REQUEST FOR PROPOSAL (RFP)

for

SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF TWO NOS OF 7.2 M C-BAND FULL COVERAGE ANTENNA TERMINAL & RF SYSTEMS

at

MCF, BHOPAL (M.P)

MASTER CONTROL FACILITY

HASSAN & BHOPAL

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3. MCF will not have any liability to any prospective Applicant/ Firm/ or any other person under any laws (including without limitation the law of contract, tort), the principles of equity, restitution or unjust enrichment or otherwise for any loss, expense or damage which may arise from or be incurred or suffered in connection with anything contained in this RFP document, any matter deemed to form part of this RFP document. MCF will also not be liable in any manner whether resulting from negligence or otherwise however caused arising from reliance of any Applicant upon any statements contained in this RFP.

4. The issue of this RFP does not imply that MCF is bound to select an Applicant or to appoint the Selected Applicant, as the case may be, for the services and MCF reserves the right to accept/reject any or all of proposals submitted in response to RFP document at any stage without assigning any reasons whatsoever. MCF also reserves the right to withhold or withdraw the process at any stage without intimation to all who submitted RFP Application.

5. MCF accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on the law expressed herein.

6. The bidder shall be System Integrator (SI)/OEM/any Authorized Agent / Vendor for OEM/SI or any organization / a limited company, private company or any agency capable of taking up works of such nature and magnitude.

7. MCF reserves the right to change/ modify/ amend/ cancel any or all provisions of this RFP document.

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1.0 Introduction

Master Control Facility (MCF), a Unit of Indian Space Research Organisation (ISRO), is nodal Centre for TT&C Operations of ISRO's INSAT/GSAT/IRNSS series of spacecraft operating from GEO/GSO Orbits during all phases of a Spacecraft Mission from Launch & Early Orbit Phase (LEOP) to on-orbit Phase till end-of-life de-orbiting Operations.

MCF plans to augment two TTC&R (Telemetry, Tracking, Command & Ranging) Full Coverage Antenna Terminal operating in C-Band at its campus located at N-Sector, Ayodhya Nagar, Bhopal.

Towards meeting above objective, Techno-Commercial Proposals are invited from OEMs /Vendors / Systems Integrators (Henceforth called bidders) for Supply, Installation, Testing & Commissioning (SITC) of Two Full Coverage Antenna (FCA) of nominal diameter about 7.2m, operating in C-Band frequency range, with Antenna Mechanical Structure and RF Transmit & Receive System along with associated interface elements & accessories.

The entire scope of work involving Supply, Installation, Testing and Commissioning of the proposed FCAs System is envisaged to be completed on TURN KEY basis, in about 10 months from the Effective Date of Contract (EDC).

2.0 Scope of Tender

The work to be carried out under this tender specification shall consist of the Supply of items, delivery at site, Installation, Integration, Testing, Commissioning and handover in approved working condition for two number of C-Band terminal at MCF, Bhopal in accordance with specifications and tender conditions.

2.1 End-to-End / Turn-key solution for supply, Installation, integration, testing and Commissioning of 2 Nos of integrated ground terminal at MCF-Bhopal, consisting of about 7.2m C-Band Circular Polarized 4-port (2-Transmit, 2-Receive) Full Coverage Antenna System with associated RF Transmit & Receive Systems.

2.2 Installation & Interfacing of the RF systems and associated electronics equipment's, etc. are to be carried out with professional craftsmanship and high quality interface elements & accessories.

2.3 Successful bidder shall submit Installation Report, Operation & Maintenance manuals, Test Certificates given by manufacturer, manufacturer's catalogues, original DVD / CD / Pen drive of the software, interface control documents etc. on completion of the Project.

2.4 Any application software as required for completion of the project shall be within the scope of this tender.

2.5 The M&C (Monitoring & Control) hardware and software is NOT in the scope of the tender. However, successful bidder shall demonstrate proper functioning of remote control interface of all the equipment's during installation. Bidder shall provide ICDs and related dependent files & drivers for M&C development.

2.6 Warranty of One-year to be provided as per the terms & conditions in Section-16.0.

3.0 General Instructions

3.1 Though sufficient care has been taken to provide as many details as possible regarding all aspects of the Project, it is the Bidder's responsibility to ensure that the information provided in the RFP is adequate and clearly understood. If in doubt on any aspect of the Project, Bidder may seek clarifications from MCF during bid submission period. Once bid is accepted based on the prices quoted, the successful bidder has to complete the entire scope of the work without any extra cost. Any claim for extra payment on the pretext that scope of the work was not understood at the time of bidding will not be accepted.

3.2 One set of Installation, Operation & Service Manual and Interface Control Document (ICD) to be provided with each supplied unit. The Successful bidder shall provide support and co-ordinate with MCF Team for the development of M&C.

3.3 **Proposal Instructions:** The proposal must consist of two parts,

Part-I: Techno-Commercial

a) Detailed Un-priced bill of material offered (Equipment and related accessories) along with make and model.
b) Data sheet / catalogue for the offered equipment.
c) Configuration diagram for the offered solution.
d) Compliance statement for all the specifications.
e) Documentary proof for meeting the bidder Eligibility criteria.
f) Commercial terms like taxes, duties, delivery schedule, payment terms, Warranty, Security deposit, and Performance Bank Guarantee (PBG) etc.
g) **Price / Cost / Financial information shall not be disclosed in Part-I (Techno-Commercial Proposal).**

Part II: Price Proposal

Price proposal shall consist of prices as per the tender deliverables. Priced bill of material to be uploaded in the Price bid.

Non-compliance to two-part instruction amounts to disqualification of the bid.

3.4 **Proposal Validity:** The bidder shall indicate the period of validity of this proposal, which shall be for at least six (06) months from the date of Bid opening. Bid subject to rejection for non-compliance to the validity as sought.

3.5 **Proposal Preparation Cost**: The cost of preparing proposal in response to the RFP shall be borne solely by the Bidder. The tendering of the RFP does not create any

financial or other obligations on part of MCF. The information contained herein is proprietary to Master Control Facility (MCF) / Purchaser, and shall not be used or reproduced, except for the purpose of responding to this RFP.

3.6 Purchaser (MCF) reserves the right to order for the whole system or a part of the system given in the RFP and also has the right to accept or reject the offer either fully or partly without giving justification or reason whatsoever.

3.7 Purchaser reserves the right to reject the offer for non-compliance to any specifications / requirement or lack of documents / proofs to substantiate the performance as per the specification / requirement.

3.8 Bidder shall mandatorily quote for the full system and optional items / accessories / add-on's in order to meet the specification. *The award of the contract will be based on overall L1 for consolidated items on which MCF chooses to place the Purchase Order.* **Partial bids will be rejected**.

3.9 The order shall be placed on successful bidder (OEM / System Integrator) and they shall be responsible to carry out the entire work.

3.10 Bidder shall consider all domestic taxes & duties applicable, while submitting the price-bid. The bid shall be evaluated on Total Landed Cost. While working out taxes & duties bidder shall consider following exemption certificates:

a) MCF shall provide Custom Duty Exemption Certificate (CDEC) under Notification No. 51/96 for imported components. The applicable Basic CD as of now is 5% + Social welfare charges.

b) MCF will be responsible for getting WPC license.

c) Quote on High Sea sales (HSS) basis shall not be accepted since this is the turn-key contract and all the responsibility lies with the successful bidder until completion of Installation, Testing and Commissioning at site.

3.11 Unit price shall be inclusive of Customs Duty and exclusive of GST.

3.12 Bidder shall submit the complete list of deliverables along with the techno-commercial offer. In technical bid, bidder shall provide the un-priced list of all the deliverables and quantity of each items. **Bidder to ensure that prices are not mentioned in the technical bid**. Bidder shall also note that wherever Unit of Measure (UoM) is "Lot/Set", breakup of item with quantity (if applicable) shall be provided. The bidder shall provide the list of all the deliverables with individual/split prices and same may be uploaded in the Price bid.

3.13 The Bidder shall clearly mention imported / indigenous components (un-priced list) in the technical bid in order to issue CDEC for the project.

3.14 With respect to RF equipment's, Interface elements, etc., Multiple Make & Models shall not be quoted. Change of Make/Model, post-submission of bids is not acceptable. Bidders are advised to comprehend the requirement of RFP and equipment specification while deciding on the make and model.

3.15 Only tender specific document to shall be uploaded.

3.16 The Bidder shall observe all the safety precautions for the safety of the labour and employees of MCF during execution of works. The Bidder shall arrange to obtain necessary insurance cover for its employees. Successful Bidder shall be responsible for the safety of the persons employed by them. Bidder shall adhere to department safety manual, which will be provided before start of installation.

3.17 The Bidder shall be responsible for injury to persons or equipment, damages to the property which may arise from omission or neglect of the Bidder and their employees whether such injury or damages arises from carelessness, accident or any other cause whatsoever, in any way connected with the carrying out of work.

3.18 The Bidder shall not employ any person who is prohibited by law from being employed for fulfilling obligations under this contract.

3.19 In case the successful Bidder does not adhere to the terms of the contract, MCF reserves the right to terminate the contract.

3.20 MCF reserves the right to check the progress of the work and adherence to the technical specifications etc. at any stage during the installation phase.

3.21 The party needs to provide compliance that all the devices which have Ethernet / IP based are free from all kind of virus/malware

4.0 Technical Requirements

4.1 The computer work station (MCF scope) will be connected to the integrated base band unit through LAN for satellite commanding & ranging operation. The integrated base band unit output will be terminated at patch panel and output will be 70 MHz that shall be up converted to L-band, and further up-converted to C-band and amplified by Linearized TWTA with BUC and transmitted through the Antenna to the satellite in the uplink chain.

4.2 In the downlink chain, the system shall receive the C-Band downlink from the satellite through Antenna, amplify this RF signal and down convert the C-band signal to 70 MHz and this 70 MHz will be patched at the patch panel. The integrated base band unit will be connected at patch panel & the computer work station (MCF scope) will be connected to integrated base band unit (IBU) through LAN/ communication network for telemetry & ranging data acquisition.

4.3 Bidder shall quote ***Commercial Off the Shelf*** **(COTS)** items only for the entire supply and shall not quote units under development. The offered products shall be a catalogued product with minimum 3-year field proven systems.

4.4 All the systems shall be field proven for 24/7 & 365 days of heavy duty operation without any deviation in the performance, Certification to this effect to be provided by the OEM.

4.5 All units having frequency conversions shall have internal reference along with the provision of external reference with auto-selection. All such units shall be connected to external reference.

4.6 Catalogue / Datasheet of the all offered items to be provided.

4.7 All the remote-controlled system/subsystem/units shall have Ethernet LAN interface with TCP/SNMP/SCPI protocol for the development of M&C and the same remote interface protocols shall be provided by the successful bidder. This terminal is being operated as unmanned, therefore all the configurable / selecting path, equipment's & system shall have remote control provision. The M&C hardware and software is **NOT** under the scope of the bidder. Bidder shall co-operate with MCF team during development of M&C in terms of providing M&C remote interface protocols & to demonstrate that individual units work for the M&C purpose.

4.8 All the interface/control cables of RF units for the M&C to be laid by the Successful bidder.

4.9 Individual unit factory test data to be provided along with the equipment at the time of supply as per the 13.4.4.

4.10 All the offered optional items for meeting the tendered technical specifications shall be clearly indicated in the technical bid. Part/model number of the optional items shall be provided. All the required optional modules shall be included in the pricing of the concerned equipment.

4.11 Blockage survey to be carried out and report to be submitted for site clearance before start of antenna foundation.

4.12 Extremely low loss cable (Preferable Cable Attenuation shall be ≤12 dB/100m at 1500MHz) to be provided from L-band Up-converter outputs (at RF Room) to Linearized Travelling Wave Tube Amplifier (LTWTA) input (at Antenna Hub) such that, it meets the EIRP requirement without compromising the performance including linearity & adjustability. However, the small length flexible cable of low loss may be used in the link wherever above cable cannot be used.

4.13 Extremely low loss cable ((Preferable Cable Attenuation shall be ≤13 dB/100m at 4200 MHz) to be used in the downlinks to connect C Band LNA output (@ Antenna hub) to C Band down converter input (@ RF room. However, the small length flexible cable of low loss may be used in the link wherever above cable cannot be used.

4.14 The distance from the proposed Antenna site to the RF room will be around 100 m at MCF Bhopal, this information may be used for planning the various waveguide/cable lengths such as Extremely low loss C-band & L-band cable, control cable, LAN cables etc.

4.15 Supply, laying and termination of screened flexible copper cable (1 No. for utility power and 2 Nos. for UPS power) of suitable rating for 02 Nos. of TWT amplifier

and one number of TLT at Antenna hub shall be provided by the bidder. (Refer Annexure-II)

4.16 Supply, laying and termination of screened flexible copper cable of suitable rating from the existing UPS power distribution board to RF racks (2 runs/rack) shall be provided by the bidder. (Refer Annexure-II)

4.17 Suitable lighting arrangements and additional power sockets/extension board of suitable IP rating at Antenna Hub to be provided. Power cables required for powering the equipment's/system at Antenna/Outdoor Hub to be provided

4.18 All electrical items including extension boards, power cables, power sockets & power chords shall be compatible to Indian standard. (All electrical items including cables shall be among CEPO approved Brands).

5.0 Site information

Table-5.1: Site Data

S/No.	Parameter	Description
1.	Location	MCF Bhopal
2.	City	Bhopal
3.	State	Madhya Pradesh
4.	Longitude	77.464°E
5.	Latitude	23.29°N
6.	Altitude	460m MSL
8.	Annual Rainfall	Annual 1090 mm, maximum rainfall in a day 120mm
9.	Temperature	4°C to 46°C
10.	GEO arc visibility	1º E to 148º East @ 5º EL Angle

5.1 Bidder may obtain permission to visit site of installation for site survey. The details mentioned above are based on site data available as per record. It will be bidder's responsibility to verify and update details of the site.

6.0 Customer (MCF) Furnished Items

On the part of MCF, the following support/facilities shall be made available to successful bidder.

6.1 Air conditioned finished built-up area for RF room will be provided for housing the RF equipment/system etc.

6.2 AC power supply required for RF racks and outdoor mount equipment's will be made available. AC power includes both Technical Power (Un-Interrupted Power Supply) 230V±1% single phase, 400V±1% three phase 4 Wire, 50Hz±1%, and Utility Power supply (Non-UPS supply) 230V±10% single phase, 400V±10% three

phase 4 Wire, 50Hz±5%. Utility power provided during installation shall be on chargeable basis.

6.3 The Baseband equipment's like GNSS Receiver will be provided by the purchaser (MCF).

6.4 Supply and laying of IF cables from Baseband (BBU) to RF Room (RF Rack) will be provided by the purchaser.

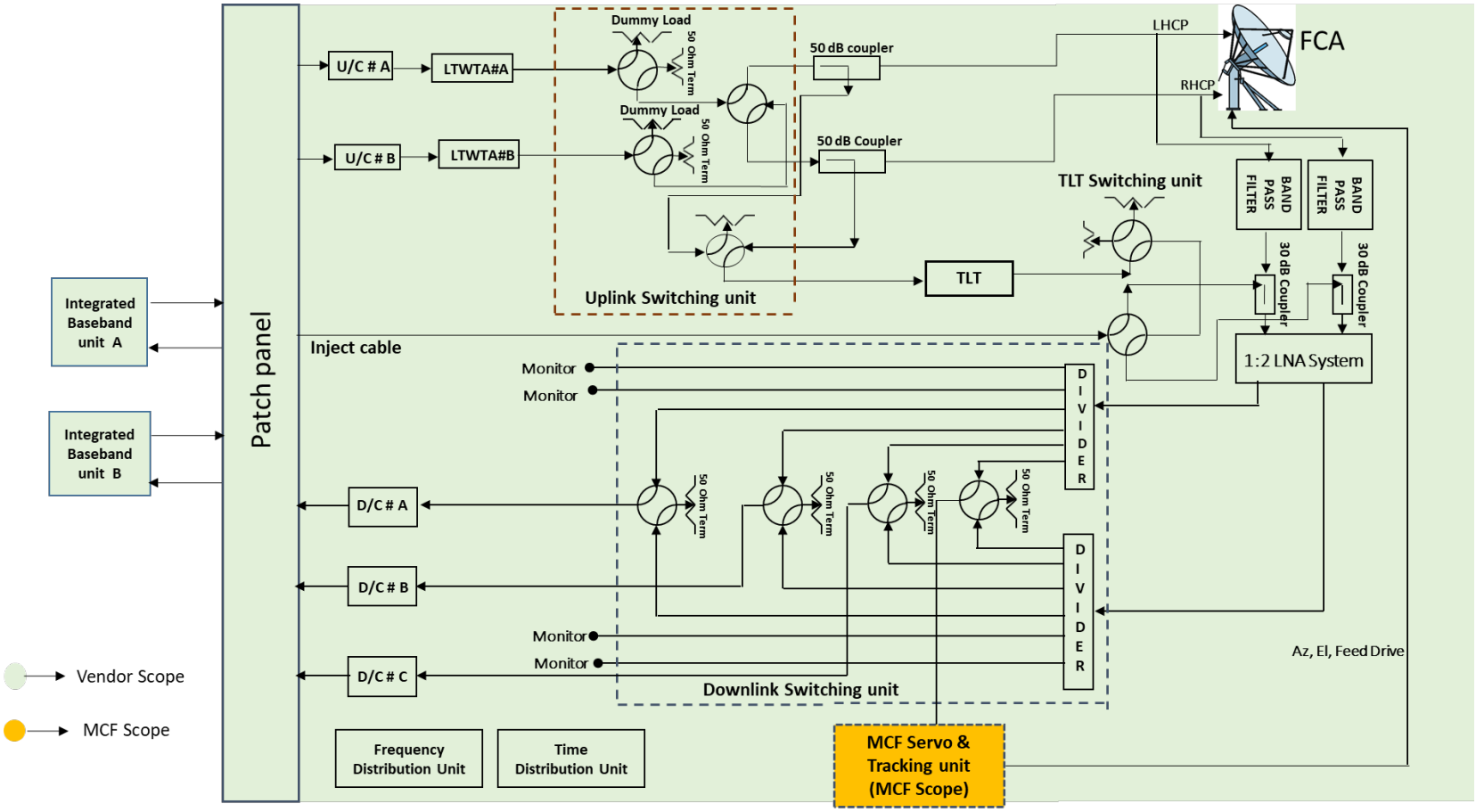
6.5 The Antenna Drive Control System, Beacon Receiver and Antenna Control Unit will be provided by the purchaser.

