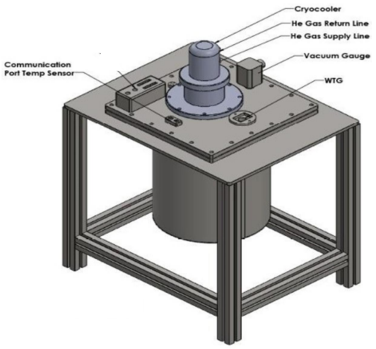
REQUEST FOR PROPOSAL (RFP)

10K Cryo cooler based X Band RF Front End



RADAR DEVELOPMENT AREA

ISTRAC

Indian Space Research Organization

Bangalore - 560058, KARNATAKA

MAR 2024

TABLE

1. Introduction

RDA/ISTRAC has taken-up development of Cryo Cooled Phased array RF receiver in which cryogenic environment will take vital role for thermal management and stability of RF electronics. The RDA team has already developed indigenous Cryo Chamber up to 77 K with liquid Nitrogen as a service fluid and tested Cryo compatible RF component as a mode of open loop configuration. The system calculated SNR improvement is around 1.2 dB during this experimental procedure. The main objective of this proposal is to develop a Cryo Chamber up to 10K with Helium Gas as a main refrigerant which can work with Cryo Cooler (10 K Cold Head) as a closed loop system with X Band LNA as a load.

2. Scope of Work

The Scope of the above proposed system described as follows:

- Indigenous design and development of closed loop Cryo cooled Dewar up to 10 Kelvin using Helium gas as a main cooling agent.
- Engineering and assembly of Cryo compatible LNA including microwave plumbing chain along with 10K cryocooler.
- Development of Cryo Temperature Monitoring and Control system.
- Performance demonstration of RF subsystem integrated with Cryo Dewar.
- Endurance test 24 Hrs×7 days for the above system.

3. Vendor qualification criteria

- Vendors should have proven track record and experience in designing, manufacturing, and supplying cryogenic Dewar up to 80 Kelvin or lower to ISRO or any other R&D Organization under Govt. of India. Also vendors should have technical capabilities in engineering, design and manufacturing of total cryogenic system. This includes their understanding of material properties, insulation techniques, Dewar design, and associated safety features.

4. Block Diagram, Overall system spec and Brief Technical Description:

The block diagram of the Cryo subsystem along with the associated RF plumbing is shown in figure A.

The specifications of the 10K Cryo Dewar subsystem are indicated in Section 5. The detailed specifications of microwave units external to the Cryocooler are provided in section 6. The interlock system requirements are given in section 7.

