

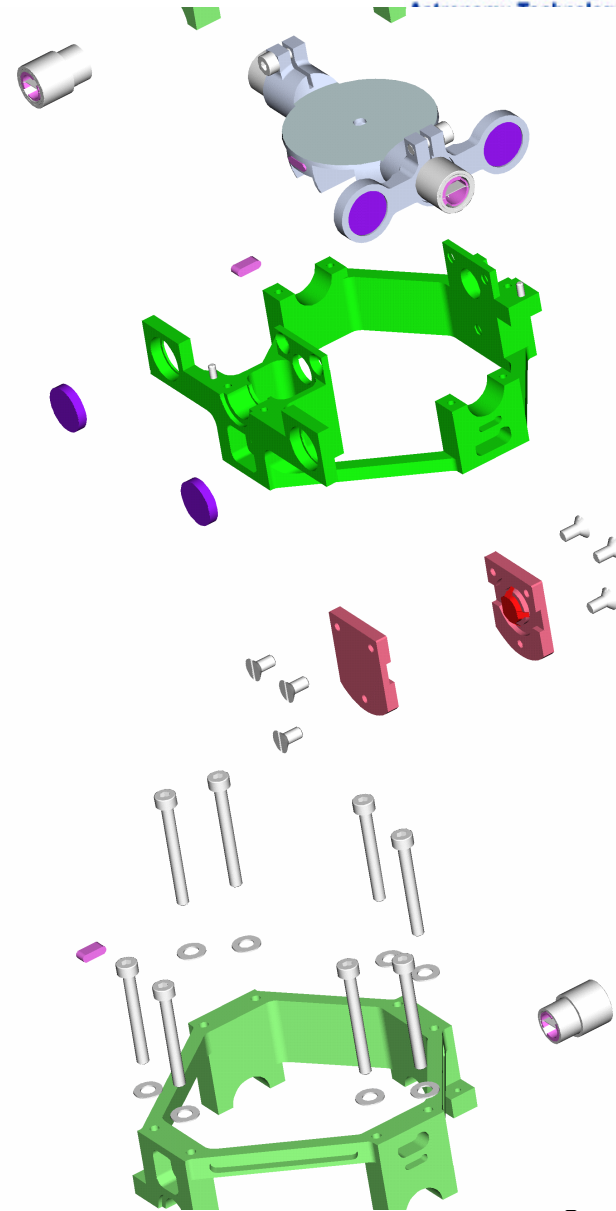
BSM Product Assurance Plan Overview

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Doc pack sec.8

Overview

- **The BSM is a high reliability precision cryogenic mechanism**
- **Goal of the ATC's PA plan is to**
 - provide a level of traceability and assurance to the customer of overall quality levels,
 - provide a specific assurance that the product is fit for purpose in the space environment.
 - end deliverable of the PA plan is the Acceptance Data Package (ADP)
 - Reduce cost!



BSM PA - People

Name	Role	Specific PA Responsibility
Dr Gillian Wright	Local Co-I, Project Scientist	Fitness for Purpose
Ian Pain	Project Manager, Mechanical Engineer, PA manager	PA manager, Design Quality
Colin Cunningham	Deputy Director/Chief Engineer, SPIRE systems engineer, BSM consultant	consultant engineer, quality of deliverables
Gary Rae	Chief Engineer, Head of Specialism (Mechanical)	quality of deliverables
Tully Peacocke,	Optical Engineer	Optical testing
Brian Stobie,	Electronics & Controls engineer	Electronics acceptability
Tom Paul,	Mechanical Design Engineer	Design Configuration
Ken Wilson,	Project Technician	Hardware configuration,
Brenda Graham	Electronics engineer	Clean Room
Gayle Reynolds	Project Assistant	Documentation Integrity

Quality Assurance at the UK ATC

- **UK ATC mission**
 - *“be the UK's National Centre for the design and production of state of the art astronomical technology”.*
- **Quality management**
 - *... is the process of ensuring that the quality expected by the customer is achieved. The customer's quality expectations must be understood ... and balanced against any constraints that time and cost may impose. All work packages must be traceable back to the customer requirements to ensure that [they] are met.*
- **General ATC practice,**
 - project engineers responsible for the quality of their work
 - supervisory aspects covered by the relevant Head of Specialism.
 - The Chief Engineer is responsible for approving the overall quality of the products delivered to customers.
- **For the SPIRE BSM a Product Assurance Manager is designated to ensure that the unique quality aspects of space flight projects are fully met.**