6.6 The M&C (Hardware & Software) will be provided by the purchaser for remote operation of all equipment. However, M&C interconnection is responsibility of the Bidder.

6.7 Onsite communication (phone and fax) for installation, test and co-ordination on chargeable basis based on local availability.

6.8 Space segment for carrying out the Required RF Testing.

7.0 Configuration requirements and Indicative Station Diagram



7.1 The indicative block diagram of the earth station is given above. However, bidder shall provide the detailed block schematic of the proposed configuration including interfaces indicating each of the subsystems/elements being proposed, in the technical bid.

7.2 The foundation shall be designed to meet the RF performance as per requirement /specifications.

7.3 Any other supply / work not specified but required to complete the project shall be in the scope of bidder, except for the Customer furnished items (Section-6). Bidder shall provide the system in "*Ready to use*" condition as per RFP requirement. The purchaser scope is indicated in the above diagram.

8.0 Order Quantities & Deliverables

Table 8.1 of the RFP provides the list of major deliverables (not exhaustive) for two antenna(FCA) system. Bidder to note that the offer needs to include all the items required to realize the station as per the required configuration and specifications.

Table 8.1: List of Major deliverables (not exhaustive) required for two FCA Ground Terminal

S/No.	Description	Quantity For 2 FCA	Units
1.	Full Coverage Antenna System (consisting of subsystem as in **Table-8.2**) with Civil Foundation & Cable Trench, fully compliant to the technical requirements as mentioned in RFP including Annexure-I.	02	Set
2.	Transmit System (consisting of subsystem as in **Table 8.3**) which is fully compliant to the technical requirements as mentioned in RFP including Annexure-I.	02	Set
3.	Receive System (consisting of subsystem as in **Table-8.4**) which is fully compliant to the technical requirements as mentioned in RFP including Annexure-I.	02	Set
4.	Baseband systems (consisting of subsystem as in **Table-8.5**) which is fully compliant to the technical requirements as mentioned in RFP including Annexure-I	02	Set
5.	Electrical system which is fully compliant to the technical requirement as mentioned in the Annexure-II	01	Lot
6.	Details on Implementation – Circuit, Wiring diagrams, photographs, Videos during various stages of installation, Training, Operational, and Maintenance Documents	02	Sets
7.	List of Major Spare items required for two FCA Terminals(As Mentioned in **Table 8.6**)	01	Set
8.	Any other things required for completion of the project.	As required	

Table-8.2: Full Coverage Antenna Systems with Civil Foundation & Cable Trench (not exhaustive) required for one FCA Ground Terminal

S/No.	Description	Quantity For 1 FCA	Units	Remarks
1.	Antenna Mount, Structural & Mechanical Motorized Drive Systems along with motors	01	Set	
2.	4-Port Feed System (02-Transmit & 02-Receive Orthogonal Port)	01	Set	
3.	Civil Trench of size 0.6mX0.6m (clear-space) with covering & cable hangers (two rows of cable hanger on either side of the trench with the hanger spacing of 0.5m) interconnecting Antenna with Earth Station Main Trench (to be quoted on per meter basis)	50	Meters	Payment will be based on actual length not exceeded 100 Meters for two FCAs
4.	Safety & Interlock Mechanisms	01	Set	
5.	Lightning Protection & Grounding	01	Set	
6.	Interface Elements	01	Lot	
7.	Antenna Foundation	01	Lot	

Table-8.3: Transmit System (not exhaustive) required for one FCA Ground Terminal

S/No.	Description	Quantity For 1 FCA	Units	Remarks
1.	C Band Outdoor LTWT Amplifier	02	Nos.	
2.	Remote control unit for LTWT Amplifier along with remote control cable of 100m length.	01	No.	
3.	Uplink & TLT Switching Network with Remote controller(As per Configuration)	01	Set	
4.	WR-137 High Power Dummy Load	02	Nos.	
5.	L-Band Up-Converters	02	Nos.	
6.	C- Band Test Loop translator	01	Set.	
7.	Outdoor Automatic Air Dehydrator	01	Nos.	
8.	Transmit W/G Plumb line etc.	01	Lots	
9.	WR-137 Waveguide Directional Coupler	02	Nos.	
10.	Interface elements	01	Lot	

Table-8.4: Receive system (not exhaustive) required for one FCA Ground Terminal

S/No.	Description	Quantity for 1 FCA	Units	Remarks
1.	1:2 LNA system with TRF and Inject Coupler	01	Set	
2.	C-Band Down Converters	03	Nos.	
3.	Band Pass filter	02	Nos.	
4.	Downlink Switching network with Remote controller	01	Set.	
5.	Low loss Interface RF Elements (Waveguide / Cables)etc.	01	Lot	
6.	WR-229 Waveguide Directional Coupler	02	Nos.	
7.	Interface elements	01	Lot	
Note: - Interface elements in each subsystem (Table-8.3 & Table-8.4) shall be treated as one set to meet the requirement.				

Table-8.5: Baseband Systems (not exhaustive) required for one FCA Ground Terminal

S/No.	Description	Quantity for 1 FCA	Units	Remarks
1.	Integrated Baseband System	02	Nos	
2.	Frequency Distribution Unit	01	Nos	
3.	Time Distribution Unit	01	Nos	
4.	Interface Elements	01	Lot	
5.	Standard Patch Panel with Jacks	01	Lot	
6.	Connectors, adaptors, cables for calibration	01	Lot	
7.	Integration material (Racks at least 1 no. for RF system & other hardware)	01	Lot	
8.	LAN Cable(CAT-6)	01	Lot	

Table-8.6: List of Major Spare items required for two FCA Ground Terminal

S/No.	Description	Quantity for 2 FCA's	Units	Remarks
1.	C Band Outdoor LTWT Amplifier	01	Nos	
2.	C Band Low Noise Amplifier	02	Nos	
3.	L Band Upconverter	02	Nos.	
4.	C Band Downconverter	02	Nos	
5.	C Band Test Loop Translator	02	Nos	
6.	Spectrum Analyzer	01	No.	
7.	SP12T Coaxial Switches	02	Nos.	
8.	Line Amplifier	04	Nos.	
9.	Spare Motors for Az and EL	02	Set	
10.	Ethernet-Based 24-Channel Digital I/O	10	Nos.	
11.	Absolute Optical Angle Encoder	10	Nos.	
	Compatible Power Cable for Encoder 5m	10		
	Compatible Encoder to Encoder EtherCat cable 5m	10		
	Compatible Encoder to EtherCat interface Cable 5m	10		

9.0 Bidder Qualification Criteria:

System Integrators or Original Equipment Manufacturers (OEMs) or their authorized representatives with following eligibility criteria are invited to bid for the project. The bids submitted by the System Integrators (SI) or OEMs or SI / OEM through authorized agent not meeting these eligibility criteria shall not be considered.

9.1 In order to provide a better understanding of the requirement, it is proposed to have a ***Pre-Bid Meeting*** with the prospective bidders before the tender sealing date either at MCF-Bhopal or through Web-based Video Conferencing. Attending the pre-bid meeting is mandatory for the bidder to become eligible for bidding. Bidders who attend pre-bid meeting will only be considered for tender evaluation. Pre-bid Meeting details are provided at Section-11.

9.2 For Tender download, as per the schedule, from the Purchaser website, Bidder shall mandatorily use registered login to become eligible for participation in pre-bid meeting and further submission of bid.

9.3 The Bidder shall be an Original Equipment Manufacturer (OEM)/System Integrator (SI)/an authorized agent on behalf of OEM/SI or an organization / a limited company/ private company, capable of taking up works of such nature and shall produce an undertaking from concerned OEM/s that the bidder is authorized to quote for this tender and will provide support and spares directly, if required, for the offered system (Major items) and also that the offered system (Major items) will be supported by the respective OEM/s for a period of **minimum** 08 years. The authorization shall be tender specific and addressed to the tender issuing authority.

9.4 The Bidder shall have at least 5-years of experience in installation and commissioning of ground station (of similar nature) for Satellite Communication. Bidder shall provide the details of Purchase Orders, Completion Certificates and completion schedule with relevant references/contact details that are executed by them to prove that the bidder has executed the project involving supply, installation & commissioning of the ground station. ***Submission of purchase order is not adequate to substantiate the experience. Satisfactory completion certificate from the customer is a must to substantiate the experience indicating the scope of work, duration of completion of work against the order, etc.***

9.5 **Relaxation to Micro, Small and Medium Enterprises:**

Offers will be evaluated and processed in accordance with relevant provisions of GFR-2017 (revised from time to time) and as per Ministry of Micro, Small and Medium Enterprises (MSME) Policy Circular No. 1(2)(1)/2016-MA dated 10th March, 2016. Following criteria is applicable for the bidders under this category.

i. Prior Experience is relaxed to 3-years in accordance with clause 9.4.

ii. Bidder shall provide relevant documents and Udyog Aadhaar Memorandum number, for availing the benefits available to MSMEs.

9.6 The bidder (OEM/SI) must submit customer satisfaction certificate with respect to the successful completion of installation and commissioning of at least two numbers of about 3.8 m or above size Antenna earth station (involving uplink, downlink systems & step track system). In case if bidder had not installed two numbers of about 3.8 m or above size Antenna earth station (involving uplink, downlink systems & step track system) then the bidder shall submit customer satisfaction certificate with respect to the successful completion of installation and commissioning of RF System of at least two numbers of about 7.2m antenna or above (involving uplink, downlink systems). In this case antenna installation should be carried out by the antenna OEM only(OEM should have experience of installation and commissioning of at least two numbers of about 3.8 m or above size Antenna).The bids not containing the successful completion certificate shall be treated as non-compliance and offer shall be rejected. Customer address and contact numbers are to be mentioned in the certificate for verification of bidder claim with regard to successful completion of the project. With regard to this the bidder need

to mandatorily fill up the following Table 9.1 with relevant information failing which the bid will be rejected.

Table-9.1: Details of Installed Antenna Terminals to be submitted by Bidder

SL No.	Customer name	Customer address	Antenna size	Freq. Band	Whether customer satisfaction certificate with regard to successful completion of installation and commissioning is enclosed (Yes/NO)	Delivery Schedule as per P.O	Time taken to complete the project after obtaining the order
1							
2							

10.0 Bid Evaluation Criteria

The technical bids will be evaluated based on the following parameters:

10.1 For this procurement, bids from Class-I and Class-II local suppliers are admissible and hence provisions contained in Public Procurement (Preference to Make in India), Order 2017 issued by Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industries vide letter No. P-45021/2/2017-PP(BE-II) dated 04.06.2020 and subsequent amendment & directives shall be followed. Accordingly, offer will be evaluated & processed in conformation with above referred GOI order. The bidder shall provide compliance and undertaking as per order and hereafter amendments:

a) '*Class-I local supplier*' means a supplier or service provider, whose goods, service or works offered for procurement, has local content equal to or more than 50%, as defined in the above mentioned order.

b) '*Class-II local supplier*' means a supplier or service provider, whose goods, services or works offered for procurement, has local content of more than 20% but less than 50%, as defined under this Order.

c) Verification of local content:

i. The '*Class-I local supplier*'/'*Class-II local supplier*' at the time to tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for '*Class-I local supplier'* / '*Class II local supplier*' as the case may be. They shall also give details of the location(s) at which the local value addition is made.

ii. In case bid value is in excess of Rs. 10 Cr., 'Class–I local supplier'/ 'Class-II local supplier' shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

iii. False declarations will be in breach of the code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules (GFR) for which a bidder or

its successors can be debarred for up to two years as per Rule-151 (iii) of the GFR along with such other actions as may be permissible under the Law.

iv. A supplier who has been debarred by any procuring entity for violation of above referred GOI Orders shall not be eligible for preference under this order for procurement by any other procuring entity for the duration of the debarment. The debarment for such other procuring entities shall take effect prospectively from the date on which it comes to the notice of other procurement entities, in the manner prescribed.

10.2 Bidder has to exclusively mention percentage of local content against each line item in order to evaluate '*Class–I local supplier*'/ *'Class-II local supplier*' criteria. **Party to note not to mention absolute value of price in technical bid.** Party shall arrange certificate from the auditor for establishing claim for 'Class–I local supplier'/ 'Class-II local supplier' as per the MCF-Requirement.

10.3 Bidder shall meet all the tender specifications. Bidder shall mandatorily provide point-wise compliance to all the sections/ paragraphs of the RFP. Bids without compliance statement will be rejected.

10.4 To substantiate the compliance, bidder needs to provide supporting document/ catalogue without which bid will be considered non-compliant. Catalogue/ document must contain the relevant information/specifications as required. If the required specification is not mentioned in the catalogue/datasheet, then OEM certification for such specification shall be submitted.

10.5 Bidder shall offer only standard and catalogued product for all major elements / components of the system like Antenna system and feed , L-Band Up-converter, C-Band Down-converter, C Band Outdoor LTWT Amplifier , Low Noise Amplifier (LNA) system, Test Loop translator, Spectrum analyser, Outdoor Automatic Dehydrator, Integrated Base band System, Frequency distribution unit, Time Distribution Unit, Waveguide and Coaxial Components etc. If the above offered items / systems / equipment's are under development / to be developed the bid will not be considered. With regard to this, the bidder needs to mandatorily fill up the following Table 10.1 with relevant information failing which the bid will be rejected. In case for Antenna Feed System which is developed and not supplied to anywhere, performance to be demonstrated towards specification compliance at Vendor facility within two weeks after bid-sealing. Only based on satisfactory performance evaluation, the offer will be considered qualifying for further processing. Offers of Bidders who fail to demonstrate performance within stipulated timeline will be summarily rejected.

Table 10.1: Offered System Details to be submitted by Bidder

SL No.	Unit	Make	Model	Catalogued product (Yes/NO)	Designed and developed (Yes/NO)	Under development (Yes/NO)	Whether technical catalogue/brochure enclosed (Yes/NO)	Where this unit is being used. Address of User to be provided
1.	Antenna System							
2.	Antenna Feed							
3.	Diplexer of Antenna feed							
4.	C Band Outdoor LTWT Amplifier							
5.	L Band Up-converter							
6.	Outdoor Automatic Dehydrator							
7.	C- Band Downconverter							
8.	1:2 Redundant LNA System							
9.	Test Loop Translator							
10.	Integrated Base band System							
11.	Frequency Distribution Unit							
12.	Time Distribution Unit							
13.	Spectrum Analyzer							
14.	Waveguide Components							
15.	Coaxial Components							

10.6 Bidders shall mandatorily quote for the full RF system required for ground terminal. Partial bids will not be considered.

10.7 Bidders shall participate in technical discussion, post-bid submission on the offered system at MCF-Bhopal, if called for.

10.8 **Certificate of compliance:** A certificate for line-by-line compliance to the requirements asked for in the tender specifications shall be provided by the bidder. The tender can be rejected if line by line compliance is not provided.

10.9 For a single item, multiple 'Makes' shall not be offered. Make and model numbers shall not be changed once the bid is submitted.