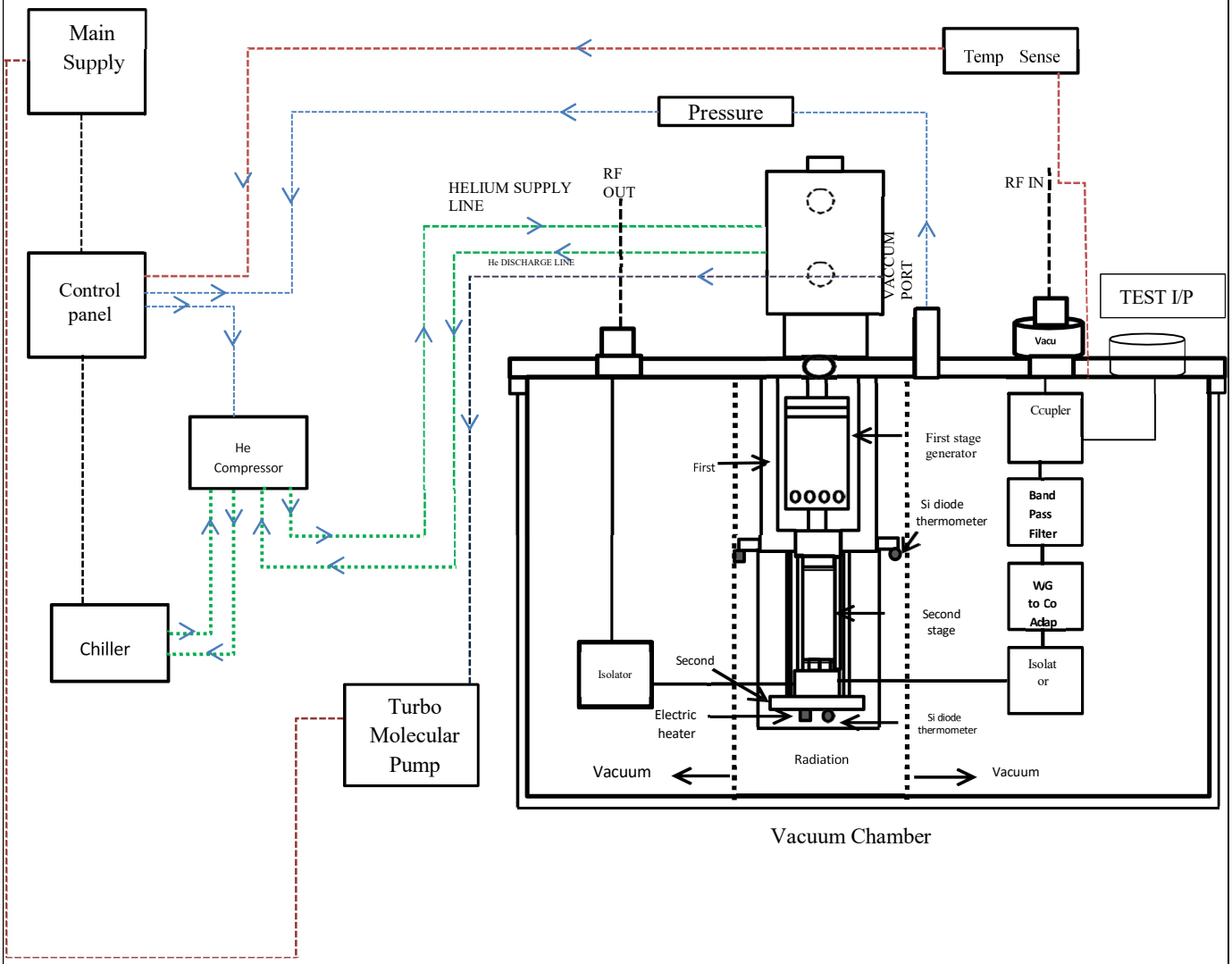


Figure A

Overall System Specification:

SL No	Parameter	Specification
1.	**Frequency Range**	8400-8500 MHz
2.	**Base Operation Temperature**	10 K with load min
3.	**Test Enclosure Environment**	10^{-8} mbar
4.	**Target Cooling Power**	20 milli Watt min
5.	**Cool down Time**	5 Hour max
6.	**System gain**	32 dB min
7.	**System Noise Temp (Before Cool down).(approx.)** **System Noise Temp (After Cool down).(approx.)**	104.86 K (LNA Input) 18 K (LNA Input)
8.	**System Noise Figure (Before cool down).(approx.)** **System Noise Figure (After cool down).(approx.)**	1.32 dB (LNA Input) 0.27 dB (LNA Input)
9.	**Out band rejection**	8120 MHz and 8780 MHz :> 50dB 7145-7235 MHz: > 90 dB 9360 MHz +/- 50 MHz: > 90 dB 2590 MHz +/- 50 MHz: > 120 dB
10.	**Dewar He pressure endurance**	Min 72 hours.

Brief Technical description:

The following subsystems are involved in the design

- Cryogenic Dewar (Cold Box)
- 10K Cryocooler with He Compressor
- Heat Exchanger (Water Chiller)
- Sensors and Controls
- Data Monitoring system
- High Vacuum turbo pump
- RF Plumb-line including LNA

A. Cryogenic Dewar

A cryogenic Dewar described here is a specialized container for housing Cryocooler and all RF Cryo compatible components hence maintaining stable temperature up to 10 K using Gaseous Helium (He). The following features are available with this particular subsystem.

- **Double-Walled Design:** The Dewar typically has a double-walled construction with an inner vessel and an outer shell. The space between the inner and outer walls is often evacuated or filled with insulating materials to minimize heat transfer and keep the contents at cryogenic temperatures.

- **Vacuum Insulation**: The vacuum or high-quality insulation between the inner and outer walls helps to reduce heat transfer via conduction and convection, allowing the subsystem inside maintain the same temperature over a period of time.

