alternatively, the equipment shall be tested at the voltage prescribed in Section III, at supply frequency available at the manufacturer's works subject to an undertaking by the tenderer that the equipment shall be successfully tested and commissioned by the O.E.M. at AIR site at the Mains Input Voltage and frequency specified in this Document in Section – III.
- e) The inspection and testing period shall be of 05 (five) working days for each transmitter along with its associated equipments at the transmitter manufacturer's works.

- f) The supplier shall ensure safety of AIR's Inspectors, while on inspection at the transmitter manufacturer's works, against any accidental injury, accidents, death etc, at no cost to AIR.
- g) The expenditure towards To & Fro Air Journey, lodging, boarding & Daily Allowance of the inspecting Officers 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 transmitter manufacturer/contractor.
 - b) Testing of equipment after its installation by AIR and testing & commissioning by the tenderer as per the ATP to confirm the performance of the equipment to Contract specifications, before finally taking-over/accepting the equipment by AIR.
 - c) If any component fails or is found defective on receipt at site as well as during the erection/testing/commissioning these will be supplied free of cost to AIR site by the transmitter 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/ transmitter manufacturer.
 - d) 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.
 - e) 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:

The tenderer shall organize to train a group of about 10 AIR engineers free of cost to AIR, for a period of 5 (five) working days 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 & Daily Allowance for the trainees as per Govt. of India norms shall be borne by AIR.)

1.12.2 At transmitter manufacturer's Works: (OPTIONAL)

- (a) The contractor shall be required to train Six (6) AIR Engineers for a period of 10 working days at transmitter 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 the same type of transmitter including associated equipments.
- (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 in his price bid. (The expenditure towards to & fro Air Journey, lodging, boarding & Daily Allowance for the trainees shall be borne by AIR)

1.13 INSTALLATION, TESTING AND COMMISSIONING:

- (a) The transmitter and it's associated equipment will be installed by All India Radio in accordance with the instructions, drawings and other details supplied by the transmitter manufacturer
- (b)The Transmitter manufacturer shall have to carry-out the testing and commissioning of the transmitter along with it's associated equipments at site as per the terms and conditions duly approved by AIR. **Testing & commissioning charges shall be quoted separately.**
- (c) All manpower, resources, tools and tackles, test and measuring instruments, special tools and any consumables required for the testing and commissioning shall be provided by the tenderer, without any extra charge or liability to AIR.
- (d) The tenderer shall ensure safety of the testing and commissioning personnel of O.E.M., while engaged in testing and commissioning of the transmitter and it's associated equipments at the AIR site against any accidental injury, accidents, death etc. at no cost to AIR.

1.14 AFTER-SALES SUPPORT:

The transmitter 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

2.0 500 KW AM-DRM SW TRANSMITTER:

Type & Configuration: Fully using state of art, field proven technology with PSM Modulator, delivering full carrier power as defined in under clause 3.2.4 of Section - III of the specification for AM / DRM / Simulcast operation modes. Change of mode shall be by press of button / soft key / touch screen.

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. The transmitter shall have adequate redundancy in equipment to ensure a reliable broadcast service with minimum interruption.
- b) The transmitter shall be capable of continuous operation (24x7 Hrs).
- c) The transmitter shall have solid-state Pulse Step Modulator, Solid- state/tube Driver circuit and single-tube final stage. Transmitter shall accept Envelope, phase modulated R.F. or I,Q Baseband signal from DRM modulator/ Exciter for DRM operation.
- d) The operating sequences will be properly enunciated and designed in logical steps for convenience of the operator.
- e) The transmitter shall have built-in supervisory, monitoring and fault diagnostic system, which should be user friendly & placed ergonomically for ease in troubleshooting.
- f) 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.
- g) The transmitter shall conform to latest safety standards applicable to radio broadcast equipment for Electrical Safety, Electromagnetic compatibility and Interference and should meet the relevant ETSI Standard for DRM transmission.
- h) Drawings: Station wiring drawing showing electrical interconnection between each system of transmitter plant shall be part of Manual.
- i) Manual: For each equipment system of transmitter plant, Manuals shall be provided for operation, maintenance, troubleshooting, Installation, adjustment, testing and commissioning in English language as per clause 1.2. Manuals shall be supplied in hard copy and in electronic format.

2.1.2 Constructional Features:

- a) Various components and sub-assemblies will 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. For maintenance, all components shall be accessible through interlocked doors.
- d) The material used shall be non- inflammable and fire-proof /fire-retardant.
- e) The various metal parts shall be painted to prevent rusting or corrosion. The transmitter panels shall be painted in non-glossy, mat finish color.
- f) The various assemblies and components shall be labeled liberally for easy identification.
- g) **Electrical Wiring:** Various wires/cables switches etc. used in the equipment shall be as per international standard and shall have atleast a factor of safety of 1.5 for both voltage and current. 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.
- j) **RF shielding:** The Transmitter construction shall ensure complete shielding of high power radio frequency circuits to minimize spurious/ interfering and harmful radiation from the transmitter cabinets in accordance with the recommendations of IEC-215/1. Suitable measures shall be incorporated to keep the radio frequency energy from leaking into power supply circuits.

2.1.3 R.F. Section: RF Section shall consist of three stages namely RF source with preamplifier, driver stage and Power amplifier, Filter & matching network.

2.1.3.1 R.F. Source: The RF Drive unit having two independent RF source shall be suitably located in Transmitter or speech Rack with following provision.

