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AUDIT REPORT

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SPACE SHUTTLE PROGRAM PROBLEM REPORTING AND CORRECTIVE ACTION PROCESS AT KENNEDY SPACE CENTER NEEDS IMPROVEMENT

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration

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Final report released by:

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Acronyms

CAAR	Corrective Action Assistance Request
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
FY	Fiscal Year
NESC	NASA Engineering and Safety Center
NSTS	National Space Transportation System
OIG	Office of Inspector General
PRACA	Problem Reporting and Corrective Action
SFOC	Space Flight Operations Contract
SIAT	Shuttle Independent Assessment Team
SNC	Single Nonconformance and Corrective Action
SSP	Space Shuttle Program
STS	Space Transportation System
USA	United Space Alliance
WebPCASS	Web-Based Program Compliance Assurance and Status System

IN BRIEF

SPACE SHUTTLE PROGRAM PROBLEM REPORTING AND CORRECTIVE ACTION PROCESS AT KENNEDY SPACE CENTER NEEDS IMPROVEMENT

The Issue

We conducted this audit to determine whether management of the Kennedy Space Center (Kennedy) portion of the Space Shuttle Program's (SSP) Problem Reporting and Corrective Action (PRACA) process was sufficiently effective to fulfill PRACA's intended purposes—track problems and their root causes, document corrective actions, and provide a source of data the Agency can use to learn from, and prevent problem recurrence. In the course of conducting two prior projects (IG-05-023, "Space Shuttle Orbiter Wiring Inspection," July 14, 2005, and IG-06-012, "Final Memorandum on the Review of Space Shuttle Cold Plates," April 28, 2006), we found indications that the Kennedy portion of the SSP PRACA system may not be working as intended. Specifically, Office of Audit personnel noted that the SSP prime contractor, United Space Alliance (USA), did not always provide consistent or accurate nonconformance[1] data in the SSP PRACA system. We note there have been a series of analyses questioning PRACA's effectiveness, including the report of the Columbia Accident Investigation Board, which stated that the system was, at best, a marginally effective decision-making tool.

This is the first of two reports concerning PRACA. This report discusses the SSP PRACA process at Kennedy. The second report will discuss contracting issues related to USA's single nonconformance and corrective action system (SNC), which was designed to consolidate or replace the functionality of USA's 19 legacy PRACA databases.

Results

The SSP PRACA process at Kennedy can be improved. Although NASA and USA adequately defined and documented PRACA roles and responsibilities, the Kennedy data set of the SSP PRACA system did not support SSP PRACA goals and contained inaccurate and incomplete data. This occurred because (1) NASA and USA did not implement clear guidance for assigning cause codes, (2) NASA did not provide adequate oversight of USA, and (3) USA policies and procedures and NASA award fee metrics

[1] A nonconformance occurs when one or more characteristics of a Space Shuttle article or material do not conform to a requirement. See Appendix B for a glossary of terms.

may have presented disincentives to reporting workmanship errors. Overall, this reduced the usefulness of the Kennedy data set as a management tool for improving Space Shuttle safety and reliability and as a historical record for NASA's Space Operations and Exploration Systems Mission Directorates. The need for improvement in the SSP PRACA process is a repeat issue previously reported in 10 NASA internal and external assessments dated between March 7, 2000, and June 3, 2005.

Management Action

We recommended that the Director, Kennedy Space Center, direct the Center's Safety and Mission Assurance Office to clarify the cause code descriptions in S00000-6-3, "Nonconformance/Problem Reporting and Corrective Action (PRACA) Data Code Manual," Revision M, March 2005. We also recommended that the Director, Kennedy Space Center, direct the Center's Safety and Mission Assurance Office and Shuttle Processing Directorate to revise SSP quality and surveillance plans to require review for cause code accuracy, problem description sufficiency, and compliance with data tracking and traceability requirements. Further, we recommended that the Manager, SSP, ensure compliance with hyperlinking procedures and that he coordinate with USA to ensure that the award fee includes a performance metric based on the accuracy of nonconformance reports. Finally, we recommended that the Associate Administrator, Exploration Systems Mission Directorate, ensure that the findings and recommendations of this report are considered when developing the requirements and goals for the problem reporting and corrective action process or system(s) that will support NASA's new human and robotic exploration programs and projects.

In response to a draft of this report (see Appendix H), the Associate Administrator for Space Operations partially concurred with the finding, concurred with four of the recommendations, and nonconcurred with one of the recommendations. He stated that the finding and recommendations did not appear to be based on a clear understanding of the SSP PRACA system architecture, but acknowledged that the SSP PRACA guidance does not clearly state the different levels of responsibility for PRACA or the SSP's intent for PRACA.

The Associate Administrator concurred with Recommendation 1, stating that the PRACA Data Code Manual would be reviewed and revised as needed and that NSTS 08126, "Space Shuttle: Problem Reporting and Corrective Action (PRACA) System Requirements," would be revised to clarify the roles and responsibilities for PRACA at each organizational level. He nonconcurred with Recommendation 2 and concurred with Recommendation 3, requesting that both recommendations be closed because the SSP had adequate quality processes in place and hyperlinking procedures were being complied with to the extent possible. The Associate Administrator concurred with Recommendation 4, stating that metrics to measure the accuracy of nonconformance reports already existed and flowed into the award fee process. Finally, the Associate Administrator concurred with Recommendation 5, stating that the NASA Constellation Safety and Mission Assurance Office has undertaken an effort to improve the PRACA

reporting process and is developing baseline PRACA requirements for the Exploration Systems Mission Directorate.

We consider management's comments to be responsive for Recommendation 1 and agree with the proposed corrective action to review and revise the PRACA Data Code Manual and NSTS 08126. We consider management's comments for Recommendation 5 to be responsive and agree with the actions that have been or will be taken to improve the PRACA system for NASA's new human and robotic programs. Recommendations 1 and 5 are resolved, but will remain open pending our receipt of the revised guidance and the baselined PRACA requirements.

We consider management's comments to be nonresponsive for Recommendations 2, 3, and 4. We request that the Associate Administrator for Space Operations reconsider his position and provide additional comments to the final report concerning the SSP quality and surveillance plans, tracking and traceability, hyperlinking, and award fee metrics. We request the additional comments for Recommendations 2, 3, and 4, by September 28, 2006.

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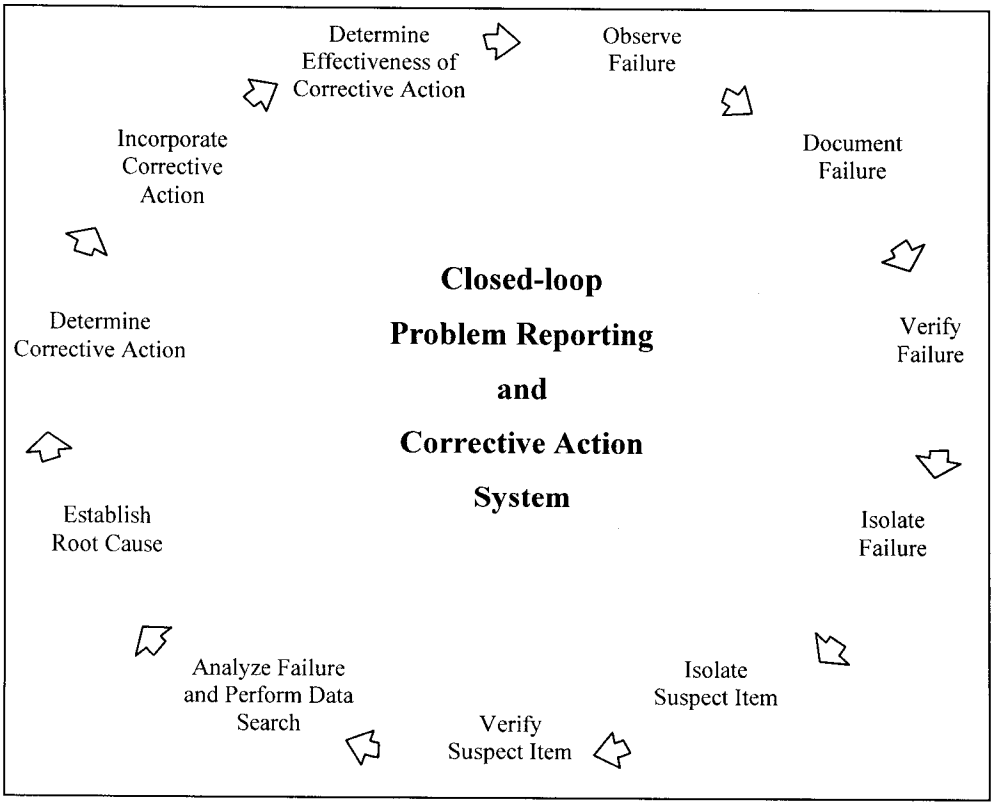
INTRODUCTION

Background

The PRACA process focuses management and engineering attention on areas needing improvement. The process provides for (1) identifying, documenting, and analyzing problems; (2) establishing root causes of reported problems; and (3) implementing and verifying effective corrective actions to prevent problem recurrence. Management can use the knowledge gained from the process to alter product design, manufacturing practices, and test procedures and to improve overall safety, quality, and reliability. Generally, management implements the PRACA process through a closed-loop system. As illustrated below in a figure from NASA's Lessons Learned Database,[2] the closed-loop PRACA system is designed to provide for repeated iterations of reporting product failures, analyzing related failure information, and taking corrective action, which should improve product reliability and performance.



[2] Lesson Number 0738, "Problem Reporting and Corrective Action System," dated February 1, 1999.

SSP PRACA. In 1987, NASA developed the current SSP PRACA process and system[3] to analyze significant problems and trends and to provide SSP management and decision makers with readily available, timely, and accurate data. Described as "an intercenter problem reporting and corrective action information system," the SSP PRACA system provides access to the individual problem reporting databases at Kennedy, Johnson Space Center (Johnson), Marshall Space Flight Center (Marshall), and selected contractor and vendor locations. According to NASA, the SSP PRACA process and system were developed to provide increased visibility into significant problems and improve the performance of independent technical assessments and in-depth trend analysis, which are essential for managing Space Shuttle safety and readiness for flight.

Responsibilities for PRACA. NASA and its contractors share responsibility for managing the SSP PRACA process and ensuring that nonconformances are accurately and completely documented in the SSP PRACA system. The Manager, Space Shuttle Safety and Mission Assurance Office, has primary responsibility for establishing policies and system requirements, providing overall system management, and conducting compliance audits. SSP project offices and their respective safety and mission assurance organizations are responsible for implementing PRACA in accordance with established requirements, performing process audits, and verifying that PRACA data are coordinated with other risk management activities. The SSP Quality Assurance organization is responsible for verifying NASA and contractor corrective action activities.

USA manages 19 SSP problem reporting databases, including those at Kennedy, and is responsible for analyzing each nonconformance reported by its personnel to determine the nonconformance cause and implement adequate measures to prevent recurrence.[4] USA's Web-based Program Compliance Assurance and Status System (WebPCASS) is the online interface to the SSP PRACA system. Personnel from the SSP design elements, projects, contractors, subcontractors, and vendors use the individual databases that comprise the SSP PRACA system and support WebPCASS to document nonconformances and corrective actions and ensure related nonconformance reports and Corrective Action Assistance Requests (CAARs) are hyperlinked to one another to allow for easy analysis and retrieval of related data. As of February 14, 2006, USA personnel had generated over 93 percent (193,204 of 207,377) of the nonconformance reports maintained in the Kennedy data set since the award of USA's contract on October 1, 1996.

[3] For the purposes of this report, the SSP PRACA process refers to the process of documenting nonconformances and implementing remedial and corrective actions. The SSP PRACA system refers to the databases in which the nonconformances and related corrective actions are recorded.

[4] Nonconformance types include "problems," which are conditions or failures that require engineering disposition, and "discrepancies," which are not as severe as problems and can normally be corrected by replacement or repair of the nonconforming item.