B. 10 K Cryocooler with He Compressor

10K Cryocooler is a type of cryogenic cooling system designed to reach and maintain temperatures around 10 Kelvin (-263.15°C or -441.67°F). They operate on the principles of thermodynamics and use various methods to achieve their cooling effects. The following features are available with this particular subsystem.

- **He Compressor:** The compressor is a vital part of the 10 K cryocooler, responsible for compressing the working gas (usually helium) to high pressures. This compressed gas is then circulated through the cooling cycle. The compressors supply pressurized Helium gas to the refrigerator cold head. The compressor is connected to the cold head through supply and return gas lines. To provide cooling, the compressor requires circulating water.

- **Expander:** The expander is used to expand the high-pressure gas, causing it to cool down significantly. This process is central to the cooling mechanism of the cryocooler.
- **Cold head:** The cold head is the section of the cryocooler that directly cools the target material or system. The lowest stage, known as the "cold finger/tip" is the coldest part and makes direct contact with the target material to be cooled.

C. **Heat Exchangers**: Heat Exchanger is connected to the He compressor unit for circulation chilled water for cooling purpose.

D. **Sensors and Controls:** Cryocooler are equipped with sensors to monitor various parameters such as temperature, pressure.

E. **Data Monitoring System:** This is used to collect monitor data from the system and digitize analog parameters. The collected monitor information includes vacuum Dewar temperatures and vacuum pressure, as well as status alarms for the compressor.

F. **Vacuum Turbo Pump:** Initially, a vacuum turbo pump is required to evacuate the cryogenic Dewar and during maintenance work. However, it is not necessary to have the pump connected to the Dewar at all times during operation. . It isrecommended to have only one pumping system that can support all the Dewar in the LNA configuration

G. **Cryo Compatible RF Plumb Chain:** A typical Cryo compatible RF Front end is used to amplify weak incoming signal with minimum added noise, hence improving sensitivity.

5. Technical Specification

The Detailed Specification for the above subsystems is listed below

Subsystem

X-Band Vacuum Dewar

SL No.	Specification	Description
1.	Chamber material and dimension:	SS304 Dewar Inner wall -2 mm & Outerwall - 4 mm Thick. Approx. Overall Size : 500mm×500mm×750mm LWH max.
2.	Temperature sensor:	Silicon Diode (Up to 1.4K) , 6 No's
3.	Door Opening :	Manual By Bolting
4.	Mass:	100 Kg max.
5.	Insulation :	Super Insulation (Vacuum + Multilayer Paper)
6.	Design Temperature Working Temperature	-269°C To + 50°C (4 K to 323 K) -263°C To + 50°C (10 K to 323 K)
7.	Annular Space Vacuum :	1.0 x10^-8 mBar, Vacuum %= 99.96
8.	MSLD Test :	To be performed at 4x10^-09 atm-cc/sec,
9.	Service Fluid :	Lab Grade Gas Helium (GHe) Grade 5 or above
10.	Cold Head LNA Mounting Area:	22mm×20mm×8mm min
11.	Safety Accessories:	• Cryogenic Hand Gloves-4 Nos • Cryogenic Apron-2 Nos • Cryogenic Face Shield-2 Nos
SL No.	Subsystem 10 K Cryocooler	
1.	Specification	Description
2.	Power Supply	3 Phase 380-415 V, 50+/- 2 Hz.
3.	2nd Stage Capacity	6.0 W @ 10 K min ± 2K
4.	1st Stage Capacity	110 W @ 50 K min ± 5K
5.	Minimum Temperature	8 K