- (a) RF frequency shall be generated by DDS (Direct Digital Synthesis)/ PLL, having spectral purity in AM band with a high degree of Stability. The frequency shall be settable in steps of 0.1Hz.

The short term and long term stability of the output frequency of the driver equipment should be **$< 1 \times 10^{-9}$ per day / $< 3 \times 10^{-8}$ per month / $< 1 \times 10^{-8}$ within temperature range** respectively and shall hold for the power supply fluctuations specified, variation of ambient temperature from 0 - 45°C and variation of external load coupling from zero to maximum.

- (b) Each Transmitter shall be provided with a driver unit tune able to entire SW frequency band
- (c) Each source shall be self-contained in all respects. The design should be such as to permit a quick wave change of any frequency in the range of shortwave band. Facilities shall be provided for the rapid and accurate tuning and matching of all the stages on full power. Special attention shall be paid to the design of moveable contacts in case variable inductance tuning is used as to ensure freedom from sparking and long trouble free service.
- (d) The tuning and matching circuits in the final stage shall be designed for optimum operating conditions leading to the highest efficiency and lowest voltage and current stresses on the components in the tuning circuits
- (e) Automatic as well as manual change over arrangement shall be provided for selecting the healthy RF Source/Exciter.
- (f) Provision for visual indication of active RF source shall be provided.
- (g) A BNC socket, (50 Ω) for monitoring of carrier frequency shall be provided.
- (h) A 50 Ω BNC Socket also shall be provided for connecting an external RF source (synthesizer).
- (i) UPS is required to be provided for RF source & its switching unit.
- (j) Location and a schematic to assess all the above provisions shall have to be supplied with tender.

2.1.3.2 Tubes: The transmitter shall use one tube in PA stage. The tube replacement procedure should involve minimum removal of components. Means for easy and quick replacement of tubes shall be provided. The tube removal device comprising of a lifting hook and a crane should be offered along with each transmitter. Suitable device (tube-trolley) for safe transportation of the heavy tubes within the transmitter building for each site shall be included in the supply.

The transmitter must use a tube in PA stage which will deliver the specified power. The tube requiring black heating will not be accepted.

2.1.4 Tuning and wave changes:

The transmitter shall be designed for, and equipped with automatic tuning facility with a frequency change time of less than 60 seconds in the complete frequency range. In addition, it should also be possible to resort to manual tuning with motorized control of tuning elements.

The automatic frequency selection and tuning control system shall also be so designed so as to have a freely programmable storage for 200 frequencies.

The control system shall be so arranged that the coarse setting of tunable elements (inductances and capacitances) is pre-determined and stored positions are always carried out without applying H.T.D.C. to driver and final stages. Fine tuning is carried out only with reduced HT on the anodes/ reduced RF Drive.

It should not take more than 1 minute for any frequency change in the frequency range of 5.9 – 26.1 MHz without any limitation.

2.1.5 Audio frequency Stages:

The AF Stages should be completely solid state including the modulator with digitalized signal processing facility. Choice of various AF filters should be available to enable full range of audio processing in all modes of operation. The semiconductor switching devices being used in the solid state modulator is to be specified and its details made available along with tender.

2.1.6 Modulation Technique:

The Transmitter shall be equipped with a pulse step modulator comprising of solid state devices which shall deliver the A.F. modulated anode voltage to the R.F. final stage. The modulator should have outstanding broadcast performance relating to **total harmonic distortion** and signal-to-noise ratio and it should have high efficiency with high power factor. The modulation system shall have a proven design and shall be fully compatible with technical specification enumerated in section III.

The tenderer shall furnish the details of the Pulse Step modulator along with the shelf life of electrolytic condensers used in the circuit.

The cooling system of the PSM equipment should be adequate either with air or water. Its module arrangement should ensure equal loading of all modules as well as highest possible redundancy for reliable operation. Each module should be capable of switching on or off independently. Module capacity to contribute voltage and current should be indicated. The above modulation system should be compatible with all the technical specifications enumerated in section-III.

2.1.6.1 The transmitter should be capable of operation in AM/DRM/simulcast mode and the change-over from one mode to another shall be by a press of button/soft key/touch screen menu.

- (a) Analogue Mode: Amplitude Modulation shall be generated with digital techniques. Detailed description of modulation technique along with audio chain and the principle and system of modulation employed with schematic/block diagram etc shall be furnished.
- (b) Dynamic Carrier Control (DCC)/ ACC+ (Adaptive Carrier Control): The transmitter shall be having built-in arrangement for operation in DCC/ ACC+ as per ITU-R.
- (c) DRM Mode: The transmitter shall be capable of DRM and simulcast operation as per DRM ETSI standard. No change or addition of components should be required for DRM operation.
 - (i) DRM encoder and multiplexer and DRM modulator/Exciter shall be stand-alone units mounted in a rack or alternatively integrated with the main transmitter and shall be supplied along with the transmitter for DRM operation. DRM encoder and multiplexer and DRM modulator/Exciter shall be designed to have selectable setting of audio encoding i.e. AAC, AAC+SBR, HVXC, HVXC+SBR, CELP, CELP+SBR, Parametric Stereo, AAC+SBR stereo, generation of MSC, SDC & FAC, selection of robustness modes and modulation bandwidth (4.5/5kHz), Nominal Bandwidth (9/10kHz), Double Bandwidth (18/20kHz), 64/16 QAM MSC

with all code rates, 16/4 QAM SDC, hierarchical modulation, standard modulation, Equal Error Protection, Unequal Error Protection Long/Short Interleaving, Service Reconfiguration, Channel Reconfiguration etc.