Objectives

The overall objective was to evaluate the effectiveness of the SSP PRACA process at Kennedy. Specifically, we determined whether roles and responsibilities for reporting, analyzing, resolving, tracking, and trending of deficiencies in Space Shuttle processing are adequately defined and documented;

- controls are in place to ensure that data in the SSP PRACA system are accurate and complete, allowing for reliable analysis and anomaly investigation; and
- NASA and its contractors have effectively implemented the process in accordance with established guidance.

See Appendix A for details of the audit's scope and methodology, our review of internal controls, and a list of prior coverage.

SSP PRACA GOALS NOT SUPPORTED AT KENNEDY

Although NASA and USA adequately defined and documented PRACA roles and responsibilities, the Kennedy data set of the SSP PRACA system did not support SSP PRACA goals and contained inaccurate and incomplete data. Of the 340 STS-114 nonconformance reports[5] we reviewed, 186 had questionable cause codes and 138 had insufficient descriptions.[6] In addition, USA hyperlinked only 2 of 36 process escapes to their corresponding corrective action reports. Those conditions occurred because (1) NASA and USA did not implement clear guidance for assigning cause codes, (2) NASA did not provide adequate oversight of USA, and (3) USA policies and procedures and NASA award fee metrics may have presented disincentives to reporting workmanship errors. Overall, this reduced the usefulness of the Kennedy data set as a management tool for improving Space Shuttle safety and reliability and as a historical record for NASA's Space Operations and Exploration Systems Mission Directorates. That critical data is inaccurately and incompletely reported in the SSP PRACA system is a repeat finding to 10 previous NASA internal and external reports.

PRACA Policies and Procedures

NASA and USA established and maintained policies and procedures for each step of the PRACA process and operation of the PRACA system. We determined that roles and responsibilities for establishing policy, implementing system requirements, managing the system, performing oversight activities, reporting nonconformances, and conducting and documenting remedial and corrective actions were adequately defined and documented in both NASA requirements and USA operating procedures.

NASA Requirements. NASA requirements establish processes for ensuring Space Shuttle safety and reliability through nonconformance reporting, correcting, and trending activities. National Space Transportation System (NSTS) 07700, "Space Shuttle System Integrity Assurance Program Plan," Volume XI, Revision B, May 14, 1993, requires the use of a closed-loop system for data related to Space Shuttle hardware and software reliability, performance monitoring, and analysis to ensure that Space Shuttle systems are reliable, safe, and perform as designed. NSTS 5300.4 (1D-2), "Safety, Reliability, Maintainability, and Quality Provisions for the Space Shuttle Program," September 10, 1997, establishes SSP safety, reliability, maintainability, and quality provisions and

[5] The 340 nonconformance reports were classified as follows: 200 problem reports, 106 discrepancy reports, 20 line-replaceable-unit problem reports, 8 interim problem reports, and 6 matrix discrepancy reports.

[6] We relied on the engineering expertise and judgment of the NASA OIG Aerospace Technologist to determine whether cause codes were questionable and nonconformance descriptions were sufficient.

requires NASA contractors to maintain nonconformance reports, determine the cause of each reported nonconformance, implement measures to prevent nonconformance recurrence, and prepare nonconformance trend analyses. NSTS 07700 and NSTS 5300.4 (1D-2) are supplemented by NSTS 08126, "Space Shuttle: Problem Reporting and Corrective Action (PRACA) System Requirements," Revision J, August 27, 2004,[7] which establishes specific requirements for the SSP PRACA system. According to NSTS 08126, the SSP PRACA system is only as accurate as the reported information; therefore, sufficient attention must be paid to ensuring accuracy and completeness of nonconformance information. Finally, Kennedy nonconformance data coding requirements are contained in S00000-6-3, "Nonconformance/Problem Reporting and Corrective Action (PRACA) Data Code Manual," Revision M, March 2005 (the Kennedy Data Code Manual).

USA Operating Procedures. USA operating procedures define the process for reporting nonconformances at Kennedy and provide guidance to ensure all related nonconformance data are cross-referenced in the PRACA system through the use of hyperlinks. USA Operating Procedure USA004642, "Problem Reporting and Corrective Action (PRACA) System," Revision 4, June 26, 2005, provides instructions for completing a Kennedy nonconformance report using Kennedy Form 2-152V3.[8] USA Operating Procedure 000383, "PCASS Reports and Query Replacement Project (WebPCASS) Functional Requirements Document (FRD)," Revision E, June 30, 2005, defines system search and reporting capabilities. Finally, USA Operating Procedure 000399, "Web Based Program Compliance Assurance and Status System (WebPCASS) Detailed Requirements and Design Document Specification (DRDS)," Revision D, July 31, 2005, states that PRACA data are to be cross-referenced in the PRACA system to allow users to search across related data sets without accessing each one separately.

SSP PRACA Goals

According to NSTS 08126, the goal of the SSP PRACA process and system is for NASA and USA to continuously improve the safety and reliability of Space Shuttle operations by identifying, reporting, analyzing, correcting, and preventing nonconformances associated with Space Shuttle hardware, software, and ground support equipment. NSTS 08126 further states that the SSP PRACA process and system should provide program and project managers, safety officials, and other interested parties accurate and immediate visibility into problem areas. The SSP PRACA system should also function as a historical database to support trend analyses, provide failure history, and document corrective and remedial actions. While NASA and USA were able to perform some

[7] During the audit, the SSP released NSTS 08126, Revision K, July 18, 2006, which clarifies and strengthens the requirement for SSP elements and projects to perform trend analyses on nonconformances based on cause, to assess recurrence, and to evaluate risk. For the purposes of this report, any references to text common to both versions of the criteria will be listed as NSTS 08126. If any references are made to text in only one revision, that revision will be identified.

[8] USA PRACA system operations personnel use Kennedy Form 2-152V3 to input all nonconformance data into the PRACA system. A sample of Kennedy Form 2-152V3 is provided in Appendix C.

trending using data from the Kennedy portion of the SSP PRACA system, such activities consisted mostly of tallying and summarizing the data for routine performance measurement, monthly metric reports, pre- and post-launch assessments, and award fee purposes. To meet SSP PRACA goals by conducting rigorous, proactive, and predictive trending and analysis of such issues as hardware performance and expected failure rates, the SSP needs accurate and complete PRACA data. Additionally, the SSP needs accurate and complete data to determine nonconformance cause and take appropriate corrective action where necessary to prevent nonconformance recurrence. However, we found that the Kennedy data set of the SSP PRACA system contained inaccurate and incomplete data.

Inaccurate and Incomplete Reporting of Critical Data

Of the 340 STS-114 nonconformance reports we reviewed, 186 had questionable cause codes and 138 had insufficient descriptions. In addition, USA hyperlinked only 2 of 36 process escapes to their corresponding corrective action report.

Questionable Cause Codes. Of the 340 nonconformance reports in our sample, 186 (55 percent) had questionable cause codes. According to the Kennedy Data Code Manual, "each operation or maintenance action performed on flight hardware or ground support equipment must be fully and accurately documented." According to the Manual, NASA and contractor personnel at Kennedy should classify each nonconformance using a data code consisting of 10 alphanumeric characters. The fourth position in the data code is the cause code.[9] The purpose of cause codes is to identify nonconformance root causes in a uniform and consistent manner, and serve as "a means of extracting data from the PRACA system for historical data trending." For each of our sample items, we reviewed the nonconformance description, the reported cause code, and the cause code definitions contained in the Kennedy Data Code Manual. One cause code we questioned was in nonconformance report D-V6-R127178. The nonconformance report description stated that Orbiter thermal protection system tile V070-191037-291 was incorrectly labeled V070-193037-291. USA assigned this nonconformance the Unexplained Anomaly cause code. According to the Manual, the Unexplained Anomaly cause code applies to conditions that cannot be duplicated, which clearly does not apply in this case.

We further analyzed the nonconformance descriptions and determined that the probable cause code for at least 1 line item related to 106 of the 186 nonconformances was Workmanship. According to the Manual, the Workmanship cause code should be used when the nonconformance is due to "noncompliance with prescribed procedures/instructions," such as the incorrect labeling of an Orbiter tile, or "damage resulting from human error." Each of the nonconformance descriptions for those 106 nonconformance reports supported, or partially supported, a cause code of Workmanship. However, almost half of the 106 nonconformances were assigned either

[9] The Kennedy Data Code Manual lists 34 possible cause codes. Appendix D contains the list of cause codes from the Manual.

the Operational Degradation[10] (21 percent) or Process Tolerance[11] (28 percent) cause codes. Nonconformance report P-V6-405907 is an example of the use of Operational Degradation when Workmanship was more appropriate. In that case, the nonconformance description stated that a wire harness was not clamped or secured in accordance with drawings and specifications. Instead, the harness was taped to a smaller harness. We do not consider that taping a harness instead of clamping it qualifies as Operational Degradation. The nonconformance description clearly indicates noncompliance with prescribed procedures and supports the Workmanship cause code. The input of inaccurate cause codes into the PRACA system hampers trending and data mining efforts, especially when trying to identify and prevent recurring problems. For a complete list of the 186 nonconformance reports with cause codes we considered questionable, see Appendix E.

Insufficient Nonconformance Descriptions. The nonconformance descriptions were insufficient for 138 (40 percent) of our sample items. Each nonconformance report contains a description of the reported nonconformance. According to USA004642, nonconformance report originators are to provide a "full description" of each reported nonconformance. Furthermore, system/support operations engineering personnel are responsible for updating nonconformance descriptions when troubleshooting or remedial action further define reported nonconformances.

For the 138 items, the nonconformance descriptions did not contain sufficient technical data to support the cited cause, permit a clear understanding of the nonconformance, or serve as an adequate historical record. For example, the description for nonconformance report P-V6-393638 stated, "Above blanket is damaged beyond repair." The description did not describe the nature of the damage or how it occurred, making it difficult to determine if USA's use of the Operational Degradation cause code was justified. Additionally, nonconformance report P-V6-400069-A, for a nonconforming wing web plate, states, "Excessive corrosion and rework damage." "Excessive corrosion" supports use of the Environmental Damage cause code, which USA assigned this nonconformance. However, the description also supports the Workmanship cause code, since damage caused by rework indicates possible human error. Overall, the description did not provide enough information to determine the proper cause code. A consequence of insufficient nonconformance descriptions is that critical information is often missing. Without critical information, management, engineers, and technicians may not have enough information to correct a problem or keep it from recurring. For a complete list of the 138 nonconformance descriptions we considered insufficient, see Appendix F.

Lack of Hyperlinks. USA hyperlinked only 2 (5 percent) of 36 process escapes to their corresponding corrective action reports. Because USA Operating Procedure USA 003061, "Corrective and Preventive Action Process," Revision 2, December 14, 2004, requires the performance of corrective action for each nonconformance described as a process escape, we chose to review process escapes to test whether NASA and USA

[10]Operational Degradation is used for nonconformances "resulting from expected wear and tear during operation or functioning of equipment."

[11]Process Tolerance is used when "the sum total of allowable tolerances" exceeds specifications.

performed hyperlinking activities. USA000383 and USA000399 further state that all data relationships in the PRACA system should be correlated and cross-referenced by using hyperlinks, which allows system users "to move between related references" and search across related data sets without accessing each one separately. Therefore, since all process escapes must have a corresponding CAAR, each should have been hyperlinked to that CAAR.

As of September 16, 2005, there were 36 closed nonconformance reports in the Kennedy data set described as process escapes. Our review of those 36 process escapes revealed that USA correctly hyperlinked only two of the process escapes to their associated CAARs. For 34 of the process escapes, the PRACA system stated that there were no associated CAARs, even though a separate search of the CAAR data set indicated that at least 13 of the process escapes had associated CAARs. We could not identify whether CAARs existed for the remaining 21 process escapes. When hyperlinks are not present, users do not have ready access to corrective action information, which could increase the time necessary to identify and correct similar nonconformances.

Unclear Guidance for Assigning Cause Codes

NASA did not provide clear guidance for assigning nonconformance cause codes at Kennedy. When reporting nonconformances and completing source documents, NASA and USA personnel assigned cause codes from the Kennedy Data Code Manual. However, the Manual does not provide definitions for the following three cause codes:

- Contamination,
- Insufficient Data, and
- Software Databank/Database Problem.