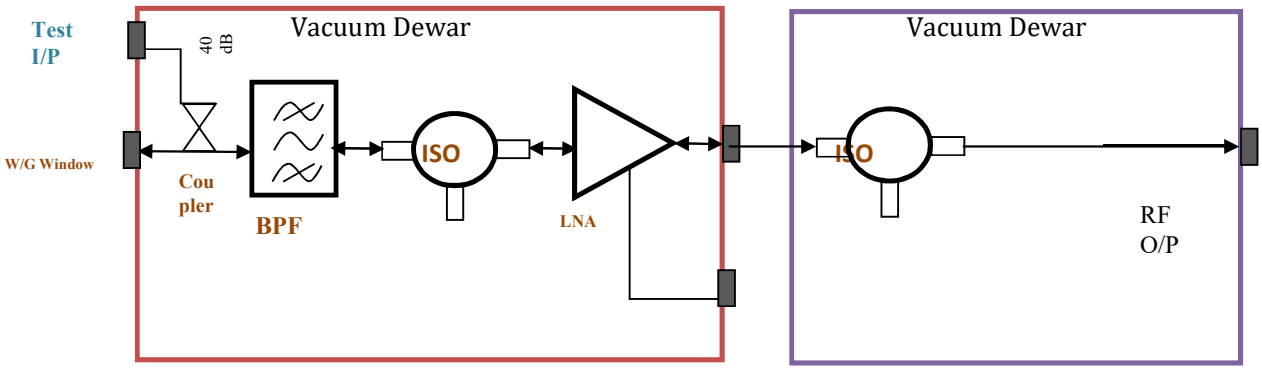
6.	Cool down Time to 10 K from ambient	5 Hrs Max
7.	Maintenance cycle	13,000 Hours min
SL No.	Subsystem He Compressor	
	Specification	Description
1.	Electrical Supply	3 Phase 380-415V , 50+/- 2 Hz.
2.	Power Consumption	6.0-8.0 KW@ 50 Hz. typical
3.	Working Ambient Temperature	4-28 °C max
4.	Cooling Water Inlet	6-9 L/min., 5-25 °C max
5.	Dimension	530 x 440 x 490 mm ,HxWxD approx.
6.	Weight	100 kg approx.
7.	Additional feature	Compressor must have He gas pressure monitoring system
8.	Cooling	Water cooled.
9.	Maintenance	30000 Hours min

	Subsystem Vacuum Turbo Pump	
SL NO	Specification	Description
1.	High-vacuum connection	ISO-K / CF
2.	Ultimate vaccum level ISO-K/CF to interface with dewar	8 *10^-8 (ISO-K) min
3.	Operating Speed, RPM	72000 max
4.	Cooling standard	Convection cooling Forced Air or Water
5.	Weight	7.0 Kg max
6.	Supply voltage	24/48V DC ± 10 % typical
7.	Max. current consumption	10A at 24V DC max

Subsystem Temperature Sensors		
SL NO	Specification	Description

1.	**Temperature Range**	10K to 325K max
2.	**Calibrated Accuracy**	10 K to 20K ±50mK max
3.	**Recommended excitation**	10 µA ±0.1% min
4.	**Max reverse voltage**	40 V
5.	**Thermal response time Measurement**	Typical <10 ms at 10 K
6.	**Dissipation** (max)	16 µW at 10 K
Subsystem Pressure Transducer		
SL NO	**Specification**	**Description**
1.	**Pressure Range**	1*10^-8 mBar to 100 mBar
2.	**Sensor Type**	Absolute Pressure Sensor
3.	**Principle of Measurement**	Filament Pirani & Capacitance
4.	**Max Measurement Uncertainty**	1*10^-8 to 1*10^-6 mBar±10 % of reading.
5.	**Status indicators**	LED
6.	**Overpressure limit**	1 Bar
7.	**Interfaces**	RS 232 or any latest interface model

6. RF Plumb line Subsystem Specification



OFHC Cryogenic Isolator		
Sl. No.	**Description of the item**	**RF Specification**
1	**Frequency of operation**	8.0 to 12.0 GHz
2	**Power Handling**	1 Watt max
3	**Structure**	Coaxial
4	**RF O/p Flange**	SMA Female
5	**Isolation of isolator**	23 dB or better
6	**Insertion Loss**	0.07 dB or better @ 50 K
7	**Material**	OFHC Copper or equivalent
8	**Environment**	Vacuum (10^-8 mBar) min
9	**Weight**	30 gm.approx.
10	**Quantity**	1 Nos
OFHC Cryogenic Directional Coupler		
Sl. No.	**Description of the item**	**RF Specification**
1.	**Frequency**	8.0 to 12.0 GHz
2.	**Coupling Value**	40 dB **+/-1dB max** @ 50 K
3.	**Directivity**	15 dB min
4.	**Insertion Loss**	0.05 dB or better @ 50 K
5.	**Power**	1 Watt max
6.	**Waveguide**	WR 112
7.	**Flange**	UG 51/U
8.	**Material**	OFHC Copper or equivalent
10.	**Weight**	30 gm approx.