10.10 For equipment, brands/makes listed in the following Table 10-2 shall only be offered.

Table-10.2: Major Equipment Brand Options to be offered by the Bidder

S/No	Equipment	Make
1.	Up-converter & Down-converter	Comtech EF-Data, Narda-Miteq, Work Microwave, GEOSYNC Microwave, CPI/Vertex RSI
2.	Test Loop Translators	Bonn Hungary, Work Microwave, GEOSYNC Microwave, Cross technologies
3.	1:2 Redundant LNA System	Comtech EF-Data, Narda-Miteq, CPI/Vertex RSI

4.	C Band Outdoor LTWT Amplifier	Communication & Power Industries (CPI) and Comtech Xicom Technologies
5.	Integrated Base band System	Safran data systems , Kratos Integral system
6.	Frequency Distribution Unit and Time Distribution Unit	Precise Time & Frequency (PTF), Time-Tech , End-run Technologies.
7.	Spectrum Analyser	R&S, Keysight, Anritsu
8.	Ethernet-Based 24-Channel Digital I/O	Measurement Computing,
9.	Absolute Optical Angle Encoder	Hengstler
10.	Electrical Cables, Distribution Board & Accessories	CEPO Approved Brands as mentioned in the Annexure-II

11.0 Pre-Bid Meeting

11.1 It is proposed to have a pre-bid meeting with the bidders either at MCF-Bhopal or through video-conferencing. In case of video-conferencing mode the link will be shared through clarification widow on the portal. It is Bidders responsibility to communicate participation in the pre-bid meeting through tender clarification window on the portal along with tender related clarifications required, which will be addressed during the pre-bid meeting and details of the officials authorized to participate in the pre-bid meet. Requests received for participation in the pre-bid meeting through portal shall only be allowed to participate in the pre-bid meet and link for video-conference shared through the portal clarification window. During the course of the pre-bid meeting any new clarifications, other than communicated earlier through the portal shall also be entertained. No clarification on the Tender shall be entertained beyond Pre-Bid meeting. It is mandatory for bidders to participate in Pre-bid meeting. Bidders who do not attend the meeting shall not be qualified for evaluation.

11.2 Bidders attending pre-bid meeting, shall prepare techno-commercial clarifications and questionnaire w.r.t the tender only.

11.3 Bidders who are desirous to attend the meeting may provide details of the team attending the meeting well in time. Team shall consist of technically & commercially competent personnel.

11.4 Refer bid schedule for pre-bid meeting.

12.0 Delivery / Completion Schedule

12.1 The delivery/completion schedule for both the Ground Terminal is 10-months from the date of purchase order. Bidder shall provide detailed project completion schedule along with milestones like supply of hardware/software, installation, testing & acceptance etc. in the technical bid.

12.2 Detailed delivery schedule specifying the timelines and milestones starting from acceptance of purchase order, procurement time, Supply, Installation, Commissioning and Testing shall be provided.

13.0 Meetings & Reviews

In the event of an award of the purchase order/contract, the bidder shall adhere to the following technical meeting and review requirements that are necessary for total understanding and successful execution of the project.

13.1 Technical Interface Meeting (TIM)

13.1.1 The successful bidder in his own interest is free to organize Technical Interface Meetings with MCF, to facilitate developmental activities and clarify interpretations of MCF requirements. Further, the bidder is obliged to arrange technical Interface Meeting through audio/video conferencing with MCF for exchange of information and review of progress when called for. These meetings could also be held as pre-design reviews and address all open issues associated with design implementation and installation.

13.1.2 Periodic Progress Report after placement of order throughout the project period till completion to be submitted to MCF. Apart from this successful bidder need to submit the status/test results as and when MCF seeks.

13.2 Preliminary Design Review (PDR)

13.2.1 A detailed preliminary design review (PDR) shall be held at MCF, Bhopal within two months from Effective date of contract (EDC) / Award of Contract.

13.2.2 The PDR will be the first major review of the detailed design after release of Purchase Order and the design shall be submitted within two months of signing the contract/Purchase order (PO) date.

13.2.3 The PDR shall discuss, among others System Engineering aspects, Ground Station configuration design, Installation plan & methodology, Operations plan, Test & Measurement plan, Acceptance Test Procedures (ATP) etc.

13.2.4 This review shall address the high-level design of the system, mapping the system requirements to a preliminary System Description Document (SDD). The SDD shall be delivered in book form (03 copies) & also in softcopy at

least two weeks before PDR. The venue of PDR shall preferably be MCF, Bhopal or mutually agreed upon place.

The SDD shall, at a minimum include:

i. System Overview.
ii. General architecture with proposed hardware and software modules at Sub-system level.
iii. Design considerations and design details of major subsystems like antenna pedestal, (Civil, Electrical, Safety etc.) foundation design, antenna mechanical systems consisting of mount, reflector, sub-reflector, antenna feed, electronic systems, etc. shall be discussed during PDR.
iv. Analysis on wind torque, drive torque, stiffness, locked rotor frequency analysis of antenna structure including mount, reflectors, quadripod/ tripods etc.
v. Performance analysis of major requirements and specifications like G/T, EIRP, pointing accuracies, surface accuracies, efficiency etc.
vi. Material specifications, mass properties, inspection and testing.
vii. Complete Mechanical details (FE Analysis for antenna assembly and support structure against RF specification etc.).
viii. Safety and security engineering considerations including ladders & railing, limits, brake system, lightning arresters etc.
ix. List of deliverables including document
x. Detailed activity schedule highlighting completion of major milestones.
xi. Detailed Project management plan.

13.2.5 The specification document shall be revised and firmed-up by the Successful bidder based on the discussions and decisions during PDR. This finalized document shall be the base-line document for the entire contract and shall be binding on the Successful Bidder.

13.2.6 It will be mandatory for the Successful bidder to close all actions generated during the PDR. Closure of actions will be without impact on cost.

13.2.7 The PDR Committee shall be formed by Purchaser. The committee shall carry out the evaluation process based on the design details provided/presented during the PDR review and will provide necessary recommendations. This report shall form the basis for the successful bidder to proceed with the manufacturing process. In response to the recommendations contained in the PDR report, the successful bidder shall provide a PDR Closeout Report within one month from date of PDR.

13.2.8 The PDR process is intended to serve as an interim step in the design consideration where the successful bidder commits that the proposed design

is meeting the RFP requirement. However, the final acceptance will be based on compliance of the total RFP specifications in entirety.

13.3 Critical Design Review (CDR)

13.3.1 After the completion of the manufacturing process and necessary tests the successful bidder shall conduct a CDR with a complete and comprehensive presentation of the entire task involved and shall formally submit the complete test results. Products, system safety, problem areas and security issues shall also be discussed during CDR. The probable venue for the CDR shall be mutually decided.

The CDR Committee shall be formed by Purchaser. The committee shall carry out the evaluation process and provide relevant recommendations. Completion of CDR and resolution of all action items generated by it constitutes the final implementation process for the entire project.

13.4 Test Plan & Procedures Preparation

13.4.1 Successful bidder to prepare detailed Test Plans and Procedures, including Test Matrix, for all levels of test and acceptance (Factory acceptance, in-plant acceptance, site acceptance tests etc.) and take approval from MCF. The verification test plan will be a comprehensive plan that comprises of tests for verifying overall system and individual sub-system specification, performance and requirements, including hardware and software elements, at different stages of the entire program.

13.4.2 The tests will be organized and conducted by the successful bidder with the participation of representatives designated by MCF. Arrangement of required test and measuring equipment and verification of its calibration status shall be the responsibility of the bidder. The final site acceptance testing will be conducted under the supervision and guidance of a Test and Evaluation Committee appointed by MCF.

13.4.3 The test program shall be implemented to cover full compliance to contract specifications. Each test shall provide a brief description of the method of testing and a block diagram of the intended test configuration. Test procedures shall also include the list of equipment and its calibration status. Test results shall be documented in test data sheets. The test procedure shall be written in sufficient detail to ensure repeatability.

13.4.4 Factory Acceptance Tests: Factory Acceptance Tests shall be performed by the successful bidder on major functional areas or subsystem, which includes hardware and software. Factory Acceptance Test shall be carried out for Antenna Feed System/ full proof assembly, at OEM premises. Individual unit factory test data to be provided for frequency converters,

Integrated Base band System, Test Loop Translator, LTWTA, Frequency Distribution Unit, Time Distribution Unit, LNA system, Spectrum analyzer along with the equipment at the time of supply. Bidder shall ensure that the tests are performed as per the approved plan and make available the Test Reports for verification and approval from the Purchaser. Purchaser will have the option of witnessing the tests at the bidder's or its associates' premises. The costs of participation of Purchaser's personnel at the bidder's or its associates' premises shall be borne by Purchaser. The place of performance of these tests may mutually be decided based on the factors like place of fabrication, transportability etc. Purchaser reserves the right to identify a third party at a later stage for certification of FAT.

13.4.5 Successful Bidder to organize system/sub-system performance tests during installation phase. Purchaser reserves the right to inspect the progress of the project at any stage such as installation, testing and commissioning activities to become familiarized with the system.

13.4.6 **Integration Tests**: Subsequent to successful completion of installation & integration, the successful bidder shall perform functional and end-to-end integration tests for verification. Successful bidder shall ensure that the tests are performed as per the approved plan & procedures. The integration testing shall take place at the site of installation jointly with the participation of MCF representatives. The test procedures and the results will be reviewed and validated by purchaser/MCF.

13.4.7 During this period Successful Bidder shall demonstrate satisfactory real time performance of the complete system by performing actual tracking and TTC operations with selected spacecraft. MCF shall be responsible for identifying the spacecraft and also for obtaining necessary permission and authorization, if required, for carrying out this task.

13.4.8 Successful bidder shall provide a Commissioning Plan detailing the activities planned to be performed. At the end of the commissioning phase Successful bidder shall submit a Commissioning Report detailing the tasks performed and the performance of each subsystem as detailed in the contract.

14.0 Installation, Commissioning & Testing

14.1 It shall be noted again that supply, installation and commissioning of the system with all accessories, auxiliaries and any item not covered in the specification but essential for proper installation, operation and maintenance of ground terminal shall be included and executed by the successful bidder.

14.2 Delivery schedule specifying the milestones starting from realization of the elements, assembly, pre-delivery test at manufacturer's site and schedule of

installation and commissioning once the site is ready shall be provided by the bidder.

14.3 Successful Bidder shall offer for Factory acceptance test for major system before delivery to site.

14.4 Final acceptance of the equipment's/systems will be done at MCF, Bhopal.

14.5 Successful bidder shall demonstrate all the features of the equipment mentioned in the technical specifications.

14.6 Successful bidder is solely responsible for the installation, commissioning and making the system operational at MCF.

14.7 **Site Acceptance Testing:** Successful bidder shall develop detailed Acceptance Test Procedures (ATP) and conduct detailed Acceptance Test for verification of performance and requirements of all parts of scope of work (Including Civil, Electrical, Mechanical, RF, etc.). All the test procedures will be traced back to the specifications and requirements. Acceptance Testing will be conducted at the installation site in presence of Purchaser's representative/team. Successful bidder shall ensure that the tests are performed as per the approved plan and procedures. Successful bidder is responsible for making available the necessary test and measuring equipment required for the tests and documentation including test results, observation and analysis. MCF shall appoint a Test and Evaluation Committee and the Acceptance Testing shall be conducted under the supervision of this committee.

14.8 **System Commissioning and Demonstration:** After successful completion of acceptance testing of the system, the commissioning phase shall begin. During this phase, Successful bidder is required to perform regular operation of the complete system in presence of MCF/purchaser personnel. This phase will also be used for training the personnel for hands-on operation and maintenance activities.

14.9 Site Readiness:

14.9.1 Preparation of the sites in terms of electricity and furniture shall be arranged by the MCF. However, the electrical load, RF system, civil foundation for antenna mount, antenna center point, true north referencing, grounding, etc. shall be the responsibility of the Successful bidder.

14.9.2 Civil trench of size 0.6mX0.6m (Clear space) with covering & cable hangers (Two rows of cable hanger on either side of the trench with the hanger spacing of 0.5m) to be made to connect to the existing trench point shall be the responsibility of the successful bidder. However, cost of trench shall be quoted in per meter basis.

14.9.3 The requirement related to electrical supply like DB's on UPS and short break power supply with fuses and RCBO for all the out goings (Refer Annexure-II). Shall be included in the technical bid.

14.9.4 Any incidental minor civil works will be the responsibility of the Successful bidder.

14.10 Transportation/Logistics

14.10.1 Successful bidder shall be responsible for the safe transportation/ delivery of total system to actual site at MCF Bhopal and shall include clearance of imported equipment's from the customs.

14.10.2 Successful Bidder shall also be responsible for all logistic arrangements like, Custom clearance, boarding/lodging for the installation-team/ operational person of the bidder, etc. No Cost shall be borne by the Purchaser except the Customer furnished items (section 6).

14.10.3 **Documents:** During installation & commissioning, successful Bidder shall provide hard & soft copies of operations, maintenance & service manuals of all the equipment used. Successful bidder shall provide station configuration document in English consisting of

- List of equipment used
- Integration Test documents
- Configuration diagram
- Cabling diagram
- Level diagram
- Interface control document (ICD)
- Interface detail etc.

14.10.4 The successful bidder shall provide individual factory test documents of all the major equipment.

14.10.5 The successful bidder shall provide the original DVD/CD/Pen drive of the required software.

14.10.6 The successful bidder shall deliver all the technical documentation that explains the theory of operation, OEM data sheets, system description, system integration, interface control, installation, operation, troubleshooting, maintenance etc., along with a complete comprehensive wiring/cabling and interface schematics of the entire earth station as required for the user. All the communication and documentation shall be in common and usable English.

14.10.7 Successful bidder shall provide the actual factory test-data/reports for all major sub-systems like Antenna, Feed system, LNA system, LTWTA , up converter, down converter, Spectrum Analyzer, Integrated Base band System , TLT, FDU, TDU, Waveguide & Coaxial Components etc. to MCF.

14.10.8 The successful bidder shall supply hard and soft copy of operation and maintenance manual in duplicate to MCF during installation. All necessary literature giving complete details shall be provided.

14.10.9 One set of installation, operation, service manual and Interface control document (ICD) to be provided with each supplied unit. The Successful bidder shall cooperate with MCF team for such integration.

14.11 Performance and Training:

14.11.1 All necessary tests shall be carried out at MCF Bhopal by the successful bidder to demonstrate whether performance of the system conforms to the specifications and meets the functional requirement indicated in the specifications.

14.11.2 Necessary training w.r.t. system configuration, operation, trouble-shooting and maintenance shall be provided to MCF team at MCF Bhopal.

i) System Training

The system-training program must address the following objectives.

a) Subsystem and equipment configuration
b) Subsystem and equipment operation
c) Subsystem interconnection and interfacing
d) Procedures for installation
e) Fault-diagnosis

ii) Operations and Maintenance Training

Operation and maintenance-training program must address the following basic requirements.

a) Configuration
b) Subsystem operation and maintenance.
c) Fault-diagnosis and corrective maintenance
d) Emergency procedures
e) All operational procedures

15.0 Delivery / Payment Terms:

15.1 **Delivery Terms**: The Price shall be on FOR DESTINATION (MCF, Bhopal). In case of imports appropriate INCOTERM shall be used for logistics.

15.2 Taxes and Duties applicable and payable shall be indicated separately (Refer section 3.10 for applicable Taxes/Duties).

15.3 **Payment Terms:** The Successful bidder will be paid at different milestones of the project appropriately. The details of the payment are as follows:

15.3.1 Max. of 15% of order value of Purchase order except the service as advance payment after PDR against Bank Guarantee.

15.3.2 Max. 55% of supply value + 100% Taxes & Duties on pro-rata basis (restricting to 5 bills or claims) on supply of items at site and production of invoice.

15.3.3 10% of supplies value after successful integration of systems at site.

15.3.4 Balance 20% Payment for supplies and 100% payment of services after successful commissioning and acceptance of entire system and submission of PBG.

15.4 **Security Deposit:** 3% of the total order value to be deposited in the form of BG/DD/Cash as security deposit within 15 days of Contract/PO date to ensure faithful execution of work. If Successful bidder fails to execute the order, this amount will be forfeited for non-adherence to contractual terms. This shall be valid till the date of acceptance with a claim period of two months. The validity shall be extended in case the delivery period is extended.

15.5 **Performance Guarantee:** The successful bidder shall guarantee satisfactory performance/ operation of the commissioned system under the conditions and for the services specified during the Warranty period. As a performance security, the successful bidder shall furnish Performance Bank Guarantee (PBG) for an amount of three percent (3%) of the total order / contract value from a Scheduled Bank, valid till the end of warranty period with a claim period of two months.

16.0 Warranty

16.1 Successful Bidder shall provide standard on-site warranty for minimum one year from the date of final acceptance of the entire system/network in total based on certification from purchaser.

16.2 Successful Bidder shall provide contact details of focal point of maintenance team which will receive the complaints from the user and resolve the problem within the stipulated time during contract period. The maintenance of the system shall be carried out by the successful bidder for 1-year standard warranty period. The warranty shall be for the entire system under this contract.

16.3 Successful Bidder shall be fully responsible for the manufacturer's warranty in respect of proper design, quality and workmanship of overall hardware, software, accessories, etc., covered by the offer. The successful bidder must cover warranty for all hardware equipment, software, accessories, etc., against any manufacturing defects/malfunctioning during the warranty period. During the warranty period the successful bidder shall maintain the critical hardware, software, accessories, and repair / replace all the defective components and software elements at the installed site free of all cost to the department.

16.4 The successful bidder should ensure that the defect in the system reported on any working day is attended to within 15 working days from the date of reporting.