Additionally, the Manual does not clearly define the following four cause codes:

- Failure/Damage due to Associated Equipment Malfunction,
- Launch Damage,
- Removed per Cannibalization, and
- Interference Physical/Electronic.

For example, the only guidance provided in the Manual for the "Removed per Cannibalization" cause code is "(For use by PGOC [Payload Ground Operations Contract] only) – (Formerly landing damage, use code P - Flight Damage)." Without clear guidance, a user of the Kennedy Data Code Manual might not understand when this cause code is most appropriate. Finally, while the Manual illustrates how the 10-character data code, which includes the cause code, describes a nonconformance, it does not provide examples that would assist personnel in assigning specific cause codes. Without clear definitions and useful examples, personnel required to assign cause codes did not consistently assign those codes, which resulted in inaccurate and inconsistent results. USA personnel stated that the Kennedy Data Code Manual, including the cause

code definitions, was adopted from the Air Force and has undergone limited revisions for NASA's use. In 2004, NASA refined the objectives for initial and recurring SSP PRACA training, developed and published additional training materials, and developed a Web-based PRACA training module. However, the guidance for assigning nonconformance cause codes at Kennedy remained unchanged, subjective, and susceptible to errors. Such guidance should be better defined to ensure that cause codes are correct and that management can rely on the data in the SSP PRACA system.

Lack of NASA Oversight

NASA did not provide adequate oversight of USA's SSP PRACA activities. The Kennedy Shuttle Processing and Safety and Mission Assurance organizations, which share responsibility for oversight of USA's SSP PRACA activities, improved contractor oversight controls, including surveillance procedures, since the Columbia accident. However, Kennedy Space Shuttle Systems Engineers and Safety and Mission Assurance officials did not always (1) review nonconformance report cause codes for accuracy or nonconformance descriptions for sufficiency or (2) ensure that USA complied with data tracking and traceability requirements and hyperlinked Kennedy process escapes to related CAARs. Improved Shuttle Process Engineering and Safety and Mission Assurance surveillance procedures include:

- KDP-P-0010, "Shuttle Process Engineering Surveillance Implementation Plan for the Space Flight Operations Contract," Revision A, October 3, 2005,
- KDP-P-0008, "Shuttle Processing Surveillance Plan for the Space Flight Operations Contract," Revision A, November 2, 2004,
- KSC-UG-2802, "Safety and Mission Assurance Quality Plan," November 12, 2004, and
- KDP-P-0016, "Safety and Mission Assurance Surveillance Implementation Plan for the Space Flight Operations Contract," February 3, 2004.

KDP-P-0010 states that the Kennedy Space Shuttle Processing Engineering divisions perform oversight of USA, in part, through review and approval of PRACA documentation, including certain categories of nonconformance reports. According to KDP-P-0008, Shuttle Processing engineers also receive insight into contractor performance through assessment of data from management information systems, including the SSP PRACA system. Additionally, KSC-UG-2802 and KDP-P-0016 state that Quality Engineering and Process Assurance personnel from the Kennedy Space Shuttle Division, Safety and Mission Assurance Directorate are responsible for reviewing and approving nonconformance material review board actions.

Although personnel within the Kennedy Shuttle Processing and Safety and Mission Assurance organizations stated that they reviewed and approved material review board actions and conducted periodic sampling of nonconformance reports, they did not always

review cause codes and nonconformance descriptions for accuracy and sufficiency. Additionally, they did not ensure that USA complied with data tracking and traceability requirements and hyperlinked Kennedy process escapes to related CAARs. To ensure that USA fulfills its responsibility to provide a closed-loop PRACA system, and reports accurate and complete PRACA data, which both organizations use to assess USA's performance and endorse the Certificate of Flight Readiness,[12] Kennedy Space Shuttle Systems Engineers and Quality Engineering and Process Assurance personnel should routinely review cause codes and problem descriptions for accuracy and sufficiency, and ensure that USA complies with data tracking and traceability requirements.

Potential Disincentives to Reporting Workmanship Errors

USA Company Policies and Procedures. We believe that USA company policies and procedures may have discouraged technicians from accurately reporting their own workmanship errors. Specifically, the following USA policies and procedures allow for disciplinary action and possible dismissal for workmanship and/or performance issues:

- USA Desk Top Instruction 354220-028, "Workmanship PR [Problem Report] Review and Reporting," Revision 3.1, March 1, 2005;
- USA Operating Procedure 003589, "Nonconformance Information System," Revision 10-7, December 15, 2005; and
- USA Human Resources Functional Policy and Procedure, "Employee Conduct," C-01-12, Revision 7, July 23, 2005.

The policies also stated that each time a USA employee generates a nonconformance report that lists Workmanship as the nonconformance cause, USA Corrective Action Engineering personnel shall log the instance in a database used to develop and report company performance metrics to USA and NASA management.

Award Fee Performance Metrics. During each award fee assessment period, NASA uses specific award fee performance metrics that may discourage the reporting of USA's workmanship errors. The Award Fee Performance Assessment metrics listings from fiscal year (FY) 1998 to FY 2005 included nine metrics that measured USA's workmanship. For example, metric CP6-023, "USA Ground Operations Workmanship PR [Problem Report] Rate," measured the rate of nonconformances attributable to the Workmanship cause code per mission labor hours for each Space Shuttle flight. This metric established a goal of less than 23 nonconformances attributable to Workmanship per 200,000 mission labor hours. We found no evidence that NASA ever used this metric to reduce USA's award fee. Additionally, since FY 2000, NASA did not use the metrics tied to workmanship as award fee metrics. However, the following three metrics

[12]Endorsement of the Certificate of Flight Readiness is the culmination of the Space Shuttle Flight Preparation Process, which consists of the required preparations for a Space Shuttle mission from acceptance of the major hardware elements through processing, mating, and launch.

continued to appear in the metrics listings through FY 2005 and, as a result, may provide USA a disincentive to reporting workmanship errors:

- Metric CP6-017, "Workmanship Error Rate,"
- Metric CP6-021, "USA Ground Operations Human Error TPE [Test Project Engineering] Log Entry Rates," and
- Metric CP6-023, "USA Ground Operations Workmanship PR [Problem Report] Rate."

Although personnel from the Kennedy Space Shuttle Processing Office stated that NASA fosters an environment of open and honest reporting, we believe that policies and procedures that support disciplinary action for workmanship errors and performance metrics tied to error rates provide a disincentive to accurately reporting such errors. Workmanship errors incorrectly classified under other cause codes could result in a greater chance of recurrence since the true cause(s) may never be addressed and corrected. To balance the potential disincentives associated with the workmanship award fee metric, NASA and USA should ensure that the award fee includes a performance metric based on the accuracy of the nonconformance reports. This action, taken in conjunction with the engineer and quality personnel reviews of the nonconformance reports, should improve the accuracy of nonconformance data but still allow USA to be held accountable for workmanship errors.

Use of Kennedy SSP PRACA Data as a Management Tool

Because the Kennedy data set of the SSP PRACA system did not contain accurate or complete data, the data set was not as useful as it could be for improving Space Shuttle safety and reliability or as a historical record for NASA's Space Operations and Exploration Systems Mission Directorates. Based on the sample we reviewed, we estimate that 64 percent of the STS-114 nonconformance reports in the Kennedy data set were deficient in at least one of the areas discussed in this report.[13]

Improving Space Shuttle Safety and Reliability. The SSP needs accurate and complete PRACA data to conduct proactive, rigorous trending activities and support Space Shuttle safety and readiness for flight decisions. Without accurate and complete data, the SSP cannot determine nonconformance cause and take appropriate corrective action where necessary to prevent nonconformance recurrence. As stated in the March 2000 report from the Space Shuttle Independent Assessment Team (SIAT):

> Problem tracking and trending is considered . . . to be a crucial process for the safe performance of the Shuttle, given the Space Transportation System's complexity and age. Risk assessment and management

[13]We selected our sample from the universe of 14,904 STS-114 nonconformance reports in the Kennedy data set of the PRACA system, as of August 8, 2005. When selecting our sample, we established a 95 percent confidence level to provide a sample size that was representative of the entire population.

> cannot be successfully accomplished, it is believed, without full disclosure of current, complete, and relevant information generated by problem tracking, resolution and trending . . . Complete, consistent, and relevant information must be directly accessible and quickly available for risk management and decision making.

Overall, the SIAT concluded that,

> . . . the data contained in the problem reporting system cannot be processed quickly or directly by the system to obtain information for decision-making. Extensive examination and interpretation is needed to process the data for trending, making the system inefficient if not ineffective.

Usefulness as a Historical Record. Deficiencies in the data from the Kennedy SSP PRACA data set also reduced the data's usefulness as a historical record for NASA's Space Operations and Exploration Systems Mission Directorates. According to NSTS 08126, the SSP PRACA system should function as an accurate historical database. Such a database could be useful to the Space Operations Mission Directorate as well as to the Exploration Systems Mission Directorate. As stated in the November 2005 Exploration Systems Architecture Study, the Exploration Systems Mission Directorate is developing a safe, reliable means of human access to space after the Space Shuttle is retired in 2010. The Exploration Systems Architecture Study team developed and assessed viable launch system configurations for future crew and cargo launch vehicles. Ultimately, the team recommended that NASA "adopt and pursue a Shuttle-derived architecture." If the Exploration Systems Mission Directorate uses Space Shuttle elements for either the Crew Launch Vehicle or Cargo Launch Vehicle, reliable SSP PRACA data would be useful as a historical record for the next-generation launch system.

USA officials have stated that the SNC system currently under development will address some of the weaknesses of the existing SSP PRACA system, to include the data tracking and traceability deficiencies. Additionally, on February 8, 2006, the SSP Safety and Mission Assurance Office issued a task order to NASA's supplier assurance contractor to (1) identify procedures used to support the PRACA process; (2) review PRACA data for accuracy and completeness, including an analysis of nonconformance reporting criteria, definitions, and requirements; (3) identify the methods and metrics used for data collection; and (4) assess PRACA training requirements. Based on this assessment, the contractor will make recommendations for organizing and standardizing the data to support effective trending. We commend management's efforts to identify solutions to improve PRACA; however, recommendations to improve the SSP PRACA process and system have been provided to SSP management in the past. Corrective action to address those recommendations was either not taken or only partially completed. The SSP must make a commitment to improve the data going into the system so that the tracking and trending data coming out of the system can be relied upon. Accurate tracking and trending data will contribute to meeting the overall goal of the SSP PRACA process, that is, to have a process that can be used to continuously improve the safety and reliability of Space Shuttle operations.

Prior Audits and Assessments

That critical data is inaccurately and incompletely reported in the PRACA system is a repeat finding reported in at least 10 previous NASA internal and external reports. Prior audits and assessments identified and reported concerns with inaccurate cause codes, insufficient nonconformance descriptions, and incomplete data traceability. For example, the SIAT searched the PRACA system for reports of nonconforming Space Shuttle Main Engine liquid oxygen pins. In the Team's March 2000 report, the SIAT noted that their search netted a number of related nonconformance reports, however, "No cross-reference was found" between the reports. The Team concluded that cross-references between related nonconformance reports might have identified the lack of proper analysis for this particular problem with the Space Shuttle Main Engine, and may have prevented the flight of a previously untested pinned liquid oxygen post on the STS-93 mission. Additionally, in July 2002, a NASA independent assessment team reported on the "avoidance of [nonconformance] coding that reflects on personnel performance" (i.e., Workmanship) at Kennedy. Also, in January and October 2004, NASA independent assessment and safety and mission assurance teams reported that

- the Kennedy data set of the SSP PRACA system was not complete or accurate due to inconsistent and incorrect use of cause codes;
- there was a perception at Kennedy that management would use reported errors to discipline USA technicians or quality control personnel who did not identify the errors; and
- Kennedy PRACA source documents often contained insufficient nonconformance descriptions, which could lead readers to incorrect conclusions as to the cause of reported nonconformances.

Finally, according to their January 2005 assessment report, a NASA Engineering and Safety Center (NESC) team found that the SSP PRACA system suffered from a variety of problems, such as a lack of accuracy and completeness, which limited the system's effectiveness for proactive trending and analysis. Although NASA responded to these reports, the Agency did not take appropriate corrective action to prevent these problems from recurring. Findings and recommendations from prior audits and assessments are summarized in Appendix G.

