

Brief Specification Document
for
Development of Environmentally Controlled
Modules



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The Specifications for Environmentally Controlled Modules given in this document may undergo minor changes during tender/DDR/CDR with mutual discussion between the firm and the IRDE.

In case of any clarifications, the firm may contact the following:

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1 Introduction

IRDE is working for development of an optimized SWaP Electro-optical solution for high altitude platform (Approx. 20 km altitude) for long endurance (90 days). It includes an HD MWIR Thermal Imager, HD Short Wave Infra-Red (SWIR) and Day Camera. Two different payload design configurations are to be developed one having static EO payload comprising of MWIR & SWIR/Day camera and the other having gimballed EO payload with same sensors.

2 Functional Description of ECM

ECM (Environmentally Controlled Module) is an enclosure that will maintain temperature of optics module and payload electronics tentatively within 20°C to +30°C. Optics module and payload electronics are separately being developed by IRDE.

Optics module comprises of optical elements, mechanical structure that supports these optical components

Payload electronics shall include two PCB boards tentatively of same size ($\approx 3'' \times 3'' \times 1''$). The payload electronics shall carry out all the processing, control & power distribution related to functioning of the EO payload. ECM will maintain the environment which is safe for operation of the various components.

ECM modules are of two types, ECM of static EO Payload configuration and ECM of gimballed EO Payload configuration. These ECMs shall be mounted on High Altitude Platform and shall be intended to operate in altitude band of 17 km to 23 km. The configuration of two modules is given as below:

A). ECM of Static Configuration (ECMS)

1. Internal housing with sapphire window: This housing will house optics module and payload electronics.
2. External housing with sapphire window: This housing shall house internal housing. All the components required for thermal management may be mounted onto these two housings. This housings arrangement shall contain required harnessing from platform till optics module and payload electronics

B). ECM of Gimballed Configuration (ECMG)

1. Internal housing with sapphire window: This housing will house optics module, payload electronics and also comprises of gyro-stabilized gimbal assembly

2. External housing with sapphire window: This housing shall house gyro-stabilized internal housing

All the components required for thermal management shall be mounted onto these two housings and optics module. This housing-in-housing arrangement shall contain required harnessing from platform till optics module and payload electronics.

3 Specification of Environmentally Controlled Modules

The specifications of ECMs are as follows:

3.1 ECM of Static Configuration (ECMS)

S. No.	Description/Specification
1.	Weight: 6 kg ($\pm 10\%$)
2.	Size: Will be shared during pre-bid meeting
3.	<ul style="list-style-type: none"> Operating altitude for the payload: ≈ 20 km Ambient pressure (absolute) for the payload: as per operating altitude Ambient temperature for the payload: as per operating altitude Permissible inside ambient temperature of inner housing should be maintained within permissible temperature variation. Detailed will be shared during pre-bid meeting.
4.	Close loop thermal management with live recording and communication of health parameters like temperature, pressure and humidity at critical location
5.	Operating Environment's Humidity: As per MIL HDBK-310
6.	Included De-icing & Defogging features
7.	Total power available to run the payload including thermal management is limited. Detail will be shared during pre-bid meeting.
8.	Power dissipation from the optics module including payload electronics will be updated at the time of signing of development contract.
9.	Both internal and external housings are hermetically sealed

3.2 ECM of Gimbaled Configuration (ECMG)

S. No.	Description/Specification
1.	Gimbal freedom: Roll $\pm 20^\circ$
2.	Weight: 11 kg ($\pm 10\%$)

3.	Size: Will be shared during pre-bid meeting
4.	<ul style="list-style-type: none"> Operating altitude for the payload: ≈ 20 km Ambient pressure (absolute) for the payload: as per operating altitude Ambient temperature for the payload: as per operating altitude Permissible inside ambient temperature of inner housing should be maintained within permissible temperature variation. Detailed will be shared during pre-bid meeting.
5.	Close loop thermal management with live recording and communication of health parameters like temperature, pressure and humidity at critical location
6.	Operating Environment's Humidity: As per MIL HDBK-310
7.	Included De-icing & Defogging features
8.	Total power available to run the payload including thermal management is limited. Detail will be shared during pre-bid meeting.
9.	Power dissipation from the optics module including payload electronics will be updated at the time of signing of development contract.
10.	Both internal and external housings are hermetically sealed

4 Scope of Work

The scope of work comprises of the following:

1. Preliminary mechanical design of both the ECMs shall be provided by IRDE. Final configuration of both ECMs shall be worked out by the firm in consultation with IRDE and same should be accepted by IRDE.
2. Detailed design, optimization, drawing generation, fabrication, assembly, testing and evaluation of both ECM modules shall be carried out by the firm with final approval of IRDE. 3D CAD models of optics module, payload electronics and sensors shall be provided by IRDE.
3. Design and fabrication of Jigs and fixtures as required for design/fabrication of both ECMs.
4. Both the ECM Modules should qualify Acceptance Criteria as mentioned in Appendix 'A'.
5. Thermal design and analysis with implementation of thermal design in both ECMs shall be carried out by the firm.