- (ii) **Simulcast Mode:** The transmitter shall be having built-in arrangement for Single Channel Simulcast (SCS) and Multi Channel Simulcast (MCS) operation with Half Bandwidth (4.5/5 kHz), Nominal Bandwidth (9/10 kHz), and Double Bandwidth (18/20 kHz) with spectrum shaping provision as per ETSI.

2.1.6.2 DRM Encoder Multi-Program Multiplexer: The DRM Encoder Multi-Program Multiplexer shall be designed to meet all the demands of DRM broadcast with provision of triple functionality i.e. DRM audio encoding, Data service, generating of full digital DRM multiplexed stream (MDI) with following key features.

- Capable of handling up to 4 audio and/or data services to generate multiplexed Stream for providing DRM/DI MDI as well as MDI+MC stream for the modulator of broadcast transmitter.
- Graphical user interface to guide the user to create and configure stream and source encoder as well as creation and configuration of input hardware.
- The equipment shall be equipped with an MPEG-4 AAC real time audio encoder, with MPEG-4 CELP as well as MPEG-4 HVXC real time speech encoders along with the utilization of bandwidth enhancement SBR technology for all the three types of audio encoders. Audio input shall include mono, stereo and Parametric Stereo Modes.
- The equipment shall be capable of inserting text messages/pictures and multi-media object transfer Data (MOT) for slide show or broadcast web site format.

2.1.6.3 DRM Digital Modulator / RF Exciter: DRM Digital RF Exciter /Modulator shall be designed to meet requirements of all broadcasting modes, to provide easy switchover between Analogue AM (DSB), pure DRM, single channel or multi channel Simulcast (SCS/MCS) with following key features.

- Real time Channel Coder / Modulator for coding and modulation functions by means of powerful embedded digital processing and shall deliver all the standardized DRM digital modes with signal bandwidth up to 20 kHz.
- Digital Integrated Synthesizer to generate RF.
- Ethernet Ports for DRM/MDI input.
- It shall offer automatic delay adjustment between phase and envelope paths.
- One AES/EBU Digital Audio Input, One Analogue Audio Input.
- SFN/MFN Operation Capability with internal GPS and/or through external NTP server.
- Spectral Shaping as per ETSI standard for meeting the requirement of providing good AM signal reception in Simulcast mode of operation of the transmitter.

2.1.7 Power Supply:

2.1.7.1 Primary AC circuits: The user shall provide supply for each of the transmitter 11KV, 50Hz at a single point. All the power supply required for the

transmitter and its auxiliary equipment should be derived from this point. All the equipments and distribution board required should be included in the offer.

Each transmitter shall have its own 11K V , 3Phase, 50 Hz input isolator. There should be provision of Circuit breaker and on-load isolator for auxiliary supply of adequate capacity for fully de-energizing the entire equipment and making the same safe for servicing and maintenance. In this condition, there shall exist no exposed terminals and bare conductors with lethal voltage anywhere in the transmitter and associated equipments.

Circuit breaker/ contactor used for supplying the power to solid-state modulator transformer is likely to be operated 15 to 20 times a day. The device used should be such as to ensure 50,000 maintenance free operation.

The transformer for auxiliary supplies shall also have its own input isolator/breaker.

11KV ,3Phase,50Hz supply distribution switchgear details with schematic diagram and literature are to be made available by the tenderer.

Different sub units of 11KV distribution switch gear shall be mechanically electrically interlocked such that there is no access to high voltage side of any unit unless the input isolator is de-energized and earthed.

HT distribution switch gear details with schematic diagrams and literature shall be made available by the tenderer along with the offer.

The transmitter shall be equipped with its own automatic voltage regulator for taking care of the specified variation in the main supply voltage. The solid state modulator transformers should be provided with tapping for $\pm 2.5\%$, $\pm 5\%$ & $\pm 10\%$.

All the power supply equipments such as auxiliary transformer, LT distribution, Auxiliary power supply distribution and voltage regulator shall form an integral part of the transmitter and shall be separately and independently provided for each of 500 KW Transmitters and shall be included in the offer.

2.1.7.2 HT (DC Supplies): All rectifier circuits for providing DC supplies to the various stages including the final stage shall use semiconductor devices. During initial switching on, the surges should be kept well within limits to ensure smooth operation. Facility to increase/ decrease smoothly the output power shall be provided for the purpose of tuning and checking.

It shall be possible for the system to remove HT instantaneously, under fault conditions.

The average power consumption for the transmitter shall be indicated along with instantaneous power requirement on the transmitter panel. It shall be possible to operate the transmitter on reduced power (to about 150 KW) if necessary. For this purpose the other potentials like bias etc. shall change along with HT with single operation only.

2.1.7.3 Filament supplies: Filament supply circuits for high power tubes shall have built-in electronic control, preferably without any moving parts and wearing contacts for current limiting and gradual build-up of voltage, to ensure longer life for the tubes.

Tenderer should specify the control incorporated for control of filament voltage and current.

2.1.8 Transmitter Control System: The Transmitter control system shall be integrated into the main transmitter and shall be designed using user friendly digital control techniques. Control system shall have self diagnostic, supervising & monitoring facilities along with visual display as well as re-settable aural alarm.