16.5 Repair to be carried out at the installed site only. In case, the system or any equipment cannot be repaired at the installed site, Successful bidder can take the equipment outside MCF either by providing bank guarantee for the particular faulty unit or by providing suitable replacement. Bank guarantee / replaced unit will be released after the faulty unit is brought back to MCF in working condition.

16.6 If faulty equipment is not repairable at the installed site, the bidder shall provide the replacement unit till the system/equipment is returned duly repaired and take the defective unit to the service centre. Successful bidder shall replace the faulty unit/equipment with equivalent/higher model meeting the required specifications at no extra cost and ensure that it gets integrated with the system seamlessly. Consent from MCF shall be obtained before replacement of faulty unit/equipment.

16.7 MCF reserves the right to get defects rectified through another agency (Department prescribed due process will be followed) in the event of failure to provide services by successful bidder within a reasonable period, Such Cost shall be charged to the successful bidder. This shall not affect the liabilities of the bidder on the warranty for its remaining period.

Section: 17.0: Overall Major Mandatory Specifications

(The system to be built on the Guiding specifications provided in Annexure-I)

17.1 Antenna System Specifications

S.No.	Item description	Specification
Mechanical System Specifications		
1	Antenna Type	Transmit & Receive Antenna system having Cassegrain geometry with shaped reflector.
2	Antenna Size	7.2m to 7.6m Diameter **Note:** Bidder to specify the proposed antenna diameter in its technical bid.
3	Antenna Mount	Elevation Over Azimuth.
4	Panel surface accuracy Main dish: Sub reflector	 Better than 1 mm (RSS) Typical Better than 0.5 mm (RSS) Typical In-order to meet G/T, figures are indicative
5	Pointing Accuracy (75 Kmph wind speeds)	Better than $1/5^{th}$ of Half Power Beam width
RF Specifications		
6	Feed type	4-Port Frequency Reuse CP feed having 02-orthogonal Transmit & 02 orthogonal Receive ports
7	Operating Freq. Transmit Receive	 5850-6450MHz 3625-4200MHz
8	Gain at Feed Point Transmit Receive	 47.5 dBi +20 log (f_{GHz}/4) or better 51.0 dBi +20 log (f_{GHz}/6) or better With antenna efficiency of 60% min.
9	G/T at 5 deg. Elevation	25.5 dB/ K (or better) at 4 GHz with 1:2 LNA Systems and BPF
10	VSWR at feed flange	1.35:1 (or better) in both receive and transmit ports of both bands
11	Axial Ratio within 1- dB beam width	0.5 dB in Receive and Transmit Bands
12	Feed Insertion Loss	To be provided by bidder. (Shall meet EIRP and G/T specifications)
13	Tx. To Rx. Port Isolation	85 dB min
14	Isolation Rx. /Rx. & Tx. /Tx Port	 17 dB min
15	Radiation Pattern	Shall conform to ITU– R S.580-6.
16	Interface Transmit Receive	WR 137 WR 229 (Standard 1:2 LNA system interface)
17	Power Handling Capability	Better than 1 KW CW per port in Transmit Continuous operation.
Drive System Specifications		

18	Drive	Suitable VFD Compatible Induction motor should be provided for AZ (with brake) and EL. Both motor shall be of IP65 Standard.
19	Max. drive speed	0.4 deg/sec in AZ and 0.2 deg/Sec in EL axis at rated motor speed
20	Antenna Coverage Elevation Azimuth	 0 to 90 Deg. 360 Deg. Continuous The azimuth coverage shall be 360 deg continuous as design, but at site will be limiting the movement by considering the limit switch and cable wrap.
21	Az Drive configuration	Gear & Pinion drives with mechanical anti-backlash system with provision for anti-backlash adjustment.
	EL Drive configuration	Screw Jack (Auxiliary support to be provided for maintenance of online screw jack, which can be either fixed or variable length)
Environmental Specifications		
22	Wind speed	75 Kmph Operational, 100 Kmph Gusting, 150 Kmph Survival
23	Operational temperature	0° to 50° C
24	Relative Humidity	0 to 100 % with condensation
25	Corrosion	Appropriate protection against salinity and other corrosive contaminants to be provided.
26	Rain	100 mm / hour continuous
27	Shock and Vibration	Shall withstand shocks and vibrations encountered during transportation and operations.
28	Total life and support	The antenna and its equipment shall be supported for trouble free operational life of 10 years minimum
29	Safety Features for mechanical system	Hand cranking facility Flexible Couplings These features are indicative, others working safety features to be included
30	All the exposed surface of the antenna structure to be galvanized.	
Antenna and Feed System Safety		
31	Auxiliary drive	Hand cranking facility for both the Az. and El axis.
32	Emergency Stop Switches	Shall be deployed at all the critical antenna locations to inhibit the drive in the event of emergency. Viz., at Az. Cone, at El platform
33	Limit switches	Two levels of limit switches in Az , El to be provided.
34	Lightening arrestor	Lightning arrester assembly conforming to the latest safety standards shall be provided and earth resistance should be less than 5 ohms or as per latest safety standard. Suitable no of earth pits shall be provided to meet the requirement. Minimum two numbers of lightning down-conductors (Insulated Copper Cable of min 35 sq. mm) to be provided and connected to the earth pit. These cables to be supported on insulated

		supporters. Suitable test link to be provided. Slip ring arrangement for bypassing azimuth bearings and suitable cable loop for elevation bearing bypass shall be provided. Antenna body to be earthed minimum at two places with minimum two Earthing.
35	Operator safety	Approach ladder with built-in safety measures to provide access to the El. Platform & Reflector surface. Safety railings around the elevation platform.
36	Ground clearance	At an elevation of 0 deg. The antenna reflector shall have a sufficient safe clearance from the ground level.
37	The antenna mount structure shall be maintenance-friendly & all parts are easily accessible for maintenance purpose.	
38	Provision of Hatch door to access the main reflector & accessing the sub-reflector is desirable.	
39	The Antenna Hub shall have sufficient clear internal space to accommodate equipment like 02 nos. of LTWTA , LNA Complex, TLT, in-line couplers (In Tx & Rx) and uplink switching with High power Termination. In case, if required provision should be there for mounting LTWTA outside the hub with suitable rain protection system. Preferable size of Hub-diameter: 1850mm and height: 1200mm. Exhaust fans & fresh air inlet louvers/perforations to be provided in the hub for proper air circulation. Hinged & lock type hub cover to be provided.	
40	**Pedestal Assembly:** The pedestal assembly shall be made of steel & suitably designed considering antenna load factors. Provision shall be made for mounting azimuth encoder, rotary joints, cable routing. The internal space shall be sufficient to accommodate personnel entry. Suitable personnel entry door, standardized cable entry & exit ducts and power distribution system shall be provided.	
41	Platform: Suitable working Platform shall be provided to enable ease of access to the RF equipment located inside and outside the reflector hub and to the azimuth and elevation drive. The platform shall have access ladder and safety hand rails. The platform shall be rigid enough to sustain point load of 120 Kg.	

17.2 Special Instructions on Antenna system

i. The antenna foundation and load analysis breakup to be provided along with the quote.
ii. Appropriate hand drive scheme with built in safety interlock mechanism for both axes to be provided.
iii. It is desirable to mount Angle encoder (Angle pick-up) on-axis.
iv. All parts exposed to the environment shall be coated with anti-corrosive, protective coating.
v. Feed bearing shall be protected against entry of water.
vi. G/T and EIRP at specified frequencies to be computed and submitted.
vii. Panel surface accuracy computation shall be inclusive of manufacturing deviation, site alignment error, gravity and thermal errors.

17.3 Specifications of Antenna Transmit & Receive chain

S. No.	Parameter	Specification
	Transmit Chain	
1.	No. of uplink chains	Two (RHCP &LHCP)
2.	Uplink EIRP at 6 GHz with 750 W LTWTA	≥76 dBW ***Note: Bidder shall provide detailed break-up of the uplink EIRP meeting the specification and margins if any, including LTWTA power, losses etc. The complete detailed specifications of the proposed LTWTA , make, model number, OEM data sheet etc. shall be provided by the Bidder in the technical bid.*** ***Provision for external reference to all frequency converter unit shall also be provided.***
3.	EIRP Adjustability @ LTWTA	25 dB
4.	Frequency Offset	±250 Hz or better
5.	Frequency Stability	± $1X10^{-7}$ or better over 24 hrs. at operating temperature
6.	Level stability	±1dB or better over 24 hrs. at operating temp
7.	Spurious (Carrier related)	-55 dBc or better
8.	Return Loss	>14 dB
9.	Third order intermodulation distortion	- 25 dBc max. with two equal carriers 1 MHz apart at 5 dB total output back-off
10.	L-Band Upconverter	Input Freq. 70 MHz (BW +/- 18 MHz) Output Freq. 950–2200 MHz or compatible with input frequency band of LTWTA. Step Size: 1KHz Gain: 24 dB min. Gain Adjust: 0- 25 dB in 0.10 dB steps
11.	LTWTA with BUC	Input Freq.: 950–2200 MHz or Compatible with output frequency band of L Band Upconverter (multiple LO may be part of solution). However, the total solution should meet the required transmit frequency band. (5.850-6.45 GHz) Output Freq.: 5.850-6.45 GHz or better Output Power: LTWT- 750 Watt min Gain: 70 dB min. at rated power output Provision for external freq. reference to LTWTA

		should exist along with internal freq. reference.
Receive Chain		
12.	No. of Receive chains	Two (LHCP & RHCP)
13.	G/T at 5 deg. EL at 4 GHz	25.5 dB/K or better with 1:2 LNA Systems and BPF **Note: Bidder to provide detailed G/T break-up meeting the specification and margins if any, including antenna noise temp, LNA noise temp, losses etc. The complete detailed specifications of the proposed LNA, make, model number, OEM data sheet etc. shall be provided by the Bidder in the technical bid.**
14.	Frequency Offset	±250 Hz or better
15.	Frequency Stability	± 1X10^{-7} or better over 24 hrs. at operating temp
16.	Level Stability	±1dB or better over 24 hrs. at operating temp
17.	Spurious (Carrier Related)	-55dBc or better
18.	1:2 redundant LNA System	Frequency: 3.625 to 4.2GHz Noise temperature: 50 K max. (Including LNA & Switching) Gain: 60 dB min Gain flatness over the band: ± 1 dB Power O/P (1dB compression): +10dBm or better BPF shall be installed at LNA input (BPF Specification as mentioned in Annex I)
19.	C-Band Down converter	Input Freq. 3.625 to 4.2 GHz or better Output Freq. 70 MHz (BW +/- 18 MHz) Gain: 40 dB min. Gain Flatness (± 18 MHz): ±0.5 dB Frequency adjustability:1KHz
Baseband Systems and Instrumentation		
20.	Integrated Baseband System	1.Number of IF Receivers: 3 Numbers. 2.One Rx Attached with Ranging Unit. 3.Two Rx's – each attached with 2 Demodulator chains 4. Number of Sub Carrier Demodulators: 4 No 5.All Demodulators equipped with CCSDS Viterbi/RS Decoding 6.Number of Modulators: 2 Nos. 7.Number of Command Units: 1 No. 8.Number of Ranging Units: 1 No.

		9.Number of Telemetry Simulator: 1 No. 10.Full-fledged Monitoring and Control software (Graphical User Interface) should be provided. 11.Should accept IRIG-B Time code for time stamping, Telemetry and Ranging data 12.Should accept external Reference source 10 MHz frequency. 13.Unit should act as telemetry server with minimum 24 clients or More. TCP/IP Interface: all data (Telemetry, Ranging, Commanding, Monitoring and control, Receiver input level) should be available through Ethernet port 10/100 Mbps. (TCP/IP protocol) which is compatible with MCF Mission software
21.	Test Loop Translator	Input Freq. 5.85-6.45GHz Output Freq. 3.625-4.2 GHz 2225±15MHz tuneable LO Capable of taking additional external LO input
22.	Spectrum Analyser	Input Frequency: 100KHz to 26.5 GHz or better with resolution of 1 Hz or better & having LAN interface for remote monitoring and control
23.	Frequency Distribution Unit	Input: 2 nos. (1:1 redundant) , 1 to 10 MHz, BNC connector , Outputs: 10 nos., BNC connector I/P & O/P Impedance: 50 ohms
24.	Time Distribution Unit	Input: 2 nos. (1:1 redundant) Input and Output Connector type: BNC-Female with port impedance of 50 Ohm No of Output Port: 10 nos
25.	Pressurization	The feed & waveguides shall be pressurized up to 0.5 psi operation with suitable safety valve. A suitable dehydrator with LAN interface shall be provided by the Supplier.
26.	Block schematic	Bidder shall provide the detailed block schematic & signal flow chart of the full system depicting each and every sub-system being proposed including interfaces. Level diagram shall also be provided.
27.	Floor Standing Rack usable height	42 U (1U=44.4 mm)
28.	All frequency converter units shall have internal reference as well as provision to accept external 10 MHz reference with auto sensing facility. All such unit shall be connected with external reference from frequency distribution unit.	
29.	The party needs to provide compliance that all the delivered hardware / software / firmware are free from all kind of Malware	

18.0 Allied and support system

18.1 Civil

18.1.1 Antenna foundation shall be carried out by the bidder for the antenna terminals. Cable Trench work shall be carried out by the bidder along with the foundation to connect to main cable trench/RF shelter. Trench shall be of size 0.6mX0.6m (Clear space) with covering of aluminium checker plate of more than 6mm thick & cable hangers (Two rows of cable hanger on either side of the trench with the hanger spacing of 0.5m) and connection to the existing trench point shall be the responsibility of the successful bidder.

18.1.2 Antenna mounting to be planned such a way that there shall be adequate clearance between antenna and ground at any elevation/azimuth angle and antenna performance will not suffer due to improper clearance between antenna and ground.

18.1.3 The antenna foundation and load analysis breakup to be provided along with the quote. Basic design of the antenna foundation to be provided along with the quote.

18.1.4 Any other civil works required to complete the project.

18.2 Safety

18.2.1 The bidder shall ensure that the antenna and the associated systems meet the local safety requirements in force at the site.

18.2.2 The safety requirements concerning the antenna, associated systems and the personnel working at the antenna, etc. shall be addressed and executed by the bidder.

18.2.3 A state of art maintenance free Grounding/Earthing System for Antenna is to be designed and installed near the antenna. The Bidder shall consider installing separate & suitable connection points of grounding/earthing for antenna.

18.2.4 The major safety devices in an antenna system to be provided for smooth functioning (tentative list mentioned) are ***Aviation warning lights***, ***Hatch panel interlock***, ***Elevation limits*** (software & hardware), ***Azimuth limits*** (software & hardware), ***Lightning protection***, ***Shock absorbers*** to remove kinetic energy in case the reflector moves beyond limit at elevation 0 deg, ***Hand cranking device*** for azimuth and elevation drive, ***Emergency stop*** at relevant areas.

18.2.5 ***Ladders*** for climbing to azimuth/elevation drive platform and also to climb quadruped structure. Proper hatch door for access to Antenna reflector top to be provided.

18.2.6 ***Electrical and signal Grounding***-Separate Antenna Body Earthing and signal grounding shall be provided.

18.2.7 ***Lightning Protection System*** for Antenna to be designed and installed by the bidder. Grounding of Lightning arrestor and Earthing shall be planned separately.

Annexure-I

GUIDELINE SPECIFICATIONS FOR RF EQUIPMENTS & INTERFACE ELEMENTS

1. 1:2 Redundant C-Band LNA System

S.No.	Parameter	Specification Value
RF Characteristics		
1.	Frequency	3625-4200MHz
2.	Noise temperature	50 K max. (Including LNA & Switching)
3.	Gain	60 dB min
4.	Gain flatness over the band	± 1 dB Max.
5.	Input VSWR	1.3 : 1
6.	Output VSWR	1.3 : 1
7.	Power O/P (1 dB compression)	+ 10 dBm or better
8.	Maximum input power (damage threshold)	0 dBm
9.	Power Supply Connector	Suitable weatherproof mating connector to be provided.
10.	I/P interface	WR 229 CPR (G), (Standard feed interface dimensions)
11.	O/P interface	N type (female) connector
LNA Controller Specifications		
12.	In the event of failure of Online LNAs, the change over from faulty LNA to Redundant LNA should take place automatically. LNA Controller shall have facility to change the LNA configurations manually.	
13.	Unit status monitor method: Controller monitors unit current. Alarm is generated if current goes out of the allowed tolerance window.	
14.	Remote Interface: Ethernet/TCP-IP/LAN interface to be provided in the control unit.	
15.	Operating Power Supply	AC 230 volts, 50 Hz, dual inbuilt power supply in control unit. LNA power supply shall be extended through control cable along with other control signals.
General		
16.	Suitable front panel Human Machine Interface (HMI) (Display and Control) shall be provided for LNA controller.	
17.	Suitable Remote control cable of Approx. 100m to be provided.	