Lessons Learned

In addition to recommendations concerning the SSP PRACA process and system, we are making a recommendation to the Exploration Systems Mission Directorate for future problem reporting and corrective action processes and systems. We believe lessons learned from the Agency's experience with the SSP PRACA process and system should be used to develop and implement improved processes and systems for follow-on missions and programs. According to the Chief of the Kennedy Safety and Mission

Assurance Exploration Project Office, two inter-center teams have been created to develop requirements for the problem reporting and corrective action process and system(s) that will support NASA's new human and robotic exploration programs and projects. We consider this a good first step and believe that those teams should contain, at a minimum, members of the management, user, safety, and quality assurance communities. In addition, the teams should consider the findings and recommendations presented in this report, develop specific life-cycle goals for the problem reporting and corrective action process or system(s), and develop requirements designed to meet those goals.

Management Comments on the Finding and Audit Evaluation of Management's Comments

Management Comments. The Associate Administrator for Space Operations stated that the overall findings and recommendations do not appear to be based on a clear understanding of the SSP PRACA system architecture. He stated that the audit report does not distinguish between the responsibilities of the SSP Design Center and those of processing activities such as Kennedy Shuttle Processing and, as a result, the recommendations seek to impose Design Center requirements on Kennedy Shuttle Processing. However, the Associate Administrator acknowledged that SSP PRACA guidance does not clearly state the different levels of responsibility or the SSP's intent for PRACA.

Evaluation of Management's Comments. We disagree that the overall findings and recommendations are based on a misunderstanding of the SSP PRACA system architecture. That architecture is defined in NSTS 08126, which states that the SSP design elements, projects, contractors, subcontractors, and vendors are responsible for documenting nonconformances and anomalies into the SSP PRACA system. NSTS 08126 also states that design elements and project offices are responsible for transferring PRACA reportable problems into their PRACA database and ensuring that PRACA reports are accurate and complete. Appendix B of NSTS 08126 lists the information required in each organization's PRACA system. For problem cause and problem description information, the requirements are the same regardless of the SSP organization level.

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

Recommendation 1. We recommend that the Director, Kennedy Space Center, direct the Center's Safety and Mission Assurance Office to review and revise S00000-6-3, "Nonconformance/Problem Reporting and Corrective Action (PRACA) Data Code Manual," Revision M, March 2005, to provide more precise and useful descriptions and examples to assist NASA and USA personnel in assigning nonconformance cause codes.

Management Comments. The Associate Administrator for Space Operations concurred that the cause code definitions could be improved but stated that the cause code problem is not as severe as reported in the audit. He stated that the SSP believes that a majority of the questionable cause codes listed in Appendix E are correct as stated in the PRACA system, and he provided an example of one of the Appendix E items that the SSP disputes.[14] He also stated that PRACA cause code data does not support the existence of disincentives for the use of the Workmanship cause code. However, the Associate Administrator stated that the PRACA Data Code Manual will be reviewed for possible revision to include adding clarifying statements in the definition section and examples, but added that the application of cause codes will remain a subjective activity.

In addition to commenting on the specific recommendation, the Associate Administrator also commented on PRACA reporting requirements as stated in NSTS 08126 Revision J. He stated that it was clear there are different interpretations of NSTS 08126 Revision J concerning the purpose of the cause code for problem reports. He stated that the purpose at the Kennedy Processing level is to perform remedial action and not to identify the root cause. To clarify that issue, the Associate Administrator stated that the SSP will update NSTS 08126 to better define the requirements and responsibilities at each SSP organizational level regarding the purpose and use of cause codes.

Evaluation of Management's Comments. Management's comments to the recommendation are responsive. However, we do not agree that we overstated the severity of the cause code problem, as our statistical sampling results indicated that 55 percent of cause codes in the Kennedy PRACA database were questionable. Those results were based on the analysis by our Aerospace Technologist who, in addition to considering the cause codes and related descriptions, consulted with personnel from the Shuttle Processing Directorate to obtain a better understanding of possible damage scenarios. Regarding the specific example cited in management's comments, our Aerospace Technologist determined that the tile bond verification test is rarely performed on tiles that have been in flight and after further analysis concluded that (1) flight damage most likely was not a contributing factor in the bond verification test failure, (2) there was not adequate rationale for the use of the Materials Deficiency/Degradation cause code, and (3) the probable cause of the nonconformance was Workmanship.

Our analysis indicated that Workmanship and Flight Damage shared the position of fourth most commonly used cause codes in our sample (8 percent, or 36 of the 456 individual items we reviewed).[15] Analysis conducted by our Aerospace Technologist indicated that 40 percent, or 184 of those 456 items, should have

[14]The example used is item 1 in Appendix E to the report.

[15] The three most commonly used cause codes for the 456 individual items reported on the 340 nonconformance reports we reviewed were (1) Operational Degradation (31 percent, or 140 of 456); (2) Process Tolerance (13 percent, or 59 of 456); and (3) Unavoidable Damage/Nonconformance (9 percent, or 41 of 456). Flight Damage and Workmanship were both used for 36 of the 456 items we reviewed.

been reported as Workmanship, which would have made Workmanship the most commonly used cause code. However, our recommendation was not based on the number of times the Workmanship cause code was actually reported but on whether the correct cause code was used. Our discussion of the potential disincentives within USA polices and procedures and award fee metrics that could lead to the underreporting of Workmanship-related nonconformances is in a separate part of the report. Additional discussion of award fee metrics is contained in our evaluation of management's comments on Recommendation 4.

Regarding the proposed review and revision to the PRACA Data Code Manual we consider the issue resolved because the corrective action states that the PRACA Data Code Manual will be revised or that rationale will be provided as to why revision is not needed. The issue will remain open for reporting purposes until we review the PRACA Data Code Manual revision or the rationale given to support that no revision was necessary.

Regarding the proposed revision to NSTS 08126, we agree with updating the guidance to better define the roles and responsibilities at each organizational level and consider the issue resolved. The issue will remain open for reporting purposes until we review the change request and the subsequent revision to NSTS 08126.

Recommendation 2. We recommend that the Director, Kennedy Space Center, direct the Center's Safety and Mission Assurance Office and Shuttle Processing Directorate to revise the SSP quality and surveillance plans to require Kennedy Space Shuttle Division Quality Engineering and Process Assurance personnel and Space Shuttle Systems Engineers to review the accuracy of cause codes, sufficiency of nonconformance descriptions, and compliance with data tracking and traceability requirements as they conduct routine surveillance of USA's PRACA activities.

Management Comments. The Associate Administrator for Space Operations nonconcurred stating that processes are already in place to review the accuracy of cause codes and the sufficiency of nonconformance descriptions. Specifically, that the Material Review Board process, as defined in KDP-P-3625, states that the Quality Engineers will verify that problem descriptions are clear and accurate and that the probable cause of the discrepancy is clear. Additionally, Process Assurance personnel, in accordance with KDP-P-3618, perform sampling activities of closed discrepancy reports and problem reports to include verifying that nonconformance descriptions reflect disposition findings and (for problem reports) the nonconformance report Conclusion/Summary section includes a probable cause statement. Finally, USA provides their own oversight to include a final review of the cause code by two specifically identified personnel. The Associate Administrator requested that the recommendation be closed.

Evaluation of Management's Comments. Management's comments are nonresponsive. We recognize that, through the Material Review Board process, Kennedy Quality Engineers review nonconformance report descriptions and cause

codes. However, not all nonconformance reports are subject to the Material Review Board process. Additionally, as management noted in their response to the draft report, Kennedy Process Assurance sampling activities do not include an evaluation of discrepancy report cause codes and, for problem reports, only ensure that a probable cause statement is listed in the report Conclusion/Summary section. This differs from an evaluation of the accuracy of the reported cause code which, according to Section 5.0 of NSTS 08126, Revision K, forms the basis for PRACA trending activities. Also, we believe that, in addition to Kennedy Safety and Mission Assurance Quality Engineers and Process Assurance personnel, Space Shuttle Systems Engineers should routinely review the accuracy of nonconformance cause codes and the sufficiency of nonconformance descriptions to fulfill their responsibilities for performing oversight of USA's PRACA activities. Finally, we recognize that USA personnel perform reviews of nonconformance cause codes. However, we disagree that such activities meet the intent of this recommendation, as USA reviews cannot be considered NASA-conducted surveillance activities.

We request that the Associate Administrator reconsider his position and provide additional comments to the final report with regard to accuracy of cause codes, sufficiency of nonconformance descriptions, and compliance with data tracking and traceability requirements.

Recommendation 3. We recommend that the Manager, Space Shuttle Program, ensure that USA complies with hyperlinking requirements contained in USA000383, "PCASS Reports and Query Replacement Project (WebPCASS) Functional Requirements Document (FRD)," Revision E, June 30, 2005, and USA000399, "Web Based Program Compliance Assurance and Status System (WebPCASS) Detailed Requirements and Design Document Specification (DRDS)," Revision D, July 31, 2005.

Management Comments. The Associate Administrator concurred but stated that the recommendation is based on the misunderstanding that personnel can enter nonconformance and corrective action data into WebPCASS. He stated that WebPCASS is a "read only" database which is populated by the various PRACA transactional source systems (including Kennedy PRACA). Because the Kennedy PRACA software does not allow for linking multiple problem report numbers to a single CAAR number, the default value of "there were no associated KSC CAAR reports found," will display in WebPCASS. The Associate Administrator stated that the default value can be misleading but added that because the Kennedy PRACA software does not allow for hyperlinking multiple nonconformance reports to a single CAAR, USA complies with its requirement to provide hyperlinks "where available." The Associate Administrator requested that the recommendation be closed.

Evaluation of Management's Comments. Management's comments are nonresponsive. We agree that the current software program for the Kennedy PRACA data set does not allow for linking of multiple, related nonconformance reports to a single CAAR and revised the statement on page 2 of this report

regarding WebPCASS input. As stated in the report, we limited our testing of USA's hyperlinking activities to 36 process escapes, which are required, by regulation, to have corresponding corrective action. We verified that, although the PRACA system states "there were no associated KSC CAAR reports found," a separate search of the CAAR data set indicated that at least 13 of the process escapes had associated CAARs. However, for 21 of the process escapes, we searched both the Kennedy PRACA data set and the Kennedy CAAR data set and found no associated CAAR. Regardless of whether multiple hyperlinks are allowed, for those 21 process escapes there should have been evidence of an associated CAAR in one or both of the databases.

We request that the Associate Administrator reconsider his position and provide comments to the final report with regard to hyperlinking CAARs to allow for easy analysis and retrieval of related data.

Recommendation 4. We recommend that the Manager, Space Shuttle Program, coordinate with USA to ensure that the award fee includes a performance metric based on the accuracy of nonconformance reports.

Management Comments. The Associate Administrator for Space Operations concurred but stated that metrics to measure accuracy of nonconformance reports already exist and flow into the award fee process as appropriate. He added that those monthly metrics are reviewed by NASA Quality Assurance for positive or negative trends. The results of that review directly affect the assessment of USA strengths and weaknesses, which is then used to determine award fees.

Evaluation of Management's Comments. Management's comments are nonresponsive. While metrics to measure accuracy of nonconformance reports may exist, they do not appear in the Award Fee Performance Assessments. The audit team reviewed 22 Award Fee Performance Assessments dating from October 1997 to September 2004. During this time, 41 metrics based on information contained in the PRACA system appeared in the assessments; however, none was related to accuracy. To meet the intent of the recommendation, the metrics should be included in the award fee determination and be included in the Award Fee Performance Assessment.

We request that the Associate Administrator reconsider his position and provide additional comments to the final report.

Recommendation 5. We recommend that the Associate Administrator, Exploration Systems Mission Directorate, ensure that the teams working on the problem reporting and corrective action process and system(s) that will support NASA's new human and robotic exploration programs and projects contain, at a minimum, members of the management, user, safety, and quality assurance communities. In addition, those teams should consider the findings and recommendations presented in this report, develop specific life-cycle goals for the problem reporting and corrective action process or system(s), and develop requirements designed to meet those goals.

