IG-02-018

AUDIT REPORT

NASA OVERSIGHT OF UNITED SPACE ALLIANCE'S SAFETY PROCEDURES AT THE JOHN F. KENNEDY SPACE CENTER

June 24, 2002

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

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Acronyms

GSE	Ground Support Equipment
PFA	Plastic Films, Foams, and Adhesive tapes
SFOC	Space Flight Operations Contract
SFOP	Safety Operating Procedure
SSP	Space Shuttle Program
SAA	System Assurance Analysis
TMR	Technical Management Representative
USA	United Space Alliance

June 24, 2002

W

TO: Distribution

FROM: HQ/W/Assistant Inspector General for Audits

SUBJECT: Final Report on Audit of NASA Oversight of United Space Alliance's Safety Procedures at the John F. Kennedy Space Center
Assignment Number A-00-041-02
Report Number IG-02-018 Redacted Report*

The subject final report is provided for your information and use. Please refer to the Executive Summary for the overall audit results. Our evaluation of your response is incorporated into the body of the report. Although you nonconcurred with two of the seven recommendations, we consider your planned corrective actions responsive to all of the recommendations. Recommendations 2 and 6 are considered closed for reporting purposes. For the remaining recommendations, please notify us when action has been completed on them, including the extent of testing performed to ensure corrective actions are effective. The final report distribution is in Appendix G.

We appreciate the courtesies extended to the audit staff. If you have questions concerning the report, please contact Ms. Sandra Massey, Program Director, Safety and Technology Audits, at (321) 867-4057, or Mr. Karl Allen, Audit Program Manager, at (202) 358-2595.

[original signed by]
Alan J. Lamoreaux

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* We have redacted portions of this report due to references to sensitive information. The redacted passages do not affect the validity of this report or management's response.

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NASA Office of Inspector General

IG-02-018 **June 24, 2002**
A-00-041-02

NASA Oversight of United Space Alliance's Safety Procedures at the John F. Kennedy Space Center

Executive Summary

Background. The Office of Inspector General has completed an audit[1] of the United Space Alliance's (USA's) safety procedures under NASA's Space Flight Operations Contract (SFOC).[2] USA, a joint venture of The Boeing Company and Lockheed-Martin, is one of five prime contractors supporting the Space Shuttle Program (SSP). USA is responsible for the contracted tasks associated with the processing and flight preparation of the Space Shuttle fleet. USA's work affects the safety of NASA's astronauts; the Space Shuttle orbiters; and space flight personnel, hardware, and equipment. The Space Shuttle Program Office located at the Lyndon B. Johnson Space Center (Johnson) is responsible for managing the SFOC and the SSP. SSP operations occur primarily at Johnson, the John F. Kennedy Space Center (Kennedy), and the George C. Marshall Space Flight Center. We reviewed USA's implementation of the SFOC safety requirements for the SSP related to ground operations[3] and integrated logistics[4] at Kennedy, as well as NASA's oversight[5] of USA's safety procedures.

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[1] This audit was the third in a series of audits of USA's safety procedures under the Space Flight Operations Contract. In our report IG-01-034, "Controls Over the Use of Plastic Films, Foams, and Adhesive Tapes In and Around the Space Shuttle Orbiter Vehicles," dated August 31, 2001, we identified a lack of control over the use of plastic films, foams, and adhesives tapes in and around the Space Shuttle orbiter vehicles that created a potential safety hazard to personnel, the orbiter vehicles, and other flight hardware and equipment. In report IG-01-017, "Space Shuttle Program Management Safety Observations," dated March 23, 2001, we identified weaknesses in NASA's management control structure for providing oversight of USA's safety operations under the SFOC. The results of both audits are summarized in Appendix B of the report.

[2] NASA awarded the SFOC to USA of Houston, Texas, on September 26, 1996. The SFOC is a cost-plus-award-fee/incentive fee/performance fee type contract and has a period of performance from October 1, 1996, through September 30, 2002. The contract includes two, 2-year option periods, which potentially extends the period of performance through September 30, 2006. As of March 8, 2002, the total contract cost plus fee was estimated at $9.7 billion.

[3] Ground operations, one of the two major SFOC components located at Kennedy, consist of vehicle integration, payload installation, launch preparation and execution, and post launch operations.

[4] Integrated logistics consist of operations such as spare parts, maintenance, and warehousing for the Space Shuttle.

[5] The SFOC defines oversight as day-to-day management, review, and approval of USA's operations.

Objectives. The overall audit objective was to evaluate USA's safety procedures for NASA's SFOC. The specific objectives related to this report were to determine whether:

- safety responsibilities between USA and NASA were clearly defined and
- NASA was performing effective oversight of USA's safety program.[6]

Appendix A contains further details on the audit objectives, scope, and methodology.

Results of Audit. The safety responsibilities between USA and NASA were clear in that NASA established all SSP safety requirements, USA implemented those requirements through the SFOC, and NASA was fully responsible for the safe launch of the Shuttle. However, Kennedy's procedures for ensuring that USA properly implemented those safety requirements were not the same procedures defined in the SFOC. The SFOC states that NASA is to provide direct safety oversight of all USA operations. Nevertheless, Kennedy did not provide direct safety oversight of USA's ground operations but rather obtained insight[7] into USA's safety operations through surveillance and audits (Finding A). Further, Kennedy did not perform any level of safety oversight for integrated logistics, a high-risk area for injuries and mishaps (Finding B). Implementing a level of oversight that contradicts that required by the SFOC could lead to lapses in safety oversight, increasing the risk of harming personnel and damaging Space Shuttle hardware.

Although USA had developed a detailed safety management system[8] to ensure compliance with NASA requirements for the safety of NASA's astronauts; the Space Shuttle orbiters; and space flight personnel, hardware, and equipment, we identified two areas where USA can further improve safety. USA inappropriately used ground support equipment (GSE)[9] at Kennedy prior to completing required analyses to ensure that all hazards associated with the GSE were properly controlled (Finding C). Additionally, there was no evidence that USA performed some critical, required safety procedures for a specific operation at Kennedy involving payload removal from an orbiter vehicle (Finding D). By using GSE prior to completion of the analyses and by not performing all required safety procedures for payload removal, USA may have increased the risk of harm to personnel and Shuttle hardware.

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[6] We also addressed this objective in report IG-01-017, "Space Shuttle Program Management Safety Observations," March 23, 2001. In that audit, we evaluated the NASA SSP Program Office's oversight of the NASA-wide USA safety program. In this current audit, we evaluated Kennedy's oversight of USA safety for ground operations and integrated logistics at Kennedy.

[7] The SFOC defines insight as audit and surveillance of work to a level of detail that provides assurance of satisfactory work accomplishment. The audits consist of the Kennedy Shuttle Safety Office's review of various USA safety operations to ensure that the operations are in compliance with SSP requirements. The Kennedy Shuttle Safety Office performs about 13 audits each year. Some of the audit topics include USA's procedures for document control, use of plastic films, and mishap reporting.

[8] USA's safety management system included a safety and health plan, detailed safety procedures, hazard analyses, and mishap reporting and investigative procedures.

[9] GSE includes equipment used in ground operations to store, transport, handle, monitor, test, check out, service, and communicate with and control aircraft, and to launch vehicles, payloads, and spacecraft.

NASA has planned six Space Shuttle flights to assemble the International Space Station from June 2002 through April 2003. Therefore, prompt management attention to all four areas is particularly important to the safety and success of the SSP.

Recommendations. We recommended that NASA ensure that SFOC safety requirements and Kennedy safety procedures are consistent. We also recommended that NASA review USA processes for implementing SSP requirements related to the approval and use of GSE in critical applications and ensure that USA's safety procedures for future payload installation and removal operations are properly implemented and documented. Finally, we recommended that NASA require the Kennedy Shuttle Processing Directorate and Shuttle Safety Office to improve procedures for ensuring that USA implements all safety requirements associated with safety analyses and payload removals. The complete text of management's response is in Appendix F.