2. L-Band Up-converter

S/No.	Parameter	Specification Value
	FREQUENCY	
1.	Range (output)	950–2200 MHz or Compatible with input frequency band of LTWTA
2.	Conversion	Dual, No Inversion
3.	Step Size	1 KHz
4.	Stability (Time)	± $5X10^{-9}$/Day
5.	Stability (Temp)	± $2X10^{-8}$ over 0 to 50 Deg. C
	IF INPUT CHARACTERISTICS	
6.	Frequency Range	52 – 88 MHz (70±18 MHz)
7.	Return Loss	18 dB Minimum
8.	Impedance	50 Ohms
9.	Connector	BNC (F)
	RF OUTPUT CHARACTERISTICS	
10.	Output Level	+ 10 dBm at 1 dB Comp.
11.	Spurious	Non–Carrier: – 70 dBm or less Carrier: –60dBc or better
12.	Third order Intercept	+20 dBm minimum
13.	Impedance	50 Ohms
14.	Connector	N-type (F)
15.	O/P Return Loss	15 dB Minimum
	TRANSFER CHARACTERISTICS	
16.	Gain	24 dB min.
17.	Gain Adjust	0–25 dB in 0.1 dB steps
18.	Gain Stability	± 0.25 dB/Day
19.	Gain Flatness(± 18 MHz)	± 0.5 dB
20.	External Reference	10 MHz @ +/- 3 dBm. In presence of external ref signal, the unit shall lock to the external ref. automatically.
21.	Phase noise	1kHz: – 79 dBc/Hz or less
		100kHz: – 102 dBc/Hz or less
22.	Remote control	TCP/IP (LAN)
22.	Power (Power ON switch to be provided)	Voltage: 230VAC
		Frequency: 50 Hz
23.	Environmental	Temperature: 0 – 50 Deg C
24.	Physical	19 Inch Rack Mountable
25.	Power chord suitable for Indian standard power sockets/outlets shall be provided with each unit.	
26.	Suitable front panel Human Machine Interface (HMI) (Display and Control) shall be provided.	

3. C Band Outdoor LTWT Amplifier

S/No	Specification Value
1.	Input Freq.: 950–2200 MHz or Compatible with output frequency band of L Band Upconverter(multiple LO may be part of solution). However, the total solution should meet the required transmit frequency band. (5.850-6.45 GHz)
2.	Output Frequency: 5850-6450 MHz or better
3.	Output Power: TWT- 750-Watt CW min. Amplifier Flange- 650-Watt min.
4.	Gain: 70 dB min. at rated power output
5.	RF Level Adjust Range: 0 to 25 dB (0.1 dB steps)
6.	Gain Stability: ± 0.25 dB/24 hr max. (at constant drive and temp.)
7.	Small Signal Gain Variation:1.5 dB pk-pk across any 40 MHz band 6 dB pk-pk max. across full band
8.	Input VSWR :1.5:1 max with BUC
9.	Output VSWR: 1.3:1 max
10.	Load VSWR: 2.0:1 max. Operational
11.	Phase Noise: As per IESS-308/309 Phase Noise Profile and better
12.	AM/PM Conversion: 2.5°/dB max. for a single carrier at 5 dB below rated power with linearizer
13.	Harmonic Output: - 60 dBc at rated power
14.	Noise and Spurious:<-150 dBW/4 kHz, 3.7 to 4.2 GHz <-60 dBW/4 kHz passband with BUC and lineariser
15.	Intermodulation: - 24 dBc max. with two equal carriers at 4 dB back off
16.	Primary Power:230 V AC,50 Hz, single phase
17.	Power factor: 0.95 min
18.	Environmental (Operating): 0°to+50°C operating Ambient Temperature:0° to +70°C non-operating
19.	Shock and Vibration: Normal transportation
20.	Mechanical Cooling (TWT): Forced air
21.	RF Input Connection: Type-N (F)
22.	RF Output Connection: Waveguide, WR-137 (G)
23.	RF Monitor: Type-N Female
24.	Mounting: Outdoor antenna hub mountable
25.	The unit shall have Ethernet interface for M&C purpose or controlling remotely.
26.	Unit shall have internal reference as well as facility of external reference of 10 MHz.In presence of external reference signal, the unit shall lock to the external reference automatically. An external arrangement (or connector) shall be made available to feed the external reference to the device.

27.	Suitable AC power chords shall be provided for each unit.
28.	Suitable Remote control cable of Approx. 100 m to be provided.

4. C-Band Down-converter

S/No.	PARAMETER	SPECIFICATION VALUE
	FREQUENCY	
1.	Range	3625 - 4200MHz or better
2.	Conversion	Dual, No Inversion
3.	Step Size	1 KHz
4.	Stability (Time)	± $5X10^{-9}$/Day
5.	Stability (Temp)	± $2X10^{-8}$ over 0 to 50 Deg. C
	RF INPUT CHARACTERISTICS	
6.	Return Loss	19 dB Minimum
7.	Impedance	50 Ohms
8.	Connector	N-type (F)
9.	Noise Figure	13 dB Max or better at min. attenuation/ max. gain
	IF OUTPUT CHARACTERISTICS	
10.	Frequency Range	52 – 88 MHz (70±18 MHz)
11.	Output Level	+10 dBm or more at 1 dB Comp.
12.	Spurious	Non–Carrier: – 70 dBm or less Carrier: –60 dBc or less at 0dBm output
13.	Intermodulation	-58 dBc min. (2 Carriers 1MHz apart) at 0 dBm Output power
14.	Impedance	50 Ohms
15.	Connector	BNC (F)
16.	O/P Return Loss	20 dB Minimum
	TRANSFER CHARACTERISTICS	
17.	Gain	40 dB Min.
18.	Gain Adjust	0 - 20 dB in 0.25 dB steps
19.	Gain Stability	± 0.25 dB/Day
20.	Gain Flatness(± 18 MHz)	± 0.5 dB
21.	Image Rejection	- 80 dB (In-band)
22.	External Reference	10 MHz @ +/- 3 dBm. In presence of external ref signal, the unit shall lock to the external ref automatically
23.	Phase noise	1kHz: – 78 dBc/Hz or less
		100kHz: – 95 dBc/Hz or less
24.	Power (Power ON Switch to be provided)	Voltage: 230VAC
		Frequency: 50 Hz
25.	Environmental	Temperature: 0 – 50 Deg C
26.	Physical	19 Inch Rack Mountable

27.	Suitable front panel Human Machine Interface (HMI) (Display and Control) shall be provided.

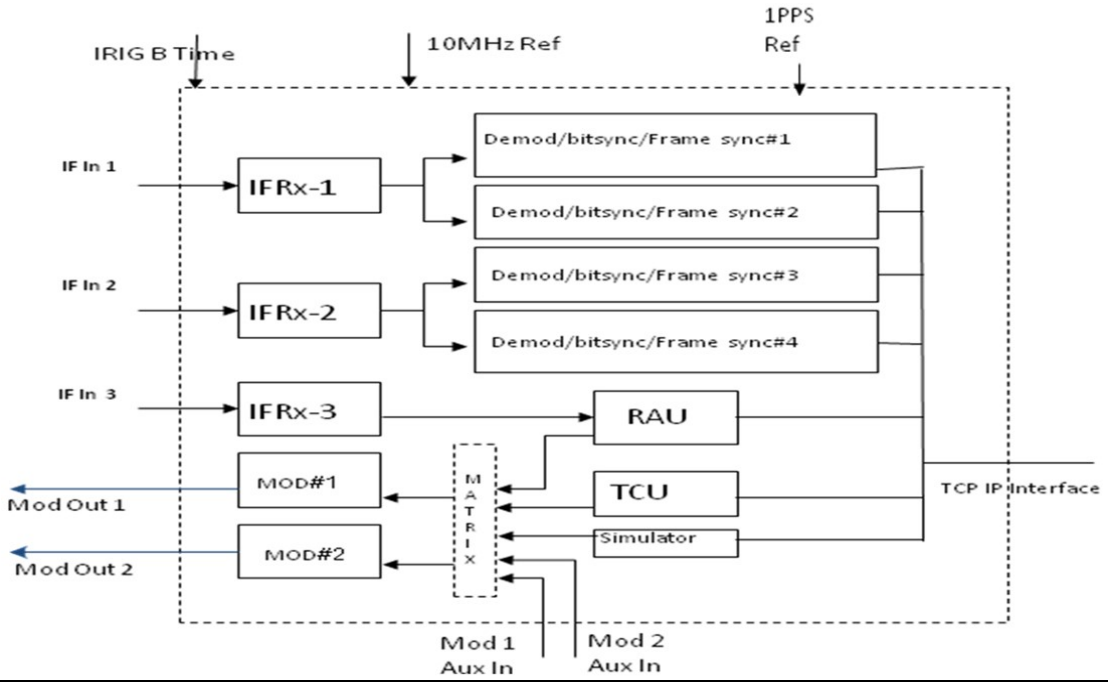
5. C Band Test Loop Translator

S/No.	Parameter	Specification
	RF SPECIFICATIONS	
1.	I/P Frequency	5850-6450 MHz
2.	O/P Frequency	3625-4200 MHz
3.	LO Frequency	2225 ± 15 MHz Tunable LO
4.	LO Step size	1 KHz
5.	Phase Noise	a) 1 KHz : -85 dBc/Hz b) 100 KHz : -105 dBc/Hz
6.	I/P Return loss (dB)	18 min
7.	O/P Return loss (dB)	18 min
8.	Impedance:	50 ohm
9.	Conversion	Single Conversion, No Inversion
	FUNCTIONAL	
10.	Conversion loss	18 dB Max.
11.	Amplitude response	± 0.5 dB over any 40 MHz ± 1.5 dB over O/P frequency band
12.	Frequency stability	± 1×10-6 (0° to 50° C)
13.	Level control	25 dB Min.
14.	I/P and O/P isolation	60 dB Min.
15.	O/P Mute Facility	From Remote to be provided
16.	Type	Outdoor Mount
	ADDITIONAL FUNCTION	
17.	10 MHz reference configuration: Automatic reference selection from internal to External 10 MHz source at 0+/-3dBm.	
18.	Remote control	TCP/IP over Ethernet, RJ45 connector
19.	External LO	External LO input option to be provided.
	PRIMARY POWER REQUIREMENTS	
20.	Voltage	230V
21.	Frequency	50 Hz
	ENVIRONMENTAL: OPERATING	
22.	Ambient temperature	0 to +50 C
23.	Shock and Vibration	Normal handling by commercial carriers
	General	
24.	Suitable power cord for outdoor mount shall be provided with each unit.	

6. Integrated Baseband System

Overall Configuration of the Unit (block Diagram Enclosed below)	
1	Number of IF Receivers: 3 Nos
	One Rx Attached with Ranging Unit.(RAU)
	Two Rxs - each attached with 2 Demodulator chains
2	Number of Sub Carrier Demodulators : 4 No
	All Demodulators equipped with CCSDS Viterbi/RS Decoding
3	Number of Modulators : 2 No
4	Number of Command Units : 1 No
5	Number of Ranging Units : 1 No
6	Number of Telemetry Simulator : 1 No
7	Full-fledged Monitoring and Control software (Graphical User Interface) should be provided.
8	Should accept IRIG-B Time code for time stamping, Telemetry and Ranging data
9	Should accept external Reference source 10 MHz frequency.
10	Unit should act as telemetry server with minimum 24 clients or More.
11	TCP/IP Interface: all data (Telemetry, Ranging, Commanding, Monitoring and control, Receiver input level) should be available through Ethernet port 10/100 Mbps. (TCP/IP protocol) which is compatible with MCF Mission software.

Block Diagram



1.0 IF Receiver:	
1	Number of IF Inputs : 3 No
2	Each IF Receiver should be individually capable of selecting any of the three Inputs.
3	Operating Mode: FM/PM,BPSK,QPSK,OQPSK selectable
4	No of IF Receivers: 3 (IFR-1, IFR-2 and IFR-3)
5	Input Frequency: 60 to 78 MHz **or** Better
6	Input level:-25 to -100 dBm or better
1.1 PM Demodulation	
7	PLL Type: 2nd order
8	Acquisition & tracking range : +/- 10 to +/- 500 kHz
9	Loop bandwidth :100Hz, 300Hz, 1000Hz, 3000Hz
1.2 Demodulation at Baseband	
10	Sub carrier Demodulation : BPSK
11	BPSK Sub-carrier frequency: ≤ 128 kHz (Programmable)
12	BIT Rate :100 bps to 25 kbps or better (Programmable)
13	Number of sub-carriers chains:4
14	PCM Decoding :NRZ-L/M/S
1.3 Frame Synchronization	
15	Frame synchronization: Synchronization word size: 8 to 32 bit
16	Frame size: 10 to 2048 bytes
17	Frame checking: CRC (CRC16, CCITT) CRC Polynomial & CRC preset values should be user– programmable. Checksum
1.4 Direct PCM Demodulation	
18	Demodulation: Direct BPSK, QPSK, OQPSK
1.5 Bit Synchronization for Direct PCM demodulation:	
19	PCM decoding: NRZ-L/M/S
20	Bit rate: Programmable from 100 bps to 5 Mbps or better
1.6 CCSDS De-commutation (Required for all Demodulator Chains)	
21	Scrambling
22	CCSDS (convolution decoder): Convolution code with maximum likelihood Viterbi decoding
23	RS Decoding: J= 8 bits per RS symbol E=16RS-symbol error correction capability with in a RS code word (coded to decoded information ratio = 223/255)
24	Symbol interleave factor: Auto-adjusted (frame length dependent)
25	Other characteristics: CCSDS recommendation 101.0-B-3
1.7 Telemetry Storage and Replay	
26	Telemetry storage on hard disc: Time tagged frames or blocks
27	Telemetry replay: Yes
2.0 Satellite Commanding	

1.	TCU shall support CCSDS commanding standard
2.	Subcarrier modulation: BPSK
3.	PCM coding: NRZ-L/M/S, RZ
4.	Bit rate: 10 to 10000 bps or Better
5.	BPSK SCF:100Hz to 100kHz or Better
6.	Idle pattern: Programmable length(1 to 16 bits)and contents
7.	Preamble length:0 to 2^{24} bits.
3.0 Ranging (Tone Type)	
1.	Ranging Standards : ESA, ESA Like
2.	Ranging tones : tone frequency : 1.78 Hz to 100 KHz programmable
3.	Number of tones: 1 major tone, 1 to 6 minor tones
4.	Integration time : 0.25 to 2.5 seconds
5.	PLL Bandwidth(2 Bn) : 0.1 to 8 Hz
6.	Ambiguity resolution :Yes
7.	Distance measurement Resolution : 1 ns
8.	Spectrum correction : +90°, -90°, 180°, None
9.	Range Quality indicator
4.0 IF Modulation	
1.	Number of modulator: 2 No. IFM-1. IFM-2
2.	Modulation mode: FM ,PM, BPSK,QPSK,OQPSK (selectable)
3.	Carrier frequency: 60 to 78MHz or better
4.	External analog input :2 V to 3V p-p / 50 Ω
5.	Frequency deviation:0 to $\pm$ 500 kHz
6.	Modulation index:0 to 2.5 radians
7.	Output level: Nominal output 0 to – 80 dBm;
5.0 Time code decoding & Data Time Tagging	
1.	Input code: IRIG-B; Amplitude :0.1 to 6V p-p
2.	Time tagged data logging messages: Telemetry, Doppler and Range data.
5.1 External Frequency Reference	
1.	Input port:1 or More
2.	Frequency : 10 MHz sine
3.	Acquisition range:>500Hz for 10MHz
4.	Impedance :50 Ω
5.2 Internal Frequency Reference	
1.	Frequency:10MHz
6.0 Telemetry Simulator	
1.	Simulated Telemetry data source: Disk File, TCP/IP data stream Modulated in Real time, Replay Mode or PRBS mode. Suitable polynomial degrees should be used to generate different PRN codes.

2.	Output : BPSK sine or direct PCM
3.	Sub Carrier Frequency : 40 Hz to 128 kHz BPSK sine wave
4.	Bit rate : 100 to 5 Mbps
5.	PCM Coding : NRZ-L/M/S
6.	Data Encoding: None, Scrambling, Viterbi inverted, Viterbi, Viterbi Inverted +Scrambling. Viterbi+ Scrambling. Optional: Turbo Encoder
7.0 Miscellaneous	
1	Chassis Size: Less than OR equal to 4 U 19 " Rack Mountable.
2	Power 230V AC 50Hz.

