

Summary of Space Shuttle/Safety-Related Products from the NASA Office of Inspector General

SUMMARY

Over the past four years, the NASA Office of Inspector General (OIG) issued 10 reports addressing NASA's management of its safety program that related to the Space Shuttle. Our work did not disclose any safety deficiencies that presented an immediate threat to Space Shuttle mission-critical operations or suggested the decision to launch the Columbia mission was flawed. We did, however, identify deficiencies in safety operations that were related to NASA oversight of contractor performance, and poorly defined roles and responsibilities for NASA and its contractors. NASA has completed or is taking action to address all of our recommendations.

Our recent reports related to the safety of the Space Shuttle Program, which are summarized in the attachment, addressed:

- Selection of Space Shuttle safety upgrades (*July 1, 2002*) – *IG-02-020*
- NASA's oversight of United Space Alliance's (USA) safety procedures for ground operations and integrated logistics at Kennedy Space Center (*June 24, 2002*)
IG-02-018
- Storage of certain flight components for the Space Shuttle at Kennedy Space Center (*May 22, 2002*) *G-02-016*
- Use of lifting devices and equipment at Stennis Space Center (*September 28, 2001, October 3, 2001*) *IG-01-042*
- Use of plastic films, foams, and adhesive tapes in Space Shuttle and payload operations (*March 30, 2000; May 22, 2001, August 31, 2001*) *IG-00-028, IG-01-034*
- NASA oversight of USA safety procedures at Johnson Space Center (*March 23, 2001*) – *IG-01-017*
- Safety requirements in NASA contracts at Kennedy Space Center and Marshall Space Flight Center. (*June 5, 2000*) – *IG-00-035*

We have also conducted numerous criminal investigations involving counterfeit and falsely certified parts that had some connection to the Space Shuttle Program. On all of these cases, we coordinated with NASA safety officials to ensure that no unsafe parts remained in service. Our review continues, but to date we have found no parts cases related to the STS-107 Columbia flight.

Our reports contained numerous recommendations to correct identified deficiencies and improve NASA's management of its safety program. NASA management has been responsive to our recommendations and completed or is taking action to address all of our recommendations. At this time corrective action is pending on three recommendations. While NASA and the OIG have agreed on the corrective actions required, the actions have not yet been completed and provided to the OIG for verification.

One of the three open recommendations involves completing an assessment of hazard analyses for cranes used in critical lifting operations at Stennis Space Center. The Center expects to

complete action by February 28, 2003. On the second open recommendation, NASA created a centralized, web-based database of plastic foams, films, and adhesive tapes that have been tested and approved for use in and around the orbiter vehicles in Space Shuttle processing facilities, but access to this database is currently blocked by a firewall. NASA is working to make the information available without compromising information technology security.

The third open recommendation centered on improving NASA's oversight of USA safety procedures at Kennedy Space Center. In response to our report, NASA agreed to verify that the appropriate Kennedy organizations are complying with NASA oversight requirements. We are aware that the Space Shuttle Program Office conducted an internal assessment and transmitted the results to NASA Headquarters on January 24, 2003. NASA has not provided the OIG a final response on the results of the assessment.

DETAILS OF OIG SAFETY-RELATED WORK RELEVANT TO SHUTTLE PROGRAM

Space Shuttle Safety Upgrades (*IG-02-020, July 1, 2002*)

<http://www.hq.nasa.gov/office/oig/hq/ig-02-020.pdf>

We reviewed NASA's suite of planned space shuttle safety upgrades to determine whether they met established safety objectives, were selected using quantitative and qualitative factors, were adequately funded for fiscal year 2002, and did not adversely affect the Space Shuttle flight schedule. We found that the proposed upgrades met objectives (although some did not improve safety very much), were adequately funded for fiscal year 2002, and would not adversely affect the flight schedule. We noted that the Congress and Aerospace Safety Advisory Panel had expressed concerns about the adequacy of funding for upgrades after 2002. We made no recommendations, but noted that further decreasing the probability of catastrophic failure would require increased funding to complete safety upgrade projects that have been reduced, deferred, or cancelled.

NASA Oversight of United Space Alliance's Safety Procedures at the John F. Kennedy Space Center (*IG-02-018, June 24, 2002*)

<http://www.hq.nasa.gov/office/oig/hq/ig-02-018r.pdf>

We reviewed NASA's procedures to ensure that the United Space Alliance (USA) properly implemented Space Shuttle program safety requirements for ground operations and integrated logistics. We found that NASA was not providing adequate safety oversight of USA ground operations and integrated logistics at Kennedy Space Center. For example, we found that NASA did not provide any surveillance of integrated logistics for two years because the NASA official delegated oversight responsibilities stated that she was not qualified for the task and refused to accept the delegation. We also found that USA used critical ground support equipment (GSE) without first completing required safety analyses. Further reviews by NASA management in response to our findings led to two GSE systems being removed from critical service.

