QUARTERLY PROGRESS REPORT
DRD 875MA-003
July 2002 – September 2002

Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179

Approved:

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October 11, 2002

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safety violations were documented in the HAZTRAK databases in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) updated three facility fire evacuation plans; (2) participated in three pre-construction conferences; (3) performed six final safety inspections of facilities under renovation or construction; and, (4) reviewed 95 sets of facility design drawings for compliance with OSHA and consensus codes.

IS provided [(b)(4)] to assist the SHE Communications and Training Teams, and general communication of safety awareness to all MSFC employees. As a significant value added effort, HEI developed a comprehensive 60-page draft of the Annual SHE Program Self-Evaluation Report for CY 2001. Other assistance included: (1) wrote multiple safety articles for publication in the Marshall Star; (2) assisted the SHE Training Subcommittee prepare an operating plan, training for SHE committee members, and assisting Center wide customers develop SHE training materials; (3) prepared and processed for web page posting, the weekly SHE highlights and monthly SSWP mandatory safety topics, (4) assisted QS01 and the Central and Area SHE Committees transition to the new SHE Committee concept as recommended by STAR Consultants; (5) prepared monthly SHE communications plans; and, (6) developed innovative safety awareness communications materials.

IS initiated, completed or followed-up on more than ten hazard analyses. Recent examples included: (1) completed the Operational Hazard Analyses (OHA) for the Structural Test Article ISS Node and Common Module dual-crane lifting and handling operations and convoy operations from Redstone Army Airfield to Building 4708; (2) completed the SA for the P41 RS-68 Upgrade Subscale Injector Hot-Fire IR&D; and, (3) continuing to perform a SA for the Micro Light Gas Gun in building 4612 IS continued to support the implementation of the NASA lifting standard by providing day-to-day advice and assistance to S&MA customers. In addition to performing several OHA's, IS: (1) updated the hazard analysis checklist (HACs) for consistency with the changes to the new NASA lifting standard; and (2) followed up with the Facilities Engineering Department and the maintenance contractor activities associated with the installation of the powered platform lifting device, purchased by MSFC, to repair/replace window calking on buildings 4200, 4201 and 4202; and (3) administered hands-on proficiency examinations to 17 overhead-crane/hoist and two aerial lift operators in support of the MSFC Personnel Certification Program.

As a significant strength and in close coordination with QS50 and QS10 IS developed a detailed PowerPoint presentation course materials for Safety and Quality monitors of critical lifts for approval by the Safety Environmental and Health (SHE) Training Committee.

As value added special projects, IS utilized [(b)(4)] from another HEI location to (1) assist S&MA improve the SHE program by preparing training materials for a 3-hour course to train civil service and contractor supervisors how to identify OSHA type deficiencies in the workplace and perform required monthly safety visits; and, (2) initiate an extensive project to prepare explosives site plans for test and other hazardous areas. In support of this effort, HEI facilitated S&MA in processing an advanced explosives siting software, VEXDAM complete with a 2 ½ day training course.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas. Examples of support included: (1) pre-test, post-test, and safety monitor duties for the 24-inch Motor; (2) reviewed and approved numerous hazardous operations test procedures; (3) monitored the test firing of the 11-inch Hybrid Motor; and, (4) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

In addition to routine Safety Design Reviews, IS continued to provide extensive support to the planning and review activities associated with the planned new Propulsion Research Laboratory (PRL). As a major significant effort, support included (1) participation in the weekly meetings; and, (2) performing numerous safety assessments and facility inspections of current hazardous operations scheduled to be relocated in the PRL; and, (3) reviewed the 60% revision drawings and specification for the Post-Bid Design changes made for the Propulsion Research Laboratory (PRL).

4.1.2 System Safety

Payload Safety completed, reviewed, and updated 14 Safety Data Packages. These were: Node 2 Phase III Ground Safety Data Package (SDP), Node 3 Phase II Flight Safety Data Package (SDP), Biotechnology Carriers (BIC) reflight SDP, Environmental Control and Life Support Systems (ECLSS) hazards for Node 3 Phase II Flight, Phase II Ground Safety Data Package for DELTA-L, Phase III Flight Safety Data Package for DELTA-L, Glovebox Integrated Microgravity Isolation Technology (g-LIMIT) Phase III Flight Standard Analysis Reports, MSG-11A Integration Flight Safety Data Package, , ProSED's MSPSP, MGM Phase III, Express ReFlight Packages for ULF-1 and 12A, ULF-1/STS-114 MPLM/Orbiter ReFlight Assessment package.

The Node 2 Phase III Flight and Ground Safety Data Package was submitted and presented successfully to the PSRP, Node 3 Flight Safety Data Package was submitted on-time to MSFC for pre-review per the SDP Review Package MSFC OI. System Safety also supported Coarsening in Solid-Liquid Mixtures (CSLM)-II Phase III safety review and prepared the Glovebox Integrated Microgravity Isolation Technology (g-LIMIT) Delta Phase III SDP. System Safety released the Propulsive Small Expendable Deployers Systems (ProSEDS) Missile System Prelaunch Safety Package (MSPSP) to Air Force Range Safety Engineering for review.