Management's Response. NASA concurred with five of the seven recommendations and has taken or planned corrective actions that we consider responsive. Although NASA nonconcurred with two recommendations, it has planned corrective actions that we consider responsive.

Introduction

As a prime contractor for NASA's SSP, USA is responsible for many day-to-day operations of the Space Shuttle fleet. USA's work affects the safety of NASA's astronauts; the Space Shuttle orbiters; and space flight personnel, hardware, and equipment. At Kennedy, USA's specific responsibilities include Space Shuttle modification, testing, checkout, and launch and landing activities. Management of the SFOC at Kennedy is divided into two components that are separately managed by Technical Management Representatives (TMR's).[10] The two components are:

- ground operations, which includes vehicle integration, payload installation, launch preparation and execution, and post launch operations.

- integrated logistics, which includes repairs, maintenance, spare parts, warehousing for the Space Shuttle orbiters, and associated GSE.

The SFOC Contracting Officer delegated the responsibility for safety oversight of USA to the SSP Safety Manager[11] who is located at Johnson. The SSP Safety Manager then subdelegated safety tasks to the ground operations TMR. Those safety tasks consisted of the preparation of a surveillance plan, insight into subcontractor safety operations, and audits of contractor safety operations to ensure that USA implemented all SSP safety requirements for ground operations. The SSP Safety Manager also attempted to subdelegate the same safety tasks for integrated logistics to the integrated logistics TMR; however, the integrated logistics TMR refused to accept the subdelegation.

[10] The SFOC Contracting Officer delegated specific technical responsibilities, including surveillance responsibilities over USA to 13 TMR's. The TMR's are assigned to each major SSP component. The major components are SSP business management, SSP systems integration, safety and mission assurance, SSP management integration, avionics and software, flight crew operations, mission operations, Space Shuttle vehicle engineering, Space Shuttle upgrades, Space Station Office at Johnson, Solid Rocket Booster Project Office at the George C. Marshall Space Flight Center, and integrated logistics and ground operations at Kennedy. As a result of our audit, SSP management combined the safety responsibilities for both Kennedy operations under one TMR.

[11] NASA Space Transportation System 07700, Volume 1, paragraph 3.4.1.3, "Space Shuttle Program Requirements," designates the SSP Safety Manager as being responsible for managing Space Shuttle Safety and Mission Assurance implementation and for oversight of all Safety and Mission Assurance activities in support of the SSP. Paragraph 1 of the SFOC statement of work requires the contractor to follow the requirements of the NASA Space Transportation System 07700.

Findings and Recommendations

Finding A. Shuttle Safety Responsibilities at Kennedy

Kennedy's procedures to ensure that USA properly implemented SSP safety requirements for ground operations and integrated logistics contradicted procedures defined in the SFOC. Specifically, Kennedy performed surveillance and audits of USA's safety operations rather than day-to-day management, review, and approval of USA's work. This occurred because the SSP Safety Manager directed Kennedy to perform safety procedures that differed from the SFOC requirements. Implementing a level of oversight that contradicts that required by the SFOC could lead to lapses in safety oversight, increasing the risk of harm to personnel and damage to Space Shuttle hardware.

SFOC Requirements Related to Shuttle Safety Oversight Responsibilities

The SFOC requires that NASA provide day-to-day management of USA's safety operations until that responsibility is transitioned (as agreed to by NASA) to USA, as documented in the SFOC statement of work, Transition Plan,[12] and Management Plan.[13]

The SFOC statement of work requires that:

> The contractor shall develop a plan, including schedule, that demonstrates and measures the transition from the existing contractor/government relationship and responsibilities to the contractor's planned approach to safety and mission assurance for this contract.

The SFOC Transition Plan describes the nature of the responsibilities that are to be transitioned from NASA to USA, stating, "NASA will move from an inspection role (review and approval) to one of insight (audit and surveillance)."

In addition, the SFOC Management Plan, which is the most current document on SFOC management approaches, roles, and responsibilities, indicates that NASA should provide day-to-day management of USA's safety process until NASA transitions that responsibility to USA. Paragraph 1.2.1 of the Management Plan defines the level of oversight required of NASA as follows:

[12] The SFOC Transition Plan, Attachment J-A of the SFOC, describes USA's proposed plan for assuming the responsibilities documented in the SFOC statement of work. Specifically, Section 2.0 of the plan describes the generic approach that all USA organizations use to plan and execute transition of NASA tasks to USA.

[13] Paragraph 1.1.1.1 of the SFOC requires USA to provide and maintain a management plan. The SFOC Contracting Officer's Technical Representative approved the Management Plan. Revision A of the Management Plan, dated February 2001, acknowledges that many operations have already transitioned from NASA to USA; however, safety was not one of the transitioned operations.

> NASA's operations management role will shift from "oversight" defined as day-to-day management of work, to "insight," defined as audit and surveillance of work to a level of detail that provides assurance of satisfactory work accomplishment.

The SFOC Transition Plan states that the SSP safety responsibility will be transitioned to USA by October 1998. However, the SSP Safety Manager stated that USA was not capable of being fully responsible for safety and, therefore, did not transition safety oversight responsibilities to USA. Additionally, USA has not submitted an updated transition plan. As a result, the Transition Plan continues to define NASA's oversight role as one of review and approval of USA's safety operations. Similarly, the February 2001 Management Plan does not acknowledge that responsibility for safety was transitioned to USA.

In accordance with the SFOC safety provisions, NASA's responsibilities for ensuring that USA implements all SSP safety requirements should consist of day-to-day management, review, and approval of USA's work. The SFOC Contracting Officer delegated the responsibility for safety oversight of USA to the SSP Safety Manager at Johnson who, in turn, subdelegated insight responsibility to the Kennedy TMR's for ground operations and attempted to subdelegate insight responsibilities to the TMR for integrated logistics.

Kennedy SSP Safety Procedures

Kennedy's procedures to ensure that USA properly implemented SSP safety requirements for ground operations and integrated logistics contradicted procedures defined in the SFOC. Kennedy performed surveillance and audits of USA's safety operations rather than day-to-day management, review, and approval of USA's work as defined in the SFOC. The Chief of the Kennedy Shuttle Safety Office, the office that provided the safety support to the TMR for ground operations,[14] informed us that his office does not oversee day-to-day USA safety operations or provide direction for the implementation of NASA's safety requirements as stated in the SFOC. Rather, the Kennedy Shuttle Safety Office gains insight into USA's safety operations through surveillance, audits, and the collection of metrics[15] on the risks to safety as required by the SSP Safety Manager's subdelegation.

SSP Manager's Direction for Safety Responsibilities at Kennedy

The SFOC safety requirements and Kennedy's safety procedures differed because the SSP Safety Manager defined oversight to mean that NASA is responsible for establishing the safety requirements and directing USA to perform those requirements. Therefore, the SSP Safety Manager directed the Kennedy TMR's to perform surveillance and audits to ensure that USA was implementing NASA safety requirements satisfactorily. This direction contradicted the SFOC statement of work, Transition Plan, and Management Plan. Although the SSP

[14] The TMR for ground operations is the Deputy Director of the Shuttle Processing Directorate at Kennedy.
[15] The SFOC requires that USA maintain metrics, which are determined by risk assessments, Government mandatory inspections, and mishap investigation reports.

Safety Manager's definition of oversight differed from the SFOC definition, Johnson and Kennedy officials made no effort to ensure that the SFOC and the SSP Safety Manager's practice for safety oversight were in agreement.