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

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

- a) Transmitter-on/off
- b) Type of modulation: AM/DRM/simulcast
- c) Power level
- d) Local/remote mode of operation
- e) Forward Power, Reverse Power
- f) Fault

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

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

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

- a) Mains input voltage.
- b) Output DC Voltages of every DC supply.
- c) DC load currents of every DC supply.
- d) Anode/ cathode voltage and current of every electron tube.
- e) Grid and Screen Grid Voltage and current of every electron tube.
- f) Filament voltage (1% accuracy)
- g) Temperature and pressure indicator at cardinal points of tube cooling system.
- h) Audio input level /percentage modulation.
- i) Forward RF power
- j) Reverse RF power
- k) VSWR
- l) Filament / Transmission hours and Comprehensive event logging.

v) Over all efficiency: It should also clearly indicate the loads accounted for calculating the efficiency. (R F out put power to Mains input power)

2.1.9 Protection of equipment and operating personnel:

- i) Safety of operating personnel: Adequate and fool-proof arrangements shall be provided for protection of the operating personnel against hazards of any nature involved in operation and maintenance of the

equipment covered under this specification as per IEC 215.

- ii) The Operating Personnel shall be protected against following hazards by providing suitable interlocking through door key inter-locks, ground hooks or mechanical locks having electrical loops etc. (provision to be confirmed by enclosing a schematic indicating type of device)
 - a) Against high RF voltages;
 - b) High voltage Power Supplies;
 - c) Energy storing components requiring discharge time
 - d) Access to moving machinery, hot / live components.
- iii) Protection of components: The Equipment and its various components will be protected by providing suitable devices like UV detectors, arc gaps corona rings (provision to be confirmed by enclosing a schematic indicating type of device and their locations) against the following:
 - a) Electrical Flash over;
 - b) Deep Voltage fluctuations/transients;
 - c) Lightning on or near the Antenna
 - d) Fire due to sparking etc.

Output RF circuit of the transmitter shall be provided with a protective device in order to by - pass/ ground the lightning strikes 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.
- vi. Earthing Rods: Earthing rods wherever required shall be provided.
- vii. Earth terminals: for connecting client's earth to the transmitter shall be provided at appropriate locations as per standard practice.

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

2.1.10 Extended/Remote Control & Monitoring Facility (Optional) : Extended/ Remote control & monitoring facility for remote ON/OFF, reduced power operation and monitoring of vital parameters, percentage modulation Meters, logging facility etc. shall be provided in addition to the transmitter control system as mentioned at 2.1.6 for working within the transmitter building up to a distance of 100 meters from the transmitter .

2.1.11 Cooling System:

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

- a. An air/liquid cooling system 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. The cooling system for the vapotron/ condensed vapour cooled tubes, VVCs, Coils and moving contact etc. should preferably be a closed circuit system. The liquid to air heat exchanger shall be outdoor type.
- c. The air-cooling system shall be designed for both closed and opened (fresh air) circuit operation in conjunction with AIR's Air-conditioning plant. The tenderer shall include the blowers, motorized louvers (for closed and open circuit operation), Air ducts and Air Handling Units (AHU) provided with duplicated blowers, 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 fold back the Power of the transmitter upto a safe operating level in case of insufficient / deficient cooling.
- g. The transmitter building layout plan shall be supplied by AIR to OEM for optimization of cooling system after placement of the order.

(ii) Air cooling System features:

- a. The capacity and static pressure of blower/blowers should be as per ventilation requirement of the transmitter. The blowers 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(where ever required) shall be fabricated with standard rust proof sheets suitable with joining collars and smooth bend. Requisite supports and anti- vibration duct hangers shall be provided.

(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, pressure gauge, temperature gauge, water conductivity meter with status monitoring and interlocking features. Water pumps (duplicated) of suitable rating for meeting the total liquid cooling requirements of all RF equipment (PA valve, VVCs ,coils & moving contacts) 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 and a spare heat exchanger fan motor shall be part of standard supply.

(iii) 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 and its associated equipments 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 air-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.

2.1.12 Input/output connections from Transmitter Cabinet:

The transmitter cubicle shall be designed for connection of the R.F. output from top and for entry of power supply cables, audio cables, control cables & other monitoring cables from top of the cubicle through overhead mounted cable trays / bottom of the cubicle through 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 to **Balun** for connecting to 300Ω balanced rigid line in overhead screen duct.
- 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.

2.1.13 IMPEDANCE TRANSFORMATION NETWORK :

The salient features of the Impedance Transformation Network shall be :

- 2.1.13.1 This Network shall be used for transforming the output impedance of the transmitter (50 Ω) to match with the feeder line impedance 300 Ω balanced.
- 2.1.13.2 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/DRM /simulcast operation.

2.1.13.3 Input/ output connections : It shall have One input port and One Output Port each rated for the power output rating to be specified as per site requirements.

2.1.13.4 The design of the network shall be such that no forced ventilation is required.

2.1.13.5 Power handling capacity : As mentioned under Section-III.

2.1.13.6 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.

2.2 DUMMY LOAD:

2.2.1 Type: Dummy load shall be of standard make soda water type and all the accessories like Heat Exchanger, Pump, Flow meter, liquid storage tank, Motor controlled automatic flow control etc. shall be included in the offer as part of the Dummy Load, all sourced from the O.E.M. of the Dummy Load. Make & Model of the dummy load offered along with its literatures shall be enclosed with the tender.

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

2.2.3 RF Power Measurement: Direct reading type RF Power measurement shall be provided.

2.2.4 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.

2.2.5 Electrical input: The dummy load shall work on mains input voltage specified under Section - III.

2.2.6 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, galvanized nut bolts may be used to prevent rusting, corrosion etc.