System Safety developed a Product Assurance Process for the Kistler Reusable Launch Vehicle (RLV) in support of Space Launch Initiative (SLI) and wrote the subsequent Design Requirements Deliverables (DRD's) which include Safety, Reliability and Maintainability, Risk Management, Quality Assurance and Verifications. In addition System Safety presented the tailored Data Requirements Descriptions (DRDs) at the Kistler Kaizen Exercise held at Ames Research Center. System Safety made modifications to these DRD's based on the Kaizen Team's inputs.

System Safety provided analysis/evaluation/presentation support for critical operational issues such as the APU Cracked Fuel Pump Investigation and the Solidification Using a Baffle in a Sealed Ampoule (SUBSA) broken ampoule investigation, Solid Rocket Booster (SRB) structure

contamination investigation SRB hydraulic pump replaced inserts investigation, SRB Ethylene Propylene Diene Monomer (EPDM) rubber debond investigation, and Auxiliary Power Unit (APU) Integrated Electronic Assembly (IEA) controller card cracked diode investigation.

System Safety provided Launch Support for the following projects by manning the console at the MCC in Houston; MPLM for UF-2/STS-111, and the Huntsville Operation Support Center (HOSC) for External Tank-112 STS-109, External Tank-112 STS-110, Solid Rocket Booster STS-109, Space Shuttle Main Engine (SSME) STS-110.

Verification Tracking Logs (VTLs) were initiated, completed, or updated for the Glovebox Integrated Microgravity Isolation Technology (gLimit), for the BTF and 11-A integrations of the Microgravity Science Glovebox (MSG), Propulsive Small Expendable Deployer System (ProSEDS), Protein Crystal Growth Single Locker Thermal Enclosure (PCG STES), Oxygen Generator Assembly (OGA), Environmental Control and Life Support Systems (ECLSS), Node 2, Node 3, Mechanics of Granular Materials (MGM), Delta L, Thermal Enclosure System (TES) and the MPLM/Orbiter (Integrated) for Flight UF-2/STS-111.

System Safety initiated, completed, reviewed, or updated Preliminary Hazard Analyses/Hazard Analysis to include Preliminary Hazard Reports (PHA's) for, Oxygen Generator Assembly (OGA), X-37, Co-Optimized Booster for ReUsable Applications (COBRA) Power Duct Design, Glast Burst Monitor (GBM), Protein Crystal Growth Single Locker Thermal Enclosure (PCG STES), Space Shuttle Main Engine (SSME) Integrated Hazard Analysis (IHA), Solid Rocket Booster (SRB) element Hazard Analysis (HA), Reusable Solid Rocket Motor (RSRM) element Hazard Analysis (HA) and External Tank (ET) element Hazard Analysis (HA).

System Safety initiated, completed, reviewed, or updated Fault Tree Analysis for the following Projects: Propulsive Small Expendable Deployer System (ProSEDS), Delta L, X-37, and Observable Protein Crystal Growth Apparatus (OPCGA).

System Safety provided analysis/evaluation for the Pre-Ship Review/Pre-Flight Readiness Review (Pre-FRR)//Flight Readiness Review (FRR) on Pore Formation and Mobility Investigation (PFMI) /Solidification Using a Baffle in a Sealed Ampoule (SUBSA), Bio Technology Carrier (BIC), Mechanics of Granular Materials (MGM), Glovebox Integrated Microgravity Isolation Technology (gLimit) and Enhance Gaseous Nitrogen Dewar (EGN)

System Safety provided analysis/evaluation for the following: Shuttle System Safety Review Panels (SSRPs); SSRP face to face, STS-108 (for External Tank (ET) Liquid Hydrogen (LH2) Burst Disc Leakage issue), STS-109 Pre Flight Assessment (PFA), STS-109 Program Mission Management Team (PMMT) tag up, STS-110 PMMT tag up, Preliminary Assessment Reviews (PAR); Space Shuttle Main Engine (SSME) STS-108, STS-109, STS-110, STS-112 and STS-113 Element Assessment Review (EAR).

System Safety reviewed the following Safety/S&MA Plans; Co-Optimized Booster for ReUsable Applications (COBRA), RS-83, Second Generation Reusable Launch Vehicle (2GRLV) and Glast Burst Monitor (GBM).

System Safety provided analysis/evaluation for Design Reviews for the following projects: Co-Optimized Booster for ReUsable Applications (COBRA), Oxygen Generator Assembly (OGA), Environmental Control and Life Support Systems (ECLSS), and Urine Processor Assembly (UPA).

For S&MA System Safety continued the Shuttle elements SSME, ET, SRB, and RSRM work/review of Major Milestone Reviews, (Acceptance Reviews, Mate Review, Pre-Launch Assessment Review, Flight Readiness Reviews, and Pre-Flight Assessment), Chief Engineering Review Board, Engineering Change Packages, Document Change Notices, Record Change Notices, Discrepancy Reports, Action Items, Change Requests, Manufacturing Process Change Proposed, Plant's Operating Work Centers, Post-flight Reviews, Launch Support, and day-to-day flight and test issues. System Safety continues to evaluate Unsatisfactory Condition Reports (UCRs), and Problem Reports (PRs), as required for shuttle support programs, as well as review changes for impacts to safety.