Effects of Contradictions in Safety Responsibilities

By using safety oversight procedures that contradicted SFOC requirements, NASA weakened the overall SSP safety management control environment,[16] resulting in a potential lack of responsibility and accountability in the event of a serious mishap. Without strict adherence to contractual requirements, line safety personnel could be confused about their responsibilities, resulting in lapses in safety oversight. Further, the SFOC makes NASA fully accountable for harm to personnel and damage to SSP assets in the event of a serious mishap.

Recommendation, Management's Response, and Evaluation of Management's Response

1. The Director, Lyndon B. Johnson Space Center, should direct the SFOC Contracting Officer and the SSP Safety Manager to ensure that NASA and USA safety personnel comply with the SFOC safety requirements or modify the SFOC, including the Management Plan and Transition Plan, to accurately reflect the actual safety practices and responsibilities NASA and USA perform.

Management's Response. Nonconcur. NASA stated that Agency policy, Center Directives, and SSP requirements establish safety responsibilities and processes; whereas the SFOC established the performance standards associated with implementing specific SSP tasks. Therefore, it is inappropriate for the Johnson Director to direct NASA safety personnel to perform tasks associated with the SFOC. However, to meet the intent of the recommendation, Kennedy and the SSP Office will verify that the appropriate Kennedy organizations are complying with NASA oversight requirements. The complete text of management's response is in Appendix F.

Evaluation of Management's Response. The SFOC, which references all NASA policy, Center Directives, and SSP requirements, is a binding agreement between USA and NASA and, as such, it should accurately reflect actual practices to be performed by both parties. Having a contract document that directly contradicts actual practices could result in a lack of responsibility and accountability in the event of a serious mishap. As stated in the report, without strict adherence to contractual requirements, line safety personnel could be confused about their responsibilities, resulting in lapses in safety oversight. Although NASA nonconcurred with the recommendation, management's planned action to verify that the appropriate Kennedy organizations are complying with

[16] The General Accounting Office's, "Standards for Internal Controls in the Federal Government," November 1999, define the control environment as the environment throughout an organization that sets a positive and supportive attitude toward internal control and conscientious management. Specifically, the standards require that appropriate authority, responsibility, and accountability be defined and delegated to accomplish the agency's mission.

NASA oversight requirements is responsive to the recommendation. As part of its assessment, management should ensure that the SFOC requirements and actual practices are in agreement. The recommendation is resolved, but will remain undispositioned and open for reporting purposes until corrective actions are completed.

Finding B. Safety of Shuttle Integrated Logistics

Kennedy had not ensured that USA implemented all safety requirements for the SSP integrated logistics function.[17] Specifically, Kennedy performed no oversight of integrated logistics as required by the SFOC. This occurred because the TMR for integrated logistics at Kennedy[18] refused to accept the subdelegated safety responsibilities because she did not feel qualified, and SSP officials did not take appropriate action to ensure that a qualified individual was accountable for integrated logistics safety at Kennedy. As a result, NASA had reduced assurance that personnel, space flight hardware, and other equipment were adequately protected in a high-risk area of the SSP.

SFOC Requirements for Contractor Surveillance

The SFOC allows the NASA Contracting Officer to appoint one or more TMR's to monitor specified work areas. Under this authority, the Contracting Officer appointed a total of 13 TMR's and assigned specific contract responsibilities to each through a formal delegation letter. The delegation letter requires the TMR to:

> Establish . . . a surveillance plan that will ensure receipt of the quantity and kinds of supplies or services required by the Statement of Work of the contract. The surveillance plan shall include, but not be limited to, identification of how the contractor will be evaluated against the metrics identified in attachment J-1-B of the contract.

One of the specific work areas was integrated logistics at Kennedy, which the SFOC Contracting Officer assigned to a TMR. Integrated logistics consists of repairs, maintenance, spare parts, warehousing for the Space Shuttle orbiters, and GSE. The SSP Safety Manager, through authorization by the SFOC Contracting Officer, subdelegates the responsibilities for surveillance and audit of USA's safety operations at the Centers to the appropriate TMR's by way of NASA Form 1430, "Letter of Contract Administration Delegation." Acceptance of the delegation is documented by NASA Form 1431, "Letter of Acceptance of Contract Administration Delegation." Appendix C lists the responsibilities specified in the subdelegation.

Safety Reviews of Kennedy Integrated Logistics

The TMR did not prepare and maintain an integrated logistics safety surveillance plan or annual audit schedule and did not perform the required surveillance or audits of USA's integrated logistics safety activities as specified in the SSP Safety Manager's intended subdelegation. The Kennedy Shuttle Safety Office prepared a general Shuttle Safety and Mission Assurance Surveillance Plan; however, the plan did not cover any specific

[17] As described in Finding A, there were discrepancies between the level of oversight required by the SFOC and the safety insight that Kennedy performed.

[18] The TMR for integrated logistics is the Director of the Logistics Division within Kennedy's Shuttle Processing Directorate.

integrated logistics operations. Similarly, the Kennedy Shuttle Safety Office prepared an annual Shuttle Safety and Mission Assurance audit schedule but had not planned or performed audits in the integrated logistics area.

Integrated Logistics Safety Subdelegation

The lack of safety surveillance and audits of USA's safety processes in the integrated logistics area occurred because there was no NASA official in charge of subdelegated safety responsibilities in the area. Although the SSP Safety Manager subdelegated safety responsibilities to the integrated logistics TMR, she never accepted the subdelegation. The TMR informed us that she refused to accept the subdelegation because she was not qualified to evaluate USA's safety procedures and, therefore, would not accept the responsibility.

The SFOC Contracting Officer, SSP Safety Manager, and Kennedy Shuttle Processing officials acknowledged that the TMR for integrated logistics had not accepted the safety subdelegation. The SSP Safety Manager issued the subdelegation in May 1999 (more than 2 years prior to our audit), and neither the SSP nor Kennedy Shuttle Processing Directorate officials took actions to ensure that a qualified individual was accountable for integrated logistics safety at Kennedy. As a result of our audit, the SSP Safety Manager revised the letter of delegation, and the Kennedy Deputy Director for Shuttle Processing agreed to accept the subdelegated responsibilities.

Integrated Logistics Hazards

The integrated logistics function covers critical Space Shuttle hardware such as the orbiter vehicles and GSE and includes repairs, manufacturing, transportation, and warehousing operations, which have a higher potential for injuries and mishaps. Prior to our audit, NASA performed no oversight or insight of USA's Space Shuttle integrated logistics operations and, therefore, NASA had no assurance that personnel, space flight hardware, and other equipment were adequately protected in a high-risk area of the SSP.

Recommendation, Management's Response, and Evaluation of Management's Response

2. The Director, Lyndon B. Johnson Space Center, should direct the SSP Safety Manager to subdelegate to a qualified NASA official the responsibility to ensure that USA implements all NASA safety requirements for integrated logistics at Kennedy and to ensure that those subdelegated responsibilities are accepted and implemented.

Management's Response. Concur. The Shuttle Safety Manager subdelegated SFOC safety insight responsibilities for both ground operations and integrated logistics to the Kennedy Shuttle Processing Directorate who has accepted and implemented the subdelegation (see Appendix F).

Evaluation of Management's Response. On May 28, 2002, NASA provided us a copy of the signed NASA Form 1431, "Letter of Acceptance of Contract Administration Delegation." We consider the action sufficient to disposition the recommendation, which will be closed for reporting purposes.

