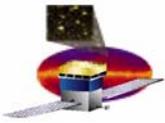


GLAST Large Area Telescope Calorimeter Subsystem

Quality Assurance Status Safety and Risks

Nick Virmani

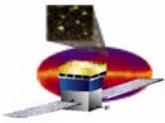




Quality Program Review

- ❑ **CAL subsystem Specific Performance Assurance Requirements derived from the GLAST LAT MAR, 433-MAR-001**
- ❑ **CAL-specific Quality Assurance Activities and Implementation Plan (LAT-SS-01472-01) describes the methods and controls to be implemented**
- ❑ **All work performed by trained and compliant personnel; personnel training/certification per NASA standards**
- ❑ **QA will audit on all activities to verify implementation and effectiveness of performance assurance activities**
- ❑ **Identification/evaluation of risk on a continuing basis**
- ❑ **Support test readiness reviews, post test readiness review, and pre-ship reviews at NRL**

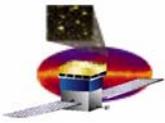




Quality Program Review (cont.)

- ❑ **Verification conformity for compliance between subsystem design and requirements by inspection and tests; reconciliation of “as-built” configuration to “as-designed” for each item up to the subsystem level**
- ❑ **The Calorimeter Performance & Safety Assurance Manager (PSAM) shall direct and monitor the activities of the LAT CAL subsystem to assure conformance, identify need for preventive and/or corrective actions, and implement them when necessary.**
- ❑ **The PSAM is point of contact for all Safety Reliability and Quality Assurance (SR&QA) issues**
- ❑ **The PSAM shall coordinate all Safety, Reliability, and Quality Assurance (SR & QA) issues with LAT Quality Manager and NASA GSFC GLAST Program System Assurance Manager**

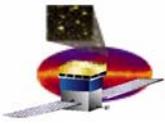




Quality Program Review (cont.)

- ❑ Adequate controls verifiable by QA, established for procurement of part, components, materials, hardware items, and integration testing of subsystem
- ❑ Flight integration, test, and maintenance will be conducted in a controlled manner so end item conforms to applicable approved procedures and test methods
- ❑ All work is performed using CAL Work Order Authorization (WOA) database system to control work, identification, and segregation of non-conforming items, recording, reporting, reviewing, disposition, and corrective action
 - Non-conformances are reviewed and dispositioned by an engineering board, including the subsystem engineer, project manager, I&T manager, and QA representative
 - Root cause identified and corrective actions implemented to prevent reoccurrences
 - A closed-loop nonconformance control system is established and maintained to systematically track and prevent recurrence
- ❑ All work orders are controlled and maintained by QA

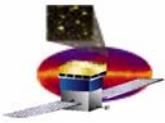




Quality Program Review (cont.)

- ❑ Each Calorimeter assembly shall be identified by a unique part/type number
- ❑ Control, calibrate, and maintain inspection, measuring, and test equipment to ensure the conformance of the calorimeter to the specified requirements
- ❑ Ensure environmental conditions i.e., temperature, humidity, and contamination controls
 - Procedure requirements will be met; tests will be performed in the controlled manner
 - All test hardware (i.e., jigs, fixtures, templates, electrical test equipment, etc.) and software shall be capable of verifying the product prior to use

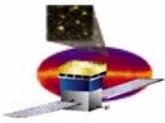




Quality Program Review (cont.)

- ❑ Test performance monitoring shall be mandatory whenever a single human error during test performance could lead to hazardous conditions or invalid test results
- ❑ Test witnessing shall be performed when manual intervention is required
 - at set-up, start, and end of continuous fully-automated test sequences
 - when automatic recording of test parameters/results is unavailable
- ❑ Test steps subjected to formal QA verification shall be identified in test procedures/test plans/work orders or other relevant documents
- ❑ Post Test Review (PTR) shall be performed after test to verify all deviations/modifications were properly authorized and any non-conformance/failure are recorded, authorized and correctly dispositioned.
- ❑ Verify the completeness of all required test data and review them for conformance to the relevant requirements.