GRLV Program, 2In support of the System Safety Engineering continued development of the Level II system safety requirements thought coordination with the other NASA Centers and the architecture contractors. This task has been very imposing due to the great differences in technical opions between all parties. The 2GRLV Safety Figure of Merit (SFOM) was also developed and was mutually accepted by the three architecture contractors.

4.2 Reliability

4.2.1 Reliability & Maintainability (R&M) Engineering

In support of the Advanced Projects Assurance Department, R&M continued providing R&M discipline support to the 2nd Generation Reusable Launch Vehicle (2GRLV) program, including review of program documentation to ensure that R&M requirements are correctly specified. R&M reviewed and provided comments on the 2GRLV Reliability, Maintainability, & Supportability Engineering Plan, X-37 Atmospheric Test Vehicle FMECA, and numerous other technical documentation. R&M participated in the DART PDR and provided inputs regarding the acceptability of the program R&M documentation. R&M is also actively involved with the Advanced Electric Propulsion program and is providing input to several trade studies regarding various vehicle design configurations.

In support of the Shuttle Assurance Department, significant R&M activities included participation in the flight readiness review and launch support activities for STS-112 as well as active participation in various anomaly resolution teams. Additionally, R&M continues to support ongoing effort related to Shuttle Upgrades, including active participation in the ET friction stir weld process development and qualification, as well as in the qualification process for the SRB Command Receiver Decoder and Altitude Switch Assembly.

In support of the Cargo Assurance Department, R&M has completed update and baselining of the ISS Node 2 FMEA/CIL, which required extensive interaction and coordination with Nodes Project Office and ISS R&M personnel. R&M also began development and coordination of verification closure documentation to support the Node 2 requirements verification activities. R&M continued development of the Node 3 FMEA/CIL and participated in the Node 3 DR2.

R&M updated the Maintainability Analysis and Limited Life Items List for the Water Recovery Subsystem (WRS) and Oxygen Generation Subsystem (OGS) to incorporate RIDs from the ECLSS Integrated Rack CDR and baselined them through the ECLSS Configuration Control Board, and continued development of the WRS and OGS FMEA/CILs. R&M also completed updated and re-release of the MSRR-1 R&M deliverables in response to RIDs from the MSRR-1 Integrated Payload Rack CDR.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, supported launch milestones, coordinated the MSFC Problem Assessment System, and operated the Corrective Action System (CAS). The PAC received and entered 23 new problem reports (PRs) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 39 PRs, received 22 prime contractor closure recommendations, supported MSFC full closure of 26 PRs, coordinated non-problem closure of 3 problems, and performed 274 individual PR database updates and reviews. We conducted 8 SSME problem review boards (PRBs) resulting in the disposition of 26 of 27 problem reports presented and issued PRB minutes covering the previous six months of Board meeting activities. The PAC generated or updated trends for all SSME, RSRM, and SRB problems submitted as newly opened or for closure. We also generated and distributed monthly problem bubble trend risk charts for 1 and 5-year problem data, 12-month new problems moving averages for data over the last year, and age charts for currently active problems, enhancing the format (per HQ and SSME suggestions) to include counts of Functional Criticality 1 and 1R problems in each area and to provide linkage to detailed entry breakdowns, all the way through 1-liner listings of the specific problem reports involved.

The PAC supported 8 pre-launch milestones for STS-112 and STS-113 in addition to Shuttle Project PFAs. We also provided various data histories in support of launch problem analysis, including STS-111 In-Flight Anomalies, ET camera diode/rectifier, and the SSME sensor.

In problem system coordination, the PAC conducted 3 SRB Problem Assessment System (PAS) status reviews for the SRB Chief Engineer and other SRB Project and S&MA personnel; reviewed and clarified issues regarding the USA-SRB BP Q-341 "PAS Reporting Requirements"; assisted IM in reducing costs of operation of the MSFC PRACA data system by reducing the number of user accounts through personal user need verifications via telephone; evaluated a microgravity R&M document for adequacy of PRACA (and ALERT) requirements; and reviewed/revised a proposed webPCASS report format to replace direct access to the KSC IBM mainframe for obtaining the KSC Shuttle PRACA problems daily summary.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly HEDS new shuttle problem charts, monthly newly opened/closed problem summaries, and quarterly Open Problems List (OPL). Special activities included review of SSME LOX pump 8015 hardware refurbishment at West Palm, training the SRB S&MA support team on PRACA, presenting and discussing problem bubble trending at SSME Rocketdyne-Canoga Park, and providing problem data on SSME MCC internal ruptures at the nozzle interface.