PA Plan Contents

- **ATC QUALITY ASSURANCE**
 - **PROCUREMENT CONTROL**
 - **MANUFACTURING AND ASSEMBLY CONTROL**
 - **NON-CONFORMANCE PROCESS**
- **PRODUCT ASSURANCE MANAGEMENT**
 - **GENERAL**
 - **DESIGN QUALITY ASSURANCE**
 - **CONFIGURATION MANAGEMENT AND CONTROL**
 - **MATERIAL AND PROCESS SELECTION AND CONTROL**
 - **ELECTRONIC PARTS SELECTION AND CONTROL**
 - **CLEANLINESS AND CONTAMINATION CONTROL**
 - **SOFTWARE PRODUCT ASSURANCE**
 - **RELIABILITY ASSURANCE**
 - **INTEGRATION AND TEST CONTROL**
 - **ACCEPTANCE AND DELIVERY**

PA Plan Appendices

- 1. UK ATC Organogram**
- 2. Procurement Control Procedure**
- 3. UK ATC Workshop Effort Request document.**
- 4. ATC Route Card**
- 5. Manufacturing and Assembly Control (Inspection Forms)**
- 6. Calibration of Measuring, Inspection and Test Equipment**
- 7. Non Conformance Reporting System**
- 8. ATC Fault Logging System**
- 9. Document Control**
- 10. CAE/Drawing Control**
- 11. Clean Room procedures**
- 12. Request For Waiver or Specification Change**
- 13. Mate/De-mate Log**
- 14. Engineering Change Request Procedure and Forms**
- 15. PAD sheet**
- 16. Declared Lists**
- 17. FMECA format**
- 18. Integration and Test Logs**

Applicability of PA to the BSM models

PA REQUIREMENTS	INSTRUMENT MODELS AND GSE					
	DM	QM	CQM	PFM	FS	GSE
PA Management	P	A	A	A	A	A
Material and Process Selection and Approval	P	A	P(1)	A	A	P
EEE Parts Selection and Control	N	P(5)	P(1)	A(2)	A(2)	P(3)
Cleanliness and Contamination Control	P	A	A	A	A	P(4)
Reliability Assurance	N	A	A	A	A	P(4)
Safety	N	A	A	A	A	A
<u>Quality Assurance</u>						
Procurement Control	P(1)	P(1)	P(1)	A	A	P(3)
Manufacturing Control	P(5)	P	P	A	A	P(3)
Integration and Test Control	P(5)	P(5)	P(5)	A	A	P(3)
Handling, Storage, Packaging	N	P (5)	A	A	A	A
Non-conformance Control	P(5)	P(5)	P(5)	A	A	A
Alerts		A	A	A	A	N
Acceptance and Delivery		N	A	A	A	A
Software PA	N	N	N	N	N	N

A = Applicable; P= Partially Applicable; N = Non-Applicable

Key to PA applicability table

- 1. Space rated parts are not required, but performance should be equivalent (e.g. Mil-Spec)**
- 2. Applied via LAM**
- 3. Applicable for components coming into direct contact with flight standard hardware (e.g. interfacing connectors from GSE cables).**
- 4. Applicable to elements directly interfacing with the flight hardware, when an impact on the flight hardware is possible.**
- 5. Applicable to all activities related to design verification**

PROCUREMENT CONTROL

- **Traceable PO's (PPARC FM's)**
- **Supplier Selection**
- **Incoming Inspection Report**
 - verification of the packaging conditions and status of environmental sensors,
 - visual inspection,
 - verification of correct identification and conformance to ordering data,
 - certificate of conformance,
 - supplier's inspections and control results,
 - remaining lifetime (for products with limited lifetimes).
- **Quarantine & Bonded Store**

MANUFACTURING AND ASSEMBLY CONTROL

- **Manufacturing Request**
- **Route Card**
- **Serial Number identification**
- **Inspection**
 - Operator Inspection
 - Independent Inspection as required
 - External attendance at MIP/KIPs if required
- **Bonded Store**
- **Assembly Control & Logs**

NON-CONFORMANCE PROCESS

- **Reporting System**
- **Quarantine**
- **Classification (major/minor)**
 - Major : an interface control document to the SPIRE system is affected
 - Major : where the sub-system specification is affected, particularly form, fit, function, performance
 - Major : where the instrument AIV plan is affected.
 - Minor - all others
- **Disposition and Reporting**
- **Close Out**

Non Conformance Report Review

- **Review**
 - investigate and close out each NCR, with a recommendation for disposition and corrective action to prevent re-occurrence.
 - NCR register reviewed at BSM project meetings,
- **NCR review panel will be at a minimum:**
 - the responsible engineer identified on the Workshop Effort Request,
 - the BSM PA manager
 - the member of staff raising the NCR.
 - Additional staff as required. UK-SPO and/or ESA for major NCR's.
- **Disposition as:**
 - 'Use as is', without requirement for waiver
 - 'Use as is', but with a Request for Waiver or Specification Change request
 - 'Re-work or Repair', with attached repair instructions where required.
 - 'Scrap'
- **Corrective action**
 - documented and circulated to the relevant HoS.