Management Comments. The Associate Administrator for Space Operations concurred and stated that the NASA Constellation Safety and Mission Assurance office has undertaken a comprehensive activity to improve the PRACA reporting process and tools for Exploration Systems Mission Directorate systems. Results of prior audit and assessment reports (including this report) were considered in developing the Information Technology system requirements for PRACA. The PRACA methodology and system requirements will be reviewed at the Constellation Systems Requirement Review in August 2006 and the requirements are planned to be baselined by December 2006.

Evaluation of Management's Comments. Management's comments are responsive. We consider the recommendation resolved, but the recommendation will remain open for reporting purposes until we receive and review the baselined PRACA requirements.

APPENDIX A

Scope and Methodology

We performed field work at Kennedy and Johnson. We reviewed portions of USA's contract, and the following NASA and USA requirements, policies, and procedures:

- NSTS 07700, "Space Shuttle System Integrity Assurance Program Plan," Volume XI, Revision B, May 14, 1993.
- NSTS 5300.4(1D-2), "Space Shuttle: Safety, Reliability, Maintainability and Quality Provisions for the Space Shuttle Program," September 10, 1997.
- NSTS 60538, "Space Shuttle Program Government Quality Assurance Program," January 21, 2005.
- NSTS 08126, "Space Shuttle: Problem Reporting and Corrective Action (PRACA) System Requirements," Revision J, August 27, 2004, and Revision K, July 18, 2006
- S00000-6-3, "Nonconformance/PRACA Data Code Manual," Revision M, March 2005.
- USA Operating Procedure USA004642, "Problem Reporting and Corrective Action (PRACA) System," Revision 4, June 26, 2005.
- USA Operating Procedure USA003061, "Corrective and Preventive Action Process," Revision 2, December 14, 2004.
- USA Operating Procedure 000383, "PCASS Reports and Query Replacement Project (WebPCASS) Functional Requirements Document (FRD)," Revision E, June 30, 2005.
- USA Operating Procedure 000399, "Web Based Program Compliance Assurance and Status System (WebPCASS) Detailed Requirements and Design Document Specification (DRDS)," Revision D, July 31, 2005.

We also interviewed NASA and USA PRACA system users, and safety and mission assurance, SSP, and NESC officials from NASA Headquarters, Kennedy, Johnson, Goddard Space Flight Center, Glenn Research Center, and Ames Research Center.

To evaluate the implementation of the SSP PRACA process, we reviewed a random[16] sample of nonconformance reports related to the STS-114 mission and maintained in the Kennedy data set of the SSP PRACA system. Our sample included 340 (or 2 percent) of the 14,904 STS-114 nonconformance reports in the Kennedy data set, as of August 8, 2005. We also reviewed all 36 closed STS-114 process escapes, and all 27 closed CAARs in the Kennedy data set, as of September 16, 2005. We chose to review PRACA data from the STS-114 mission because, according NASA's Return to Flight Implementation Plan, the SSP conducted a review of problem tracking and disposition processes from the three previous missions.

To determine if USA's award fee metrics provided appropriate incentive for USA's PRACA-related activities, we reviewed the Kennedy Shuttle Processing Office's award fee input for the past six periods (April 2002 through March 2005), and 22 award fee reports dating from October 1997 to September 2004.

We performed this audit from August 2005 through May 2006 in accordance with generally accepted government auditing standards.

Use of Computer-Processed Data. We assessed the reliability of computer-processed data from the SSP PRACA system to perform this audit. As discussed in the report, we determined that the data was inaccurate and incomplete and, therefore, largely unreliable, which supports our finding. Beyond that, the computer-processed data did not impact our finding.

Review of Internal Controls

Specific internal controls reviewed included USA's award fee performance metrics, NASA and USA's PRACA requirements and procedures, PRACA system controls, and NASA's oversight of USA's PRACA activities. As stated in the report, we identified weaknesses with each of these controls.

During the audit, we also identified potential weaknesses with management controls over the personal use of scrapped Space Shuttle hardware at Kennedy. As a result, we made a referral to the OIG Office of Criminal Investigations.

Prior Coverage

During the last 5 years, the NASA OIG has not issued any reports of particular relevance to the subject of this report. Prior audits and assessments conducted by NASA or other external organizations are summarized in Appendix G.

[16]For the random sample of nonconformance reports, we used EZ-Quant software to determine the sample size and generate random numbers for selecting our sample. We selected a risk factor of 5 percent, which generated a confidence level of 95 percent that errors would be detected in the sampled population.

GLOSSARY OF TERMS

Definitions are established in and commonly used throughout various NASA and USA requirements documents, including NSTS 07700, "Space Shuttle System Integrity Assurance Program Plan," Volume XI, Revision B, May 14, 1993; NSTS 08126, "Space Shuttle: Problem Reporting and Corrective Action (PRACA) System Requirements," Revision J, August 27, 2004; and USA Operating Procedure USA004642, "Problem Reporting and Corrective Action (PRACA) System," Revision 4, June 26, 2005.

Cause Code. An alphanumeric character used on a problem report, interim problem report, or discrepancy report to identify the root cause of the nonconformance. There are 34 possible cause codes used to classify nonconformances reported at Kennedy.

Corrective Action. Action taken beyond remedial action to correct a problem and prevent problem recurrence. Also referred to as recurrence control.

Corrective Action Assistance Request. Record used to request and document corrective action.

Discrepancy. Any nonconformance that does not affect form, fit, or function; does not require recurrence control; and the item can be returned to an acceptable condition through such actions as remove-and-replace, return-to-print, or repair in accordance with an approved procedure. Discrepancy reports are used to record and correct nonconformances that do not meet the requirements of a problem. Discrepancy reports do not require engineering disposition or review for correctness or completeness.

Disposition. The remedial action taken to correct a problem or discrepancy, such as repairing or replacing damaged hardware.

Interim Problem Report. A document to record an apparent nonconformance, failure, or unsatisfactory hardware or software condition that usually requires troubleshooting to authenticate the problem, determine the component end item containing the failure, or rationalize as a procedural problem or explained condition. When a nonconformance or suspected nonconformance is detected and cannot readily be isolated to an end item, component, or software, the nonconformance will be documented as an Interim Problem Report.

Line Replaceable Unit. An item that can be removed and replaced as a unit from a system at the organizational level of repair or the lowest assembly level.

Material Review. The process that implements corrective actions and documents resolutions to correct defective or nonconforming items that cannot or will not be returned to drawing or specification. Material reviews are conducted by a board of quality and engineering representatives whose function is to provide disposition for

nonconformances in accordance with the SSP safety, reliability, maintainability, and quality requirements.

Matrix Discrepancy Report. A discrepancy report used to annotate defects that are minor in nature and repaired by appropriate specifications. Matrix Discrepancy Reports initiated at Kennedy for Thermal Protection System components do not contain or require all of the data elements of other nonconformance reports.

Nonconformance. A condition that exists when one or more characteristics of any article or material does not conform to specified requirements. Nonconformances include discrepancies and problems.

Operational Degradation/Wear Out. The cause code that identifies nonconformances at Kennedy resulting from expected wear and tear during operation or functioning of equipment.

Problem. Any nonconformance which fits or which is suspected of fitting one of the following categories: (a) failure; (b) unsatisfactory condition; (c) unexplained anomaly; (d) overstress or potential overstress of hardware; (e) in-flight anomaly; or (f) any nonconformance which has shown by trend analysis to need recurrence control. Problem reports are used to record any unsatisfactory condition or failure related nonconformance that requires engineering disposition and review for correctness and completeness.

Problem Cause. The event or series of events occurring at the lowest level of assembly and is directly responsible for the problem.

Problem Reporting and Corrective Action. A management system for identifying, reporting, analyzing for cause, remedying, and preventing recurrence of problems.

Process Escape. Any problem identified after it should have been detected during normal processing.

Trend Analysis. The analysis and evaluation of performance of an item, system, or subsystem in relation to designed quantitative and qualitative parameters based upon actual maintenance data collection reports.

Workmanship (Fabrication/Installation/Buildup Error). The cause code that identifies nonconformances at Kennedy resulting from noncompliance with prescribed procedures, instructions, or rules, or damage resulting from human error.

KENNEDY SPACE CENTER
FORM 2-152V3

National Aeronautics and Space Administration
John F. Kennedy Space Center

1. Report Number
☐ Interim Problem Report _____
☐ Problem Report _____
☐ Discrepancy Report _____

PAGE 1 OF

2. Detected During	3. Work Area / Location / Zone	4. End Item Control Number

5. Part / Program Name	6. Part / Program Number	7. Serial / Rev No.

8. NHA Part Number	9. STS / Elf	10. Reported by	11. Date / Time

12. Item	13. Problem Description
	TPS/RSI Inst'd: ☐ Yes ☐ No C/P Inst'd: ☐ Yes ☐ No C/P Part Number:

14. Process Escape	15. Constraints	16. Crit	17. Eng Grp	18. MR Reqd	19. Out of Family
☐ Yes ☐ No	See CRR ☐ To	Part N/C		☐ Yes ☐ No ITEMS:	☐ Yes ☐ No ITEMS:

20. Step	21. Disposition / Cause / Corrective Action	22. Tech	Contr	Govt

23. Data Code	24. Final Acceptance Date / Stamp

25. PC Action Reqd	26. Related Reports
☐ Yes ☐ No ITEMS:	

27. FMEA Number: _____ 28. CIL Affected ☐ Yes ☐ No 29. Addl SE Data? ☐ Yes ☐ No
30. HR Number: _____ 31. HR Cause Num: _____

KSC FORM 2-152V3 (REV. 06/05) PREVIOUS EDITIONS ARE OBSOLETE
ORIGINAL

KENNEDY SPACE CENTER CAUSE CODES

The Kennedy Data Code Manual contains the following list of 34 cause codes:

Cause Code	Cause Code Name	Cause Code Definition
1	Console Operator Error	Nonconformance resulting from an incorrect command entered from a terminal or console.
2	Design Deficiency/Nonconformance	Caused by insufficient or incorrect drawing or specification requirements. (In most cases this requires an engineering change or material review type disposition.)
3	Procedural/Work Auth Error	Nonconformance resulting from mistakes in WADS. (Includes procedural logic deficiencies, incorrect instructions or callouts, etc.)
4	Workmanship (Fabrication/Installation/Buildup Error)	Nonconformance due to noncompliance with prescribed procedures, instructions (rules), or damage (nonconformance) resulting from human error.
5	Other SFOC Organizations	(Formerly disassy/refurb deficiency) Only applies when the paperwork is transferred to another SFOC organization and they are responsible for the repair. This code should not be used in place of Code A, Vendor Responsibility.
6	Failure/Damage Due To Associated Equipment Malfunction	(Formerly Calibration Error/Out of Adjustment)
7	Expired/Limited Shelf Life/Life Cycle	Used when an item has expired shelf life or has exceeded time/life cycle. This code should not be used for overdue PM's.
8	Failure	Used when a functional component does not perform to specification and requires additional investigation to determine the cause. (Not to be used when a more specific code applies.)
9	Materials Deficiency/Degradation	Nonconformance as a direct result of a material not performing as specified due to a weakness (aging, settling, etc.) or defect in composition. Does not include expired shelf life, environmental damage or operational degradation.
A	Vendor Responsibility	Only applies to nonconformance apparently caused by vendors. Used especially when part is discrepant upon receipt or installation.
B	Shipping/Handling Damage	Any damage incurred during transporting of hardware.
C	Contamination	
D	Environmental Damage (formerly Corrosion)	Damage resulting from exposure to operational or environmental elements.
E	Launch Damage (Pad FAC and GSE)	Not to be used for flight hardware (See code P - Flight Damage)

Cause Code	Cause Code Name	Cause Code Definition
F	Removed Per Cannibalization (For use by PGOC Only)	(Formerly landing damage, use code P - Flight Damage)
G	Recovery Damage (SRB Only)	Damage incurred to flight hardware which is a result of splash down retrieval, towing or landing during SRB recovery operations.
H	S/W Program/Coding Error	Incorrect, missing logic, or syntax error.
J	S/W Configure Error	Error in S/W package build.
K	S/W Media/Bad Copy/Parity	Error caused by faulty stored data.
L	Unexplained Anomaly	A condition (ghost/phantom), which cannot be duplicated.
M	Insufficient Data	
N	No Discrepancy/Explained Condition	Used when investigation or troubleshooting determines the condition is normal to system operation.
O	Process Tolerance	The sum total of allowable tolerances. (Formerly TPS Step and Gap only).
P	Flight Damage	Applies to flight hardware between "T minus 0" to "Wheel Stop" on landing or SRB splashdown.
Q	S/W Compiler Incompatibility	Incorrect compiler used.
R	Housekeeping	Used to describe improper storage of equipment, supplies, etc., FOD (Foreign Object Debris), messy/cluttered work areas, or unemptied trash cans.
S	Interference Physical/Electronic	(Not to be used when caused by design, workmanship, or other applicable cause code.)
T	Operational Degradation/Wear Out	Nonconformance's resulting from expected wear and tear during operation or functioning of equipment.
U	Unavoidable Damage/Nonconformance	Damage/ nonconformance as a direct result of rework, repair, or normal processing.
V	Duplicate Paper/Previously Documented Discrepancy	(Formerly Designated Verification (DV) Escape. When a duplicate PR/IPR/DR is written on a previously documented discrepancy.
W	Planning/Scheduling Error	Unforeseen planning /scheduling conflict that results in the nonperformance of required operations. Also includes overdue PM's, calibration, validation etc.
X	S/W Databank/Database Problem	
Y	S/W Timing Problem	Interface timing incorrect or incomplete.
Z	S/W DATA BAD	Data incomplete, missing or incorrect.