In implementation and operation of the MSFC CAS, we received 62 potential CAS reports, screened 62 draft Recurrence Control Action Requests (RCARs), and initiated 5 new RCARs. We received 7 responses from laboratory points of contact with either disposition rationale or response extension requests. We coordinated Corrective Action Board review of 5 RCARs, resulting in full closure of all. We also provided open RCAR status reports and discussed them at the Marshall Management System (MMS) Implementation Team meeting, issued monthly RCAR status and delinquent response reports, presented monthly metric charts of RCAR activities and statuses at the MMS Implementation Team, and presented Corrective/Preventive Action System activities and status charts at the Marshall Quality Council. In addition, we submitted revisions to MWI 1280.5, "MSFC ALERT Processing" and coordinated DCB approval, submitted completion of corrective action regarding the NQA finding regarding regular ALERT status report, and performed annual review of four S&MA OIs, resulting in submitting requests for revision of one and cancellation of two of them.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as we coordinated MSFC ALERT processing. HEI received 14 and distributed 13 ALERT announcements for MSFC review and obtained 1,791 responses from MSFC project, contractor, and laboratory contacts. The other ALERT was reformatted as released as an information announcement as directed by the OIG. We assisted HEI's Information Management in implementing NASA-mandated additional security requirements for the MSFC ALERT Notification, Status, and Response Data System and reviewed 75 account ID requests for the new environment. We participated as an Industry Advisory Group (IAG) board member at the quarterly GIDEP Business meeting in Alexandria, VA. We also formatted and distributed the first Quarterly Open Delinquent ALERT Response Tabulation Report based on the MSFC ALERT Data System, resulting in our assisting the Science Directorate in dispositioning over 1,000 delinquent ALERTs. In support of Gravity Probe-B, we used GIDEP and related resources to speedily locate and obtain a thermistor, prevent missing its mission manifest schedule.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering conducted analysis of cause and corrective actions in four problem investigations during this review period. The investigations included: a debond foam condition on the Liquid Oxygen (LO2) feed line; a nonconforming Gaseous Oxygen (GO2) diffuser installed on a tank at MAF; intertank stringer foam damage on a tank at KSC; and discrepant primer on the thrust strut end fittings supplied by a Lockheed Martin vendor. In addition, ET Quality Engineering prepared a one-page summary identifying the LH2 tank changes resulting from implementation of the SSME Block II engine cluster and exchanged technical views and information in a Technical Interchange Meeting (TIM) on the ET Gaseous Oxygen (GO2) vent valve seals.

Solid Rocket Booster (SRB) Quality Engineering represented MSFC S&MA on Phase II and Phase III review teams for Pyrotechnic hardware and Booster Separation Motors during this reporting period. These teams reviewed manufacturing process paper, acceptance test results and hardware inspections. Quality Engineering evaluated contractor submitted Engineering Change

Proposals, Certificates of Qualification, and Failure Modes and Effect Analysis/Critical Items List updates.

Space Shuttle Main Engine (SSME) Quality Engineering represented and assured the implementation of NASA S&MA Independent assessment position and assisted in the development of documents used to perform the qualification, certification, demonstration, and final weld repair of Atlantis (OV-104) inconel flow liner. Quality Engineering provided real time inspection and consultation during the inconel flow liner weld repair procedure qualification and welder certification at MSFC and during the end-to-end demonstration and final repair at the orbiter processing facility at KSC.

Reusable Solid Rocket Motor (RSRM) Quality Engineering was involved in two RSRM special issues. These included O-Ring resiliency issues and wire contamination in the propellant. RSRM Quality engineering also prepared a one-page summary on possible thrust imbalance Contract End Item (CEI) specification limit violations. Quality Engineering also attended MSFC Quality training and RSRM Failure Mode Effect Analysis/Critical Items List training, and ensured Certificates of Qualifications data reports were distributed and signed in a timely manner.

Quality Engineering continued to support the Joint Group on Pollution Lead-Free Solder Project and the NASA Workmanship Technical Committee with the review and drafting of addendums to class 3 of J-STD-001C "Requirements for Soldered Electrical and Electronic Assemblies" to support NASA Requirements. Quality engineering also provided technical supported to QS20.

Software Quality Assurance (SQA)

Software Quality Assurance (SQA) prepared and presented an overview presentation of the SQA Plan at the Glast Burst Monitor (GBM) Preliminary Design Review at the National Space Science and Technology Center (NSSTC). SQA was assigned to the review team for the Materials Science Research Rack (MSRR-1) Critical Design Review. SQA review design documentation packages and submitted Review Item Discrepancies (RIDs) on the Space Product Development Module (SPDEM) Software Development Plan. SQA witnessed the RAD6000 Flight Software Load, version 2.0, on the MSRR-1 Master Controller (MC) Ground Unit and monitored the Combined Components Interface Testing (CCIT). SQA also, conducted a Software Configuration Management Audit of the MSRR-1. SQA was an audited participant in the Software Capability Evaluation (SCE) Capability Maturity Model (CMM) Level III assessment of ED14, Flight Software Group. SQA Level II activities and processes were audited in addition to participation in Level III Key Process Areas. HEI SQA reviewed and revised MSFC documentation as necessary to comply with applicable CMM and Software Assurance requirements.

ISO

Quality Engineering has continued to play a key role to ensuring the maintenance of ISO 9001 at MSFC during this time period. Efforts have dealt with continuing implementation of the ISO 9001: 2000 revision, maintenance of documentation, internal quality audits, and planning and support for the NQA registrar audit, including follow-up and closure of corrective actions. Quality Engineering provided general ISO support, including documentation reviews and

consulting support on internal audits, training, continual improvement, and other aspects of ISO 9001, to various MSFC Organizations.
Quality Engineering also performed an initial gap assessment of the MSFC management system against the AS 9100 Aerospace standard and began coordination with directives OPRs to finalize the assessment.