2.2.7 Interlocking: In addition to it's internal interlocking, the dummy load shall be interlocked with the transmitter. The interlock connection shall switch-off the transmitter R.F. Power automatically or would prevent switching-ON of the transmitter RF power for the following conditions of the Dummy load:

- a. The R.F. Connection between the Dummy Load and the transmitter is not through.
- b. The Dummy Load impedance is outside the permissible variation.
- c. The cooling system of the Dummy Load is not functioning properly.
- d. There are any overloads or abnormal working conditions of the dummy load.

2.3 PROFESSIONAL DRM MONITORING RECEIVER:

This professional grade stand alone DRM Monitoring receiver shall be used for DRM reception and transmitter monitoring & measurement. The receiver shall be capable of continuous (24x7Hrs) operation. The receiver shall have well tested DRM receiver software updateable via built-in DVD drive, fully remote controlled via LAN and Ethernet. It should have following key features:

- Applications:
DRM/AM/SSB Reception, Modulation quality measurements, Modulation parameter measurements, two configurable alarm signals to trigger conditions (e.g. audio dropouts or field strength), Spectrum monitoring, logging of RSCI, RSCI output (compatible to ETSI TS 102 349 V1.2.1) via LAN, QoS(Quality of Service) monitoring, high accuracy field strength measurement.
- Monitoring
 - Display, recording and online UDP output (RSCI) of
 - Field strength (antenna factor can be specified)
 - Estimated signal-to-noise ratio
 - Estimated delay spread
 - Estimated Doppler spread
 - Audio quality
 - Frequency offset
 - Location information via external NMEA-complaint GPS receiver interface
 - Display of power spectrum, channel impulse response, field strength, Signal-to-noise ratio
- Alarm: Two independent alarms(associated with relays) configurable to multiple trigger conditions:
 - Spectrum mask violated above specified level
 - RF level below specified value.
 - S/N level below specified value
 - Audio dropouts above specified ratio
 - Audio level below specified value
 - MDI errors above specified rate
 - Frequency offset above specified value
- Interfaces
 - Headphones output with volume control
 - Built-in loudspeaker with volume control
 - Line output
 - Two relays output
 - Ethernet 100 Base T-port
 - Two RS 232 connectors
 - Two USB 2.0 connectors
 - Antenna input N type female connector with 50 Ohm
 - External loudspeaker output
- Remote Control via
 - Graphical user interface
 - RSCI (Receiver Status and Control Interface)
 - Web interface

SECTION – III**TECHNICAL SPECIFICATIONS OF TRANSMITTER, ASSOCIATED EQUIPMENTS AND ACCESSORIES****3.1 AMBIENT CONDITIONS:**

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

- a) Ambient Temperature : 0 to 45°C
- b) Humidity : 0 to 95% Non-condensing.
- c) Altitude : 0 to 1000 Mt.

3.2.0 500 KW AM-DRM SW TRANSMITTER:

S. No.	Parameters	Specifications
3.2.1	Type of Emission	A3E (Double side Band full carrier B'casting), DRM all modes and AM-DRM Simulcast modes.
3.2.2	R.F. Range	5.90- 26.1 MHz.
3.2.3	Carrier Frequencies Stability	Within± 0.1Hz for any frequency 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	i) 500KW (Nominal) with 100% modulation for AM-DSB ii) 200KW pure DRM(10dB below analogue PEP) iii) 487.5KW analog and 12.5KW DRM (16dB back-off) for MCS Simulcast. iv) 492.0 KW analog and 8 KW DRM (18 dB back-off) for SCS simul cast.
3.2.5	Reduced power operation	There will be a provision for operating the transmitter on reduced carrier power. 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	a) Harmonics b) Spurious Emission	RF Harmonics i) < 0.5 mW between 40 – 400MHz. ii) < 50 mW up to 40MHz. For DRM out of band emission limit shall be as per ETSI EN302 245-2 (amended upto date) < 1 mW.
3.2.7	R.F. Impedance	Final output impedance of transmitter System will be 300 ±j0 Ω balanced.
3.2.8	Load mismatch / VSWR withstand Capacity	1. Full rated R.F. output upto a VSWR of 2:1 2. Reduced RF output(within safe limit) for VSWR greater than 2:1

		<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>R.F. output vs. VSWR relation for equipment offered would be specified by the tenderer.</p>
3.2.9	Type of Modulation	<p>a) Analogue: Amplitude modulation generated with digital techniques. The modulated waveform for Sine, Triangular/Saw Tooth, Square/Rectangular, will be seen on oscilloscope for proof of fidelity of modulation.</p> <p>b) Digital: DRM modulation as per ETSI standards would strictly apply as per clause 2.1.6.1 (c) of Sec. II</p> <p>i) Pure DRM</p> <p>ii) Simulcast (SCS& MCS): Analogue(AM) and Digital(DRM) with selectable Half Bandwidth (5kHz), Nominal Bandwidth (10kHz), Double Bandwidth (20kHz)</p> <p>NB: Type of modulation i.e. AM/DRM/ Simulcast(SCS/MCS). shall be operator selectable.</p>
3.2.10	Modulation capability	<p>Continuous modulation with frequencies between 50Hz – 7500Hz.</p> <p>a) 100% -10 mts per hour.</p> <p>b) 70% - 50mts per hour.</p> <p>i) Repeated in the sequence hour after hour.</p> <p>ii) Short period modulation with frequencies between 50 HZ to 7500Hz 100% positive and negative peaks.</p>
3.2.11	Peak Modulation capability	Up to 110% positive peak programme modulation at nominal carrier power for 1 minute from 50 Hz to 10 kHz.
3.2.12	Modulation Linearity	Within ± 0.5 dB up to 12dB below the reference level at 95% modulation on 1 KHz.
3.2.13	(a) Audio input level range (b) Digital audio input range for digital broadcast	<p>a) Analogue: 0 dBu to +10 dBu (Nominal for 100% modulation, adjustable from -10 to +10 dBu)</p> <p>b) AES-EBU Digital: -10 dBfs to 0dBfs for 100% modulation</p>
3.2.14	Audio Input Overload Protection	The Audio Input level will be protected upto 10dB higher level over the nominal audio level required for 100% modulation.
3.2.15	Audio input impedance	600 Ohms (balanced) for analogue audio input. 110 ohm Unbalance for Digital (AES-EBU) input.