6. Design of thermal management scheme and its implementation will consider all environmental conditions (Temperature, Pressure, Humidity, Solar & Earth Radiation and Earth Albedo) at operating altitude. However, both ECMs will be tested as per acceptance criteria without considering radiation effects of sun and earth. For this purpose, the firm shall carry out a separate analysis without considering radiation effects.
7. Servo sensors & gimbal components (Gyros, Motors & bearings (ABEC 7) etc.) will be finalized, supplied and integrated by the firm after vetting by IRDE.
8. Design should avoid dissimilar metals joints and also materials listed as in MIL-STD-810G Table 508.6B-I. Group II.
9. The firm will develop embedded software and hardware for thermal management & gimbal control for testing and evaluation of both ECMs as standalone units using customized MMI, developed by the firm based on IRDE inputs.
10. The firm will provide all the necessary protocols along with source code and other relevant technical details in CD/DVD/applicable suitable media. Further, the firm shall implement the same on IRDE developed MMI. IRDE designed electronics hardware is based on ZmqMPSoC processor, accordingly interfaces will be implemented as per IRDE requirements.
11. Electronics Interface (Power & Communication) details between ECMs and payload electronics is provided in Appendix B. Accordingly, it will be developed and implemented by the firm
12. Electronics interface (Power & Communication) details between platform & ECMs shall be provided by IRDE. Accordingly, it will be developed and implemented by the firm.
13. Supply and integration of hermetically sealed connectors (MIL-38999 series/EN4165) after vetting by IRDE.
14. Design of internal wiring layout, supply and routing of wires (MIL grade) inside both ECMs with approval of IRDE.
15. The opto-mechanical materials should be selected and vetted by IRDE which are less susceptible to UV/ozone.
16. The mounting interface of both ECMs modules with optics module, sensors, payload electronics and platform will be decided mutually considering acceptance criteria as per Appendix A.

17. Design and fabrication of interface plates for integration of both ECMs with platform as per IRDE inputs.
18. Selection/Design and supply of static/dynamic seal (whichever applicable) for both ECMs.
19. Design and fabrication of Test Jigs for testing/performance evaluation and required accessories/packaging case & transportation (MIL grade).
20. Structural including thermo-structural analysis as well shall be carried out by the firm with standard tools designed for analysis for such cases. Bench marking of the software tool shall be shared by the firm and it should be accepted by IRDE. Thermal analysis under operating environmental conditions should be carried out as per Appendix A.
21. Detailed Design Review (DDR)
22. Critical Design Review (CDR)
23. The responsibility of integration of both the ECMs with optics module & payload electronics (developed by IRDE) and its performance evaluation/testing after integration as per Appendix A will also lie with the firm. The performance evaluation/testing will be performed in presence of IRDE representative.
24. The firm shall be carried out reliability analysis of both the ECMs.
25. The Acceptance Test Procedure (ATP) document as per Appendix A will be prepared by the firm as per IRDE inputs and approved by the IRDE.
26. Technical Documentation-
 - DDR Document
 - CDR Document
 - Master Drawing Index
 - Assembly procedure documents
 - Structural & Thermal Analysis Report
 - Datasheet of components used in thermal management
 - Calibration certificate of the sensors
 - Testing and Performance Evaluation Report
 - Reliability analysis report
 - Material testing report/CoC of optical, mechanical, electronics, servo and thermal management components

- Document for Algorithm/software design for thermal management & gimbal control
- Design/Selection document for static/dynamic seal
- Acceptance Test Procedure
- Acceptance Test Report
- Maintenance Manual
- User/operation Manual
- FMEA report
- Quality Assurance Plan
- System Safety Analysis
- Analysis of Life Cycle Cost
- BoM and any other relevant document as per BoM

5 Deliverables

In the development of Environmentally Controlled Modules, 01 set is to be developed which comprises of the following deliverables as listed below:

S. No.	Item	Qty
1.	Environmentally Controlled Module of Static Configuration (ECMS)	03 Nos.
2.	Environmentally Controlled Module of Gimbaled Configuration (ECMG)	02 Nos.
3.	All jigs, fixtures and required accessories: As mentioned Sl. No. 19 of para 4 of this document	02 Set*
4.	Technical Documents/Report: As mentioned Sl. No. 25 of para 4 of this document	02 Set*

* For each configuration i.e., for S. No.1 & S. No. 2 of deliverables.