7. Spectrum Analyser

S/No.	Parameter	Specification
1	Frequency Range	100 kHz to 26.5 GHz or better
2	External Reference frequency	Input: 10 MHz, Output : 10 MHz
3	Aging Rate	±1X10^-6/year or better
4	Frequency Counter Resolution	1Hz or better
5	Frequency span	0 Hz (Zero span), 10Hz to max frequency
6	SSB Phase Noise @ 10KHz offset	< -96 dBc/Hz @ 1 GHz carrier
7	Sweep time for Span≥ 10Hz	2 ms to 4000 s or better
8	Sweep time for Span=0 Hz	10 micro sec to 5000 s or better
9	Resolution Bandwidth& Video Bandwidth	1 Hz to 8 MHz in steps 1 Hz to 8 MHz in steps
10	Max. Input level for Protection: & for measurement	+30 dBm or better +20 dBm or better (RF attenuation=0 dB)
11	Reference level setting	–130 dBm to 23 dBm in steps of 0.01 dB
12	Displayed Average Noise Level	≤ -125 dBm or better for entire range
13	Input Attenuator	0 to 40 dB in 2 dB steps or better
14	VSWR	< 2.2
15	Display Scale units	dBm, dBmV, dB micro V, dB micro A
16	No. of markers	4 or more
17	Marker modes	Normal, Delta
18	Traces	3 or more with different colours
19	Display	≥ 8 inches
20	Input Connector	N type, 50 Ohms, if required suitable adapters may be provided **(Desirable)**/50 Ω, test port adapter, PC 2.92 mm female (interchangeable port connector system)
21	Interfaces	10/100/1000 Base-T LAN & GPIB for remote control, USB2.0 type-A-2 no's
22	Remote programming language	SCPI
23	Operating Temperature	5º to 40ºC

24	Power Requirement	230V, 50 Hz
25	Rack mount kit with handles	Suitable for 19" rack

8. Frequency Distribution Unit

S/No.	Parameter	Specifications
	Input	
1	Number of inputs	02 (1:1 redundant) Auto Switched
2	Input frequency range	1 KHz to 10 MHz
3	Channel isolation	> 80 dB
4	Reverse Isolation	>100 dB
	Output	
5	Number of outputs	10 or more
6	Channel Isolation	> 80 dB
7	Output level	13+/-1 dBm
8	Harmonics	< -40 dBc
9	Spurious	<-70 dBc
10	I/P & O/P connector	BNC, 50 ohms
11	Frequency Stability	Same as Input
12	Remote	Remote M&C control TCP/IP or SNMP on LAN RJ45
13	Power Supply	Dual redundant AC Power Supply 230 V ± 10%, dual input sockets (3-pin Indian standard)
14	Operating Temperature	0 to +50°C or better

9. Time Distribution Unit

S/No.	Parameter	Specifications
1.	Input and Output Connector type	BNC-Female with port impedance of 50 Ohm
2.	No. of input ports	02 (1:1 redundant) Auto switched
3.	Input to Input port Isolation	> 80 dB
4.	Output to Output port Isolation	>80 dB
5.	IRIG Time Code (AM) Input level	1 to 6 Vpp
6.	IRIG Time Code (AM) output level	1 to 6 Vpp
7.	Number of outputs	10 or more

8.	AM IRIG output compatible	Compatible to any IRIG format, Modulation frequency 1KHz, modulation ratio 3:1
9.	Remote	Remote M&C control TCP/IP or SNMP on LAN RJ45
9.	Power Supply	Dual redundant AC Power Supply 230 V± 10%, dual input sockets (3-pin Indian standard)
10.	Operating Temperature	0 to +50°C or better

10. WR-137 Waveguide Switches for Uplink Switching

S/No.	Parameter	Specification Value
1.	Switch Type	WR-137 Waveguide Rotary Transfer Switch
2.	Waveguide Size	WR-137
3.	Operating Frequency	5850 to 7000 MHz
4.	Minimum Isolation	60 dB or better
5.	Maximum VSWR	1.1:1
6.	Power Handling Capability	1.5 KW CW (Minimum)
7.	Power Supply	24V - 28V DC
8.	Operating Temperature	0° to 50°C
9.	Drive Mechanism	Motorized Latching Type
10.	Life	1,00,000 operations minimum.
11.	Suitable Power Connector	To be supplied
12.	Position Indication	To be provided
13.	Manual Override and Internal Current interruption to be provided.	

11. WR-137 Waveguide Directional Coupler

S/No.	Parameter	Specification Value
1.	Waveguide size	WR-137
2.	Main line Flanges	CPR-137 (G)
3.	Operating Frequency	5850 to 7000 MHz
4.	Coupling Factor	50 dB
5.	VSWR a. Main line b. Secondary line	1.15max. 1.25 max.
6.	Directivity	≥ 20 dB
7.	Coupling flatness	± 0.75 dB
8.	Coupled Port Connector	Coaxial 'N' type (female), 50 Ohm

9.	Guide Material	Copper
10.	Flange Material	Brass
11.	Finish Outside	Black Epoxy Paint
12.	Coupling Factor V/S Frequency chart to be fixed on the Coupler Guide.	

12. WR-229 Waveguide Directional Coupler

S/No.	Parameter	Specification Value
1.	Waveguide size	WR-229
2.	Main line Flanges	CPR-229 (G)
3.	Operating Frequency	3600 to 4200 MHz
4.	Coupling Factor	30 dB
5.	VSWR a. Main line b. Secondary line	1.15max. 1.25 max.
6.	Directivity	≥ 20 dB
7.	Coupling flatness	± 0.75 dB
8.	Coupled Port Connector	Coaxial 'N' type (female), 50 Ohm
9.	Guide Material	Copper
10.	Flange Material	Brass
11.	Finish Outside	Black Epoxy Paint
12.	Coupling Factor V/S Frequency chart to be fixed on the Coupled Guide.	

13. WR-137 High Power Dummy Load

S/No.	Parameter	Specification Value
1.	Operating Frequency	5850 -7000 MHz
2.	Waveguide Size	WR-137
3.	Power Handling Capability	1.5 KW (CW) min
4.	Max. VSWR	1.15:1 or better
5.	Flange Material	Brass.
6.	Flange Type	CPR-137 (G)
7.	Outside Finish	Black Epoxy Paint

14. WR-137 Straight Rigid Waveguides

S/No.	Parameter	Specification Value
1.	Operating Frequency	5850 -7000 MHz
2.	Waveguide Size	WR-137
3.	VSWR	Better than 1.1:1
4.	Power Handling Capability	1.5 KW CW (Minimum)
5.	Insertion loss	0.09 dB / meter or better

6.	Flanges	CPR-137 (G)
7.	Flange Material	Brass
8.	Guide Material	Copper
9.	Inside Finish	Rust Free (Passivated)
10.	Outside Finish	Black Epoxy Paint

15. WR-137 Flexible & Twistable Waveguide

S/No.	Parameter	Specification
1.	Operating Frequency	5850 -7000 MHz
2.	Power handling capacity	1.5 KW CW
3.	Max. VSWR	1.2 : 1
4.	Insertion loss	0.11 dB / foot or Better
5.	Flange type	CPR-137 (G)
6.	Flange material	Brass
7.	Jacket material	Neoprene or black silicone jacket
8.	Inside finish	Silver Plated

16. Standard Patch Panel with Jacks

Sl. No.	Parameters	Specifications
1.	Patch Panels	Insulated gray aluminum
2.	Panel size	19 Inch
3.	Number of holes	24 (In two rows of 12 nos. each)
4.	Hole shape	Circular
5.	Jacks	BNC (50ohm)
6.	Jack center pin dia	0.07 INCH
7.	Frequency	DC – 180 MHz
8.	Jacks mounting	Mounted with screw and Detachable type
9..	Jacks mounting direction	Jacks mounting should be such that patching (with Looping Plugs or Patch cords) can be done from front side and permanent BNC connection is at the rear side.
10.	Panel mounting	Holes at the corners to mount the panel onto the standard 19” rack

17. Band Pass Filter

S/No.	Parameter	Specification Value
1.	Passband Frequency	3700 to 4200 MHz
2.	VSWR	1.4:1 or better
3.	Insertion Loss	0.5dB Max.
4.	Rejection	25dB min @ 3650 MHz & 4250 MHz 60dB min @ 3550 MHz & 4350 MHz 65 dB min @ 3500 MHz & 4400 MHz 60 dB min @ 5800 MHz to 6500 MHz
5.	Waveguide Interface	WR-229
6.	Length of filter	≤ 120 mm
7.	Accessories	Suitable mounting accessories to be provided

18. Line Amplifier

S.No.	Parameters	Specifications
1.	Frequency	1 GHz to 12 GHz
2.	Noise Figure	3.5 dB typical @ 25 Deg C
3.	Output at 1 dB Compression Point	+10 dBm Min.
4.	Small Signal Gain	25 dB Min@ 25 Deg C
5.	Gain Flatness	+/- 1.5 dB Max.
6.	Input/output VSWR	2.5:1 or better
7.	Input Connector/ Output Connector	SMA (F) or N(F)
8.	Power Supply	5 V - 24 V DC

19. SP12T Coaxial Switches

S/No.	Parameter	Specification
1.	Operating Frequency Range	DC to12.0 GHz
2.	VSWR	1.8 : 1 Max
3.	Insertion Loss	0.7 dB Max
4.	Isolation	60 dB min
5.	Impedance	50 Ω
6.	Operating Mode	Latching, Self Cutoff , terminated
7.	Switching sequence	Break before make
8.	Operating Voltage	24 to 30 V DC
9.	Connectors	SMA (F)
10.	Indicator Contacts	To be Provided

11.	RF Power Handling	10 watts Avg. min @ 12.0 GHz
12.	Life	10^6 Operations min.
13.	Coil Common	Negative
14.	Actuator Terminal	D-SUB
15.	Operating temperature	0 to 50ºC

20. Floor Standing Racks

S/No.	Parameter	Specification
1.	Type	19-inch floor standing steel racks / cabinets with perforation
2.	Usable Height	42 U (1U=44.4 mm)
3.	Depth	1000 mm
4.	Frame	Made out of 9 fold of 1.6mm sheet steel/Aluminium extrusion
5.	Rack Panels	Racks side panels shall be removable & lockable from rear. Empty space to be covered with blank aluminium plate.
6.	Top cover	Made out of 1.6mm CRCA sheet with louvered for air exhaust
7.	Load capacity	500 kg
8.	Earthing Strip	Full length tin coated Earthing copper strip of suitable cross section to be provided & isolated for continuity point of view. M4 tapped holes to be provided at equal intervals (50 mm) all along the strip.
9.	Cable channel	Cable channel with cabling loops of dimensions height 75 mm and depth 45 mm made out of PVC(flexible& Unbreakable) to be fitted vertically at back side of the rack for full length.
8.	Cooling Arrangements and door lamps	Fan housing unit with 4 nos. of Fans of size 6 inch fitted at underneath of top cover for air exhaust. Totally wired with suitable indication. Fans shall have low acoustic noise. Door lamps should be provided with door switch.
9.	Colour	Standard Grey for the frames

21. Ethernet Based 24-Channel Digital I/O

S. No.	Parameter	Specification
1.	Number of I/O	Minimum 24 (Configurable for input /output)
2.	DIO configuration	All DIO lines can be individually configured as Input / Output
3.	Power supply	5 V ± 5%
4.	Ethernet type	100 Base-TX, 10 Base-T
5.	Connector	RJ-45
6.	Protocols	TCP

22. Absolute Optical Angle Encoder with Accessories

Specifications for Item-1 Absolute Optical Angle Encoder		
S.No	**Parameters**	**Specification**
1.	Type	Absolute Optical Encoder
2.	Resolution	17 bit, single turn
3.	Supply Voltage	DC 10 - 30 V
4.	Flange	Clamping
5.	Protection class	IP-67
6.	Shaft	10mm
7.	Interface	EtherCat
8.	Interface Connector	M12 Connector
Specifications for Item-2 Power Cable for Encoder		
1.	Type	Power Cables - Matching with encoder connector
2.	Connector	M12
3.	Length	5m
Specifications for Item-3 Encoder to Encoder EtherCat cable		
1.	Type	Encoder to Encoder EtherCat - Matching with encoder connector
2.	Connector	M12 and M12
3.	Length	5m
Specifications for Item-4 Encoder to EtherCat interface Cable		
1.	Type	Encoder to EtherCat - Matching with encoder connector
2.	Connector	M12 and RJ45
3.	Length	5m

ANNEXURE-II

GUIDELINE SPECIFICATIONS AND ELECTRICAL REQUIREMENTS FOR ELECTRICAL CABLES, DISTRIBUTION BOARD & ACCESSORIES FOR SITC OF TWO NUMBERS OF ABOUT 7.2M FCA SYSTEM

1. Power Cable specification

Sn	Description	Unit	Quantity	Remarks
1	Supply of Braided / Screened Flexible Copper Cable Type (Cable code): YY, Voltage grade: 1100 VAC, 50 Hz, Conductor: Fine strands of Annealed Bare Copper Flexibility: Class 5 of IS 8130, Insulation: PVC as per IS 5831, Colour code: Red, Black & Yellow-Green -For Three core cable Red, Yellow, Blue and Black -For Four core cable Inner sheath: Malinex / Mylar tape, 25% over lapp before braiding, Screening: Annealed Tinned Copper (ATC) wire with >60% coverage, Outer Sheath -PVC as per IS 5831, Colour: Black / Grey, Length marking: At every one meter of cable. Printing: '1100V, ISI logo, Core & Size of Cable' Make: CEPO approved.			
1a	No. of cores: Three (3) Core Area of cross section: Four (4.0) Sq. mm	Meter	600	TWTA's
1b	No. of cores: Three (3) Core Area of cross section: Two & half (2.5) Sq. mm	Meter	1000	Racks & Hub
1c	No. of cores: Four (4) Core Area of cross section: Four (4.0) Sq. mm	Meter	200	Servo
1d	No. of cores: Four (4) Core Area of cross section: Twenty five (25.0) Sq. mm	Meter	100	Input to DB

2. Earthing System

Sn	Description	Unit	Quantity	Remarks
1	Copper Plate Earthing Providing standard plate earth for earth station with 600x600x3.15mm electrolytic tinned copper plate, conforming to IS:3043 with latest amendments and as per drawing No. CED/ELE/S/4 including excavation and refilling of earth and supply of all materials and providing chamber with necessary civil works using good quality bricks, sand etc. with a cover plate made of GI for the chamber with all necessary materials complete as required at 2.5 Meter depth with copper plate	Nos	6 Nos	RF System earthing

3. UPS Power DB Specification for Bhopal, about 7.2M FCA & RF sys

Sn	Description	Quantity in Nos	Remarks

Incomer			
1	RCBO Type-c, 10kA, 4P, Rating -63A,100mA Bi-connect facility –Cable & Bus bar, Din rail mounting, confirming to IS 60898 Part-1, 2002.	1 No	Incomer
2	Modular Fuse Holders: Suitable for 14x51 mm cylindrical HRC fuse, Din rail mounting, 600 VAC, 50 Hz, Finger safe protection. Number of poles: 3	1 No	
3	HRC Fuse Links: Size -14x51 mm cylindrical, Class of operation –General gG/gL, Rated voltage – 400 to 690 VAC, Rating: 63A, Breaking capacity at 415 VAC: 80 kA, Low let through energy, Confirming to IS –13703 (part I & II)	3 Nos	
4	Terminal Blocks: CAGE Clamp type, 800 VAC, Including end plate, Din rail mounting type, Front Entry, Continuous operating temp. 105 degree C, Electrolytic copper Ecu		
4.1	Terminal Blocks -Cable termination up to 25 sq. mm, Including end plates, Color Grey.	3	For Incoming cable termination
4.2	Terminal Blocks -Cable termination up to 25 sq. mm, Including end plates, Color Blue.	1	
4.3	Terminal Blocks -Cable termination up to 25 sq. mm, Including end plates, Color Yellow-Green	1	
Indicating Lamps			
5	LED type, 230 VAC, 50 Hz, Din rail mounting type, Single pole, Number of module –1 (18 mm / module). Colour: Red, Yellow / Orange and Blue	3 Nos	
6	Modular Fuse Holders: Suitable for 10x38 mm cylindrical HRC fuse, Three pole, Din rail mounting, 600 VAC, 50 Hz, Finger safe protection, Confirming to IEC 60269.	1 No	
7	HRC Fuse Links: Size -10x38 mm cylindrical, Class of operation –General gG/gL, rated voltage -400 to 690 VAC, breaking capacity at 415 VAC: 80 kA, confirming to IS –13703 (part I & II). Rating: 2A	3 Nos	
Outgoing Feeders			
8	Miniature Circuit Breakers: Type-c, 10kA, 4P, Rating -25A, Bi-connect facility –Cable & Bus bar, Din rail mounting, confirming to IS 60898 Part-1, 2002.	4 Nos	
9	Modular Fuse Holders: Suitable for 10x38 mm cylindrical HRC fuse, Din rail mounting, 600 VAC, 50 Hz, Finger safe protection, Confirming to IEC 60269. No of Poles: 3	4 Nos	
10	HRC Fuse Links: Size -10x38 mm cylindrical, Class of operation –General gG/gL, rated voltage – 400 to 690 VAC, breaking capacity at 415 VAC: 80 kA, confirming to IS –13703 (part I & II). Rating: 25 Amps	12 Nos	
11	RCBO: Protection –OC, SC & EL, Suitable for AC, Type C, breaking capacity – >10 kA, Sensitivity – 100 mA, 2P, No. of modules –2 (18 mm / module), Bi-connect facility –Cable & Bus bar, Din rail mounting, confirming to IS/IEC 61009.		
11.1	Rating - 16 A	6	

11.2	Rating - 10 A	12	
11.3	Rating - 06 A	6	
12	Insulated Fork Copper Busbars: Shall be of same make of MCB & RCBO's, Rating 63A, 2P, 12 mod & 4P, 12 Mod including end caps	As per requirement	
13	Modular Fuse Holders: Suitable for 10x38 mm cylindrical HRC fuse, Din rail mounting, 600 VAC, 50 Hz, Finger safe protection, Confirming to IEC 60269. No of poles: Single, (18 mm / pole)	24	
14	HRC Fuse Links: Size -10x38 mm cylindrical, Class of operation –General gG/gL, Rated voltage – 400 to 690 VAC, Breaking capacity at 415 VAC: 80 kA, Confirming to IS 13703 (part I & II)		
14.1	Rating –06 Amps	6	
14.2	Rating –10 Amps	12	
14.3	Rating –16 Amps	6	
15	Terminal Blocks: CAGE Clamp type, 800 VAC, Including end plate, Din rail mounting type, Front Entry, Continuous operating temp. 105 degree C, Electrolytic copper Ecu,		
15.1	Distribution terminal blocks. Input 1x screw clamp contact up to 35 Sq. mm, Output 3x10 sq. mm, Cage clamp contact, Current rating 125A, Color grey.	16	For distribution in place of Copper Busbar
15.2	Cable termination up to 6 sq. mm, Rating 41A, Including end plate, Grey -color	12	Phases
15.3	Cable termination up to 6 sq. mm, Rating 41A, Including end plates, Blue color.	4	Neutral
15.4	Cable termination up to 6 sq. mm, Rating 41A, Including end plates, Color Green yellow	4	Earth
15.5	Cable termination up to 4 sq. mm, Rating 32A, Including end plate, Red -color	8	R phase
15.6	Cable termination up to 4 sq. mm, Rating 32A, Including end plates, Yellow -color.	8	Y phase
15.7	Cable termination up to 4 sq. mm, Rating 32A, Including end plates, Blue -color	8	B phase
15.8	Cable termination up to 4 sq. mm, Rating 32A, Including end plates, Black -color	24	Neutral
15.9	Cable termination up to 4 sq. mm, Rating 32A, Including end plates, Yellow-Green -color	24	Earth
16	Rittal ISV **OR** Schneider Prisma make Distribution B having transparent front door with all the associated accessories, panel may be wall mounted / floor mounted type, part nos. and quantity shall be provided for approval.		
17	Single Line Diagram (SLD), General Assembly (GA) diagram and bill of material shall be provided for approval		
18	Insulated end sleeves shall be used for cable termination.		