QUESTIONABLE CAUSE CODES

Of the 340 STS-114 nonconformance reports reviewed, 186 had a questionable cause code for at least one reported line item.[17] We relied on the engineering expertise and judgment of the NASA OIG Aerospace Technologist to determine whether cause codes were questionable. For each line item on the 186 nonconformance reports, we identified the most likely cause code based on an engineering review and comparison of the nonconformance description and cause code shown on the official PRACA report, and the cause code definitions contained in the Kennedy PRACA Data Code Manual. Because nonconformance descriptions were insufficient as shown in Appendix F, we could not determine the most likely cause code for at least 1 line item related to 60 of the nonconformance reports. Where the reported cause code matched our assessment of the most likely cause code, a justification was not applicable.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
1	P-V6-R120083	(9) Materials Deficiency/Degradation	(4) Workmanship	The nonconformance description states the tile failed bonding verification testing, which tests the strength of the tile's attachment to the orbiter. Most likely, the process was not performed correctly.
2	P-V6-398373	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(4) Workmanship	(4) Workmanship	Not Applicable.
3	P-V6-398934	(2) Design Deficiency/Nonconformance	(4) Workmanship	The nonconformance description and disposition state that the wire was cut too long and had to be reworked to comply with specifications.
4	D-V6-R120506	(O) Process Tolerance	(4) Workmanship	Most likely, the gap filler was removed without authorization.
5	P-V6-399745	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
6	D-V6-400397	(M) Insufficient Data	(4) Workmanship	The technician should have noticed that a portion of the metal structure was exposed and making contact with the harness.

[17] PRACA reports often contain multiple nonconformances identified as separate line items.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
7	D-V6-400708	(T) Operational Degradation/Wear Out	(T) Operational Degradation/Wear Out	Not applicable.
		(D) Environmental Damage	(D) Environmental Damage	Not applicable.
		(M) Insufficient Data	(T) Operational Degradation/Wear Out	The elongated hole in the bracket was most likely caused by operational use.
8	P-V6-401164	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
9	P-V6-401292	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description supports the conclusion that the Kapton wire insulation was scuffed and not cracked or broken, most likely indicating that the technician either pulled on or rubbed the wire.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(4) Workmanship	A grommet should not tear due to operational use; only when treated improperly.
10	P-V6-401689	(T) Operational Degradation/Wear Out	(4) Workmanship	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
11	P-V1-011013	(N) No Discrepancy/Explained Condition	(4) Workmanship	The nonconformance description field states that technicians were not following the prescribed process.
12	D-V6-R121971	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. Based on the location of the damage, this is most likely a Workmanship error.
13	D-V6-R122148	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
14	P-V6-404175	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
15	D-V6-R122475	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. The nonconformance description supports the conclusion that human error caused this nonconformance.
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
16	P-V6-404740-A	(8) Failure	(T) Operational Degradation/Wear Out	This does not appear to be a failure. No damage actually occurred, and the nonconformance description states that the life cycle limit was met/exceeded at 28 flights.
17	P-V6-405997	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description states that the convoluted tubing used to protect the wiring was crushed. Most likely, a technician caused the damage to the tubing while working in the area.
18	D-V6-R123083	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
19	P-V6-360838-A	(3) Procedural/Work Authorization Error	Cannot Make a Determination	Insufficient description to determine cause.
20	P-V6-410977	(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description and disposition state that tape and insulation were missing.
21	P-V6-411456	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description supports the conclusion that this item was determined to be undersized, which most likely occurs when the item is constructed incorrectly.
22	P-V6-412088	(N) No Discrepancy/Explained Condition	Cannot Make a Determination	Insufficient description to determine cause.
23	P-V6-413450	(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description and disposition state that the item was not inspected as required.
24	P-V6-414219	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. Because of the material properties of cold plates, the damage is most likely the result of improper handling by technicians during installation.
25	D-V6-415728	(M) Insufficient Data	(4) Workmanship	The nonconformance description states that ten screws were installed that were not to specification.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
26	P-V6-412818-A	(M) Insufficient Data	(4) Workmanship	The nonconformance description states that the wire was cut short.
27	D-V6-R125519	(O) Process Tolerance	Cannot Make a Determination	Insufficient description to determine cause.
28	D-V6-R125735	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
29	P-V6-R125244	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	Not applicable.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
30	D-V6-R126733	(O) Process Tolerance	Cannot Make a Determination	Insufficient description to determine cause.
31	P-V6-R126994	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
32	D-V6-R127178	(L) Unexplained Anomaly	(4) Workmanship	The nonconformance description states that the tile was labeled with an incorrect identification number.
33	D-V6-R127296	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
34	P-V6-424233	(A) Vendor Responsibility	(4) Workmanship	Blankets are made at Kennedy Space Center, not by a vendor. Most likely, the blanket was not manufactured to specification and could not be re-worked to comply with specifications.
35	D-V6-R127651	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	
36	D-V6-424855	(9) Materials Deficiency/Degradation	Cannot Make a Determination	Insufficient description to determine cause.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
37	P-V6-425478	(A) Vendor Responsibility	(4) Workmanship	The nonconformance description supports the conclusion that the nonconformance should have been caught by inspection at the NASA facility.
38	P-V6-426714	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
39	P-V6-430315	(T) Operational Degradation/Wear Out	(8) Failure	The nonconformance description supports the conclusion that the calibration equipment failed.
40	P-V6-397401	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
41	P-V6-398720	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
42	P-V6-R120439	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	Cannot Make a Determination	Insufficient description to determine cause.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
43	P-V6-399693	(A) Vendor Responsibility	(4) Workmanship	The solder sleeves are installed by a wiring technician at Kennedy Space Center, not a vendor location.
		(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, the torn grommet is a result of mishandling.
44	P-V6-399206-B	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
45	P-V6-400581	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties not due to operational use.
46	D-V6-R120898	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
47	P-V6-401217	(M) Insufficient Data	(4) Workmanship	The nonconformance disposition supports the conclusion that the nonconformance was most likely caused by installation error.
		(M) Insufficient Data	(4) Workmanship	
		(M) Insufficient Data	(4) Workmanship	
48	P-V6-400069-A	(D) Environmental Damage	(4) Workmanship	The nonconformance description states that the damage was caused during rework.
49	P-V6-R122049	(N) No Discrepancy/Explained Condition	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
50	P-V6-404153	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
51	D-V6-R122412	(O) Process Tolerance	(4) Workmanship	An under-tolerance gap is most likely the result of a technician not removing enough structure for the tile to fit.
		(O) Process Tolerance	(O) Process Tolerance	Not Applicable.
52	D-V6-R122731	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
		(4) Workmanship	(4) Workmanship	Not applicable.
53	P-V6-405822	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description and disposition support the conclusion that the harness clamp was incorrectly rotated during previous work, allowing too much bending of the wire and stress on its insulation.
		(T) Operational Degradation/Wear Out	(4) Workmanship	
54	P-V6-405907	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description states that the wire harness was not clamped according to specification.
55	P-V6-406308	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
56	P-V6-R123346	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	
		(S) Interference Physical/Electronic	(S) Interference Physical/Electronic	Not applicable.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description states that 0.750" plugs were fabricated to plug 0.480" screw holes.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
57	P-V6-R124052	(O) Process Tolerance	(4) Workmanship	The technician should have seen that the gap was incorrect.
58	P-V6-411779	(A) Vendor Responsibility	(4) Workmanship	The nonconformance disposition states that the welded seam of the insulator was not folded and welded per specification. The item had to be returned to NASA's Shuttle Logistics Depot to be corrected.
59	D-V6-412766	(O) Process Tolerance	(4) Workmanship	The nonconformance description states that the harness clamp was missing.
60	P-V6-413852	(8) Failure	(4) Workmanship	The nonconformance disposition states that the nonconformance occurred due to extreme temperature during the brazing operation. The technician performing the work should have noticed the temperature.
61	P-V6-414552-A	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
62	P-V6-409812-A	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
63	P-V6-416216	(S) Interference Physical/Electronic	(4) Workmanship	The technician should have noticed that the thermal control blankets were pinched while they were being attached.
64	P-V6-416520	(N) No Discrepancy/Explained Condition	(4) Workmanship	The nonconformance description states that the bolts were under torqued.
		(N) No Discrepancy/Explained Condition	(4) Workmanship	The nonconformance description states that the nut was wired incorrectly.
65	P-V6-418166	(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description and disposition state that the required washers were omitted.
		(3) Procedural/Work Authorization Error	(4) Workmanship	
66	D-V6-R125803	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile gap tolerance was trimmed too close.
67	D-V6-R125950	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile gap tolerance was trimmed too close.
68	D-V6-419614	(M) Insufficient Data	(4) Workmanship	The technician should have recognized that the protrusions did not conform to the work authorization document.
		(M) Insufficient Data	(4) Workmanship	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
69	P-V6-421530	(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description states that the wrong panel was closed out and photographed, although the work authorization document listed the correct panel.
70	P-V6-421764	(N) No Discrepancy/Explained Condition	(4) Workmanship	The nonconformance description states that foreign object debris was found in the auxiliary power unit, and the nonconformance disposition indicates that the material was not found during pre-flight inspections.
71	D-V6-422583	(2) Design Deficiency/Nonconformance	(4) Workmanship	The nonconformance descriptions support the conclusion that, during blanket fabrication, the snaps were placed so that the blanket could not be attached to the structure of the orbiter. Also, the grounding strip was not fastened.
		(2) Design Deficiency/Nonconformance	(4) Workmanship	
72	D-V6-R127216	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
73	D-V6-R127334	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile gap tolerance was trimmed too close.
74	P-V6-424386	(M) Insufficient Data	(4) Workmanship	The nonconformance description states that a spring was found missing on a needle nose vice grip. This should have been noted during the tool's prior use.
75	D-V6-427862	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
76	P-V6-R113052	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
		(P) Flight Damage	Cannot Make a Determination	
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	
77	D-V6-R113154	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
78	D-V6-R115452	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
79	D-V6-R117247	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. Based on the size of the damage, this is most likely inadvertent technician-induced damage.
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
80	P-V6-390795	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
81	P-V6-R117631	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. Most likely, this damage was technician–induced and occurred while the technician was working in the area.
82	P-V6-392119	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
83	D-V6-R117996	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
84	D-V6-R118118	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
		(P) Flight Damage	Cannot Make a Determination	
85	P-V6-R118359	(U) Unavoidable Damage/Nonconformance	(9) Materials Deficiency/Degradation	The nonconformance description states that foam is lacking the required deflecting qualities.
86	P-V6-393587	(T) Operational Degradation/Wear Out	(D) Environmental Damage	Environmental damage most likely causes discoloration.
87	P-V6-393752	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
88	D-V6-R119738	(9) Materials Deficiency/Degradation	(4) Workmanship	Most likely, the nonconformance occurred due to a deviation from the accepted process.
89	D-V6-R113093	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
90	D-V6-R113758	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
91	P-V6-381096	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
92	P-V6-R114593	(M) Insufficient Data	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
93	D-V6-R115678	(O) Process Tolerance	(T) Operational Degradation/Wear Out	Process Tolerance usually applies to new tile. This appears to be an existing tile and, therefore, the nonconformance was more likely caused by Operational Degradation.
94	P-V6-389811	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description supports the conclusion that, most likely, a technician applied force which caused the noted damage.
		(T) Operational Degradation/Wear Out	(4) Workmanship	
95	D-V6-R117263	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
96	P-V6-390898	(T) Operational Degradation/Wear Out	(T) Operational Degradation/Wear Out	Not applicable.
		(S) Interference Physical/Electronic	Cannot Make a Determination	Insufficient description to determine cause.
		(T) Operational Degradation/Wear Out	(T) Operational Degradation/Wear Out	Not applicable.
97	P-V6-391638	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance disposition supports the conclusion that the nonconformance occurred due to the improper application of coating material.
		(M) Insufficient Data	(4) Workmanship	The nonconformance disposition states that the damage was most likely due to a spinning drill bit.
		(M) Insufficient Data	(8) Failure	The nonconformance description states that the item failed to pass inspection criteria.
		(2) Design Deficiency/Nonconformance	(2) Design Deficiency/Nonconformance	Not applicable.
98	D-V6-R117646	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(4) Workmanship	(4) Workmanship	Not applicable.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
99	D-V6-392193	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
100	P-V6-393638	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
101	P-V6-395227	(M) Insufficient Data	(3) Procedural/Work Authorization Error	The nonconformance disposition states that the nonconformance was caused by erroneous drawing and installation procedures.
102	P-V6-396550	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
103	P-V6-396712	(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, the grommet was torn in a remove–and-replace effort.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
104	P-V6-396874	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
105	D-V6-R113156	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
106	P-V6-380607	(T) Operational Degradation/Wear Out	(2) Design Deficiency/Nonconformance	The nonconformance disposition states that this is "a second occurrence." Therefore, this should most likely be reported as a Design Deficiency due to the design material's inability to sustain operation without cracking or deforming.
107	D-V6-R114038	(T) Operational Degradation/Wear Out	(T) Operational Degradation/Wear Out	Not applicable.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(M) Insufficient Data	(4) Workmanship	Most likely, the technician did not follow procedures, causing the tile to come off during tape removal.
		(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description states that the tile was processed incorrectly.
108	D-V6-R115337	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
109	D-V6-R117225	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
110	P-V6-391056	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance disposition supports the conclusion that, most likely, the conductor was compressed during installation.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
111	P-V6-390684-A	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
112	P-V6-392912	(M) Insufficient Data	(4) Workmanship	Most likely, damage occurred due to mishandling.
113	P-V6-393506	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
114	D-V6-R118461	(P) Flight Damage	(P) Flight Damage	Not applicable.
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. Most likely, gap filler was destroyed during a procedure on another tile.
115	P-V6-394360	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
116	D-V6-R119658	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
117	P-V6-396751	(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, this item was stripped by accident, not operational use.
		(T) Operational Degradation/Wear Out	(4) Workmanship	Damaged connector most likely indicates a Workmanship issue.
		(4) Workmanship	(4) Workmanship	Not applicable.
118	D-V6-R120179	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
119	D-V6-R120784	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
		(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
120	D-V6-R120966	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
121	P-V6-401573	(T) Operational Degradation/Wear Out	(4) Workmanship	It is possible for wiring to loosen; however, it is unlikely without an outside force acting against it.
		(T) Operational Degradation/Wear Out	(4) Workmanship	
122	P-V6-R121470	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description states that the tile was improperly labeled.
123	P-V6-403442	(S) Interference Physical/Electronic	(4) Workmanship	Interference would most likely result from incorrect installation.
		(S) Interference Physical/Electronic	(2) Design Deficiency/Nonconformance	The nonconformance description states that the duct did not fit. The nonconformance disposition states that a "best-fit" engineering evaluation was performed, and the parts were re-engineered to fit, indicating that the design was incorrect.
124	D-V6-R122339	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
125	D-V6-R122417	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	
126	P-V6-405308	(S) Interference Physical/Electronic	(3) Procedural/Work Authorization Error	The nonconformance description and disposition state that the work authorizing document called for the use of the wrong sized screws.
127	D-V6-R122735	(O) Process Tolerance	(4) Workmanship	Size of damage indicates that this is most likely a Workmanship error.
128	P-V6-405998	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description and disposition state that the convoluted tubing was crushed. Most likely, a technician crushed it or caused it to be crushed.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
129	P-V6-406355	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
		(T) Operational Degradation/Wear Out	Cannot Make a Determination	
130	P-V6-406675	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
131	P-V6-407960	(M) Insufficient Data	(4) Workmanship	The nonconformance description and disposition state that the stud was bonded to the wrong location.
132	P-V6-409032	(D) Environmental Damage	(D) Environmental Damage	Not applicable.
		(D) Environmental Damage	(D) Environmental Damage	
		(D) Environmental Damage	(D) Environmental Damage	
		(D) Environmental Damage	(D) Environmental Damage	
		(D) Environmental Damage	(D) Environmental Damage	
		(M) Insufficient Data	(4) Workmanship	The nonconformance description and disposition state that the rub strip was 0.200" too long, preventing proper installation. Most likely, this is a Workmanship issue because the rub strip was not cut to the proper length.
		(M) Insufficient Data	Cannot Make a Determination	Insufficient description to determine cause.
		(M) Insufficient Data	Cannot Make a Determination	
133	D-V6-414805	(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, the physical damage to the fastener was caused by a technician working in the area.
134	P-V6-415890-A	(2) Design Deficiency/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
135	P-V6-416354	(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, the bolt was damaged by technician on installation or removal.
136	D-V1-011308	(L) Unexplained Anomaly	(4) Workmanship	The nonconformance description states that the thermal control system blanket incurred damage. Most likely, the damage occurred when someone came in contact with the blanket or something was dropped on the blanket.
137	P-V6-R125846	(O) Process Tolerance	(4) Workmanship	Most likely, the tile was incorrectly fabricated.
		(O) Process Tolerance	(4) Workmanship	
		(O) Process Tolerance	(4) Workmanship	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
138	D-V6-R126199	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	The size of the damage indicates that this is most likely technician-induced damage and probably was avoidable.
139	D-V6-421479	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description states that numerous screws had no thread protrusions. This should have been noticed by technician.
140	D-V6-R126580	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	Most likely, the damage was avoidable and was the result of gap filler being incorrectly installed.
141	P-V6-419537-A	(8) Failure	Cannot Make a Determination	Insufficient description to determine cause.
142	D-V6-423493	(M) Insufficient Data	(4) Workmanship	A raised scratch in the metal mating surface would most likely be caused by a technician working in the area.
143	D-V6-R127256	(O) Process Tolerance	(4) Workmanship	If the recessions are not within specifications, the nonconformance would most likely be caused by improper Workmanship.
		(O) Process Tolerance	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	Not applicable.
		(4) Workmanship	(4) Workmanship	
144	P-V6-425480	(A) Vendor Responsibility	Cannot Make a Determination	Insufficient description to determine cause.
145	D-V6-R128361	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
146	P-V6-R113864	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
		(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	The nonconformance disposition supports the conclusion that the tile was not processed correctly.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(M) Insufficient Data	(P) Flight Damage	White spots most likely indicate heat damage from flight.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(O) Process Tolerance	(4) Workmanship	