3.2.16	i)Audio Response ii)Audio Distortion iii) Noise level	Frequency Frequency	± 1.0 dB from 50 Hz to 7.5 kHz w.r.t 70% modulation at 1kHz. < 3.5% for a nominal power output at m=20-90% for any frequency from 50- 7.5 KHz. ≤ 55 dB unweighted.
3.2.17	MER		30db minimum for DRM transmission
3.2.18	Inter Modulation Distortion		< 1.0 % at 60/7000 Hz at 85%. Modulation as per SMPTE standards.
3.2.19	Modes of operation		NORMAL: 1) AM DSB without DCC/ACC+ 2) AM DSB with DCC/ACC+ up to 3/6dB carrier reduction DRM: i. DRM mode only ii. Simulcast mode DRM with Analogue transmission. 3 Mode of operation shall be easily selectable by operator. 4 DRM mode audio coding and bandwidth (full/half) as per clause 2.1.6.1 (c) of section II should be easily selectable by operator 5 In simulcast mode MCS/SCS with half/ full/ double(5Khz/10KHz/20KHZ) band width as per clause 2.1.6.1(c) of section II should be easily selectable by operator.
3.2.20	Performance parameters for DCC/ACC+ and DRM mode of operation		Technical performance in DCC/ACC+ and DRM mode shall be within the parameters specified for AM mode.
3.2.21	A.C. Mains input		11K V $\pm 5\%$, 50 Hz ± 2 Hz for the system(without AVR). The various loads within the transmitter shall be evenly distributed on the three phases of AC mains. The Transmitter load shall not cause an unbalance more than $\pm 5\%$ between the three phases.
3.2.22	Power Factor		> 0.9
3.2.23	Overall Efficiency		> 70% (including all the ancillary equipment of the transmitter) from 0 to 100% modulation. (Efficiency calculation to be enclosed)
3.2.24	Acoustic Noise due to rotating machinery		< 65 dB A at 1.5 meters from the Transmitter panel.

3.3 DUMMY LOAD:

S. No.	Parameters	Specifications
3.3.1	Capacity	1000 KW
3.3.2	Input Impedance	300 Ω $\pm 2\%$ (Balanced)
3.3.3	Frequency Range	5.9-26.1 MHz

3.3.4	Mains Input supply for system	400 V AC±10%, 3 phase, 50 Hz
3.3.5.	Type	Soda water

3.4 IMPEDANCE TRANSFORMATION NETWORK

S. No.	Parameters	Specifications
3.4.1	R.F. Power Handling Capacity	1000KW
3.4.2	Impedance	a) INPUT : 50 Ω \pm 2 % b) OUTPUT : 300 Ω \pm 2%(balanced)
3.4.3	Mismatch/VSWR due to switch	< 1.05
3.4.4	Frequency range	5.9 – 26.1 MHz

3.5 DRM ENCODER MULTI-PROGRAM MULTIPLEXER:

S. No.	Parameters	Specifications
3.5.1	Input Characteristics	
a)	Audio input	(i) Analog Audio: Four (Stereo) (ii) Digital Audio AES/EBU: Four (Stereo)
b)	Impedance	(i) Analog Audio: 600 Ohm (ii) Digital Audio: 110 Ohm as per AES/EBU Standard
c)	Connector	XLR3 female
d)	Frequency	i) Digital Audio: sample standard from 22.05KHz. to 48 KHz. ii) Analog Audio: Maximum 20 KHz.
3.5.2	Output Characteristic	
a)	Output	MDI Ethernet
b)	Connector	RJ45 female
c)	Frequency	10/100 M bauds
d)	Remote Monitoring	Ethernet, RJ45 female 10/100 M bauds
3.5.3	General characteristics	
a)	Standard	As per relevant ETSI Standard
b)	Single frequency network (sfn)	Internal GPS Receiver/ External NTP Server.
c)	Mounting	19" Rack Mounting or integrated with the transmitter
3.5.4	Mains power supply	230V AC \pm 5%, 1 Phase, 50 Hz.
3.5.5	Environmental condition	
a)	Operating Temperature	0° C to 45° C
b)	Altitude	Upto 1000 Mtrs.