Finding C. Shuttle Ground Support Equipment Safety Analyses

USA improperly used critical GSE[19] for critical Space Shuttle operations before the completion of required safety analyses[20] and without adequate safety procedures to ensure the safe use of the GSE pending the completion of the analyses. The questioned GSE included monitors designed to alert personnel to an oxygen-deficient environment, cranes for hoisting critical solid rocket booster components, a ground coolant system that monitors the environment of the Space Shuttle crew compartment, transporters for moving the Space Shuttle to and from the launch pads, platforms for lifting personnel, and a fire extinguishing system. Improper GSE use occurred because of insufficient USA and NASA management control over USA's System Assurance Analysis (SAA)[21] process to ensure that USA implemented all NASA requirements for safety analyses. Using GSE for which all possible hazards had not been identified and controlled may have increased the safety risks to personnel and Shuttle hardware.

NASA Requirements for Safety Analyses

NASA has several requirements[22] governing the performance of GSE safety analyses. Those requirements generally state that USA should perform safety analyses to identify and control hazards associated with new GSE or hazards that may be introduced into the GSE through a modification. Sound safety practices require that personnel implement sufficient interim safety procedures (such as installing special safety devices or safety warnings) for the use of any GSE before completing a safety analysis. USA documents its safety analyses in the SAA. USA's engineering community, including USA's Safety and Reliability Engineering Division, Ground Systems Design Engineering Division, and Systems Engineering Division, review and approve the SAA's.

The TMR for ground operations was responsible (by subdelegation from the SSP Safety Manager) for the performance of surveillance and audit of USA's operations to ensure that USA met all NASA requirements for safety analyses. The Kennedy Shuttle Safety Office supported the TMR by performing the surveillance and audits.

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[19] A GSE system is considered critical if loss of overall system function or improper performance of a system function could result in loss of life, loss of an orbiter vehicle, or damage to a vehicle system. An operation is considered critical if significant hazards are present to personnel, space flight hardware, or space flight hardware systems.

[20] The required analyses were (1) Hazard Analyses and (2) Failure Modes and Effects Analyses.

[21] An SAA includes a system description, ground rules/assumptions, criticality assessment, Failure Modes and Effects Analysis/Critical Items List, and Hazard Analysis. Collectively, the analyses included in the SAA are intended to identify the necessary actions to eliminate or control any failures or malfunctions of GSE that could independently or collectively present a hazard.

[22] Requirements are in NASA Space Transportation System 22206, "Requirements for Preparation and Approval of Failure Modes and Effects Analysis and Critical Items List"; NASA Space Transportation System 5300.4 (1D-2), "Safety, Reliability, Maintainability, and Quality Provisions for the Space Shuttle Program"; Kennedy Program Directive 8710.1, "KSC/Safety, Reliability, Maintainability and Quality Assurance Programs"; and the SFOC Safety and Health Plan.

Critical GSE Undergoing Analysis

USA's Reliability Engineering Division provided us a list of the critical GSE systems[23] for which SAA's were in process as of October 1, 2001. The list consisted of 101 GSE systems. From that population, we reviewed 11 (11 percent) critical GSE systems to determine whether USA used the GSE properly and safely in critical and noncritical operations. We found that USA used 6 (55 percent) of the 11 GSE systems, comprising 10 items of GSE, prior to completion of safety analyses and without interim safety procedures governing the use of the GSE before completion of the SAA. USA had completed SAA's for the remaining five GSE systems we reviewed; however, the analyses should have been updated as a result of modifications to the equipment or a change in equipment use. A detailed description of our review is in Appendix D.

SAA Management Controls

The use of critical GSE prior to the completion of required SAA's occurred because of insufficient USA and NASA management controls over the SAA process. Although USA had procedures regarding when and how to perform SAA's, USA had not established procedures (such as implementing special safety guards or warnings) to ensure the safe use of GSE in critical operations pending the completion of an SAA. Instead, USA relied on the institutional knowledge of the technicians and system engineers to ensure the safe use of the GSE. Kennedy Shuttle Safety Office personnel were familiar with the SAA process and stated that USA should have procedures to ensure the safe use of GSE in critical operations prior to completion of SAA's. However, we found no evidence that the Kennedy Shuttle Safety Office reviewed USA's procedures for using the GSE or reviewed the corresponding SAA's that we sampled.

Kennedy Shuttle Safety officials acknowledged the need for increased attention to USA's processes for implementing requirements related to the approval and use of GSE in critical applications. As a result of our audit, the Shuttle Processing Directorate intends to review USA's processes for managing new and modified equipment.

Effects of Using Ground Support Equipment Prior to Completion of an Analysis

By allowing the use of critical GSE in critical operations prior to the completion of SAA's, NASA and USA lacked assurance that all possible hazards were adequately identified and properly controlled. Without such assurance, the safety risks to personnel, critical items of Space Shuttle hardware, and other equipment were potentially increased. The 10 GSE items in our sample consisted of 2 oxygen deficiency monitors, 2 overhead bridge cranes, a ground coolant system, 2 crawler transporters, 2 mobile manlift platforms, and a fire extinguishing system.

USA's Lead Reliability Engineer told us that USA's use of the oxygen deficiency monitors was a problem and that USA would take immediate corrective action. However, he was

[23] A GSE system can consist of one or several items of GSE. For example, the Space Shuttle crawler transporters are listed as one system but consist of two crawlers.

confident that the other items of GSE were used safely, even though the use of the items was not supported by current SAA's, interim safety procedures, or safety office approval. The risks associated with using the items of GSE in question are significant and warrant the implementation of interim safe operating procedures to ensure that the GSE is safe to use prior to the completion of SAA's, as discussed below:

Sensitive information and corresponding footnotes 24, 25 and 26omitted**

[24] **Sensitive information omitted**
[25] **Sensitive information omitted**
[26] **Sensitive information omitted**

Sensitive information and corresponding footnotes 27 and 28omitted

Conclusion

Each item of questioned GSE is critical because failure of the system could be hazardous to personnel, space flight hardware, or other items of GSE. Using the GSE without identifying all potential hazards increases the risk of those hazards. Further, because we questioned the use of unanalyzed GSE based on only an 11-percent sample of 101 GSE items, the magnitude of the problem could be even greater. Until USA completes the SAA's, it should have adequate interim safety procedures in place to ensure the safe use of each item of GSE.

Recommendations, Management's Response, and Evaluation of Management's Response

The Director, John F. Kennedy Space Center, should:

3. Direct the Kennedy Shuttle Processing Directorate to review USA's processes for implementing SSP requirements related to the approval and use of GSE in critical applications. The assessment should include reviewing USA's SAA's to ensure GSE is used properly.

[27] **Sensitive information omitted**
[28] **Sensitive information omitted**

Management's Response. Concur. NASA will complete an internal assessment of USA implementation of SSP requirements related to the approval and use of GSE in critical applications (see Appendix F).

Evaluation of Management's Response. Management's planned action is responsive to the recommendation. The recommendation is resolved but will remain undispositioned and open for reporting purposes until the corrective action is completed.

4. Direct the Kennedy Shuttle Processing Directorate to review the 101 critical GSE systems for which SAA's are in process and either approve or suspend USA's continued use of the systems pending completion of the SAA's.

Management's Response. Partially concur. The report makes an erroneous conclusion that if an SAA is in process, then the GSE or GSE system cannot be used in operations. Management reviewed the 101 critical GSE systems for which SAA's were in process and found that 57 of the SAA's were for either systems that were in the design phase or modifications that had not yet been implemented, and 2 of the systems were not in use. Based on the same review, management also removed two systems from use until the appropriate analysis and precautions are in place. In conjunction with the corrective action associated with recommendation 3, NASA will finish the assessment of the remaining critical GSE systems for proper implementation of safety requirements (see Appendix F).