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
147	P-V6-R114386	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description and disposition state that the tile re-waterproofing gun(s) was used in the improper configuration.
148	P-V6-385186	(T) Operational Degradation/Wear Out	(4) Workmanship	Most likely, the threads were damaged due to misuse.
149	D-V6-R115445	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
150	P-V6-389000	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the material properties of its insulation and not due to operational use.
151	P-V6-390570	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
		(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	
152	D-V6-R117666	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
		(O) Process Tolerance	Cannot Make a Determination	
153	D-V6-R117959	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
154	D-V6-R118114	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description states that three threads were not showing as required. Additionally, an outside force or improper tension was most likely applied to break the threads.
155	D-V6-393939	(T) Operational Degradation/Wear Out	(4) Workmanship	Since ground lugs do not have moving parts, the reported damage was most likely caused by a technician working in the area.
		(T) Operational Degradation/Wear Out	(4) Workmanship	
156	P-V6-394374	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
157	P-V6-396499	(2) Design Deficiency/Nonconformance	(4) Workmanship	The nonconformance description and disposition support the conclusion that the required parts were not installed.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
158	D-V6-R119764	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
		(4) Workmanship	(4) Workmanship	Not applicable.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault, which supports the assumption that an error was made while hand trimming.
		(4) Workmanship	(4) Workmanship	Not Applicable.
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
		(8) Failure	(4) Workmanship	It seems that the tile was not processed correctly by technicians.
		(8) Failure	(8) Failure	Not Applicable.
		(8) Failure	(8) Failure	
159	P-V6-396913	(N) No Discrepancy/Explained Condition	(4) Workmanship	The nonconformance descriptions state that the nonconformance occurred because equipment was not used in accordance with specification.
		(N) No Discrepancy/Explained Condition	(4) Workmanship	
160	D-V6-398032	(8) Failure	(4) Workmanship	The nonconformance description supports the conclusion that the screws were not installed per specification.
		(8) Failure	(4) Workmanship	
161	P-V6-398561	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
162	P-V6-R120430	(U) Unavoidable Damage/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
163	P-V6-399928	(M) Insufficient Data	(4) Workmanship	Most likely, this is technician-induced damage to the cold plate either on this installation or during the previous work.
164	D-V6-400786	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description states that the preload screw cap was damaged and not properly attached. Most likely, this occurred due to Workmanship.
165	D-V6-R121068	(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
166	P-V6-401342	(2) Design Deficiency/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
167	P-V6-402020	(T) Operational Degradation/Wear Out	(D) Environmental Damage	The nonconformance disposition indicates a corrosion problem, which should be report as Environmental Damage.
		(T) Operational Degradation/Wear Out	(D) Environmental Damage	
		(T) Operational Degradation/Wear Out	(T) Operational Degradation	Not Applicable.
168	D-V6-R121997	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that the damage was unavoidable. The location of the damage indicates that it most likely occurred due to technician contact.
169	D-V6-R122216	(P) Flight Damage	Cannot Make a Determination	Insufficient description to determine cause.
		(O) Process Tolerance	(4) Workmanship	The nonconformance description supports the conclusion that the tile was constructed incorrectly. There is no indication that the milling machine was at fault. Therefore, the error was most likely the result of the hand trimming process.
170	D-V6-R122666	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that the damage was unavoidable. The location of the damage indicates that it most likely occurred due to technician contact.
171	P-V6-405900	(2) Design Deficiency/Nonconformance	Cannot Make a Determination	Insufficient description to determine cause.
172	D-V6-R123001	(U) Unavoidable Damage/Nonconformance	(4) Workmanship	There is no data in the nonconformance report to indicate that damage was unavoidable. The location of the damage indicates that it most likely occurred due to technician contact.
173	P-V6-R123195	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
		(O) Process Tolerance	Cannot Make a Determination	
		(O) Process Tolerance	Cannot Make a Determination	
		(O) Process Tolerance	Cannot Make a Determination	
174	P-V6-408805	(A) Vendor Responsibility	(4) Workmanship	The nonconformance description states that the blanket was not installed. Since blankets are fabricated on site, this is most likely a Workmanship issue.
175	D-V6-411023	(M) Insufficient Data	(4) Workmanship	The nonconformance description supports the conclusion that the nose cap was not produced in accordance with specifications.
176	P-V6-415860	(T) Operational Degradation/Wear Out	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.