Payloads
Quality Engineering (QE) supported the Window Observation Research Facility (WORF) project as a member of the Quality Assurance (QA) Panel in the WORF Functional Configuration Audit/Physical Configuration Audit (FCA/PCA). During this review QE reviewed test procedures. They included: WORF Video Qualification Test, WORF Command and Data Handling Qualification Test, WORF Thermal Qualification Test, WORF Power Qualification Test and the WORF Mechanical/Light Diffusion Test. The testing and test procedures were incomplete, but the QA Panel knew this going into the audit. There were a total of 3 (three) QA Panel action items submitted.

Quality Engineering (QE) supported the Glast Burst Monitor (GBM) project's Preliminary Design Review (PDR) at the National Space Science and Technology Center (NSSTC). The PDR was conducted to review the hardware and software developed from the Marshall Space Flight Center (MSFC), University of Alabama Huntsville (UAH) and the Max Planck Institute (MPE) for the GLAST project. QE presented charts for S&MA. The charts included a brief overview of the S&MA Plan and the preliminary hazards that have been identified by the project.

Quality Engineering (QE) supported the Materials Science Research Rack/ Experiment Carrier project's Integrated Payload Critical Design Review (CDR) as Lead of the S&MA Review Team. The CDR demonstrated the interface compatibility between the MSRR-1/EC, the European Space Agency Materials Science Laboratory (ESA MSL) the Space Product Development (SPD) Experiment Module (EM), the International Space Station, the MSRR-1 operations center and the ground systems. The S&MA Review Team generated 11 Type 2 Review Item Discrepancies.

Inspection and Test
HEI quality assurance continued to provide support in all MSFC test areas to MSFC test engineers and contract support personnel. The plasma arc facility, Test Stand (TS) 116, TS 300, TS 500, and the hot gas test facility are among the test areas supported by Quality Assurance. Test procedures and planning were reviewed to ensure that proper quality and test requirements are met on a day-to-day basis. HEI Quality Assurance continued to perform receiving inspections and witnessing of assembly and testing for DELTA-L, PCG, g-LIMIT, PCAM, MSG, VCD, ProSEDS, UPA, MSRR, QMI, SUBSA, PFMI, InSPACE, MGM III, PCAM, and OGS.

4.4 Information Management (IM)

The most significant activity performed by Information Management (IM) during the quarter was implementation of the integrated login functionality and modification of several applications to utilize the functionality. The applications, It Could Happen To You (ICHTY), Dr. Know, Alerts and Certrak, allow MSFC users to login with IDS information and to have access to integrated

applications from a centralized access point. Mascots, Supervisor Safety Web Page (SSWP) and Inventory of Hazardous Operations (IHOPs) were also revised to utilize the functionality.

IM performed an analysis of needs versus capabilities, and identified and implemented several opportunities for improvement. Two training classes for programmers were recommended, procured and attended. An updated email package that will provide for improved formatting of automated emails resulting from S&MA applications was implemented. Server improvements were recommended and are currently being implemented. Several other software applications or licenses were recommended and are currently being prioritized for procurement. In addition, IM recommended and implemented an improvement to the Dr. Know application that will result in cost savings through deletion of five email boxes.

The S&MA public web site was rewritten to utilize a standard format and be dynamically updated by a database. The QS01 and QS30 sites are ready for release after review, acceptance, and population with personnel, team and project information.

Numerous changes were made to existing applications supporting Industrial Safety. The Safety Concerns Reporting System (SCRS) application was revised to incorporate significant changes requested by a Safety, Health and Environmental Committee. Changes included removal of Assignee rejection, addition of a reassignment function, and improved email and age reporting functionality. The Safety Bulletins web pages were revised to incorporate categorization and to provide administrative functionality. The Contractor Evaluation database was revised to provide for processing of fifth quarter evaluations. The Crane database was modified for new document updates and to produce a laptop version to support travel. CERTRAK was modified to provide an additional email module. HAZTRAK was revised to show equipment rooms on the reports. Design screens for the web-based HAZTRAK replacement system, called SAFETRAK, was demonstrated to clarify requirements, and coding of the system began. IM supported a vendor selection meeting for the Incident Reporting Information System (IRIS) application. ICHTY and I Got Caught (IGC) were rewritten from Tango to Active Server Pages (ASP) languages, although IGC was later deleted on request.

The Alerts application was revised to add projects and modify associated information. Queries were created to update historical records to current assignees. In addition, the application was relocated to improve access by off-site personnel.

Other activities included rewriting applications from Tango to ASP, assuring Section 508 compliance, and server modifications, including procurement and implementation of encryption software, support of migration activities, and update of security plans.

4.5 Human Exploration and Development of Space (HEDS) Assurance

During this reporting period, management of the MSFC HEDS IA group transitioned from NASA Headquarters to MSFC S&MA. Significant time and effort has been expended in planning for the future under this operating arrangement. An Operating plan and a work instruction document have been prepared for management review and approval. Emphasis in developing these documents was placed on keeping the best of the past while integrating a new vision for the future. The goal is to be a value added partner on the S&MA team. Leading and

trailing indicators which may lead to an assessment. Methods of capturing and evaluating the metrics are being studied.

One team member completed training to become a certified internal auditor to ISO 9001:2001. Another team member passed the American Society for Quality (ASQ) Certified Quality Auditor exam for ISO 9000, and attended a course and passed an exam for AS9100 certification. His application is currently with the Registrar's Accreditation Board for approval. The course instructor reported that only 100 people were certified to this level (AS 9100) prior to the course and exam.

