EUROPEAN SPACE AGENCY
DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT
MISSION OPERATIONS DEPARTMENT

INTEGRAL
FLIGHT OPERATIONS PLAN

Volume 0
Scope of FOP

INT-MOC-FOP-FOP-1001-TOS-OGI

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INTEGRAL FOP Volume 0
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AD2 INTEGRAL AOCS Users Manual
INT-MA-MMB-0001

AD3 User Manual for the IBIS Instrument
IN.IB.IAS.UM

AD4 IREM User Manual
IREM-UM-PSI-001

AD5 Spectrometer User Manual
SPI-MU-0-1062-CNES

AD6 JEM-X User Manual
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AD8 Product Assurance during INTEGRAL Operations
INT-ESOC-OPS-TN-0001-TOS-QO

AD9 INTEGRAL OGS Configuration Management Plan
INT-ESOC-CM-PL-0001-TOS-QO

AD10 MOC – SGS ICD
INT-MOC-SYS-ICD-0001-OGI

Reference Documents

RD1 INTEGRAL Mission Operations Concept
INT-SYS-MIS-TN-0001-OGI

RD2 INTEGRAL Mission Planning Concept
INT-SYS-MIS-TN-0002-OGI

RD3 INTEGRAL On-Board S/W Maintenance Concept
INT-SYS-MIS-TN-0003-OGI

RD4 INTEGRAL Operations from Launch to Final Orbit
INT-SYST-MIS-TN-1002-TOS-OGI

RD5 INTEGRAL Reference Orbit Operations
INT-MOC-SYS-TN-1009-TOS-OGI

RD6 INTEGRAL on PROTON Consolidated Report on Mission Analysis
INT-RP-22772

RD7 INTEGRAL on ARIANE 5 Consolidated Report on Mission Analysis
INT-RP-14237

RD8 moved to AD10

RD9 MOC Computer Hardware Configuration
INT-MOC-TN-0002-CS

RD10 OGS Ground Facilities Users Requirements Document
INT-SYST-SYS-URD-0001-OGI

RD11 INTEGRAL Ground Segment Management Plan
INT-PL-23045

RD12 INTEGRAL Mission Implementation Plan (MIP)
INT-MOC-MGT-MIP-0101-OGI

RD13 INTEGRAL Mission Implementation Requirements Document (MIRD)
INT-SR-1593

RD14 INTEGRAL Science Ground Segment Implementation Plan (SGSIP)
INT-PL-03197

RD15 INTEGRAL Ground Segment Design Report
INT-RP-22519

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RD21 Instrument Modes and Mode Transitions
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RD22 The ISOC Operations Concept
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RD24 The Broadcast Packet
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RD25 FOPGEN Document Editor Guide

RD26 INTEGRAL Database Configuration Control Requirements Document
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RD27 ESOC QMS Quality Manual
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GLOSSARY OF TERMS

ACC	Attitude Control Computer
AHF	Attitude History File
AMA	Absolute Measurement Accuracy
AO	Announcement f Opportunity
AOCS	Attitude & Orbit Control System
AOS	Acquisition Of Signal
APD	Absolute Pointing Drift
APE	Absolute Pointing Error
APF	Attitude Parameter File
ARTS	Anomaly Recording & Tracking System
ASF	Attitude Snapshot File
B/U	Back-Up
BOA	Begin Of Activity
BOM	Begin Of Mission
BOT	Begin Of Track
BUV	Bus Undervoltage
CBH	Cat Bed Heater
CCB	Configuration Control Board
CCCF	Conditional Configuration Change Flag
CCT	Central Communications Terminal
CDMU	Central Data Management Unit
CHF	Command History File
CI	Configuration Item
CLCW	Command Link Transmission Word
CLTU	Command Link Transmission Unit
CP	Commissioning Phase
CRP	Contingency Recovery Procedure
CSSW	Common Service Software
DBOB	Database of Observable Bins
DCA	Dedicated Control Area
DPE	Data Processing Electronics
DSMS	Deep Space Mission System
DSS	Deep Space Station
DV	Delta Velocity
ED	Event Designator
EGSE	Electrical Ground Support Equipment
EOA	End Of Activity
EOC	End Of Charge
EOM	End Of Mission ESTRACK Operations Manual
EOT	End Of Track
EPOS	Enhanced POS
EPS	Electrical Power Subsystem
ESA	European Space Agency
ESAM	Emergency Sun Acquisition Mode
ESOC	European Operations Centre
FCP	Flight Control Procedure
FCT	Flight Control Team
FCV	Fuel Control Valve
FD	Flight Dynamics
FDS	Flight Dynamics System
FOP	Flight Operations Plan
FOPGEN	FOP Generation Tool
FOV	Field Of View