Evaluation of Management's Response. The OIG recognizes that, in certain circumstances and by implementing appropriate safety precautions, GSE systems can be used safely prior to completion of the SAA. However, as stated in the report, our review of a sample of 11 critical GSE systems undergoing analysis showed no evidence of appropriate safety precautions for 6 (55 percent) of the systems, even though those systems were in routine use. According to the GSE documentation, the revised SAA's were required because modifications to the systems or systems' intended use affected safety. Accordingly, we believe interim safety precautions should have been in place to ensure the safe use of the GSE prior to completion of the analyses. As management found during its review of the 101 critical GSE systems, there was a lack of control over the safe use of modified GSE systems for which SAA's were in progress. This was evidenced by NASA's decision to remove two systems from service until the appropriate analyses and precautions are in place. Although NASA partially concurred with the recommendation, its planned action to review the remaining questioned GSE systems is responsive. The recommendation is resolved but will remain undispositioned and open for reporting purposes until the corrective action is completed.

Finding D. Safety Procedures for Payload Installation and Removal

USA did not have adequate evidence to show that it had performed several required safety procedures for the removal of a payload from an orbiter vehicle in Kennedy's Orbiter Processing Facility. This condition occurred because the Kennedy Shuttle Safety Office did not review USA's procedures to ensure USA performed and documented all required payload installation and removal safety procedures. Nonperformance of safety procedures increases the risk of harm or damage to personnel, space flight hardware, and other equipment related to hazardous operations.

SFOC Safety Requirements

The SFOC statement of work, Section 1.3.1 states, "The contractor shall develop documented and auditable approaches to achieve safe program operations and assure flight safety." USA documents its safety approaches at Kennedy in its Ground Safety Operating Procedures 5400 document.[29] The purpose of Ground Safety Operating Procedures 5400 is to specify and establish safety policies and procedures required during operations and maintenance activities at USA-designated areas of Kennedy. Volume II of the document describes USA's 77 Safety Operating Procedures (SFOP's)[30] that govern the safety procedures required in key operations USA performs at Kennedy under the SFOC. According to USA and Kennedy safety personnel, the specific safety procedures for each SSP operation should be documented in various work authorization documents[31] (see Appendix E).

The SFOC safety subdelegation requires the Kennedy Shuttle Safety Office to perform surveillance and audits of USA's safety activities to ensure safe operations at Kennedy's Space Shuttle processing facilities.

SFOP 33, "Payloads Installation/Removal in the Orbiter Processing Facility"

We reviewed[32] SFOP 33, "Payloads Installation/Removal in the Orbiter Processing Facility," for a payload removal that occurred in May 2001. The payload removal operation was a hazardous operation because it involved hoisting and moving large pieces of space flight hardware up, over, and around personnel and the Space Shuttle orbiters. The photographs that follow show a similar operation that we observed:

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[29] Ground Safety Operating Procedures 5400 is incorporated into the SFOC by reference.

[30] The 77 SFOP's are the primary processes used in preparing the Space Shuttle for launch. They consist of such operations as mating the orbiter to the external tank and solid rocket boosters and transferring the vehicle to the launch pad.

[31] Work authorization documents are the detailed instructions, including safety procedures, that direct USA's work and the work of its subcontractors in the performance of SFOC operations.

[32] We selected an SFOP that was well documented, recently performed, and involved work relating to the Space Shuttle orbiters. USA safety officials agreed that SFOP 33 would be representative of the type of work performed by USA and the Kennedy Shuttle Safety office in support of the SFOC and that an audit trail of documented safety procedures could be easily followed.

Payload lifting and removal operation[33]

The SFOP specifies the support, safety equipment, safety instructions, responsibilities, and emergency procedures to be followed during tasks and operations involved in payload installation and removal from the Space Shuttle orbiter vehicles while in the Orbiter Processing Facility. USA safety personnel told us that a review of the top-level work authorization documents[34] would illustrate and provide sufficient evidence of work performed in satisfaction of the SFOP and that most activities specified in the procedure would be easily traced to the actual work authorization documents that contained sign-offs and/or stamps by the individuals who performed or witnessed the work. We reviewed the work authorization documents and other supporting documentation pertaining to the removal and transportation of the May 2001 payload removal (International Space Station Multi-Purpose Logistics Module) from Orbiter Vehicle 105 and found no evidence that USA or NASA performed several required safety procedures.

Evidence Of Required Safety Procedures

We found no evidence that either USA or NASA had performed several required safety procedures for the May 2001 payload removal. Specifically, we determined the following:

[33] **Detailed description of photograph omitted**

[34] USA stated that work authorization documents S0065.002-B01-R01 (S0065) and N52100-A01-R01 (N52100) are the top-level documents that control payload removal in the Orbiter Processing Facility. In addition, we reviewed two lower-level Boeing subcontracting work authorization documents (L5050 and L5051) that supported the operation.

- There was no evidence that USA performed some critical safety procedures required by SFOP 33. The procedures were to verify that (1) personnel were certified for tasks as required; (2) safety showers and eyewash fountains were operational; (3) all hoisting and handling equipment had current certification and preoperational checks had been performed; (4) fire detection, suppression, and alarm systems were operational; (5) tag lines[35] were used to control the load; (6) operations would be immediately terminated if communications were lost and would not recommence until communications were restored; and (7) the crane ground controller had sole responsibility for communications with crane operators during crane operation.

- USA documentation required by the SFOC was inadequate to show the NASA or USA Safety Office involvement required by SFOP 33 for some of the activities specified in the work authorization documents. The work authorization documents require USA safety office support, but do not clearly state or document what support was provided. Also, one of the top-level work authorization documents (N52100) states that hazardous operations cannot commence until a safety official has given concurrence, evidenced by that safety official's signature. Although we identified USA safety personnel signatures within the work authorization documents, we could not associate the signatures with any specific activity.

- The work authorization documents were inconsistent regarding essential personnel, that is, those whose presence was deemed critical during the operation. Specifically, the Operations Support Setup and the Post Operation Instructions sections of S0065 specify that NASA representatives, including safety office personnel, are essential personnel. In fact, the Operations Instruction section specifies that at least one NASA safety engineer is essential at Level 13,[36] whereas N52100 states that a NASA safety representative is not essential at Level 13. None of the work authorization documents indicated whether the personnel considered essential during certain phases of the operation were, in fact, present.

- Some specific safety procedures described in the work authorization documents were not in SFOP 33, indicating that SFOP 33 may need updating. For example, one top-level work authorization document (S0065) states that during the pre-operation safety walkdown, safety representatives are to look for flammable or static-producing materials in the control area. This procedure was not included in the SFOP.

[35] Tag lines are ropes or wires used by ground personnel to guide the movement of the hoisted payload.
[36] Level 13 is comprised of the highest level of access platforms surrounding the orbiter as it undergoes processing and checkout activities in the Orbiter Processing Facility. In addition to providing access to the orbiter, Level 13 is used for observation of activities.

NASA Review of USA SFOP's

The Kennedy Shuttle Safety Office did not review USA's operations to ensure that its payload installation and removal safety procedures were properly followed and documented. The SFOC safety subdelegation requires the Kennedy Shuttle Safety Office to perform surveillance and audits of USA's safety activities to ensure safe operations at Kennedy's Space Shuttle processing facilities. The Chief of the Kennedy Shuttle Safety Office informed us that his office performed a proactive safety role by developing safety procedures for work authorization documents that USA must follow when performing SFOC operations, such as removing a payload from an orbiter. The Chief further stated that Kennedy Shuttle Safety Office personnel are present during high-risk operations, such as those involving moving large pieces of space flight hardware, and are available in case of an emergency. However, he stated that our audit approach of evaluating USA's safety operations by reviewing one particular operation and ensuring that USA performed and documented all required safety steps was unique and that neither the NASA Shuttle Safety Office nor USA have performed reviews in that manner.

