Critical Design Review (CDR)
Of
ULTRA VIOLET IMAGING TELESCOPE (UVIT)

(June 17th -18th 2011, ISAC, Bengaluru)

FM Status and Issues of Delivery

UVIT-CDR-00-001.2

Indian Institute of Astrophysics
Bangalore-560034

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Compiled by:

Shyam N Tandon, IIA, Bengaluru, and IUCAA, Pune

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Abbreviations

ASTROSAT	Astronomy Satellite, India
BMU	Bus Management Unit of the satellite
BS	Beam Splitter, to split the beam in NUV and VIS.
CCD	A solid state imaging device
CFRP	Carbon fibre reinforced plastic
CMOS imager	A solid state imager
CSA	Canadian Space agency
CPU	Camera Proximity Unit; contains the Detector Module, and some electronics, and mounts on focal plane
DHU	Data Handling Unit of ASTROSAT; receives data on images from UVIT
DM	Detector Module; contains photo-cathode, microchannel plate intensifier, and phosphor coupled with fibre taper to CMOS detector
EM	Engineering/qualification model
EU	Electronic Unit for control etc. of detectors
FUV	Far UltraViolet : 130 nm to 180 nm wavelengths
FM	Flight Model, to be launched
FWHM	Full width at half maximum; used here as measure of image size
FWDE	Filter Wheels Drive Electronics
HVU	High Voltage Units for detectors
ICD	Interface control document
IISU	ISRO Inertial Systems Unit; a laboratory of ISRO
INSAT 3D	An Indian satellite
ISAC	ISRO Satellite Centre
ISRO	Indian Space Research Organisation
LEOS	Laboratory for Electro-Optics Systems (ISRO)
MFD	Mechanical Fixing Device for mirrors/optics
NUV	Near UltraViolet: 200 nm to 300 nm wavelengths
Photek	Contractor for IIA, who supply the DMs
PSF	Point spread function
RFP	Request for Proposals to supply the required material
Routes	Contractor for CSA, who make detector system
P/L	Payload (UVIT)
S/C	Spacecraft
SAC	Satellite Applications Centre; a laboratory of ISRO
STR team	Structural engineering team at ISAC
Star 250	A CMOS imager from Fill Factory, Belgium
TC	Telecommand
TM	Telemetry
UV	Ultraviolet range of electromagnetic spectrum
UVIT	UltraViolet Imaging Telescope
UVITEU	Electronic Unit for detectors in UVIT
VIS	Visible: 320 nm to 550 nm wavelengths

1. Scope of the Document

This document gives a very brief summary of the state of readiness for assembly, testing, and delivery of the payload to ISAC for environmental tests and integration with the S/C. In particular any uncertainties affecting the process of assembly/testing are highlighted for seeking guidance of the CDR-committee.

In the introduction an overall idea is given of what is involved in integration, testing, and delivery of the payload. In the following chapters state of the specific items is presented. The last chapter highlights the uncertainties affecting assembly/testing.

2. Introduction

The payload, at the time of delivery, consists of four physical parts: the "Main Assembly" of optics and detectors which is assembled on a "Titanium Cone", the Electronics Unit for the detectors (EU), Filter Wheels Drive Electronics (FWDE), and electrical harnesses. The Titanium Cone sits inside the cylinder of S/C, while the other parts sit on the decks; the harnesses run between the Titanium Cone and EU & FWDE.

The "Main Assembly" consists of two individual telescopes- each with own mirrors, detectors, and filter-wheel with motor. These two telescopes are mounted on the "Titanium Cone" before being transported to ISAC. The other parts are transported to ISAC as individual units. Each of these telescopes goes through a set of tests, and the full "Main Assembly" too goes through some tests before transport to ISAC.

During the transport to ISAC, as well as during all the activities- involving storage or assembly or testing or transport or waiting in the rocket- strict contamination control and monitoring is to be implemented.

3.0 FM Status

Here we give status of the various elements which go into completing the payload for delivery to ISAC.

3.1 Assembly of the individual telescopes:

All the mechanical parts required are ready after mounting of the heaters etc. for thermal control. The mirrors are ready after completion of all the optical and environmental tests– the mirrors for NUV/VIS telescope are delivered, while those for FUV are ready at LEOS. The detector systems are in hand after completion of all the tests and calibrations. *However, the motors for the filter-wheels are not yet ready at LEOS.* All the accessories for assembly are ready, and have been used during assembly of the EM.

3.2 Testing of the individual telescopes:

During its assembly and after the assembly several tests are done to ensure that the mirrors and the other optical elements, and the detectors are mounted correctly. The overall image quality, and possible thermal effects on focus (and hence image quality) are also assessed.