FSS	Fine Sun Sensor
FTP	File Transfer Protocol
GCR	Ground Control Room
GRB	Gamma Ray Burst
GS	Ground Segment
H/W	Hardware
HK	Housekeeping
HV	High Voltage
I/F	Interface
IASW	Instrument Application Software
IBAS	INTEGRAL Burst Alert System
IBIS	Imager On-Board INTEGRAL Satellite
ICD	Interface Control Document
ICP	Instrument Command Parameter
IFDS	INTEGRAL Flight Dynamics System
IFOP	Instrument Flight Operations Plan
IFRD	
IFTS	INTEGRAL File Transfer System
IMCS	INTEGRAL Mission Control System
IMU	Inertial Measurement Unit
IODB	INTEGRAL Operational Database
IOS	INTEGRAL Overall Simulator
IPF	Immediate Parameter File
IPS	Inertial Pointing & Slew
IREM	INTEGRAL Radiation Monitor
ISDC	INTEGRAL Science Data Centre
ISDS	INTEGRAL Security Distribution System
ISGRI	
ISOC	INTEGRAL Science Operations Centre
ISWT	INTEGRAL Science Working Team
JEM-X	Joint European X-Ray Monitor
JPL	Jet Propulsion Laboratory
LAN	Local Area Network
LCL	Latch Current Limiter
LCTF	Local Command and Telemetry Facility
LEOP	Launch & Early Orbit Phase
LOS	Loss Of Signal
LOS	Loss Of Signal
LUT	Look Up Table
LV	Latch Valve
MIP	Mission Implementation Plan
MOC	Mission Operations Centre
MOM	Mission Operations Manager
MOUT	Message Out
MOUTP	Message Out Processed
MPS	Mission Planning System
NASA	National Aeronautics & Space Agency
NCTRS	Network Control and Telemetry Distribution System
NOP	Network Operations Plan
OBDH	On-Board Data Handling
OBS	On-Board Software
OBSM	On-Board S/W Maintenance
OBSMS	On-Board S/W Maintenance System
OD	Flight Operations Director
ODB	Operational Database
OEOB	On Event Operational Buffer
OGS	Operational Ground Segment

OLF	Observation Log File
OLP	Off-line Processing
OM	Operations Manager
OMC	Optical Monitoring Camera
OOL	Out Of Limit
OTF	On Target Flag
P/L	Payload
PAF	Predicted Attitude File
PAS	Performance Analysis System
PDU	Power Distribution Unit
PG	Project Manager
PGT	Proposal Generation Tool
PHS	Proposal Handling System
PI	Principal Investigator
PICSIT	
PL	Payload
PLM	Payload Module
POS	Preferred Observation Sequence
PS	Project Scientist
PSC	Project Science Coordinator
PSF	Planning Skeleton File
PST	Polling Sequence Table Project Support Team
PV	Performance Verification
QA	Quality Assurance
QLA	Quick Look Analysis
RCS	Reaction Control Subsystem
REPOS	Replanned EPOS
RF	Radio Frequency
RGA	
RMU	Rate Measurement Unit
ROM	Read Only Memory
RPE	Relative Pointing Error
RPOS	Replanned POS
RTU	Remote Terminal Unit
RW	Reaction Wheel
RWB	Reaction Wheel Bias
RX	Receiver
S/C	Spacecraft
S/W	Software
SCHEDO	Scheduling Office
SCOM	Science Operations Manager
SCT	Spacecraft Control Team
SDB	Satellite Database
SECL	Spurious Eclipse
SGS	Science Ground Segment
SI	Service Instance
SICF	Service Instance Configuration File
SOE	S/C Operations Engineer Sequence Of Events
SOM	S/C Operations Manager
SOP	Standard Operations Procedure
SPACON	S/C Controller
SPI	Spectrometer
SSL	Sun Steering Law
STC	Station Computer
STR	Star Tracker

SUM	Satellite Users Manual
SVM	Service Module
TAC	Time Allocation Committee
TBC	To Be Confirmed
TBD	To Be Defined
TC	Telecommand
TCM	Thruster Control Mode
TCS	Thermal Control Subsystem Telecommand Schedule
TDRS	Telemetry Data Retrieval System
TM	Telemetry
TOO	Target Of Opportunity
TPF	Task Parameter File
TSF	Timeline Summary File
TT	Time Tag
TX	Transmitter
VC	Virtual Channel
VETO	
W/S	Workstation
WAN	Wide Area Network

1 INTRODUCTION

This version of the INTEGRAL Flight Operations Plan (FOP) defines the Rules, Procedures, and Contingency actions governing the INTEGRAL Mission during the Routine Scientific Mission Phase.