In addition, the Chief of the Kennedy Shuttle Safety Office told us that Ground Safety Operating Procedures 5400 and the corresponding SFOP's were originally NASA requirements. However, under performance-based contracting, USA assumed responsibility for the documents and, over the years, USA drifted away from properly performing and documenting all the procedures outlined in the SFOP's. The Chief agreed that all required safety steps must be performed and properly documented and that he would take action to ensure that USA initiated corrective action.

Risks Involved in Payload Removal and Installation

Our review of the operation and all associated documentation (SFOP 33 and the work authorization documents) disclosed no evidence that USA personnel performed some critical safety procedures, including (1) ensuring that all hoisting and handling equipment had current certifications and (2) performing all pre-operational checks. Further, the Kennedy Shuttle Safety Office did not ensure that USA performed and adequately documented its safety procedures. By not performing and documenting all required safety procedures and by not performing adequate oversight, USA and the Kennedy Shuttle Safety Office, respectively, increased the risk to personnel and space flight hardware. NASA and USA should ensure that all required safety procedures are performed for hazardous SSP operations and that complete documentation exists as evidence of those safety procedures.

Recommendations, Management's Response, and Evaluation of Management's Response

The Director, John F. Kennedy Space Center, should:

5. Require USA to ensure that all the safety procedures defined in SFOP 33 are properly implemented and documented for all future payload installation and removal procedures at Kennedy.

Management's Response. Nonconcur. NASA did not concur because there is no requirement for all SFOP 33 requirements to be documented within the work authorization documents. The Kennedy Shuttle Processing Directorate will verify that payload installation and removal procedures at Kennedy are accomplished in accordance with requirements (see Appendix F).

Evaluation of Management's Response. We are aware that there is no requirement for documenting all SFOP's in the work authorization documents. However, the SFOC statement of work, Section 1.3.1 states, "The contractor shall develop documented and auditable approaches to achieve safe program operations and assure flight safety." We interpreted this contract requirement to mean that there would be a clear traceability from USA's written safety procedures to evidence that the procedure was actually performed. USA safety officials agreed with that interpretation and told us that SFOP 33 would be representative of the type of work performed by USA and the Kennedy Shuttle Safety office in support of the SFOC and that evidence of all required safety procedures could be found in the associated work authorization documents. We could not find that evidence or determine whether NASA and USA performed specific safety procedures and, if they had performed the procedures, a record to document the work performed was not readily available.

The intent of our recommendation was to ensure that USA provides a clear traceability of work performed to assure safe operations and SSP flight safety. Management's planned action to verify that payload installation and removal operations are accomplished in accordance with NASA requirements meets the intent of our recommendation provided that there is documented evidence of the work performed. Therefore, the recommendation is resolved but will remain undispositioned and open for reporting purposes until the corrective action is completed.

6. Direct USA to determine whether SFOP 33 should be updated to include safety procedures that are specified in the work authorization documents but are not in the SFOP, and to update it as deemed necessary.

Management's Response. Partially concur. NASA stated that the SFOP requirements are itemized in the work authorization documents and that having additional items in the work authorization documents is acceptable and expected. The Kennedy Shuttle Processing Directorate and USA have reviewed the referenced work authorization documents and have determined that no update to SFOP 33 is required (see Appendix F).

Evaluation of Management's Response. Management's action is responsive to the recommendation. We consider the action sufficient to disposition the recommendation, which will be closed for reporting purposes.

7. Direct the Kennedy Shuttle Safety Office to include audits in its annual audit plan to ensure that USA performs all applicable SFOP requirements and properly documents the corresponding work authorization documents.

Management's Response. Concur. The Kennedy Shuttle Safety Office will ensure that SFOP requirement audits are incorporated into that office's annual audit plans (see Appendix F).

Evaluation of Management's Response. NASA notified us on April 29, 2002, that the Kennedy Shuttle Safety Office revised its annual audit schedule to include audits to ensure that USA implements SFOP's into USA work authorization documents. The audit is planned for August 2002. The recommendation is resolved but will remain undispositioned and open for reporting purposes until corrective actions are completed and we have verified that USA has properly documented that all SFOP requirements have been completed.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall objective of the audit was to evaluate United Space Alliance's (USA's) safety procedures for NASA's Space Flight Operations Contract (SFOC). The specific objectives related to this report were to determine whether:

- safety responsibilities between USA and NASA were clearly defined and
- NASA performed effective oversight of USA's safety program.

Scope and Methodology

To accomplish our objectives, we did the following:

- Discussed Space Shuttle Program safety with the NASA SFOC Contracting Officer, Administrative Contracting Officer, Contracting Officer's Technical Representative and Safety and Mission Assurance Technical Management Representative, as well as safety personnel from the Lyndon B. Johnson Space Center (Johnson), John F. Kennedy Space Center (Kennedy), George C. Marshall Space Flight Center, and USA Safety and Mission Assurance offices.

- Reviewed the SFOC Management Plan, Transition Plan, Safety and Heath Plan, and several NASA Space Transportation System documents.

- Discussed with NASA and USA safety officials and staff from the USA Reliability Engineering Division the process for preparation of ground support equipment System Assurance Analyses.

- Reviewed Agencywide, Kennedy specific, and USA policies and procedures for System Assurance Analyses of ground support equipment.

- Judgmentally selected and reviewed a sample of 11 items (11 percent) from the 101 items of Kennedy ground support equipment for which System Assurance Analyses were in process as of October 1, 2001.

- Judgmentally selected and reviewed a USA safety procedure and associated work authorization documents governing the removal of a payload from a Space Shuttle orbiter vehicle in the Kennedy Orbiter Processing Facility.

- Observed the removal of an International Space Station Multi-Purpose Logistics Module from Orbiter Vehicle 103.

We did not assess the reliability of computer-processed data because we did not rely on it to achieve our audit objectives.

Management Controls Reviewed

We interviewed SFOC contracting, Space Shuttle Program, and USA safety personnel to identify applicable management controls such as contract administration and oversight responsibilities. We identified management control weaknesses as identified in the findings section of this report.

Audit Field Work

We performed audit field work from June 2001 through January 2002 at NASA Headquarters, Johnson, and Kennedy. We performed the audit in accordance with generally accepted government auditing standards.

Appendix B. Summary of Prior Audit Coverage

The NASA Office of Inspector General issued two prior audit reports related to USA safety practices. (See www.hq.nasa.gov/office/oig/hq/issuedaudits.html for copies.)

"Controls Over the Use of Plastic Films, Foams, and Adhesive Tapes In and Around the Space Shuttle Orbiter Vehicles," Report Number IG-01-034, August 31, 2001. John F. Kennedy Space Center (Kennedy) management acknowledged the safety risks of not properly controlling the use of plastic films, foams, and adhesive tapes (PFA's) in NASA facilities and requires all such materials to be evaluated for flammability resistance, electrostatic discharge rate, and hypergolic compatibility[37] characteristics. However, in and around the orbiter vehicles and other segments of the Space Shuttle, United Space Alliance (USA) routinely used PFA's for which those characteristics were unknown. Neither the USA Safety Office nor the Kennedy Shuttle Safety Office had approved the materials for use. Further, USA's procedures for the safe handling and use of PFA's in and around the orbiter vehicles were not effective.

The lack of control over the use of PFA's created a potential safety hazard to personnel, the orbiter vehicles, and other flight hardware and equipment. We recommended that Kennedy (1) clarify procedures for approving the use of unapproved PFA's, (2) request USA to reestablish its PFA's testing requirements, (3) direct the Kennedy Shuttle Safety Office to be more actively involved in the safe use of PFA's, (4) develop a centralized list of PFA's approved for use in and around the Space Shuttle orbiter vehicles, and (5) direct the Kennedy Shuttle Safety Office to perform assessments on the control and use of PFA's found in Kennedy Space Shuttle processing facilities. Kennedy concurred with one recommendation, partially concurred with the remaining four, and has completed or planned appropriate corrective actions.