11.	**Environment**	Vacuum (10^-8 mBar)
12.	**Quantity**	1 Nos
13.	**Operation Temp**	50 K min
	OFHC Cryogenic Band Pass Filter	
1	**0.1 dB Bandwidth**	8400-8500 MHz
2	**In-band loss**	0.05 dB or lower @ **50 K**
3	**In-band ripple**	< 0.1 dB pp
4	**Group delay ripple**	< +/- 1 ns pp over the full < 0.2 ns/MHz linear
5	**VSWR**	< 1.2:1
	Rejection	8120 MHz and 8780 MHz > 50dB 7145-7235 MHz: > 90 dB 9360 MHz +/- 50 MHz: > 90 dB 2590 MHz +/- 50 MHz: > 120 dB
8	**Waveguide**	WR 112
9	**Flange**	UG 51/U
10	**Material**	OFHC Copper or equivalent
11	**Environment**	Vacuum (10^-8 mBar)
12	**Quantity**	1 Nos
	OFHC Waveguide Vacuum Window	
1	**Frequency Range**	8400±100 MHz
2	**Power Handling**	1 Watt max
3	**VSWR**	1.1:1 min
4	**Vacuum Compatibility**	10^-8 mbar max
5	**Operating Pressure**	0.5 Psi max
6	**Leak Rate**	5×10^-10 mbar/sec max
7	**Waveguide**	WR 112
8	**Flanges**	UG 51/U
9	**Transmission Loss**	0.05 dB or lower @ 50 Kelvin
9	**Material**	OFHC Copper or equivalent
10	**Quantity**	1 Nos
	OFHC Cryogenic Waveguide to Coaxial Adapter	
1	**Frequency**	8.0 to 12.0 GHz
2	**Insertion Loss**	0.05 dB or lower @ 50 K
3	**Power Handling**	1 Watt Max
4	**VSWR**	1.15:1 max
5	**Material**	OFHC Copper or equivalent
6	**Waveguide**	WR 112

7	**Flange**	UG 51/U
8	**Connector Type**	SMA Female
9	**Environment**	Vacuum (10^-8 mBar) max
10	**Quantity**	1 Nos

Cryo LNA Specification:

This particular item is already procured by ISTRAC and will be supplied to vendor as a Free issue material.

SL No.	DESCRIPTION	SPECIFICATION
1	**RF Bandwidth**	6-20 GHz
2	**Noise Temperature**	4.7 Kelvin
3	**Noise figure**	.070 dB
4	**Gain**	32 dB
5	**DC Power**	V_d =1.00 v, Id=22 mA
6	**RF Connector**	Female SMA
7	**DC connector**	9 pin female Nano D
8	**RF input drive level**	-10 dBm
9	**IRL**	15 dBm
10	**ORL**	15 dBm
11	**Quantity**	1 Nos

Power supply for Cryo LNA Specification

1.	**AC Input voltage range**	230V±10%
2.	**Input Frequency**	50 Hz
3.	**Maximum Total**	+12V
4.	**Output Current Max**	1.7 A
5.	**Efficiency**	55%
6.	**Ripple and noise**	3 mV P_K-P_K
7.	**Load Regulation**	0.05%
8.	**Status and feedback monitoring**	V_d sense and V_g sense.
9.	**Quantity**	2 Nos

7. Interlock:

The following interlocks will be provided by Vendor

Type Of Interlock	Description	Nature Of Interlock
Temperature Interlock	A temperature interlock monitors the temperature of the cryo cooler, particularly at critical points such as the cold head, cold finger, and sample chamber. If the temperature exceeds predefined limits or deviates significantly from the set point, the interlock can initiate an automatic shutdown to prevent overheating and damage.	GUI display(Settable and controllable)
Pressure Interlock	Cryocooler operate under vacuum or low-pressure conditions. A pressure interlock monitors the pressure levels inside the cryocooler's vacuum vessel. If the pressure rises above safe levels due to a leak or other issue, the interlock can disable vacuum gauge.	GUI display(Settable and controllable)
Power Supply Interlock	This interlock ensures that the cryocooler is receiving the correct voltage and current from its power source. If there is an issue	GUI display(Settable and controllable)