We also found that safety practices contemplated in contract documents implementing the Space Flight Operations Contract did not match safety oversight practices actually in place at Kennedy. In our view, the contract documents anticipated day-to-day management of safety by NASA rather than surveillance and audit of USA's safety practices. We recommended that contract documents and actual safety practices be made consistent to avoid confusion in safety oversight. NASA did not agree, but offered an alternative course of action that met the intent of our recommendation. Specifically, NASA agreed to verify that the appropriate Kennedy organizations are complying with NASA oversight requirements. We are aware that the Space Shuttle Program Office conducted an internal assessment and transmitted the results to NASA's Space Flight Enterprise on January 24, 2003 for approval. The Enterprise has not provided the OIG with a final response.

In response to our recommendation regarding GSE, NASA reviewed 101 critical GSE systems and found that 33 required further analysis and that two needed to be removed from critical service. USA also found "a significant disparity" between internal requirements and NASA's

requirements and reported, “there is a potential for requirements to be missed.” As a result, USA rewrote its policy to incorporate all NASA requirements and revised its internal operating procedures to require appropriate review, approval, and concurrence of the Kennedy Shuttle Safety Office. Finally, a Kennedy official accepted responsibility for the oversight of integrated logistics and the Space Shuttle safety office added surveillance steps for integrated logistics and reviews of USA’s work authorization documents.

Rapid Action Notice - Storage of Critical Flight Components at the Kennedy Space Center
(G-02-016, May 22, 2002)

We found that a Space Shuttle 8-inch fill-and-drain valve and an actuator assembly were improperly stored in an uncontrolled environment at Kennedy Space Center and exposed to potential contaminants. We were told that the parts had been moved from an over-crowded clean room. Kennedy management disagreed that there was a safety problem, but responded to our recommendations by conducting a survey to identify other potential problems with contamination to flight components, ensuring that the affected items would meet cleanliness levels prior to returning to service, and providing refresher training for personnel involved with critical processes. All recommendations are now closed.

Safety Alert – Safety of Lifting Devices and Equipment at Stennis Space Center *(Safety Alert 02-01, October 3, 2001)*

Safety of Lifting Devices and Equipment at Stennis Space Center *(IG-01-042, September 28, 2001)*

<http://www.hq.nasa.gov/office/oig/hq/ig-01-042.pdf>

We reviewed whether Stennis Space Center and its contractors properly managed the safety of the Lifting Devices and Equipment program. We found that critical lifts were not being performed safely, operators and riggers were not properly trained and certified, operators used cranes with safety deficiencies and crane maintenance and inspections were inadequate. We issued a safety alert and an audit report.

Upon issuance of our reports, Stennis Space Center immediately established a “Lift Team” comprised of lifting experts to correct deficiencies in its lifting program. The Center designated a Lifting Device and Equipment Manager, established a program plan, properly trained and certified operators, and made necessary repairs to some of its cranes. The Center also improved maintenance and inspection processes. The only recommendation remaining open concerns required hazard analyses for cranes used in critical lifting operations (those that involve personnel, critical flight hardware such as Space Shuttle Main Engines, or one-of-a-kind assets such as experimental engines). The Center expects to complete an assessment of the analyses that need to be performed by February 28, 2003.

Safety Concerns With Kennedy Space Center’s Payload Ground Operations *(IG-00-028, March 30, 2000)*

<http://www.hq.nasa.gov/office/oig/hq/ig-00-028r.pdf>

Safety Alert – Controls Over the Use Of Plastic Films, Foams and Adhesive Tapes In and Around the Space Shuttle Orbiter Vehicles *(Safety Alert-01-01, May 22, 2001)*

Controls Over the Use of Plastic Films, Foams, and Adhesive Tapes In and Around the Space Shuttle Orbiter Vehicles *(IG-01-034, August 31, 2001)*

<http://www.hq.nasa.gov/office/oig/hq/ig-01-034.pdf>

Prompted by a congressional inquiry, we reviewed the use of potentially hazardous materials such as plastic foams, films, and adhesive tapes (PFA's) under Boeing's Payload Ground Operations Contract and the United Space Alliance's (USA) Space Flight Operations Contract. PFA's are used to protect flight hardware for the Space Shuttle, expendable launch vehicles, and the International Space Station during processing on the ground. Improper use of these materials could result in damage to flight hardware or harm to ground workers.

Our reports found that contractors were improperly using PFA's that had failed required tests for flammability resistance and electrostatic discharge. Boeing's safety office did not adequately inspect the use of these materials as required by the contract, and the process for approving variances for the use of some of these materials was not effective. NASA-issued variances were ineffective because neither Kennedy nor Boeing safety officials reviewed the variances, and Boeing had not performed required risk assessments to support them. We also found that USA was routinely using PFA's that had no records of being tested. Neither Kennedy nor USA safety personnel approved the use of these materials, and USA, without NASA's knowledge, had changed its procedures rather than comply with established testing and safety requirements. These materials, used by USA years earlier, contributed to two fires in the Kennedy facilities that house Space Shuttle orbiters, flight hardware, and equipment.