One team member prepared a presentation for S&MA to present to the NASA SMA directors meeting showing the emerging role of Independent Assessment at the center and another presentation for S&MA to present to the center director regarding S&MA Core Competencies.

IA continues to support various CODE Q initiatives through participation in the Quality Leadership Forum (QLF).

IA was tasked to support the Space Launch Initiative (SLI) during this period, and as a result added one new team member, bringing the total to 8.

4.5.1 International Space Station (ISS) Independent Assurance

ISSP program evaluations/assessments performed or in process during this period included: MSFC ISS Payloads Compliance with SSP 50431, Gravity Probe B Gas Management Assembly (GMA), and the Payload Operations Integration Center (POIC).

4.5.2 Space Shuttle Independent Assurance

Space Shuttle element evaluations/assessments performed during this period included: Booster Separation Motor (BSM) Foreign Object Debris (FOD) and Space Shuttle Main Engines (SSME) fuel flow liner cracks.

4.5.3 Space Launch Initiative Independent Assurance

SLI effort during this period was organizational. Assignments have been made for IA personnel involvement in the various architecture studies. Team members attended the SLI quarterly review, participating in discussions to develop strategies for promoting better total life cycle designs.

4.6 Project Assurance

During the reporting period, the Advanced Projects, Project Assurance Lead coordinated activities for the SLI S&MA RMS Working Group. It was determined that the responsibility for implementation of Reliability and Maintainability (R&M) engineering tasks, had become fragmented among multiple MSFC organizations which resulted in duplication of effort and inefficient use of limited resources. The working group was comprised of S&MA civil service and HEI personnel and was responsible for creating a presentation and publishing a point paper for the MSFC Center Director. The decision was subsequently made by the MSFC Center Director to pull all MSFC, R & M resources back into the S&MA Organization.

Payload Project Assurance participated in numerous reviews during this period, some requiring travel to various contractor facilities. Tasks included preparation and participation in the review and assuring closure of all issues/action items resulting from the review. The following were supported by QE: g-Limit Delta Critical Design Review (CDR), Propulsion Module Delta Preliminary Design Review (PDR), Solar B Project PDR, Quench Module Insert CDR, and MSRR-1 PDR.

Project Assurance was heavily involved in flight readiness activities and participated in all Shuttle Element S&MA Preflight Assessments and project flight readiness reviews. QE prepared 10 one-page summaries in support of flight readiness. QE also supported numerous shuttle element project reviews such as ET Shuttle Observation Camera Technical Interchange Meeting, Block II SSME Design Certification Review, HPFTP/AT Design Certification Review, Friction Stir Welding Review, RSRM Propellant Casting Process Review, and Booster Separation Motor Review.

Project Assurance has continued supporting Shuttle pyrotechnic device and booster separation motor procurement and flight certification. This involves review of pyrotechnic hardware design changes and supplier manufacturing, inspection and test documentation and pre-production and lot acceptance reviews.

HEI Project Assurance (PA) personnel provided technical support and assessments of Space Shuttle flight readiness for Pre-launch Assessment S&MA reviews and the Center Director's Technical Issues Briefing for STS-112. Project Assurance (PA) provided support for the ET/SRB Mate Milestone Reviews, Orbiter Rollout Milestone Reviews, Pre-launch Assessment Reviews (PARs), Flight Readiness Review Tagup PARs, PMMT Tagup PARs and Technical Issues Briefings (TIB) to Center Director for STS-112.

Project Assurance completed design and development of an access program to better collect and display DCMA hours spending for MSFC. The output of this program is used by Shuttle Assurance Department to monitor the DCMA spending verses actuals for the center. PA prepared charts for the monthly Human Exploration and Development of Space (HEDS) teleconference with the HEDS Enterprise Centers S&MA Directors.

Project Assurance teamed with QS20 and USA Vendor Quality Engineering to develop enhancements to the SRB Element supplier survey program. Problems at USA hardware supplier facilities raised concerns with the effectiveness of the USA supplier survey process capability. Project Assurance was instrumental in assisting in the development of improvements to the USA survey checklist elements and survey personnel training program to assure future surveys will focus more on hardware manufacturing and test processes.

PA assisted Shuttle Assurance Department by preparing briefing material, for Headquarters Code Q visit. PA briefed Code Q on the current status of Defense Contract management Agency (DCMA) support. The topics covered: the utilization of DCMA; actual expenditures of DCMA for MSFC; the current DCMA Letter of Delegation (LOD) for the Solid Rocket Booster (SRB) at the Assembly and Refurbishment Facility (ARF), which expires this fiscal year; and allocation of

travel and training to NASA. The briefing was well received and the Shuttle Assurance Department was assured that HQ would cover the current level of support from DCMA.

Project Assurance represented QS20 during the following pyrotechnic hardware procurement reviews: Aft Separation Bolt Phase II and III Reviews, Forward Separation Bolt Phase III Review, CDI Initiator Phase III Bolt Review, RSS S&A Device Explosive Lead Phase III Review, Frangible Nut Booster Cartridge Phase III Review.