3.6 DRM DIGITAL MODULATOR / RF EXCITER:

S. No.	Parameters	Specifications
3.6.1	General Characteristics	
a)	Standard	As per relevant ETSI Standard.
b)	Transmission structure	COFDM, Analog AM
c)	Signal Bandwidth	4.5, 5, 9, 10, 18 and 20 kHz.
d)	DRM MODES	Modes A, B, C and D.
e)	Single frequency network (sfn)	Either Internal or External GPS receiver Or through NTP Server & 1 PPS time reference.
3.6.2	Input characteristics	
a)	Input	i) MDI Ethernet, ii) Digital Audio (stereo) AES/EBU. iii) Analog Audio (stereo), iv) RF GPS Analog v) RF Feed- back Analog.
b)	Input connector	RJ45 female, XLR3 female, SMC, BNC
c)	Frequency	i) MDI Ethernet: 10/100 M bauds. ii) Digital Audio Stereo: Sample Standard from 22.05 KHz. to 48 KHz. iii) Analog Audio Stereo: 20KHz. maximum. iv) RF Feedback: 50KHz. to 26.1 MHz.
d)	Impedance	i) Digital Audio Stereo: As per AES3 Standards. ii) Analog Audio Stereo: 600Ω. iii) RF Feedback: 50Ω iv) RF GPS: 50Ω
3.6.3	Output Characteristics	
a)	Output	Envelope, Phase modulated RF (A, Ø) or I, Q Base Band signal.
b)	Frequency	3.9-26.1MHz
c)	Connectors	Standard BNC and standard XLR connectors
3.6.4	Environmental conditions	
a)	Operating temperature	0° C to 45° C
b)	Altitude	Upto 1000Mtrs.
3.6.5	Mains power supply	230V AC ± 5%, 1 Phase , 50 Hz
3.6.6	Mounting	19" Rack Mounting or integrated with the transmitter

3.7	Professional DRM Monitoring Receiver	
3.7.1	Applications:	DRM/AM/SSB Reception, Modulation quality measurements, Modulation parameter measurements, two configurable alarm signals to trigger conditions (e.g. audio dropouts or field strength), Spectrum monitoring, logging of RSCI, RSCI output (compatible to ETSI TS 102 349 V1.2.1) via LAN, QoS(Quality of Service) monitoring, high accuracy field strength measurement.
3.7.2	Reference Oscillator accuracy	< 5ppm
3.7.3	Input Freq. range	100KHz to 27.4 MHz
3.7.4	Level measurement accuracy	±1dB
3.7.5	RF Data Band width	40 KHz, ripple 0.2 dB
3.7.6	DRM spectrum mask monitoring	within ±30 kHz
3.7.7	Input level	DRM decoding : – 110 to 20dBm In-channel IP3: + 15dBm (noise figure 15 dB) Out of band IP3; + 30dBm (noise figure 15 dB)
3.7.8	Phase noise at ± 20 Hz	-80dBc/Hz
3.7.9	Phase noise at ± 20 kHz	-130dBc/Hz
3.7.10	DRM Parameter according to ETSI ES 201 980 V2.1.1	4.5, 5.0, 9.0, 10, 18, & 20 kHz bandwidth Modes A, B, C and D, QAM 4, 16, 64, All code rates, EEP & UEP, Hierarchical modes and Simulcast modes.
3.7.11	Audio decoder	MPEG-4 AAC+SBR, HVXC+SBR, CELP+SBR
3.7.12	Monitoring	Field strength, Estimated signal-to-noise ratio Estimated delay spread, Estimated Doppler spread, Audio quality, Frequency offset
3.7.13	Display	Power spectrum, Channel impulse response, Field strength, Signal-to-noise ratio
3.7.14	Alarm	Two independent alarms(associated with relays) configurable to multiple trigger conditions: i) Spectrum mask violated above specified level ii) RF level below specified value. iii) S/N level below specified value iv) Audio dropouts above specified ratio v) Audio level below specified value vi) MDI errors above specified rate vii) Frequency offset above specified value
3.7.15	Interfaces	i) Headphones output with volume control ii) Built-in loudspeaker with volume control iii) Line output iv) Two relays output v) Ethernet 100 Base T-port vi) Two RS 232 connectors vii) Two USB 2.0 connectors viii)Antenna input N type female connector 50 Ohm ix) External loudspeaker output
3.7.16	Remote Control	GUI, RSCI & Web interface

3.7.17	Power Supply:	230V , 50Hz AC
3.7.18	Environmental Specification	Temperature range: 0-40 °C

Spec/XTE-SW/1003/1

SECTION - IV

(SCHEDULE OF REQUIREMENTS / PRICES)

AIR requires the following equipment / services as per technical specifications detailed under Sections I, II & III. The tenderer shall quote price of each item separately with necessary break-up details keeping in view the following:

- i. Make & Model of each item, to be indicated.
- ii. Indenter reserves the right to choose & decide the quantity of Equipments at the time of finalization of Tender.
- iii. All items mentioned in the Schedule under Essential Items from Sl. No. 4.1 to 4.11, will be taken in to consideration for ranking purpose where as all items mentioned in the Schedule under Spares and Optional items, at Sl. No. 4.12(a-u) will not be taken in to consideration for ranking purpose. However the tenderer must quote for all the items under the schedule of requirements.
- iv. Tenderers must comply with Para 1.0 of Section I of the Specifications while quoting for the schedule of requirements.