In response to our recommendations, Kennedy greatly increased its attention to the use and control of PFA's in Kennedy processing facilities. Kennedy management developed a procedure requiring safety office review, assessment, and approval for the use of any material that does not meet NASA standards. Management also initiated various reviews, surveillance processes, and audits of payload ground operations. Additionally, all proposed changes to USA's Ground Operating Procedures are now coordinated with Kennedy Shuttle Safety engineering. Although NASA created a centralized, web-based database of plastic foams, films, and adhesive tapes that have been tested and approved for use in and around the orbiter vehicles in Space Shuttle processing facilities, access to this database is currently blocked by a firewall. NASA is working to make the information available without compromising information technology security.

Space Shuttle Program Management Safety Observations *(IG-01-017, March 23, 2001)*

<http://www.hq.nasa.gov/office/oig/hq/ig-01-017.pdf>

This audit reviewed the oversight of USA's safety procedures for the Space Shuttle Program at NASA's Johnson Space Center. We had numerous findings, including:

- Johnson's safety office did not provide required personnel support to the Space Shuttle Program for oversight of USA's safety operations. Even though \$13 million was designated for this personnel support, none was provided due to unclear roles, responsibilities, and lines of authority. As a result, Space Shuttle Program management could not ensure control over some funds or perform effective safety oversight of USA activities.
- We found that Space Shuttle Program surveillance (e.g., oversight) plans either did not include specific safety surveillance requirements or did not address safety at all, hindering NASA safety monitoring.

- We found that the classification and reporting of USA's close calls and mishaps could be improved at Kennedy and Johnson.

We made several recommendations intended to fix these problems. In response to our recommendations, Johnson clarified roles and responsibilities of safety offices at the Center and modified surveillance plans to include specific requirements for safety. All recommendations are now closed.

Contract Safety Requirements at Kennedy Space Center and Marshall Space Flight Center
(IG-00-035, June 5, 2000)

<http://www.hq.nasa.gov/office/oig/hq/ig-00-035.pdf>

This audit looked at whether NASA contracts contained provisions to ensure the contractors had appropriate safety programs. We reviewed whether contractor safety programs are adequately assessed as part of the pre-award procurement process and whether the contracts contained appropriate safety clauses. Although the NASA Federal Acquisition Regulation requires that NASA contracts include a safety clause, we found that 15 of 25 contracts reviewed did not include such a clause.

In response to our recommendations, Kennedy and Marshall reviewed every applicable open contract to determine whether the contracts included the required clauses and plans. Procurement officials then modified the contracts as needed. Additionally, both Centers developed detailed instructions directing the safety offices to be more involved in the contract process with regard to safety requirements. We reviewed the instructions and a sample of contracts at both Centers to ensure that the applicable contracts had been properly modified. All recommendations are now closed.

OTHER OIG SAFETY-RELATED WORK MENTIONED BY THE MEDIA

The media recently mentioned OIG reports on NASA's use of Quality Assurance Surveillance Plans (QUASP's) and on the composition of the Aerospace Safety Advisory Panel in the context of the Columbia accident.

Review of Performance-Based Service Contract Quality Assurance Surveillance Plans (G-02-011, June 24, 2002)

<http://www.hq.nasa.gov/office/oig/hq/inspections/g-02-011.pdf>

To measure contractor performance and facilitate effective contract surveillance, Federal procurement regulations require agencies to develop QASP's for all service contracts. A QASP uses a contract's specified performance standards to measure contractor performance and to ensure that the Government receives the quality of services called for under the contract and pays only for the acceptable level of services received. We reviewed the Agency's surveillance plans and found several weaknesses related to NASA's use of QASP's as part of the contract surveillance function. We recommended NASA clarify and improve Agency guidance and the NASA Centers improve QASP training for its Contracting Officer's Technical Representatives. NASA management concurred with our five recommendations and has taken appropriate corrective actions. Although the report was mentioned by the media as relevant to the Columbia accident, it is not particularly relevant, since only 1 of about 30 contracts reviewed could have (but did not necessarily) included tasks related to the Space Shuttle Program.

Follow-Up Assessment on 1997 Inspection of the NASA Aerospace Safety Advisory Panel (G-99-020, November 24, 1999)

<http://www.hq.nasa.gov/office/oig/hq/inspections/g-99-020.pdf>

We first reviewed the Aerospace Safety Advisory Panel (ASAP) in 1997 to assess the continued need for the ASAP. We found unanimous support for an independent and respected ASAP as a necessary and potentially vital component of NASA's program management. However, we recommended that NASA ensure an effective balance of the Panel's membership to meet program needs and that the ASAP expand the list of available consultants to broaden the expertise available to the panel. Our 1999 follow-up report noted that NASA had diversified the panel somewhat and recommended NASA develop and implement a recruitment plan to facilitate its ability to identify and recruit diverse potential candidates for Board membership. NASA developed and implemented a recruitment plan in 1999. The turnover in the ASAP that has been noted in the media occurred in 2001.

ONGOING OIG SAFETY-RELATED WORK:

Railroad Operations Involving Hazardous Commodities at Kennedy Space Center,
Discussion Draft issued February 5, 2003.

Weaknesses in Stennis Space Center's Acquisition of High-Pressure Valves
Discussion Draft Report to be issued in February 2003

Mismanagement of Stennis Pressure Vessels and Pressurized Systems
Discussion Draft Report in process.