The INTEGRAL Flight Control Team (FCT) has prepared this document, under the responsibility of the INTEGRAL Spacecraft (S/C) Operations Manager (SOM).

However, some chapters of the FOP have been prepared with the support of and in cooperation with external personnel:

- The Volume 3 that defines the interactions between the Mission operations Centre (MOC) and the Science Ground Segment (SGS) has been prepared in cooperation between the FCT and representatives of the SGS.
- The Volumes 6 and 8 that define the nominal and contingency S/C flight procedures have been derived from the Satellite Users Manual (SUM) and generated in cooperation with the Satellite Prime Contractor.
- The Volumes 7 and 9 that define the nominal and contingency Payload (PL) flight procedures have been derived from the Satellite Users Manual (SUM) and generated in cooperation with the corresponding Prime Investigator (PI) / Instrument Teams.

2 SCOPE AND STRUCTURE OF THE FOP

The INTEGRAL FOP contains all information that is necessary to operate the Satellite from Launch until the end of the mission. In addition, it contains some high level procedures to operate the INTEGRAL Operational Ground Segment (OGS) as far as the Flight Control Team (FCT) is concerned. Further details are provided in the Network Operations Manual (NOP), the Flight Dynamics Manual, the Ground Facility Manual and the Operations Manuals of the INTEGRAL Science Operations Centre (ISOC) and the INTEGRAL Science Data Centre (ISDC).

The FOP is split into the following volumes:

Volume 0 : Scope of FOP

The volume 0 provides an introduction into the FOP.

Volume 1: Mission Management

The volume 1 defines the mission management during the Routine Scientific Mission Phase and is split into various books:

- Book 1 provides a Mission Summary to give an overview of the mission characteristics, set-ups and goals.
- Book 2 defines the management set-up.
- Book 3 defines the Mission Rules.
- Book 4 defines the system configuration management and the change control processes.
- Book 5 describes the mission reporting concept.

Volume 2: Mission Support Procedures

The volume 2 identifies the mission support procedures. They define the procedures that are needed to complement the flight procedures. This volume is split into the following books:

- Book 1 provides the mission planning procedures.
- Book 2 defines the On-Board Software (S/W) Maintenance (OBSM) concept for the S/C and Instrument On-Board S/W (OBS). It includes also the procedures that are needed to operate the OBSM System (OBSMS) at MOC. The corresponding flight procedures are defined in the volumes 6 to 9 of the FOP.
- Book 3 defines the Flight Dynamics procedures as far as they concern the operations of the Flight Dynamics System (FDS) that is part of the Dedicated Control Area (DCA). The operations concerning the FDS that is operated by FD personnel is defined in the Flight Dynamics Manual (see RD TBD).
- Book 4 defines the procedures that are needed to operate the INTEGRAL Mission Control System (IMCS) that is part of the DCA. Further details are provided in the Ground facility manuals.
- Book 5 defines the procedures concerning the maintenance of the OGS. It addresses the Hardware (H/W) as well as the operational products (e.g. database).
- Book 6 defines operational ground procedures that are not covered by the flight procedures.
- Book 7 provides operational support information in form of TNs concerning the handling of special on-board tasks.

Volume 3: MOC – SGS Interfaces

The volume 3 defines the interactions and the corresponding interface (I/F) procedures between the MOC and the SGS. It is split into two books:

- Book 1 addresses the interactions between the MOC and ISOC.
- Book 2 addresses the interactions between the MOC and ISDC.

Volume 4: Ground Station Operations

The volume 4 defines the ground station operations as far as they have to be performed by the FCT. The operations to be performed by the Ground Control Operators from the Ground Control Room (GCR) are defined in the NOP. The volume is split into two books:

- Book 1 addresses the MOC – ESA station I/F including the remote control of the ground station.
- Book 2 addresses the MOC – NASA station I/F including the required interactions between ESA and NASA.