PA assisted with the Silver Snoopy Awards Presentations for the STS-111 crew visits. Also assisted with the preparation of the STS-112 Launch Honoree Event at Kennedy Space Center.

Project Assurance (PA), the TA-1 OSP Project Office and TA-9 Project Office reviewed the status of Lockheed Martin's OSP development status that was presented at JSC. The decision to use ejection seats, augmented by propulsion, for crew escape and survivability was well supported with sensitivity and trade studies. In addition, PA traveled to Huntington Beach and evaluated Boeing's September Quarterly presentations

Project Assurance (PA) reviewed, with other S&MA and contractor representatives, the Federal Aviations and Administration (FAA) requirements for launching re-usable launch vehicles. The meeting concluded with the understanding that more in-depth understanding of FAA requirements that impact SLI was needed.

Project Assurance (PA) acted as a member of an OSP Project Office team that is assisting JSC in conducting a special study on the Re-usable Launch Vehicles (RLV) vs Expendable Launch Vehicle (ELV). The study includes identifying differences, integration issues, top mounted vehicle vs side mounted ones, human rating issues and requirements and main features of each vehicle.

Project Assurance assisted in preparing the Safety and Quality inputs for the 2nd GEN RLV Systems Requirements Document Drafts 2-10. The Project Assurance S&MA working group developed Level II Safety requirements, which were added to the draft.

HEI provided inputs to the Space Launch and Transportation Systems (SLaTS) handbook that is currently in development at MSFC, a very quick turnaround task. R&M Engineering provided an overview of the R&M engineering disciplines and their role in the NASA system development process for current and future space launch vehicles. System Safety Engineering provided an overview of the Hazard Risk Assessment concept in which hazards are ranked and classified in a risk matrix. Independent Assessment provided review of all inputs to assure consistency in approach and readability.

Transition/Privatization

Project Assurance reviewed the history of Space Shuttle competitive sourcing (privatization, transition, outsourcing). This was documented and reported to QS20. An assessment was conducted on the current status of NASA and Space Shuttle competitive sourcing under present Whitehouse, OMB, and Congressional edicts. PA also monitored daily governmental issues and

debates on Federal competitive outsourcing. A white paper was written on an HEI independent assessment of the role of MSFC S&MA in future shuttle flights.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

In the area of Continuous Risk Management (CRM), two additional personnel, for a total of three, passed classwork to become certified CRM trainers. One was a co-instructor for a CRM class taught to GEDS project personnel, and two others aided in other classes. One team member participated in an Assessment Control Team (ACT), co-led by S&MA and SMO. With assistance from outside facilitators reviews were conducted with project managers and risk managers to determine the level of performance of MSFC projects in the Risk Management discipline.

HEI PA is also participating in the Center Risk Management Capability to Perform Assessment Control Team. The team is co-chaired by S&MA and SMO at MSFC. PA has worked with the team to develop assessment criteria, and has participated in the project interview process that will lead to an assessment of the centers capability to perform risk management. HEI sub-contractor Futron Corporation is facilitating the assessment. The results of the assessment process will be analyzed and summarized for center management later in the calendar year.

Project Assurance (PA) has been working with the MSFC Systems Management Office (SMO) to incorporate information on the electronic Project Online Reporting Tool (ePORT) database into the CRM training program. SMO developed the ePort that includes a complete, cross platform, web-based CRM tool. The course material has been modified. Future innovations currently being pursued will incorporate the use of ePORT directly into the CRM workshops.

PA has been researching tools and techniques for analyzing risk to provide additional value to the products provided to our customers and stakeholders. Particular emphasis has been placed on acquiring tools to better analyze risk associated with cost and schedule. And example of innovations in the future will be the use of Monte Carlo simulations in analyzing schedule risk. PA attended the Southern California Risk Management Symposium in Long Beach California and the NASA Risk Management Colloquium III at Ames Research Center to further investigate innovations for use at MSFC.

4.7.2 Risk Assessment

Risk Assessment (RA) continued to work on the Space Shuttle PRA project with each of the MSFC Prime Contractors. RA delivered PRA logic models for all MSFC Shuttle elements to JSC before the scheduled due date. The models were delivered as fault trees in the SAPHIRE (Systems Analysis Programs for Hands-On Integrated Reliability Evaluations) software, and all event names were coordinated with the JSC analysts. For each of the propulsion elements, RA also prepared a summary of the modeling ground rules, a list of hazard reports not modeled and why, and a list of cross-element interface items for JSC Integration Office.

RA focused on the following areas during this reporting period. On ET PRA effort, RA performed data gathering and analysis, selected model quantification and documentation. On SRB PRA, RA has worked with USA SRB to complete the SRB PRA modeling and database.

On SSME PRA, RA continued to work with Rocketdyne and Pratt-Whitney on mission-initiated failure models and database construction. RA has also started communicating the results of the new SSME PRA effort with SSME Project Office.

Risk Assessment represented MSFC at PSAM6 (Probabilistic Safety Assessment and Management Sixth International Conference) and PRAXI-3 (Third PRA Exchange of Information Workshop) at NASA-AMES.