4. Power Distribution Units for about 7.2M, FCA RF racks

Accessories for
1. Power distribution units for RF Racks (Vertical fixing) (2 Nos / Rack)
2. Nine universal sockets + control switch / PDU. 2 PDU's per rack.
3. Power distribution units for racks front side 1 Nos.

Sn	Description	Unit	Quantity	Remarks
1	UPVC Trunking system Single compartment, Size: 50x80 mm, Colour: White RAL 9003, Complies to new standard EN 50085-2-1, Non-flame propagating, Ingress protection: IP 40, Make: Legrand, Part no: 0104 12	Meters	As per requirement	
2	UPVC Trunking system -Flexible cover Suitable for 50x80 mm size trunking system Make: Legrand, Part no: 0105 21	Meters	As per requirement	
3	UPVC Trunking system -End cover Suitable for 50x80 mm size trunking system Make: Legrand, Part no: 0107 22	Sets	As per requirement	
4	UPVC Trunking system -Holding cable in plane Suitable for 50x80 mm size trunking system Make: Legrand, Part no: 0106 82	Nos	As per requirement	
5	Asterior supports for mounting Switches & Sockets No of Modules: 6, Clip-on supports suitable for 65 mm cover, supplied with finishing plate. Make: Legrand, Part no: 0109 61	Nos	As per requirement	
6	Asterior supports for mounting Switches & Sockets No of Modules: 3, Clip-on supports suitable for 65 mm cover, supplied with finishing plate. Make: Legrand, Part no: 0109 31	Nos	As per requirement	
7	Asterior supports for mounting Switches & Sockets No of Modules: 2, Clip-on supports suitable for 65 mm cover, supplied with finishing plate. Make: Legrand, Part no: 0109 21	Nos	As per requirement	
8	Blank plates Single module, 22.5x45 mm, White colour, Make Legrand, Part no: 5734 49	Nos	As per requirement	
9	Indian Standard Socket Modular, Universal socket, Rating 6A, 240V, white colour, Sockets with ISI mark confirming to IS 1293, Finger proof terminals for IP 20 protection against accidental contact. Make: Legrand, suitable for the Arteor supports	Nos	As per requirement	
10	Single pole switch Modular with indicator, Rating 10A, 230V, white colour, Single module, Finger proof terminals for IP 20 protection against accidental contact. Make: Legrand, Part no: 573401	Nos	As per requirement	
11	Modular Terminal Strip with fixing flanges Suitable for 0.08 - 4 Sq. mm, Gray colour, No of poles: 3, Make: Wago Part no: 262-103	Sets	As per requirement	Each PDU

12	Power Distribution Unit as per the above specification shall be provided in pre-wired and fixed in the racks condition.
13	Single Line Diagram, General Assembly drawing is attached for reference..
14	Insulated end sleeves shall be used for PDU's cable termination.
15	Make and model is provided for reference only, however vendor can provide the alternate make which meets the above specification.

5. Wire mesh Cable Tray

Sn	Description	Unit	Quantity
1	Cable tray manufactured from steel wires, welded together and bent into final shape prior to surface treatment. Hot dipped Galvanized to EN ISO 1461. **Cable Tray dimensions are all internal**. Steel wire Cable Tray will be produced from lateral and longitudinal sidewall steel wires, with minimum diameters of 4 mm for trays of width up to 100 mm, 4.5 mm for trays of width of 300mm, Trays will be manufactured with a longitudinal 'T – Welded 'safety edge along the top wire of the sidewall. Trays will be constructed with a 50x100 mm mesh configuration. All tray fittings shall be constructed on site, to the manufactures instruction, using side action bolt croppers and fastened using 25 & 30 mm counter clamps with M6 bolts and nuts, all surface treated as the tray. Trays will be coupled together using either a fast spring coupler or a 25/30 mm counter clamp combination with supporting lateral splice plate on trays over 300 mm width. The coupling will have the same surface finish as the tray. Trays are to be supplied with cover and suitable cover clips. Trays shall be supported at maximum span of 2.5 m by the trapeze, wall, floor or channel mounting methods and will not exceed maximum loads as specified by the manufacturer. The fixture of the cable trays to the supported system shall be fast fixing type bolt free system. Traditional nuts and bolts shall not be used in coupling and fixture of cable baskets to the support systems. Fire test certification should be submitted in accordance with the E30/E90 standard. Loading & deflection characteristic of the tray should be tested and the results published in accordance with the European standard IEC 615357. All the fixtures like supporting structures, bends, tees etc., are to be supplied along with the cable tray Make: Cablofil, Size: Height: 54 mm, Width: 300 mm Make is provided for reference only, however vendor can provide the alternate make which meets the above specification.	Mtrs	50

6. General requirements:

1. Make shall be considered any one among the CEPO approved brands. (CEPO approved brands list is enclosed along with the RFP)
2. Electrical items for which, CEPO approved make / brands are not available, approval shall be obtained from MCF for the make / brand proposed.

3. Model no. for the proposed make shall comply to the tender specification and it will be finalized during PDR meeting. If required, data sheet for the same shall be obtained for verification of technical compliance.
4. Confirm for the proposed make and model numbers or propose the alternate equivalent make which meets RFP requirement.

4.

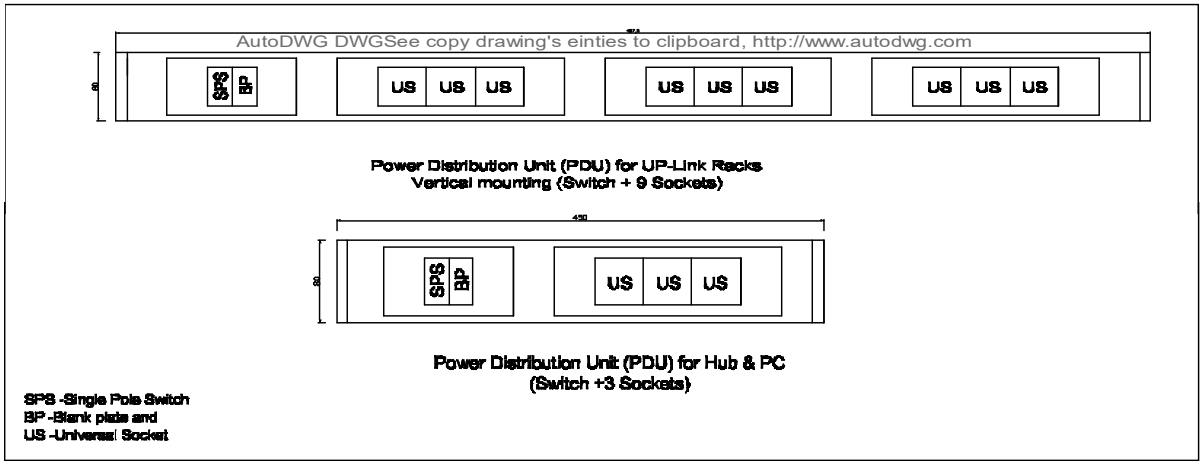


Figure 1. Power Distribution Unit for RF racks layout.

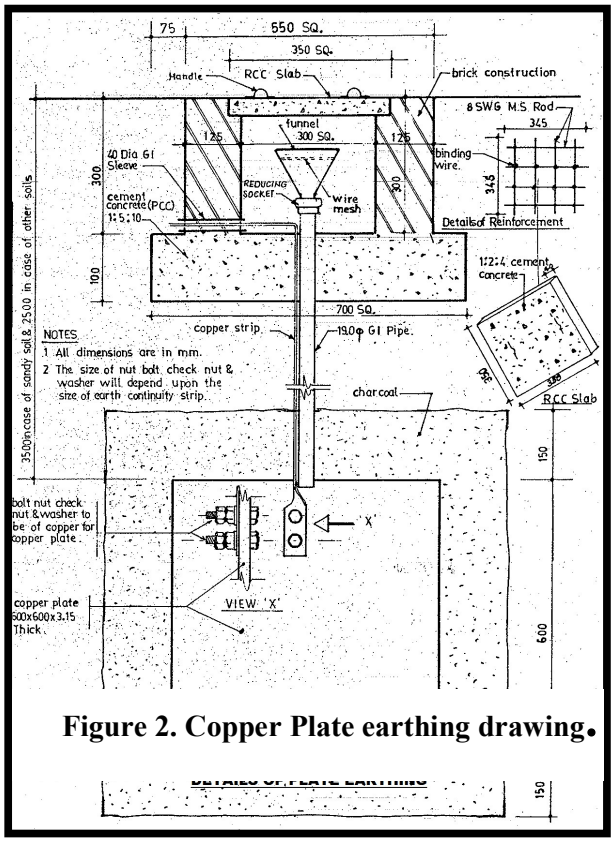


Figure 2. Copper Plate earthing drawing.

List of CEPO approved brands

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS W.E.F. 20-09-2019

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
1		Automatic Transfer Switch (ATS)	VERTIV	APC	RIELLO	PILLER	EPI	SOCOMEC
			GE	L&T				
2		Automatic Voltage Regulators (AVR) / Servo-Controlled Voltage Stabilizers (SCVS)	AUTOMATIC ELECTRIC (AE)	KRYKARD				
3		BATTERIES						
	a	Batteries: SMF	EXIDE	AMCO	PANASONIC	AMARA RAJA	SONNENSCHEIN	
	b	Batteries: Non-SMF	EXIDE	AMCO	PANASONIC	AMARA RAJA		
4		CABLES, END TERMINATIONS & ACCESSORIES						
	a	Armoured HT Power Cable (PVC & XLPE)	UNISTAR	GLOSTER	POLYCAB	HAVELLS	RPG	CCI
			TORRENT	KEI	FINOLEX			
	b	Armoured LT Power Cable (PVC & XLPE)	UNISTAR	GLOSTER	POLYCAB	HAVELLS	RPG	CCI
			TORRENT	KEI	FINOLEX	RHINO	RAVIN	BONLON
			VICCO	SINCO	TERA	THERMO CABLES	UNICAB	V-GUARD
			RALLISON	AVOCAB	CRYSTAL CABLES	ELKAY	GEMSCAB	INDOCAB
			CORDS CABLE	INSUCON				
	c	Armoured/Unarmoured Control Cable (PVC & XLPE), Special Purpose Cables & Instrumentation Cable	LAPP INDIA	GLOSTER	POLYCAB	HAVELLS	UNISTAR	RPG
			CCI	TORRENT	FINOLEX	RALLISON	ADVANCE CABLES	
	d	Armoured/ Unarmoured Telephone Cable	POLYCAB	HAVELLS	RPG	FINOLEX	UNICAB	V-GUARD
			THERMO CABLES	ELKAY	ADVANCE CABLE	VICCO	LAPP INDIA	
	e	PVC Wires (FRLS/ FRLSH / FR-ZH / FR-HR)	LAPP INDIA	FINOLEX	GLOSTER	ANCHOR	KUNDAN CAB	DARSHAN PLUS
			POLYCAB	STANDARD	RALLISON	Q-FLEX	RHINO	RAJNIGANDHA CABLE
			V-GUARD	RR-KABEL	AVOCAB	KEI		
	f	Cable Jointing Kits : Heat /Cold Shrinkable Type (HT & LT)	RAYCHEM	M-SEAL (3M)	MULTI PRESSINGS	GEE SEAL	DENSON	
	g	Cable Trays (FRP, Hot Dip GI / Electro Galvanised) (Perforated / Ladder / Wire Mesh)	SINTEX	L&T	PROFAB	CABLOFIL (LEGRAND)	OBO BETTERMANN	SUMIP COMPOSITES
			INDIANA	PATNY SYSTEMS	MUPRO			
5		Cable Management System (CMS) & Underfloor Raceways	OBO BETTERMANN	LEGRAND	MK	CENTAUR	EUBIQ	
6		DG SETS & CONTROLLER						
	a	Diesel Engine for DG Sets	CUMMINS	PERKINS	VOLVO PENTA	CATERPILLER	MTU	MITSUBISHI
			EICHER (Upto 125kVA)					
	b	LT Alternators for DG Sets	STAMFORD-AVK	LEROY SOMER	CROMPTON GREAVES			

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
	c	HT Alternators for DG Sets	STAMFORD-AVK	TDPS	LEROY SOMER	CROMPTON GREAVES		
	d	DG Set Controller for Synchronising Panel	WOODWARD	BERNINI	DEIF	DEEPSEA ELECTRONICS (DSE)		
10	EARTHING, LIGHTNING PROTECTION & ACCESSORIES							
	a	Maintenance-free earthing kit with solid earth electrode & Earth Enhancing Compound	OBO BETTERMANN	TEREC (SGI)	ERICO (GEM)	LORESS	ASHLOK	JMV LPS
			CAPE ELECTRIC					
	b	Lightning Protection Accessories	DEHN	ERICO	OBO BETTERMANN	CAPE ELECTRIC		
	c	Exothermic Welding	OBO BETTERMANN	ERICO (GEM)	CAPE ELECTRIC	JMV LPS		
11	ELECTRICAL BUS DUCTS / BUSBAR TRUNKING SYSTEM							
	a	Air Insulated Electrical Bus Ducts	ALL APPROVED LT PANEL MANUFACTURERS					
	b	Sandwiched Busbar Trunking System	SCHNEIDER	LEGRAND	GE ENERGY	L&T	C&S ELECTRIC	
12	FANS							
	a	Ceiling Fans (Star Rated)	USHA	ORIENT	KHAITAN	BAJAJ	HAVELLS	RALLIFAN
			CROMPTON GREAVES					
	b	BLDC Ceiling Fans	VERSA DRIVES (SUPERFAN)	USHA	ORIENT	ATOMBERG (GORILLA)	HAVELLS	
	c	Wall mounted / Pedestal Fans	USHA	ORIENT	KHAITAN	BAJAJ	HAVELLS	RALLIFAN
			CROMPTON GREAVES					
	d	Air Circulator Fans	ALMONARD	KHAITAN	EPC	BAJAJ	CROMPTON GREAVES	
	e	Exhaust Fans	USHA	KHAITAN	POLAR	EPC	CROMPTON GREAVES	V-GUARD
			ORIENT	CATA				
13	FLAMEPROOF (FLP) LIGHTS & SWITCHGEARS							
	a	Flameproof Luminaires (Including LED) & Controlgears	BALIGA	FCG	STAHL	FLEXPRO	BAJAJ LIGHTING	SUDHIR SWITCHGEAR
	b	Flameproof Switchgear & Accessories	BALIGA	FCG	STAHL	FLEXPRO	SUDHIR SWITCHGEAR	
14	FIRE ALARM & DETECTION SYSTEMS							
	a	Fire Alarm/Smoke Detection System & Control Panels (FACP) & Aspiration System	RAVEL	SECUTRON	HONEYWELL	HOCHIKI	NOTIFIER	MORLEY (HONEYWELL)
			SIEMENS	ZITON	EDWARD	TELEFIRE	SIMPLEX	THORN SECURITY
			GST (UTC)	SCHRACK SECONET	FFE LTD.	SECURITON	GODREJ & BOYCE	
	b	Flame proof Detection system	FFE LTD.					
	c	Gas Detectors, Gas Monitoring System	SUBTRONICS	CROWCON	AMBETRONICS			
	d	Linear Heat Sensing Cable (LHSC)	SECURITON	HONEYWELL	PATOL	SYSTEM SENSOR		