4.0 MAIN ITEMS:

S.No.	Equipment	Quantity
4.0	Transmitter and its associated equipment	
4.1	500 KW AM – DRM SW Transmitter having auto change-over facility for selection between three modes of operation i.e., AM, DRM and Simulcast along with all accessories and auxiliary equipments (as per section II and III)	1Set
(a)	DRM Encoder Multi-program multiplexer	2 No.
(b)	DRM digital RF Exciter/ Modulator	2 No.
(c)	Air Ventilation Units. Please refer to Para 2.1.11 (i) and (ii Sets) of Section-II.	1 Set
(d)	Liquid Cooling System with standby pump . Please refer to Para 2.1.11(iii).	1 Set
(e)	Air ducts, motorized close/open loop arrangements for fixing to AHU & weather proof Louvers for fixing on wall opening for inlet and outlet	1 Set
(f)	Self contained RF Drive Unit .	1 Set
4. 2	Mains Power Supply Distribution Panel for complete system	1No.

4.3	Dummy Load, Soda Water type 1000KW capacity with heat exchanger and Control Panel.	1 No.
4.4	Transmitters coolant heat exchanger unit.	1 Set
4.5	Complete installation material for all the above items S.I. No. 4.1 to 4.4 , including the cables etc. for the entire system including the extender cards. (Details to be enclosed)	1set .
4.6	Professional DRM Monitoring Receiver	2 No.
4.7	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 set
4.8	Operation and maintenance manuals for Transmitter and all associated Equipment (Please refer Para 1.6.1 of Section - I)	7 sets
4.9	Charges for factory inspection/Acceptance tests of 1No. of Transmitter by 2 AIR engineers including charges, if any, for arranging the power supply at 50 Hz for testing the equipment. (Please refer Para 1.11.1 of Section-I)	1 lot
4.10	Charges for testing and commissioning of 1 No. of Transmitters	1 lot
4.11	Any other Equipment required for the completeness of 1 No. of 500KW SW transmitting system (To be indicated with details)	1 set
4.12	Optional items & Spares:	
a	Charges for training of 6 AIR engineers for 10 working days at manufacturer's works.(Please refer Para 1.12.2 of Section - I)	1 lot
b	Solid state modulator transformer	1
c	Driver tube socket(If tube used)	1
d	PA tube socket (complete)	1
e	Solid state modulator modules	20
f	Spares for all switching systems	1 set.
g	Pre-driver RF amplifier module (Complete)	1
h	Motor for XTR. Water to air heat exchanger	1
i	Breaker/ contactor for solid state mod. Transformer	1
j	Driver spare tube (If tube used)	1
k	PA spare tubes	1
l	Additional Cards of each type for Transmitter Control system (List to be enclosed)	1 set
m	Additional Cards of all type for all R.F stages.	1set
n	Additional Cards of all type for all Audio stages from Audio processing to modulation encoding. (list to be enclosed)	1 set
o	Additional Ventilation Unit.	1 set
p	All variable vacuum capacitors used in one transmitter	2 each
q	All ceramic capacitors—25% of each type or minimum 1 each	1 lot
r	Frequency Synthesizer	1 No.
s	Discrete components like power transistors (MOSFETs), main I.C 's, Semi conductors & other special components.	1 set.

t	Spares for the dummy load	1 set.
u	Other items of spares recommended by the tenderer N.B.: 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.	1 set.

Spec/XTE-SW/1003/1

ANNEXURE - I

ACCEPTANCE TEST PROCEDURE FOR THE TRANSMITTER, ITS ASSOCIATED EQUIPMENTS AND INSTALLATION MATERIALS

1. General :-

1.1 The Transmitter along with its associated equipments and installation materials 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 transmitter manufacturer/contractor shall put up the equipment for Inspection / Testing and Acceptance of the Inspectors deputed by All India Radio, only after being satisfied themselves first that the equipment offered meets the stipulated standards and specifications.

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

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

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

2.1 Physical/Visual Inspection:

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

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

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

c) **Quality checks during manufacture:** The certificates issued by the transmitter manufacturer 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 has 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 inter-locking 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 will also be checked for proper operation.

d) Protective / Control Circuits of the Auxiliary Equipment:

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

2.3 Performance tests on the equipment:

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

a) The transmitter along with its associated equipment **as well as optional items such as spares mentioned in Section –IV, Schedule of Requirements** (excluding power supply cables and other installation materials), **shall be tested in the transmitter manufacturer's works**, 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, **as per ATP duly approved by AIR.**

The equipment shall be tested at the Mains Input voltage and frequency specified for the various equipment under Section - III . Alternatively, the equipment shall be tested at the voltage prescribed in Section III, at supply frequency available at the manufacturer's works subject to an undertaking by the tenderer that the equipment shall be successfully tested and commissioned by the OEM at AIR site at the Mains Input Voltage and frequency specified in this Document in Section – III.

b) After successful testing of the technical performance of the transmitter and its associated equipments as specified under Para 2.3 (a) above, Heat run test for 24 hours shall be conducted on the transmitter and its associated equipments at the transmitter

manufacturer's works as defined in per Para 1.11.2. (d) of Section-I of these specifications.

c) All the Sub assemblies / amplifiers / oscillators and modules etc, ordered as spares shall be tested in circuit at the transmitter manufacturers works and performance of the equipment shall be checked against the specifications. The various discrete components, ordered as spares, shall be checked physically / visually.

d) The remaining equipment (not covered under Para 2.3 (a) to 2.3 (c) shall be inspected for acceptance as per the specifications subject to successful testing of these equipments later at the AIR site against the technical parameters specified under Section - III of these specifications or the technical parameters claimed by the contractor whichever are better.

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(a) to 2.3(c) above, and the above equipment shall be tested at the set of SW frequency at AIR site.

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

The results of the various tests conducted at the transmitter 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 transmitter 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.