"Space Shuttle Program Management Safety Observations," Report Number IG-01-017, March 23, 2001. We evaluated NASA's oversight of USA's safety program. We identified several weaknesses pertaining to NASA's management control structure for providing oversight of USA's safety operations under the Space Flight Operations Contract. Specifically, we found the following:

- the Lyndon B. Johnson Space Center (Johnson) Safety, Reliability, and Quality Assurance Office was not providing the required support to the Manager, Space Shuttle Program Safety and Mission Assurance for oversight of USA's safety activities;

[37] Kennedy Handbook 1710.2, references the Kennedy Materials Sciences Division Intranet, which also includes foams as materials that must pass the acceptance criteria. The basic requirements are:
Flammability resistance – the material should be self-extinguishing before 6 inches of the test sample is consumed, should not drip flaming particles, and should not permit fire to propagate to another object.
Electrostatic discharge rate – the material cannot hold a charge of more than 350 volts, 5 seconds after termination of the initial charge.
Hypergolic compatibility – the material should not have an extreme reaction such as discoloration or temperature increase when exposed to hypergols (rocket fuel).

- NASA's contractor surveillance plans did not address all contract requirements for safety;

- USA had not updated its Management Plan commensurate with the changes to the contract; and

- USA could improve its reporting to NASA of close calls and mishaps.

We recommended that Johnson ensure that (1) surveillance plans address all contract requirements for safety, (2) USA's Space Flight Operations Contract Management Plan is kept current, and (3) USA promptly and accurately reports all required close call and mishap information to NASA's reporting system. Johnson did not agree with all of the findings, but concurred with the recommendations. NASA implemented corrective actions to improve the overall management of safety for the Space Shuttle Program.

Appendix C. Safety Responsibilities Subdelegated to the Integrated Logistics Technical Management Representative

The Space Flight Operations Contract Contracting Officer's Letter of Contract Administration Delegation subdelegated the following duties to the Technical Management Representative for integrated logistics at the John F. Kennedy Space Center:

- Perform surveillance and evaluation of contractor and associated subcontractor/supplier activities associated with risk management and safety, reliability, maintainability, and quality assurance as defined in the statement of work or program requirements.

- Gain real-time insight into activities at selected subcontractors. If delegation to other organizations is necessary, a strong framework of teamwork and regular communication should be developed and maintained.

- Manage the resources provided to perform the obligations of this delegation.

- Perform oversight of authorized subdelegated activities.

- Provide Safety and Mission Assurance evaluation and technical assessment of engineering change requests.

- Evaluate contract deliverable products for compliance and acceptability.

- Resolve Safety and Mission Assurance technical issues in conjunction with United Space Alliance managers as required to fully facilitate United Space Alliance performance.

- Prepare and maintain a Safety, Reliability, and Quality Assurance surveillance plan. This plan will outline the surveillance activity and information to be provided in support of the Safety and Mission Assurance Technical Management Representative.

- Recommend to the Space Shuttle Program Safety Manager any desired changes in contract scope and/or technical provisions with justification.

- Provide immediate notice of significant program problems or issues to the Space Shuttle Program Safety Manager.

- Provide performance evaluation with substantiated metrics to the Space Shuttle Program Safety Manager.

- Prepare and submit an annual audit schedule to the Space Shuttle Program Safety Manager.

** Details of sample review information omitted**

** Details of sample review information omitted**

Appendix E. Audit Trail of United Space Alliance Safety Procedures

Appendix F. Management's Response

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

April 19, 2002

M

TO: NASA Headquarters
Attn: W/Assistant Inspector General for Auditing

FROM: M/Associate Administrator For Space Flight

SUBJECT: Draft Report on Audit of NASA Oversight of United Space Alliance's Safety Procedures at the John F. Kennedy Space Center, Assignment Number A-00-041-02

Regarding your letter dated February 21, 2002, subject as above, NASA has reviewed your report, evaluated the conclusions that you have drawn and considered the recommendations made in the draft report. Our response is the Agency position on the draft report. Johnson Space Center, Kennedy Space Center, and the NASA Headquarters, Office of Safety and Mission Assurance have all submitted comments, which have been incorporated into this response. Their concurrences are included.

We are nonconcurring with 2 of the 7 Recommendations contained in your report (Recommendations 1 and 5). We consider action complete on Recommendations 2 and 6 and request that they be closed upon issuance of the final report.

Our specific comments related to this matter are enclosed.

Frederick D. Gregory

2 Enclosures:
1. Responses by Recommendation
2. RedLines of specific sections of the report

Office of Space Flight
Response to OIG Draft Report on Audit of NASA Oversight of
United Space Alliance's Safety Procedures at the John F. Kennedy Space Center
Assignment Number A-00-041-02

RECOMMENDATION 1
The Acting Director, Lyndon B. Johnson Space Center (JSC), should direct the SFOC Contracting Officer and the SSP Safety Manager to ensure that NASA and USA safety personnel comply with the SFOC safety requirements or modify the SFOC, including the Management Plan and Transition Plan, to accurately reflect the actual safety practices and responsibilities NASA and USA perform.

AGENCY RESPONSE
Nonconcur. NASA policy, NASA Center Directives and Space Shuttle Program requirements establish the safety responsibilities and processes. The Space Flight Operations Contract (SFOC) establishes the expectations and performance standards associated with implementing specific tasks associated with supporting the Space Shuttle Program (SSP). It is inappropriate for the JSC Director to direct NASA safety personnel to perform tasks associated with the SFOC.

To meet the intent of the recommendation, KSC and the SSP Office will verify that NASA requirements are being complied with by the KSC organizations and are properly implemented by USA in accordance with the SFOC. The SSP office will conduct an assessment to verify that requirements are being met. The assessment will be completed by August 30, 2002.

RECOMMENDATION 2
The Acting Director, Lyndon B. Johnson Space Center, should direct the SFOC Contracting Officer and the SSP Safety Manager to sub-delegate to a qualified NASA official the responsibility to ensure that USA implements all NASA safety requirements for integrated logistics at Kennedy and to ensure that those sub-delegated responsibilities are accepted and implemented.

AGENCY RESPONSE
Concur. The SSP Manager – Safety and Mission Assurance has sub-delegated SFOC safety insight responsibilities to the KSC Shuttle Processing Manager including both Ground Operations and Logistics safety activities performed at KSC. Prior to accepting the sub-delegated responsibilities, a review of the current Kennedy Shuttle Safety Office Surveillance Plan verified that planned surveillance activities of the integrated logistics processes met minimum insight requirements of the safety TMR delegation. The delegation has been accepted and has been implemented. Action is completed.

Enclosure 1

Appendix F

RECOMMENDATION 3
The Director, John F. Kennedy Space Center, should direct the Kennedy Shuttle Processing Directorate to review USA's processes for implementing SSP requirements related to the approval and use of GSE in critical applications. The assessment should include reviewing USA's SAA's to ensure GSE is used properly.

AGENCY RESPONSE
Concur. As a function of current KSC insight responsibilities, the KSC Shuttle Processing Directorate is responsible for surveillance of USA's implementation of SSP safety requirements. Current safety surveillance activities and an independent assessment of the USA SAA process performed in 2001, have not indicated concerns with USA SAA's processes or with the implementation of the safety requirements. An internal assessment of USA implementation of SSP requirements related to approval and use of GSE in critical applications will be performed. Action is to be completed by August 30, 2002.

RECOMMENDATION 4
The Director, John F. Kennedy Space Center, should direct the Kennedy Shuttle Processing Directorate to review the 101 critical GSE systems for which SAA's are in process and either approve or suspend USA's continued use of the systems pending completion of the SAA's.