	with the power supply, such as a voltage drop or ripple, the interlock can shut down the cryocooler to protect it from damage.	
Coolant Flow Interlock	10K Cryocooler require the circulation of a coolant or working fluid to remove heat from the system. A coolant flow interlock monitors the flow rate of the coolant. If the flow rate falls below a certain threshold, indicating a coolant blockage, leak or pump failure, the interlock can shut down the cryocooler to prevent overheating.	GUI display(Settable and controllable)
Overcurrent Interlock	This interlock monitors the electrical current flowing through the cryocooler's components. If the current exceeds safe levels, it can indicate a malfunction or electrical fault. The interlock can then initiate a shutdown to prevent damage.	GUI display(Settable and controllable)
Pressure Relief Device Interlock	To prevent pressure buildup at the time of Maintenance or Cold head Changeover, when we performing vacuum	GUI display(Settable and controllable)

	breakdown, the Dewar should have pressure relief valves for safety features.	
Fill Hose Interlock	When filling a cryogenic Dewar from a supply source, a fill hose interlock will ensure that the fill hose is properly connected and secure before allowing the filling process to commence	GUI display(Settable and controllable)

8. General Terms & conditions:

SL NO	General Terms & conditions :	
1	**Documentation:** The documentation for the Cryo Dewar shall include the following details:	
	a.	The operational manual, technical manual (design methodology, description & wiring), integration manual, maintenance manual (including calibration/ test procedures and trouble-shooting procedures).
	b.	Detailed schematics and fault diagnosis procedures.
	c.	The parts list for the complete system should include electrical and mechanical specifications along with manufacturers /supplier's address, part numbers, data sheet and test reports from OEMs.
	d.	Both hard copies and soft copies of above documents shall be supplied.
2	List of recommended / preferred makes/manufacturer for RF components is given below. The party should preferably use components from these manufacturers. Any deviation from these needs to be approved by the review committee during Preliminary Design Review.	

	Sl. NO	Components	Preferred manufacturer
	1	Cryocooler	Sumitomo/Sunflower
	2	Vacuum Window	XCENS Inc/Richardson Electronics/Quinstar
	3	Band Pass Filter	XCENS Inc/ Richardson Electronics/Quinstar
	4	Circulator	XCENS Inc /Richardson Electronics/Quinstar
	5	Directional Coupler	XCENS Inc/Richardson Electronics/Quinstar
	6	Waveguide to coaxial adapter	XCENS Inc/Richardson Electronics/Quinstar
3	**Training:** The supplier shall provide training to the operating personnel of the Cryostat operation, maintenance and troubleshooting the cryo subsystem for duration of two weeks after installation at RDA.		
4	The useful life of the system shall be 10 years minimum after acceptance at RDA.		
5	**Product Assurance:** The development process for the system shall follow the commonly adopted methodology in ISRO for product assurance with technical reviews like Preliminary Design Review (PDR),Detailed design review(DDR), Factory acceptance Test (FAT), Site acceptance Test (SAT) and regular progress reviews of the overall system by the committee, constituted by RDA.		
6	The supplier shall prepare the preliminary design report on system offered within two months after receiving the purchase order. This document will be reviewed by a PDR (Preliminary Design Review) committee, constituted by RDA. The recommendations of the committee are to be incorporated at no extra cost.		
7	The supplier shall prepare the acceptance test plan (ATP) document and submit it to the committee constituted by RDA. The total system needs to be integrated at supplier's premises and overall system performance shall be demonstrated as per ATP.		

8	The vendor has to successfully demonstrate all the technical specifications listed in Table A in standalone mode and Performance of cryo system shall be demonstrated after interfacing with other RF sub systems.
9	All development tools and environment for developing the application programs has to be sourced by the vendor.
10	Vendor should provide a technical compliance table for all the specifications of the deliverable.
11	RDA will provide **Cryo** cable assemblies, cables, LNA (part no), connectors and cable harnesses required within or external to the system. Integration is to be done by vendor and will be delivered to RDA along with these units.
12	Industrial graded components are to be compulsorily used in the cryo system and commercial graded components are to be avoided.
13	Necessary safety interlocks to be introduced as mention in section 6.
14	All the off the shelf items, MTBF to be mentioned.
15	The vendor shall undertake full responsibility to complete all activities within scheduled time frame. The vendor's team will have to interact with RDA/ISTRAC technical team through secured ftp gateway created by the vendor for this purpose, on regular basis.
16	Vendor shall also submit a table of technical compliance addressing all the aspects in the format given in the following table.