6 General Terms & Conditions

- The specifications/work may undergo change of minor nature ($\leq 10\%$ of the design). The firm should absorb such changes/modifications without repercussions on cost.

- Before submission of any document, the firm will send a draft copy of document for the necessary amendments/ corrections by IRDE. IRDE will hold the right to accept/ reject the document as per IRDE standards.
- Mode of operation of the payload, duty cycle of electronics/detectors and their individual power dissipation shall be provided at the signing of development contract.
- Drawing generation of all optical & mechanical components will be done by the firm in **IRDE drawing format**. Optical, mechanical and electronic design and their drawings must be handed over to IRDE before launching of fabrication and after final modification.
- **All Intellectual Property Rights (IPR) of the ECM Modules (designs and drawings) will rest with IRDE.** The firm will not sell or modify the product or its variant to any party without written consent of The Director, IRDE, Dehradun.
- Material testing report/CoC of optical, mechanical, electronics, servo and thermal management components will be provided by the firm.
- Datasheet of all the components, such as heating and sensing elements of thermal management of the modules shall be vetted and accepted by the IRDE.
- Calibration certificate of all the sensors should be valid till warranty period.
- The firm shall depute their team at IRDE for Testing/Performance Evaluation as and when required during development and warranty period.
- The Director, IRDE reserves the right to short-close the contract at any stage of contract if the firm did not achieve the any milestone of the contract or if firm violates any of the technical or commercial terms and conditions.
- Freight charges for any warranty replacement should be borne by the firm.
- The firm is responsible for ensuring the performance as per the specifications given in contract.
- The firm will provide the product with a warranty of 12 months. The warranty will start after all the milestones given in specification sheets are completed.
- Onsite maintenance and technical support are required during development and warranty period.
- The firm will provide post warranty product support for 05 years.

- The firm must provide the development plan including micro-plan in the techno-commercial bid.
- The firm must submit a compliance matrix with respect to all specification requirements and terms & conditions mentioned in this document for vetting by the TCEC. The firm may be required to give a presentation before TCEC to enable the overall assessment of the firm.
- The firm is liable to supply the item, developed under this contract to IRDE/IRDE designated agency, if required in future at reasonable cost.

7 Milestones with Acceptance Criteria

S. No.	Activity/Item description	Acceptance Criteria	Delivery period/Completion (Months)
1	DDR of ECMS and ECMG	Acceptance by IRDE	T0 + 09
2	Realization of Unit 1 of ECMS and its functional testing	Delivery of Unit 1 of ECMS and Acceptance by IRDE	T0 + 18
3	CDR of ECMS	Acceptance by IRDE	T0 + 20
4	Design modification, if any, in ECMS and Realization of Unit 2 of ECMS and Unit 1 of ECMG	Delivery of Unit 2 of ECMS and Unit 1 of ECMG and Acceptance by IRDE	T0 + 30
5	CDR of ECMG	Acceptance by IRDE	T0 + 32
6	Design modification, if any, in ECMs of the two payloads and realization of Unit 3 of ECMS and Unit 2 of ECMG	Delivery of Unit 3 of ECMS and Unit 2 of ECMG & remaining deliverables and Acceptance by IRDE	T0 + 45

Appendix-A**Acceptance Criteria:**

The Acceptance Criteria of both ECMs is as follow:

Sl. No.	Test Name	Standard Followed	Remarks
1	Performance Check/Functional Testing	As per ATP document	Performed on Unit 1 of ECMS and ECMG
2	Environmental Stress Screening	MIL-STD-2164	Performed on Unit 2 of ECMS and Unit 1 of ECMG
3	High Temperature	Test Derived from MIL-STD-810H at operating environmental conditions	Performed on Unit 3 of ECMS and Unit 2 of ECMG
4	Low Temperature		
5	Low Pressure (Altitude)		
6	Sealing Test (Hermetically sealed)		
7	EMI/EMC	DO-160G	Both ECMs should be designed at test parameters and supported by design documents. (No tests are required to be conducted)
8	Electrostatic Discharge	DO-160G Section 25	
9	Voltage Spikes	DO-160G Section 17	
10	Ingress Protection	IP67 rating	
11	Shock Test	MIL-STD-810H (2g, 24ms, half sine, one in all three direction)	
Note: Test No. 6 will be conducted without optical module, electronics and sensors			