Volume 5: Mission Anomalies

The volume 5 describes the concept for handling mission anomalies. It is split into the following books:

- Book 1 defines the decision process in case of anomalies concerning the ground and space segment.
- Book 2 provides the anomaly handling procedures that are needed to recover from anomalies.
- Book 3 provides the necessary information that is needed to maintain and operate the Local Command and Telemetry Facility (LCTF) that is a Back-Up (B/U) of the MOC and is used in case of long term outages (greater than 24 hours) of the MOC.
- Book 4 provides complementary information concerning the handling of special anomaly cases.

Volume 6: S/C Flight Control Procedures

The volume 6 contains the nominal S/C Flight Control Procedures (FCP). It is organised according to the various S/C subsystems. The FCP's define the elementary operations that are needed to operate the equipment (e.g. switch on/off) as well as the system procedures that are needed in the context of the Mission Timeline (e.g. eclipse procedures). It is split into the following books:

- Book 1 : System
- Book 2 : Attitude and Orbit Control Subsystem (AOCS)
- Book 3 : Reaction Control Subsystem (RCS)
- Book 4 : On-Board Data Handling Subsystem (OBDH)
- Book 5 : Electrical Power Subsystem (EPS)
- Book 6 : Thermal Control Subsystem (TCS)
- Book 7 : Radio Frequency Subsystem (RF)
- Book 8 : INTEGRAL Radiation Monitor (IREM)
- Book 9 : On-Board S/W (OBS)

Volume 7: Payload Flight Control Procedures

The volume 7 contains the nominal PL FCP's. It is organised according to the various instruments and is split into the following books:

- Book 1 : Payload System
  This book contains the procedures that are relevant to all instruments, e.g. Broadcast Packet.
- Book 2 : Spectrometer (SPI)
- Book 3 : Imager (IBIS)
- Book 4 : X-Ray Monitor (JEM-X)
- Book 5 : Optical Monitor (OMC)
- Book 6 : Instrument On-Board S/W

Volume 8: S/C Contingency Recovery Procedures

The volume 8 contains the S/C Contingency Recovery Procedures (CRP) that are needed to recover from S/C contingencies including the reestablishment of stable conditions. It is organised according to the various subsystems and split into the same books as volume 6:

- Book 1 : System
- Book 2 : Attitude and Orbit Control Subsystem (AOCS)
- Book 3 : Reaction Control Subsystem (RCS)
- Book 4 : On-Board Data Handling Subsystem (OBDH)
- Book 5 : Electrical Power Subsystem (EPS)
- Book 6 : Thermal Control Subsystem (TCS)
- Book 7 : Radio Frequency Subsystem (RF)
- Book 8 : INTEGRAL Radiation Monitor (IREM)
- Book 9 : On-Board S/W (OBS)

Volume 9: Payload Contingency Recovery Procedures

The volume 9 contains the PL CRP's that are needed to recover from PL contingencies including the reestablishment of stable conditions. It is organised according to the various instruments and split into the same books as volume 7:

- Book 1 : Payload System
- Book 2 : Spectrometer (SPI)
- Book 3 : Imager (IBIS)
- Book 4 : X-Ray Monitor (JEM-X)
- Book 5 : Optical Monitor (OMC)
- Book 6 : Instrument On-Board S/W

Volume 10 : LEOP and Perigee Raising Manoeuvres Phase

The volume 10 defines the special implementation of the LEOP and the Perigee Raising Manoeuvres Phase. It covers all operations that are needed to take the Satellite from launch until the start of the Commissioning Phase. It is split into the following books:

- Book 1 provides the detailed Timelines for each orbit during the mission. The timelines identify all required operations and PL configurations to perform the required manoeuvres.
- Book 2 provides all special flight procedures that are needed only in this phase.
- Book 3 defines the special system / management set-up and rules that are applicable in this phase.
- Book 4 defines the special ground segment procedures that are due to the special system set-up in this phase.

Volume 11 : Commissioning, Calibration and Verification Phase

The volume 11 defines the special implementation of the Commissioning, Calibration and Verification Phase until the start of the Routine Scientific Mission Phase. The special functions are derived from the Commissioning Plan (see RD TBD) as provided by the Project. This volume is split into the following books:

- Book 1 provides a [illegible] this phase and the detailed timelines for those periods where a strict timeline is to be followed. The strict routine mission planning system won't be used in this phase to leave sufficient flexibility.
- Book 2 provides the special flight procedures that are needed only in this phase.
- Book 3 defines the special system / management set-up and rules that are applicable in this phase.
- Book 4 defines the special ground segment procedures that are due to the special system set-up in this phase, in particular concerning the interactions with the SGS and the [illegible]'s.