Sl.No	Parameter / feature/ Aspect	Specification/ Requirement Asked	Specification/ Requirement offered	Remarks	Reference in the technical proposal

17	Supplier should arrange own material handling equipment and necessary tools, in this regard RDA/ISTRAC will not provide any material handling equipment.
18	The supplier shall maintain records of all inspection and testing which shall be made available to the purchaser, RDA/ISTRAC, ISRO or his authorized representative.
19	The supplier shall notify the purchaser, RDA/ISTRAC/ISRO of the dates on which manufacture of items is to commence at his own factory or the dates on which standard items will be available for inspection.
20	Bought out components shall be inspected at vendor/supplier's premises for the compliance with the specifications and datasheet shall be provided to ISTRAC.
21	Fabricated components shall be inspected at the vendor/supplier's works for compliance with the component drawings. Sub-assemblies shall be inspected at the vendor/supplier's works for the compliance with the sub-assembly drawings and for performance requirements
22	No item is to be delivered unless an acceptance certificate for the same has been issued by RDA/ISTRAC.
23	Vendor shall provide hardware & software trouble shooting and monitoring procedures for the Cryo system.
24	Integration of all RF modules inside the system using suitable cable assemblies has to be done. Required signals are to be terminated on to the chassis using suitable connectors and cable assemblies.
25	The supplier shall be given pre-defined time to complete the action

	points rose during various reviews such as preliminary design review and critical design review. The action points have to be closed within the given time. Otherwise it is considered as delay from supplier side and time will be considered to impose LD.
26	**Warranty Clause:** The Supplier shall provide warranty for the satisfactory performance of the subsystem for a period of **36 months** from the date of acceptance by user agencies, wherein supplier shall repair or replace the defective parts at no extra cost. The Supplier has to attend one periodic maintenance in a year and breakdown maintenance as and when required. Break down maintenance should be responded within 48 Hours' time and shall be completed within 48 Hours after response. Warranty period will be extended by the additional duration taken for breakdown maintenance.
27	**Payment clause:** 100% pro-rate within 30 days after installation and commissioning at site and submission of PBG.
28	**Liquidated Damage (LD):** In the event of order placement, if the supplier fails to deliver, install and commission the system as per the delivery schedule, the purchaser shall recover from the supplier as Liquidated damages a sum of one half (0.5%) percent of the ordered price for each calendar week of delay. The Liquidated damages shall in no event exceed ten percent (10%) of the total order value.
29	**Security Deposit (SD):** In event of order placement, the party should submit security deposit at 3 % (Three percent) of the order value of the purchase order towards due performance of the order. The security deposit shall be valid for a period of 60 days beyond the date of completion of the contract. The SD will be discharged without any interest after completion and acceptance of the contractual obligations.
30	**Performance Bank Guarantee (PBG):** In event of order placement, the party shall provide PBG for 3 % (Three percent) of the order value valid till the completion of warranty period plus two months claim period, towards performance of system during warranty.

9. Acceptance test procedure (ATP) for Cryostat 10K includes the following:

➢ Factory Acceptance Test (FAT):

1. MSLD (Mass Spectrometer Leak Detector) test should be conducted at the time of fabrication and test report should be at the time of FAT.
2. Vacuum leak test (VLT) should be carried out at the time of FAT.
3. Cold test of Cryo Dewar (mainly to check the evaporation rate of He and temperature stability) should be carried out at the time of FAT. (Typically 24 Hours).
4. Integrated test with RF plumb line components.
5. Note:

    A. In case any failure or faulty of component during FAT, the supplier has to replace the component or sub system with free of cost. And the endurance test to be repeated.

➢ Site Acceptance Test (SAT):

The Cryostat 10K is to be integrated with RF subsystems like LNA etc. after integration; the vendor has to repeat all the checks listed below.

1. Cooling System Verification: Ensure that the cryostat's cooling system is operating properly and capable of reaching and maintaining the desired temperature of approximately 10 Kelvin.

2. Vacuum System Testing: Verify that the vacuum system can achieve and maintain the required vacuum level inside the cryostat chamber.