AGENCY RESPONSE
Partially Concur. An erroneous assumption or conclusion was made that if an SAA is in process, the GSE equipment or system cannot be used. But if system modifications were to components that did not affect the criticality of the system, modifications to the SAA are not required. It is sound safety and business practice to periodically update SAA's to reflect the latest system configuration. We have reviewed the 101 critical GSE systems that have SAA's under review. Of these, 57 of the SAA's are for systems that are in the design phase or the modifications have yet to be implemented. Two systems are not operational and are not in use. The remaining systems have had SAA's performed for them, and we are assessing the reasons for the SAA's in process. Based on our review, one of the systems has been tagged so it will not be used for critical operations, and another system has been tagged out completely and will not be used at all. These two systems will not be used until the appropriate analysis and precautions are in place.

To meet the intent of the recommendation, in conjunction with the action of recommendation 3, we will finish the assessment of the 101 critical GSE systems for proper implementation of safety requirements. Action is to be completed by August 30, 2002.

RECOMMENDATION 5
The Director, John F. Kennedy Space Center, should require USA to ensure that all the safety procedures defined in SFOP 33 are properly implemented and documented for all future payload installation and removal procedures at Kennedy.

AGENCY RESPONSE
Nonconcur. There is no requirement for all SFOP 33 requirements to be documented within the work authorization documents (WAD). The SFOP 33 requirements may be implemented in USA operating procedures, as well as, being part of the USA training program. For examples, the audit report alleges discrepancies in that there was no evidence in the WAD that (1) personnel were certified for tasks as required; (2) operations would be immediately terminated should communications be lost and would not recommence until communications were restored; and (3) the crane ground controller had sole responsibility for communications with crane operators during crane operation. These requirements are implemented elsewhere.

****USA's process information omitted****

USA will continue to implement existing review and approval policies for WAD generation and modification. Current practices/policies provide systems engineers generating WAD's and safety engineers reviewing and approving them with the proper tools necessary to provide the workforce with the necessary documentation to protect the hardware and themselves from harm.

To meet the intent of the recommendation, the KSC Shuttle Processing Office will verify that payload installation and removal procedures at KSC are accomplished in accordance with KSC and SSP requirements. Action is to be completed by April 30, 2002.

RECOMMENDATION 6
The Director, John F. Kennedy Space Center, should direct USA to determine whether SFOP 33 should be updated to include safety procedures that are specified in the work authorization documents but are not in the SFOP, and to update it as deemed necessary.

AGENCY RESPONSE
Partially Concur. The Safety Operating Procedure (SFOP) contains minimum requirements to perform a safe operation. The specific operational steps that fulfill SFOP requirements are itemized in the Work Authorization Documents (WADs). Having additional items in the WAD is acceptable. In fact, unique operational steps for specific payloads are expected. The KSC Shuttle Processing Directorate (PH) and United Space Alliance (USA) have reviewed the referenced WAD's and have determined that no update to SFOP 33 is required. Action is completed.

Appendix F

RECOMMENDATION 7
The Director, John F. Kennedy Space Center, should direct the Kennedy Shuttle Safety Office to include audits in its annual audit plan to ensure that USA performs all applicable SFOP requirements and properly documents the corresponding work authorization documents.

AGENCY RESPONSE
Concur. The KSC Shuttle Safety Office will ensure that Safety Operating Procedure (SFOP) requirement audits have been incorporated within their annual audit plans. The KSC Shuttle Safety Office Audit Plan will be updated to include an audit of SFOP requirements compliance. Action is to be completed by April 30, 2002.

Appendix G. Report Distribution

National Aeronautics and Space Administration (NASA) Headquarters

HQ/A/Administrator
HQ/AI/Associate Deputy Administrator
HQ/AA/Chief of Staff
HQ/AB/Associate Deputy Administrator
HQ/B/Acting Chief Financial Officer
HQ/B/Comptroller
HQ/BF/Director, Financial Management Division
HQ/G/Acting General Counsel
HQ/H/Assistant Administrator for Procurement
HQ/HK/Director, Contract Management Division
HQ/HS/Director, Program Operations Division
HQ/J/Assistant Administrator for Management Systems
HQ/JM/Director, Management Assessment Division
HQ/L/Assistant Administrator for Legislative Affairs
HQ/M/Acting Associate Administrator for Space Flight
HQ/Q/Associate Administrator for Safety and Mission Assurance
HQ/QS/Director, Safety and Risk Management Division

NASA Advisory Officials

Chair, NASA Aerospace Safety Advisory Panel

NASA Centers

ARC/D/Director, Ames Research Center
DFRC/X/Director, Dryden Flight Research Center
GRC/0100/Director, John H. Glenn Research Center at Lewis Field
GSFC/100/Director, Goddard Space Flight Center
JPL/1000/Director, Jet Propulsion Laboratory
JSC/AA/Director, Lyndon B. Johnson Space Center
KSC/AA/Director, John F. Kennedy Space Center
KSC/CC/Chief Counsel, John F. Kennedy Space Center
LaRC/106/Director, Langley Research Center
MSFC/DA01/Director, George C. Marshall Space Flight Center
SSC/AA00/Director, John C. Stennis Space Center

Appendix G

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Branch Chief, Science and Space Programs Branch, Energy and Science Division, Office of Management and Budget
Director, Acquisition and Sourcing Management Team, General Accounting Office
Senior Professional Staff Member, Senate Subcommittee on Science, Technology, and Space

Chairman and Ranking Minority Member – Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA, HUD, and Independent Agencies
Senate Committee on Commerce, Science, and Transportation
Senate Subcommittee on Science, Technology, and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on VA, HUD, and Independent Agencies
House Committee on Government Reform
House Subcommittee on Government Efficiency, Financial Management, and Intergovernmental Relations
House Subcommittee on Technology and Procurement Policy
House Committee on Science
House Subcommittee on Space and Aeronautics

Congressional Member

Honorable Pete Sessions, U.S. House of Representatives

NASA Assistant Inspector General for Audits
Reader Survey

The NASA Office of Inspector General has a continuing interest in improving the usefulness of our reports. We wish to make our reports responsive to our customers' interests, consistent with our statutory responsibility. Could you help us by completing our reader survey? For your convenience, the questionnaire can be completed electronically through our homepage at http://www.hq.nasa.gov/office/oig/hq/audits.html or can be mailed to the Assistant Inspector General for Audits; NASA Headquarters, Code W, Washington, DC 20546-0001.

Report Title: NASA Oversight of United Space Alliance's Safety Procedures at the John F. Kennedy Space Center

Report Number: _____ **Report Date:** _____

Circle the appropriate rating for the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
1. The report was clear, readable, and logically organized.	5	4	3	2	1	N/A
2. The report was concise and to the point.	5	4	3	2	1	N/A
3. We effectively communicated the audit objectives, scope, and methodology.	5	4	3	2	1	N/A
4. The report contained sufficient information to support the finding(s) in a balanced and objective manner.	5	4	3	2	1	N/A

Overall, how would you rate the report?

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

If you have any additional comments or wish to elaborate on any of the above responses, please write them here. Use additional paper if necessary. _____

How did you use the report? _____

_____

_____

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_____

How could we improve our report? _____

_____

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_____

_____

How would you identify yourself? (Select one)

- ☐ Congressional Staff
- ☐ NASA Employee
- ☐ Private Citizen
- ☐ Government: _____ Federal: _____ State: _____ Local: _____
- ☐ Media
- ☐ Public Interest
- ☐ Other: _____

May we contact you about your comments?

Yes: _____ **No: _____**
Name: _____
Telephone: _____

Thank you for your cooperation in completing this survey.

Major Contributors to the Report

Sandra A. Massey, Program Director, Safety and Technology Audits

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