All the accessories required for these tests are in hand. Further, procedures for the tests have been documented, and many of the tests have been completed on the EM. The collimator required to test the overall image quality has been developed and used by LEOS and it would be transferred to IIA soon.

3.3 Preparing the "Main Assembly":

The "Main Assembly" done on the "Titanium Cone". The "Titanium Cone" is ready. Some tests have been done to check that the "Titanium Cone" mates well with S/C – this process, which has gone on for many weeks, is expected to be closed soon.

The two telescopes have to be aligned to each other, and an alignment cube on the "Titanium Cone" is calibrated wrt the telescopes – all the accessories for this are rady and have been used in the EM.

3.4 Transporting to ISAC:

The assembled telescope is transported to ISAC in a clean box which is purged with high purity N2. Shock monitors are used on the box to record any shock during the transportationi. The box has been used successfully to transport the EM.

3.5 Tests on the "Main Assembly" at ISAC:

While the electrical parts (in detector system and in filter-wheel-drives) can be checked, for their performance, after the main assembly is ready, it is not possible to make detailed checks on the optical performance. However, a limited set of sets have been developed to ensure, at different stages of environmental testing, that health of theoptics is good.

3.6 Handling at ISAC:

All the accessories required for handling the payload at ISAC are ready and have been tested during the tests of the EM at ISAC.

3.7 Environmental Tests at ISAC:

Most of the accessories required for these tests are ready and have already been used for tests on the EM. Some additional electrical-harnesses are required for the FM, and these are being prepared at IIA.

3.8 Integration with S/C:

3.8.1 Mechanical Aspects:

The "Main Assembly" sits on "Titanium Cone". Final tests on mating of the "Titanium Cone" with S/C are expected to be completed before end of June, 2011.

The EU is a heavy box and has a large heat loss. In order to have a good mounting on the deck, two requirements are to be satisfied: a) Inserts in the deck should be able to take the preload on the bolts with a good margin, b) thermal conduction through base of the EU to the deck must be very good. These aspects are yet to be checked.

3.8.2 Electrical Aspects:

The electrical harnesses which connect the "Main Assembly" to S/C etc. are summarized

below:

Two end Points	Supplier	Readiness
Main Ass. & EU	IIA	Ready
Main Ass. & FWDE	IISU	To be obtained
Main Ass.-Thermal & BMU	IIA	To be made
EU & BMU etc.	ISAC	??
FWDE & BMU etc.	ISAC	??

EMI/EMC interference has been tested for the EM detector system. It is expected that the FWDE would be delivered by IISU after the EMI/EMC tests.

3.9 Contamination Control:

Contamination control and monitoring is regularly done at IIA during all the processes relating to UVIT project – these processes have been verified to be successful during assembly/testing of the EM.

At ISAC procedures have been initiated for contamination control during the TV tests; *experience with EM suggests that these procedures are useful but need some improvements.*

Procedures for control and monitoring of contamination at various stages between delivery to ISAC to launch have been discussed in the past. A concrete plan and process for implementing that has been taken up by the project.

4. Issues of delivery

4.1 Gross Schedule for delivery to ISAC for environmental tests

Assuming that the filter-wheel-drives would be received from IISU by the end of June 2011, the following gross schedule can attempted:

ACTIVITY	Total Weeks from Start
1. Begin assembly of NUV/VIS on June 13	0 week
2. Assembly and alignment of the NUV/VIS mirrors	2 weeks
3. Tests on thermal effect on the focus	2.5 weeks
4. Alignment of the Detectors' mounts and BS	4 weeks
5. Mounting of the filter wheels	5 week
6. Mounting of the Detectors and alignment checks	6 week
7. Tests on the focus, focal plane, effective area	7.5 weeks
8. Begin assembly of FUV	7.5 weeks
9. Assembly and alignment of FUV mirrors	9.5 weeks
10. Alignment of the Detecor's mount	10.5 weeks
11. Mounting of the filter-wheels	11.5 weeks

12. Mounting of the detector and alignment checks	12.5 weeks
13. Tests on the focus, focal plane, effective area	14 weeks
14. Mounting the two telescopes on the "Titanium Cone"	15 weeks
15. Anchoring of all the cables	16 weeks
16. Mounting the thermal cover	17 weeks
17. Mounting the main baffles and the doors	18 weeks
18. Transferring to the transport box	18.5 weeks
19. Transport to ISAC BY OCTOBER 25, 2011	19.5 weeks

4.2 Issues/Uncertainty

While the above schedule is very tight, the delivery of the Filter-wheel-drives by the end of this month (June, 2011) is yet to be confirmed by IISU, and that remains a critical uncertainty.

Drafted on June 8, 2011 by S N Tandon