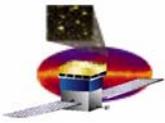




Quality Program Review (cont.)

- ❑ **Test planning, including WOA and associated documents, shall be reviewed and approved by QA to ensure they include configuration details, inspection, test operations to be performed, record of test conditions, recording of data, pass/fail criteria, test data evaluation, procedure deviations and sign-off sheet**
- ❑ **Control measures in place to mitigate all possible hazards to ensure hardware is safe and complies with subsystem safety requirements**
- ❑ **QA will verify implementation of required control measures during testing of flight hardware**





Equipment Calibration

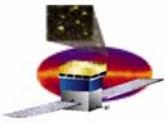
- ❑ **Electrical Functional Test Equipment**
 - **TEM/TPS and supporting VME equipment certified by SLAC**

- ❑ **EMI/EMC Test Equipment**
 - **Quantitative measurement equipment (sensors, antennas, etc.) calibrated to NIST standards**
 - **Calibration performed annually**
 - **All items are (will be) within calibration at time of testing**
 - **Total system (end-to-end) measurement error shall be less than +/- 3 dB and is verified during EMI testing (MIL-STD-461)**

- ❑ **Vibration Test Equipment**
 - **Accelerometers calibrated against a standard accelerometer traceable to NIST (calibrated annually or as required)**
 - **Signal conditioners calibrated annually**

- ❑ **TVAC Test Equipment**
 - **Thermocouples calibrated against standard temperature (0°C); calibrated prior to test**
 - **Thermocouple reader calibrated every 2 years; calibrated prior to test**

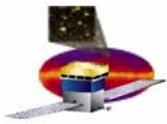




Subsystem Safety

- ❑ **EGSE**
 - Safe-to-mate, functional verification
 - Configuration control: hardware/software
 - Calibration verification
 - Functionality verification of EGSE prior to test of flight hardware
- ❑ **MGSE**
 - Load margin verified by analysis
 - Lifting fixtures have been proofed and certified as per NASA requirement.
- ❑ **Environment**
 - Temperature actively controlled throughout test facility
 - Humidity actively controlled in clean-room; hardware bagged and purged when required
 - Cleanliness actively controlled in clean-room; hardware bagged and purged when required
- ❑ **Training**
 - ESD training complete
 - Clean room training complete
 - Radiation safety training complete
 - Material and weight handling training complete
 - Crane operators certified





Work Order and Problem Report Status

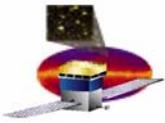
❑ WOAs

- Released (as of 9/1/04) 535
- Closed 432
- Open for FMA 1
- Open for work other than FMA 102

❑ Problem Reports

- Total 117
- Closed 101
- Open 16
- Open for FMA None



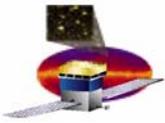


Risk Assessment

❑ Liens against FMA

- **CAL ASIC qualification program not completed at GSFC**
 - No significant issues to date
 - Qual test completion in October
 - Derating of ASIC being resolved
- **Recent change to 22nF 100 volt QML capacitor on AFEE cards (from leaky NovaCap capacitor) approved by GSFC and the PCB will require a waiver for not meeting the derating requirement.**
- **Unexpected high ESD sensitivity (200 volt, class 0) of GCRC and GCFE present risk of hidden damage due to handling, storage, testing and integration.**
 - **Parts may be partially damaged and weakened. It may suffer a change or drift in the characteristic. Potential failures are unknown**
 - **Mate/demate and safe-to-mate processes for installing TEM/TPS on CAL are particular concerns, due to ESD, cable sensitivity, and threat to reliability of the Calorimeter**
 - **ESD protection procedures are being revised/tightened at NRL**





Risk Assessment (cont.)

❑ Schedule

- Pressure to deliver FMA to SLAC could force less-than-complete characterization and analysis of FMA performance; could result in replicating a problem in follow-on modules
- Availability and verification of additional EM2 TEM/TPS can impact test and delivery of subsequent modules

❑ Performance

- None