3. Temperature Control: Test the temperature control system to ensure it can accurately set and maintain the desired temperature.

4. Leak Testing: To conduct leak tests to ensure that there are no leaks in the cryostat's vacuum or cooling systems.

5. Electrical Feed through Testing: Verify the integrity and functionality of any electrical feed through, ensuring that they maintain a proper vacuum seal.

6. Pressure Gauge Calibration: As a part of yearly maintenance calibrate and test any pressure gauges or sensors used to monitor the cryostat's internal environment

7. Safety Checks: Ensure that all safety features, interlocks, and emergency shutdown systems are in place and functioning correctly.

8. Data Acquisition and Monitoring: the cryostat is equipped with data acquisition systems, test their functionality and ensure they can accurately record experimental data.

9. Gas Inlet/Outlet Testing: As a part of yearly maintenance if the cryostat has gas inlets or outlets, verify that they are functioning correctly for controlling the internal environment or for specific experimental needs.

10. Documentation Review: Review the documentation provided by the manufacturer, including manuals, specifications, and safety guidelines, to ensure compliance with the intended use.

11. Performance Verification: Heat load test of Cryo chamber for 72 Hours with LNA (dissipation 200 mWatt) at site.

Note: In case any failure or faulty of component during SAT, the supplier has to replace the component or sub system with free of cost. And the endurance test to be repeated.

A. Non completion of the ATP at SAT would lead to "complete rejection of RDA/ISTRAC stores"

The overall system specification should be verified at the time of SAT.

10. Deliverables

The vendor shall be required to supply all items as given in table below, demonstrate the working of cryostat system after integration with the LNA and conduct ATP tests as mentioned. The final acceptance shall be subject to clearance of ATP tests and completion of qualification tests.

Cryostat 10K should have the following deliverables

SL .No	System Description	Qty
1	Cryogenic Chamber including vacuum gauge, vacuum window	1
2	Vacuum suction port	1
3	Rotary Vacuum Pump with Turbo Molecular Pump With accessories	1
4	Mounting plate for LNA	1
5	PLC Control Panel with SCADA	1
6	System PC with control and monitoring unit	1
7	Helium (GHE) Compressor with Chiller 2 T	1
8	Cryocooler 10K with cold head	1
9	Helium Gas Cylinder	1
10	Power supply unit for LNA	2
11	Cryo LNA including Nano D Connector	1
12	RF Front end plumb line Including LNA and associated Circuit Thermal Shield, Isolator,Coupler,Filter,Adapter,vaccum window	1 Set

	Cable, Waveguides, Sprinkle Leak detector	

11. Delivery schedules

The following delivery schedule is to be met by supplier after placement of purchase order. System shall be dispatched to site only after FAT and clearance given by RDA/ISTRAC. Proposed schedule of realization is given below:

SL .No	**Activity**	**Completion of activity**
1.	Purchase order (PO) release	T0
2.	Submission of preliminary design document.	T0+1 months=T1
3.	Technical Discussion and Clearance for Preliminary design review	T1+1 month= T2
4.	Detailed design review(DDR)	T2+3 months=T3
5.	Supplier Intimation to RDA/ISTRAC for Inspection readiness of 10K Cryo Dewar	T3+2 months=T4
6.	Factory acceptance test	T4+1 months = T5
7.	FAT RDA/ISTRAC committee review and clearance	T5+1 months =T6
8.	Site acceptance test	T6+1 months =T7

9.	System functioning in standalone mode for 24 hours/day (for 10 working days)	T7+1 months=T8

N.B: Total delivery, installation and acceptance to be completed within 9 month after PDR Clearance.

12. Responsibility Matrix

SL NO	DESCRIPTION	RESPONSIBILITY		
		ISTRAC	**VENDOR**	**ISTRAC and VENDOR**
1.	Conceptual design , configuration and specification of 10K Cryocooler based RF Front End system			✓
2.	RF Components Finalization			✓
3.	Design Engineering and realization of cryogenic chamber along with 10K Cryocooler		✓	
4.	PDR			✓
5.	DDR			✓
6.	Integration of cryocooler with LNA and RF Plumb line inside chamber		✓	
7.	Cryogenic performance test for 72 Hours			✓
8.	RF performance under Cryogenic			✓

	environment			
9.	FAT and SAT			✓
10.	Submission of test report		✓	