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
15	FIRE PROTECTION SYSTEM							
	a	Fire Resistant Coating (FRC)	VIPER	STANVAC	HILTI			
	b	Fire Stop Products	3M	HILTI	OBO BETTERMANN			
16	Geysers (Star Rated)		AO SMITH	JAQUAR	RACOLD	V-GUARD	VENUS	USHA
			JOHNSON	REMSON	CROMPTON GREAVES			
17	HRC FUSE & CARRIERS							
	a	HRC Fuses	L&T	SIEMENS	GE POWER CONTROLS	C&S ELECTRIC	HAVELLS	INDO ASIAN
			CROMPTON GREAVES	STANDARD				
	b	HRC Fuse Base & Carriers	L&T	SIEMENS	ABB	GE POWER CONTROLS	HAVELLS	STANDARD
			SCHNEIDER					
18	HT 11kV Panel with Vacuum Circuit Breakers (VCBs)		SCHNEIDER	L&T	ABB	SIEMENS	EASUN REYROLLE	ANDREW YULE
			MEI	BHEL	CROMPTON GREAVES			
19	HDPE Double Walled Corrugated Pipes (for UG Cables)		GAMSON	DURA-LINE	REX POLYEXTR-USIONS			
20	Junction Box / Switch box & Distribution Boards (Thermoplastic/Polycarbonate/FRP / GRP/ SMC / Steel)		HENSEL	SPELSBERG	BCH-ELECTRIC	ABB	PYROTECH ELECTRONICS	DEVI POLYMER
			PUSTRON	SAFYBOX	SINTEX	FIBOX		
21	LIGHT FIXTURES & ACCESSORIES							
	a	Light fittings (Indoor)#	PHILIPS	OSRAM	ENDO LIGHTING	IGUZZINI	HYBEC LIGHTING	LIGHTING TECHNOLOGIES
			WIPRO	TRILUX	BAJAJ	SURYA	HAVELLS	CROMPTON GREAVES
	b	Light fittings (Outdoor applications only)#	PHILIPS	OSRAM	BAJAJ	IGUZZINI	SCHRÉDER	ENDO LIGHTING
			WIPRO	TRILUX	K-LITE	SURYA	HAVELLS	LIGHTING TECHNOLOGIES
			DISANO	CROMPTON GREAVES	HYBEC LIGHTING			
			# LEDs SHALL BE OF NICHIA, CREE, OSRAM, PHILIPS LUMILEDS, CITIZEN & SEOUL SEMICONDUCTORS MAKE ONLY					
	c	Solar Street light (Standalone)	PHILIPS	BAJAJ	TATA POWER	ANY MNRE APPROVED VENDOR IN CURRENT YEAR		
	d	Emergency Light Fittings with self-contained Batteries	PHILIPS	EVEREADY	WIPRO			
	e	Lamps, Controlgears & Accessories	PHILIPS	OSRAM	WIPRO	SURYA	BAJAJ	HAVELLS
			CROMPTON GREAVES	MEANWELL	BAG ELECTRONICS			

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
22	LIGHTING MANAGEMENT SYSTEM & CONTROL							
	a	Lighting Management System	SCHNEIDER	LUTRON	PHILIPS	HONEYWELL	WIPRO	DELTA CONTROL
			LEGRAND					
	b	Lighting Control Sensor	HONEYWELL	SCHNEIDER	LUTRON	WIPRO	PHILIPS	LEGRAND
			HAGER					
23	LT Power Capacitors		SCHNEIDER	EPCOS	L&T	UNISTAR	SIEMENS	ABB
			VISHAY SPRAGUE					
24	LT SWITCHGEARS / BREAKERS							
	a	Miniature Circuit Breakers (MCBs) & Distribution Boards	LEGRAND	SCHNEIDER	ABB	GE	INDO ASIAN	SIEMENS
			L&T	HAVELLS	HPL	STANDARD	HAGER	C&S ELECTRIC
	b	Earth Leakage Circuit Breakers (RCBO/RCCBs)	LEGRAND	SCHNEIDER	ABB	GE	L&T	INDO ASIAN
			SIEMENS	HAVELLS	HPL	STANDARD	HAGER	C&S ELECTRIC
	c	Moulded Case Circuit Breakers (MCCBs) up to 400A	SCHNEIDER	L&T	LEGRAND	HAVELLS	STANDARD	C&S ELECTRIC
			ABB	SIEMENS				
	d	Moulded Case Circuit Breakers of all ratings	SCHNEIDER	L&T	ABB	LEGRAND	SIEMENS	GE
	e	LT Air Circuit Breaker (ACB)	SCHNEIDER	L&T	ABB	SIEMENS	GE	C&S ELECTRIC
			LEGRAND					
	f	Changeover Switches	L&T	SIEMENS	SCHNEIDER	HPL	GE POWER CONTROLS	INDO-ASIAN
			C&S ELECTRIC	STANDARD	HAVELLS			
	g	MV Switch fuse units & Isolators up to 250A	L&T	SIEMENS	ABB	HPL	INDO-ASIAN	GE POWER CONTROLS
			C&S ELECTRIC	HAVELLS	SCHNEIDER	STANDARD		
	h	MV Switch Fuse Units & Isolators of all ratings	L&T	SIEMENS	ABB	SCHNEIDER	GE POWER CONTROLS	
	i	Air-break Power / Control Contactors	L&T	ABB	C&S ELECTRIC	SIEMENS	CROMPTON GREAVES	BCH-ELECTRIC
			GE	SCHNEIDER				
25	MEASURING INSTRUMENTS							
	a	Measuring Instruments (Analog & Digital meters, Data Loggers & Event Recorders)	L&T	SCHNEIDER	MECO	NEUTRONICS	NIPPEN	SATEC
			ELMEASURE	RISHAB	KRYKARD	CIRCUTOR	AUTOMATIC ELECTRIC (AE)	SECURE
	b	Single & Three phase Energy Meters	SCHNEIDER	L&T	LEGRAND	CAPITAL POWER SYSTEMS	SATEC	SECURE
			SIEMENS	ECE	PROK DV's	CIRCUTOR	NIPPEN	THEBEN

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
22	LIGHTING MANAGEMENT SYSTEM & CONTROL							
	a	Lighting Management System	SCHNEIDER	LUTRON	PHILIPS	HONEYWELL	WIPRO	DELTA CONTROL
			LEGRAND					
	b	Lighting Control Sensor	HONEYWELL	SCHNEIDER	LUTRON	WIPRO	PHILIPS	LEGRAND
			HAGER					
23	LT Power Capacitors		SCHNEIDER	EPCOS	L&T	UNISTAR	SIEMENS	ABB
			VISHAY SPRAGUE					
24	LT SWITCHGEARS / BREAKERS							
	a	Miniature Circuit Breakers (MCBs) & Distribution Boards	LEGRAND	SCHNEIDER	ABB	GE	INDO ASIAN	SIEMENS
			L&T	HAVELLS	HPL	STANDARD	HAGER	C&S ELECTRIC
	b	Earth Leakage Circuit Breakers (RCBO/RCCBs)	LEGRAND	SCHNEIDER	ABB	GE	L&T	INDO ASIAN
			SIEMENS	HAVELLS	HPL	STANDARD	HAGER	C&S ELECTRIC
	c	Moulded Case Circuit Breakers (MCCBs) up to 400A	SCHNEIDER	L&T	LEGRAND	HAVELLS	STANDARD	C&S ELECTRIC
			ABB	SIEMENS				
	d	Moulded Case Circuit Breakers of all ratings	SCHNEIDER	L&T	ABB	LEGRAND	SIEMENS	GE
	e	LT Air Circuit Breaker (ACB)	SCHNEIDER	L&T	ABB	SIEMENS	GE	C&S ELECTRIC
			LEGRAND					
	f	Changeover Switches	L&T	SIEMENS	SCHNEIDER	HPL	GE POWER CONTROLS	INDO-ASIAN
			C&S ELECTRIC	STANDARD	HAVELLS			
	g	MV Switch fuse units & Isolators up to 250A	L&T	SIEMENS	ABB	HPL	INDO-ASIAN	GE POWER CONTROLS
			C&S ELECTRIC	HAVELLS	SCHNEIDER	STANDARD		
	h	MV Switch Fuse Units & Isolators of all ratings	L&T	SIEMENS	ABB	SCHNEIDER	GE POWER CONTROLS	
	i	Air-break Power / Control Contactors	L&T	ABB	C&S ELECTRIC	SIEMENS	CROMPTON GREAVES	BCH-ELECTRIC
			GE	SCHNEIDER				
25	MEASURING INSTRUMENTS							
	a	Measuring Instruments (Analog & Digital meters, Data Loggers & Event Recorders)	L&T	SCHNEIDER	MECO	NEUTRONICS	NIPPEN	SATEC
			ELMEASURE	RISHAB	KRYKARD	CIRCUTOR	AUTOMATIC ELECTRIC (AE)	SECURE
	b	Single & Three phase Energy Meters	SCHNEIDER	L&T	LEGRAND	CAPITAL POWER SYSTEMS	SATEC	SECURE
			SIEMENS	ECE	PROK DV's	CIRCUTOR	NIPPEN	THEBEN

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
26	MOTORS & STARTERS / DRIVES							
	a	Electric Motors	ABB	GE	SIEMENS	KIRLOSKAR	CROMPTON GREAVES	JYOTI
			BHARAT BIJLEE	NGEF	LAXMI HYDRAULICS (LHP)			
	b	Starters	L&T	ABB	SIEMENS	SCHNEIDER	BCH-ELECTRIC	GE POWER CONTROLS
			CROMPTON CONTROLS					
	c	Soft Starters	ABB	SCHNEIDER	ALLEN-BRADLEY	CROMPTON CONTROLS	SIEMENS	
	d	Variable Speed Drives	ABB	SIEMENS	SCHNEIDER	DANFOSS	NELCO	LANDIS & STAEFA
			HITACHI	VERTIV	L&T	YASKAWA		
27	POLES							
	a	Streetlight Pole (Decorative/Special)	BAJAJ	K-LITE	TRANSRAIL LIGHTING			
	b	FRP / GRP Type Poles	SUMIP COMPOSITES	BAJAJ				
28	Photoluminescent Signages		3M	SAFEX	PROLITE AUTOGLO	AUTOLITE		
29	Push-Button Stations, Key Actuators, Rotary Switches, Toggle Switches, Indicators, Selector Switch		TEKNIC	ABB	L&T	SIEMENS	CROMPTON GREAVES	BCH-ELECTRIC
			SCHNEIDER	KAYCEE	JAY	JAINSON	C&S ELECTRIC	GE POWER CONTROLS
			VAISHNAV					
30	RELAYS							
	a	Automatic Power factor Correction (APFC) Relay	SCHNEIDER	L&T	BELUK	PROK DV's	EPCOS	
	b	Protective Relays (Electromechanic & Numeric)	ABB	SIEMENS	L&T	JYOTI	ALIND	EASUN REYROLLE
			SCHNEIDER	C&S ELECTRIC	PROK DV's			
	c	Electronic time switch, Time delay relay, Timer	LEGRAND	L&T	HAGER	BCH-ELECTRIC	THEBEN	SIEMENS
			SCHNEIDER	GE POWER CONTROLS	ABB	HAVELLS		
31	Shock-Proof Insulation Mat & Paint		SAFEVOLT	STANVAC	ELECTROMAT	HILTI		
32	Solar Inverter / Solar Hybrid UPS		DELTA	REFUSOL	KACO	SMA	OPTIMAL POWER SYNERGY (OPS)	
33	Static Transfer Switch (STS)		VERTIV	APC	RIELLO	PILLER	EPI	SOCOMEC
			GE					
34	Surge Protection Devices (SPDs)		OBO BETTERMANN	LEGRAND	SCHNEIDER	SIEMENS	ABB	ERICO
			DEHN	RAYCAP	NOVARIS			

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
35	SWITCHES & SOCKETS							
	a	Modular Switches & 5A/15A Sockets	LEGRAND	ABB	CRABTREE	LITASKI	LISHA	NORTH-WEST
			STANDARD	L&T	ROMA (ANCHOR)	VEGA	FINOSWITCH (FINOLEX)	TOYAMA
			SCHNEIDER	HAGER	MK	KOLORS	SALZER	GOLDMEDAL
	b	Sockets & Plugs (with Polycarbonate/FRP/ Metal Clad Body)	ABB	MENNEKES	LEGRAND	HAVELLS	NORTH-WEST	BCH-ELECTRIC
			SCHNEIDER	HENSEL	STANDARD	CYCLO	BEST & CROMPTON	CROMPTON GREAVES
	c	Modular Electronic Fan Regulators	LEGRAND	STANDARD	CRABTREE	SALZER	LISHA	NORTH-WEST
			ABB	L&T	ROMA (ANCHOR)	TOYAMA	FINOSWITCH (FINOLEX)	RIDER (ANCHOR)
			SCHNEIDER	HAGER	MK	VEGA	LITASKI	KOLORS
			GOLDMEDAL					
36	TRANSFORMERS							
	a	Transformers (Oil-cooled)	HAMMOND POWER SOLUTIONS (HPS)	SCHNEIDER	BHARAT BIJLEE	ESSENAR	ECE INDUSTRIES LTD.	KEL
			KAVIKA	CROMPTON GREAVES	VOLTAMP			
	b	Transformer (Resin Cast, Dry type)	BHEL	VOLTAMP	ABB			
	c	Transformer Oil: FR3 Natural Ester	CARGILL					
	d	LT Current/Voltage Transformer	NIPPEN	PARAS	INTRANS	KAPPA ELECTRICALS	AUTOMATIC ELECTRIC (AE)	NEUTRONICS MANUFACTURING COMPANY (NMC)
	e	HT Current /Voltage Transformer	SCHNEIDER	INTRANS	PARAS	MEI	KAPPA ELECTRICALS	AUTOMATIC ELECTRIC (AE)
			VOLTAMP	All OEMs of 11kV Vacuum Circuit Beakers				
	f	Isolation Transformers	VERTIV	PILLER	ESSENAR	SOCOMEC	APC	ECE INDUSTRIES LTD.
			RIELLO	APLAB	BHARAT BIJLEE	SCHNEIDER	AUTOMATIC ELECTRIC (AE)	VOLTAMP
			NUMERIC (LEGRAND)	PROLEC GE (INDO TECH)	ABB			
	g	Nitrogen Injection Fire Protection System (NIFPS)	CTR	EASUN MR				
37	Unitised/ Package /Compact Substation**		ABB	SCHNEIDER	SIEMENS	HAMMOND POWER SOLUTIONS (HPS)	VOLTAMP	
			***WITH APPROVED MAKES OF HT, LT BREAKERS & TRANSFORMERS**					

Sl. No.	Sub- Sl. No.	Items/ Products	Name of Brand / Make					
38	UPS SYSTEM (CONVENTIONAL)							
	a	UPS (of all ratings)	VERTIV	APC	RIELLO	PILLER	EPI	SOCOMEC
	b	UPS (of rating up to 160 kVA)	VERTIV	APC	RIELLO	PILLER	EPI	SOCOMEC
			NUMERIC (LEGRAND)					
	c	UPS (of rating up to 80 kVA)	SOCOMEC	VERTIV	APC	PILLER	EPI	NUMERIC (LEGRAND)
			RIELLO	ABB	CONSUL-NEOWATT	DELTA		
	d	UPS (of rating up to 30 kVA) & Inverters	SOCOMEC	VERTIV	APC	PILLER	EPI	NUMERIC (LEGRAND)
			RIELLO	APLAB	GE	EATON	CONSUL-NEOWATT	KELTRON
			TECHSER POWER	DUBAS	HITACHI HI-REL	ABB	DELTA	
	e	UPS (of rating up to 10 kVA) & Inverters	SOCOMEC	VERTIV	APC	PILLER	EPI	NUMERIC (LEGRAND)
			RIELLO	APLAB	GE	EATON	CONSUL-NEOWATT	KELTRON
			TECHSER POWER	POWER ONE	ENERTEC	DUBAS	HITACHI HI-REL	ABB
			DELTA					
39	UPS SYSTEM (MODULAR)							
	a	Modular UPS (of rating up to 80 kVA)	VERTIV	APC	RIELLO	SOCOMEC	ABB	NUMERIC (LEGRAND)
			DELTA					
	b	Modular UPS (of all rating)	VERTIV	APC	RIELLO	SOCOMEC		