Flight Issues

Risk Assessment (RA) was asked to analyze fatigue life data from testing simulated MPS Flow Liner ports and repair welds. Regression analysis was performed to find equations describing fatigue life as a function of normalized stress, along with the usual confidence limits, for both parent material and repair welds. As requested by the Orbiter project through ED33, tolerance bounds (a confidence limit on a population percentile, in this case 95% for 1%) were calculated over the range of stress values for the repair weld case. This calculation is not typically performed on regression results, so some investigation was required to find the appropriate equation. Revised test data was provided recently and will be analyzed and presented to the team immediately.

A piece of silicone maintenance sealant was found in an SRB Booster Separation Motor (BSM) during a manufacturing step. Such foreign object debris (FOD) could hit and damage the Shuttle. RA represented S&MA in team meetings looking for cause and impact on this problem. RA constructively critiqued, found problems with and requested revision of probabilistic calculations initially used in a risk assessment that was to be part of flight rationale. RA materially participated in discussions on coming up with replacement risk assessment models of FOD ejection and harm, including an event sequence diagram, rational estimation of some inputs, and lists of assumptions for ET and SRB submissions. RA was also involved with explaining statistical concepts to the team.

Missing data at liftoff from a high-pressure turbopump speed sensor was investigated by an SSME team. RA assisted in analysis of quality and problem history data in advance of the Shuttle's return. RA delivered a synopsis of the data to the S&MA management team. The team investigating the problem put together a several statistical risk models based on flight and test history and asked RA for an analysis. RA assessed their validity, finding the final model adequate.

A cracked casting was found during routine inspection during refurb on an SRB Thrust Vector Control (TVC) hydraulic pump. That Anomaly Resolution Team (ART) requested that RA assist them in constructing a risk assessment model. A model was constructed using real-time expert inputs from Marshall and remote locations. In this way, a firmly agreed-upon assessment resulted. It was determined by this method that the likely risk to the fleet from this defect was very small.

RA was asked to assess risk to flight should a pair of diodes in the ET camera's charging system fail. The risk in this case is that failed diodes would allow current from the camera's battery to pass current to a shuttle umbilical at liftoff, potentially causing a spark in a dangerous

atmosphere. With the help of HEI Reliability and Maintainability, it was found that the probability of the diodes both failing is extremely low.

The RSRM project investigated the importance of missing nozzle radiographic photographs. A risk assessment was assembled, and RA proofed it and gave comments. The risk assessment was ultimately not used because a non-probabilistic pitch was deemed strong enough to justify a recommendation to fly without the film.

Other Analyses

RA presented a paper describing analyses of predictors of erosion in the nozzle to the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee conference. The paper was well received. Topics of other papers presented at the conference included recession (erosion), the SRB BSM cracked throat investigation, test motors, new thermal protection systems, materials and processes for nozzle manufacture and novel nozzle designs, among others.

RA was approached by ED34, who are comparing a strength testing procedure to be handled by both external and MSFC labs. The study is being done in support of the RSRM nozzle team. The aim is to identify and quantify amounts and causes of differences in the results of the two labs. Working with TD53, RA recommended a DOE matrix that looks at five factors (variables) at two or three levels each in a relatively small number of experimental runs. It thus produces a large amount of statistically useful information with a minimum of cost and time.

The SRB Deceleration Subsystem (DSS) (parachute) team asked RA to look at historical pull data on parachute cords. They are proactively looking for how aging affects the nylon material. RA did preliminary analysis work on a small set of data and will perform a more detailed analysis as data becomes available.

ET had asked RA to analyze any relationships between variables in nose cone manufacturing data within their sizeable quality database. RA presented the study to the nose cone team and pointed out some potentially useful relationships between variables.

Additional Topics

RA helped to represent S&MA at ATK Thiokol Utah's presentation and discussion on trending of quality and flight data. Thiokol wishes to expand its already well-regarded statistical trending process. They used this opportunity to explain and get input on its goals and methods. The TIM was informative and useful for both NASA and Thiokol in educating and aligning expectations of both teams. Thiokol appears to be moving in a direction beneficial to them and to NASA as a whole.

RA was asked to better outline potential changes to MPG 8730.1 and MPG 8730.4, and to estimate potential effects of any change on center operations. A presentation will be made in the future to the center's AS9100 implementation team regarding this estimate.

A consulting group working with NASA management to explore the applicability of Six Sigma quality processes to NASA held a training and information session for potential department-level leaders of Six Sigma. RA assisted in representing S&MA and will present a synopsis of the class

to S&MA and HEI. Six Sigma builds on TQM and ISO9000 by giving an advanced framework for improving quality, eliminating waste and achieving optimal designs in all parts of an organization. It does this by referring to organizational goals and using both simple and sophisticated opportunity-locating and problem-solving techniques to achieve those goals. The seminar covered the basic tenets of Six Sigma, discussions of how it might be applied within NASA, an overview of problem-solving and quality tools used and roles for champions and others set by the process in the organization. While it is not clear that NASA will adopt the process, if it does, S&MA and HEI will likely have a key role at Marshall in support and training within the Six Sigma framework.

RA also attended a course entitled "Quality 101". This course was offered through the American Society for Quality as an overview of general Total Quality Management (TQM) principles. It was arranged by HEI and QS40. RA is also participating in a team process assembling recommendations for moving HEI and center civil service S&MA staff physically closer to their customers. Preliminary recommendations are to be presented soon.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicial acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.