DESIGN QUALITY ASSURANCE

- **Design Description [RD 3] documents the current design state,**
- **Product assurance during the design process consists of**
 - **Verifying the presence of all necessary inputs,**
 - **Safety and reliability studies,**
 - **The formalization of the functional analysis,**
 - **Verifying interactivity between mechanical-electrical and software design,**
 - **Verifying the presence and compliance of "latest design" files and documents.**
- **Design Staff**
 - **a team of experienced professional engineers,**
 - **additional expertise is available for design input from the ATC Specialisms.**
- **Design Review Framework**

MATERIAL AND PROCESS SELECTION AND CONTROL

- **Material and process controls implemented**
 - hazardous and forbidden materials,
 - outgassing,
 - strength and stress corrosion resistance
- **The BSM will select materials from**
 - the ESA approved materials list
 - NASA approved materials
- **Preference will be given to materials with**
 - Proven flight heritage within the SPIRE consortium,
 - Proven cryogenic heritage within ATC or SPIRE consortium
- **Declared Materials List , Declared Process List**
 - maintained as part of the design package, presented at relevant design reviews and incorporated into the ADP.
- **Material approval and evaluation activities finalized by**
 - the Instrument Baseline Design Review (IBDR)
 - the start of manufacturing of qualification flight hardware

ELECTRONIC PARTS SELECTION AND CONTROL

- **Warm Electronics:**
 - Responsibility divided between ATC & LAM, broadly
 - ATC - design intent, system functionality
 - LAM - hardware detailed design, build and qualification
- **Cold Electronics**
 - **Motors**
 - Zeiss/PACS
 - **Sensors**
 - Infineon (ISOPhot) - up-screen & PAD
 - **Harness**
 - approved wiring
 - trained personnel
- **Components**
 - **Common Parts Procurement**

CLEANLINESS AND CONTAMINATION CONTROL

- **Design**
 - For assembly
 - Materials selection
- **Clean Room assembly**
 - Class 1000 cleanroom
 - Class 100 air-bench
- **Bakeout**
 - 80degC
- **Test Dewar**
 - cleanliness enforced (semi-clean area)
- **Storage**
 - Dry Nitrogen purge of storage containers

SOFTWARE PRODUCT ASSURANCE

- **No BSM deliverable software**
- **BSM-MCU interaction**
 - **D-Space development environment**
 - **FPGA parameters via D-Space C code**

RELIABILITY ASSURANCE

- **Reliability Block Diagram**
- **Single Point Failures**
- **FMEA/FMECA**
- **Cumulative Operating Time**
- **Environmental Assurance**
- **Environmental Testing**
- **Critical Items Identification and Control**

INTEGRATION AND TEST CONTROL

- **Assembly, Integration and Test**
- **Test Procedures**
- **Test Witnessing**
- **Test Reports**
- **Fault Logging**
- **Historical Record (Logbook)**
- **Handling, Storage, Packaging, Marking and Labeling, Transportation**

Acceptance data pack

- **Shipping Documents**
- **Procedures for Transport Handling & Installation**
- **Certificate of Conformance/Delivery Review board MOM AI Lists**
- **Qualification Status/Test Matrix**
- **Top Level Drawings incl. Family Tree**
- **Interface Drawings**
- **Functional Diagrams (Block Diagram)**
- **Electrical Circuit Diagrams**
- **As built configuration lists**
- **Serialised Components List**
- **List of Waivers**
- **Copies of Waivers**
- **Operation Manual**
- **Historical Record**
- **Logbook/Diary of Events**
- **Operating Time/Cycle Record**
- **Connector Mating Record**
- **Test Record**
- **Calibration Data record**
- **Temporary Installation Record**
- **Open Work / Deferred Work / Open Tests**
- **List of Non-Conformance reports (NCR's)**
- **Copies of Non-Conformance reports (NCR's)**
- **Test Reports**
- **Mass records / Power Budgets**
- **Cleanliness Statement**
- **Compliance Matrix**
- **Photographs**

PA Plan Summary

- **PA Plan Goal: Fitness for purpose**
- **Purpose:**
 - **Reliable cryogenic high precision mechanism**
 - **Space qualified**
 - **Integrated to SPIRE**
- **Method:**
 - **Rigorous Design**
 - **Configuration Control**
 - **Traceable Materials, Parts, Documents**
 - **Fully documented clean room assembly**
 - **Non-conformances & design changes, raised & tracked**
 - **Qualification Programme backs the design**
 - **ADP demonstrated fitness for purpose**