No.	PRACA Report Number	Reported Cause Code	Most Likely Cause Code	OIG Rationale
177	P-V6-417967	(C) Contamination	(D) Environmental Damage	The nonconformance description states that the damage was caused by exposure to rain.
		(2) Design Deficiency/Nonconformance	(2) Design Deficiency/Nonconformance	Not applicable.
178	P-V6-418113	(M) Insufficient Data	(4) Workmanship	The nonconformance description supports the conclusion that the technician either dropped a trunnion barrel or caused it to drop.
179	P-V6-421407	(9) Materials Deficiency/Degradation	(9) Materials Deficiency/Degradation	Not applicable.
		(9) Materials Deficiency/Degradation	(9) Materials Deficiency/Degradation	
		(N) No Discrepancy/Explained Condition	(9) Materials Deficiency/Degradation	Damage to Kapton-insulated wiring is normally the result of the insulation's material properties and not due to operational use.
		(4) Workmanship	(4) Workmanship	Not applicable.
		(4) Workmanship	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	
		(4) Workmanship	(4) Workmanship	
180	P-V6-421733	(S) Interference Physical/Electronic	(3) Procedural/Work Authorization Error	The nonconformance disposition states that the required spacer and bolt could not be installed due to interference with adjacent fitting. The procedure should call for a spacer and bolt size that will allow for installation.
		(S) Interference Physical/Electronic	Cannot Make a Determination	Insufficient description to determine cause.
181	D-V6-R127110	(O) Process Tolerance	(4) Workmanship	The nonconformance descriptions state that this damage was to a previously repaired area, indicating the repair was most likely not performed correctly.
		(U) Unavoidable Damage/Nonconformance	(4) Workmanship	
182	D-V6-R127181	(T) Operational Degradation/Wear Out	Cannot Make a Determination	Insufficient description to determine cause.
183	D-V6-R127731	(O) Process Tolerance	Cannot Make a Determination	Insufficient description to determine cause.
184	P-V6-426847	(1) Console Operator Error	(4) Workmanship	The nonconformance description and disposition state that hydraulic fluid was inadvertently sprayed on the engine nozzles.
185	D-V6-427473	(3) Procedural/Work Authorization Error	(4) Workmanship	The nonconformance description states that tape was not applied in accordance with specification.
186	P-V6-429918	(T) Operational Degradation/Wear Out	(4) Workmanship	The nonconformance description and disposition state that the washer was not installed.

INSUFFICIENT NONCONFORMANCE DESCRIPTIONS

Of the 340 STS-114 nonconformance reports reviewed, 138 had an insufficient nonconformance description for at least one reported line item. We relied on the engineering expertise and judgment of the NASA OIG Aerospace Technologist to determine whether nonconformance descriptions were sufficient. For each line item on the 138 nonconformance reports shown below, we assessed the nonconformance description (shown verbatim) as recorded on the official PRACA report and determined whether there was sufficient technical data to permit a clear understanding of the nonconformance, support the cited cause, or serve as an adequate historical record.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
1	P-V6-R120083	Tile did not reach minimum load required during bond verification. Loadpulled = 188.2 (S/B 237 min. to 249 max).	The nonconformance description and disposition sections of the report have conflicting information. The description section states that the tile did not pass the bond verification; while the disposition says that the work was approved for use "as is."
2	P-V6-398934	Wire 3H1001G24 has excessive length due to wire separation and needs to be re-terminated at 30P858 X=526 Y=-30 Z=478.	The nonconformance description should state what process was used.
3	D-V6-R120506	Ames gap fillers were removed from sides No. 2 and No. 4 due to removal of the adjacent tile.	The nonconformance description should specify the tile location or gap filler in the nonconformance description.
4	P-V6-401164	Panel 05 (V070-730388-006) appears to have a loose wicket.	The nonconformance description does not give adequate information about the nonconformance.
5	P-V6-401292	Wire P427C20 has a clamshell repair that has deteriorated approx. 10" from connector 50P792. Location: X=1420 Y=52 Z=360 damage is between GOX flow control valave and wire tray. Red tag attached.	Description considered sufficient.
		Wire P427C20 has conductor damage approx 6-8 inches inboard of the R/H side of the wire tray red tags attached X=1420, Y=+75, Z=360.	The nonconformance description does not give adequate information about the nonconformance.
		Wire 1P723B20 has multiple radial cracks with damaged kapton and exposed conductor damage is between 1st clamp and connector X=1420 Y=75 Z=360	Description considered sufficient.
		During insertion of wire 1P723B20 into 50P792 it was discovered that termination point 1 has a tear in the grommet X=1420 Y=75 Z=360.	The nonconformance description does not give adequate information about the nonconformance.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
6	P-V6-401689	Wire 3F254BB22-2 has damaged conductor. Location X=420 Y=-45 Z=360 L/H side of wire tray. Red tag attached.	The nonconformance description does not give adequate information about the nonconformance.
7	D-V6-R121971	Leading edge tile has the following IML damage on S-2.25L X .2W X .2D.	The nonconformance description does not give adequate information about the nonconformance.
8	D-V6-R122148	Ames along S-4 is damaged.	The nonconformance description is not sufficient to determine a cause, and should specify the tile location or gap filler in the nonconformance description.
9	D-V6-R122475	Above noted tile was contaminated with epoxy resin during a BV load test Tile also has damage that is 1.65L X .65X X.4D from the result of the epoxy.	Description considered sufficient.
		N/C pattern for above noted cavity does not fit.	The nonconformance description should better describe how the tile does not fit.
10	D-V6-R123083	Tile is a no fit.	The nonconformance description should better describe how the tile is a no fit.
11	P-V6-360838-A	Original locking feature has been used once and removed from the fastener. Locking feature (insert) needs to be replaced.	The nonconformance description is not sufficient to determine a cause, and should state why the locking feature was removed.
12	P-V6-411456	Lower inboard clevis is slightly undersized. Clevis minimum diameter: 0.3740.	The nonconformance description states that the clevis is undersized but does not state what size it is or what the nonconformance was that led to replacing the clevis.
13	P-V6-412088	After removal of crushed convoluted tubbing. it was determined that there were multiple locations of deformed/damaged coaxial cable approximate locations: X=970 Y= 24, 30, 34 Z= 230 Red tag attached No damage found	The nonconformance description is not sufficient to determine a cause.
14	D-V6-415728	During final installation of the boots five screws on each boot on the left and right are not correct per print. Five MD112-3003-0408 screws on V070-333889-012 S/N AU 4308 need to be reinstalled per print. Five MD112-3003-0408 screws on V070-333889-012 S/N AU4309 need to be reinstalled per print.	The nonconformance description should provide more detail to explain why the screws were not to print.
15	P-V6-412818-A	Transducer has broken wire shielding at wire/transducer interface. No further damage noted. Note: Wire cut short per DEV T/04 SETP 20-6.1. See Copy.	The nonconformance description does not justify reported cause code. Additionally, the description should specify which transducer and wire.
16	D-V6-R125154	Tile failed PST test at minimum bond pressure.	The nonconformance description should identify the minimum bond pressure as well as the pressure at which the tile failed.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
17	D-V6-R125519	Above noted door has filler bar debonds.	The nonconformance description is not sufficient to determine a cause, and should explain the amount of debonded material.
18	D-V6-R126733	Tile has IML damage of .300X.300X.250 on S-5.	The nonconformance description is not sufficient to determine a cause.
19	P-V6-R126994	T/B Part No. V070-398819-029 in above assy has broken loop stitches.	The nonconformance description is not sufficient to determine a cause and does not give adequate information about the nature of the damage.
		T/B Part No. V070-398818-012 in above assy has broken loop stitches.	
20	D-V6-R127296	New damage measuring .8INL X .3WIN X .1D adjacent to existing P-311 measuring 3.1L X 2.2W with maximum known repair depth of .08IN	The nonconformance description is not sufficient to determine a cause.
		.3INL X .2INW X .04IND.	
21	D-V6-R127651	The above noted tile has an out of tolerance step of +.090 to the V070-395006-545.	Description considered sufficient.
		Unable to verify Step 20-3 Step .090 -S/B .060.	The nonconformance description does not give adequate information about the nonconformance.
22	D-V6-424855	100 ft ground cable 79K14446-23 attached to pigtail ground on aft skirt and routs to forward grain velostate has 3 ea areas of damage, frayed wiring and corrosion S/B no damade or corrosion.	The nonconformance description is not sufficient to determine a cause.
23	P-V6-426714	Stable aft GHE concentration is reading 12200 PPM (S/B 12000 PPM) After initiating ORB/ET LH2 disconnect cavaity purge NASA: M. Vinjeph G1/1-3874.	The nonconformance description is not sufficient to determine a cause.
24	P-V6-R120167	Repair exceeded depth limitation on 211 repair	The nonconformance description should also provide data on the minimum depth limit and proper specification.
25	P-V6-R120439	Above noted tile does not permit proper fabrication adjacent - 355 tile.	The nonconformance description should explain why the tile will not permit fabrication of the adjacent tile.
		NC pattern is no-fit.	The nonconformance description is not sufficient to determine a cause and should better describe how the tile is a no fit.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
		O/T gap of 30 exists at 391036-354/391036-309 intersection. Gap S/B 35. Reference attached P-310, Item 2.	Description considered sufficient.
26	P-V6-399693	Unable to install connector backshell NB-RFI-22-5 on wire harness V070-775069-001 due to solder sleeve buildup (solder sleeves not staggered).	The nonconformance description does not give adequate information about the nonconformance. It is unclear whether the solder sleeve build-up or solder sleeve stagger is the issue.
		Connector 50P511 has torn grommet P/N (NB6GE22-55SYT).	The nonconformance description does not justify the reported cause code.
27	P-V6-399206-B	Polyimide seal set is damaged at YW384.V070-198546-002.	The nonconformance description is not sufficient to determine a cause and should indicate the type of damage incurred.
28	P-V6-400069-A	Excessive corrosion and rework damage.	The nonconformance description should better describe the type of damage or corrosion present.
29	P-V6-R122049	Item 4 of MDR MRWNG-3-J3-5351 is being obstructed by the V070-198955-009 therm assy.	The nonconformance description is not sufficient to determine a cause and should indicate the type of obstruction.
		Above noted tile has damage 0.9L X 0.2W X 0.060L Ref. MR WNG-3-J3-5351.	The nonconformance description is not sufficient to determine a cause.
30	P-V6-404153	While working RTOMI V9045/3-102003-06 heat blanket burned out vacuum bag burned through lost bond. Clip 2-4 L/H Bay 4.	The nonconformance description is not sufficient to determine a cause.
31	D-V6-R122412	The above noted tile has an under tolerance gap on Side 2. R/H side.	The nonconformance description should specify what the gap is and what it should be.
		Unable to achieve IML mismatch during prefit per Step 5.4.5 of TPS 221 above noted tile. Noted tile did not pass Burke impression.	Description considered sufficient.
32	D-V6-R122731	Damage is 1.3L X 0.8W X 0.15D. Tile has previous damage adjacent to current damage. (3.1L X .3W).	The nonconformance description is not sufficient to determine a cause.
		While working pg. 10-1, step 10-1 technician inadvertently worked item as a detailed step not initiating a PCR for process TPS-330. Technician also did not hold 092 certification required for TPS-330.	Description considered sufficient.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
33	P-V6-405822	Wire harness has too small a bend radius.	The nonconformance description should specify the nonconformance bend radius, along with the value of the required bend radius.
		Unknown wire has too small of a bend radius. X=408 Y=-44 Z=389. Location FWDAV Bay 1 Shelf 1A, Portside near side wall. Red tag attached.	
34	P-V6-406308	Hole number 1 has a ding at the edge of the hole "length =.1022 width =.0268 radius =.0401	The nonconformance description is not sufficient to determine a cause.
		Hole number 2 has thread marks depth = 0.0032 width =.0089 radius =.0030	
		Hole number 4 has thread marks depth = 0.0030 width = .0285 radius = .0057	
		Hole number 6 has thread marks depth = 0.0031 width =.0124 radius =.0056 calibration number Y31228.QC note see attached drawing for location of hole numbers.	
35	P-V6-R123346	N/C pattern for the above noted cavity is a "No Fit."	The nonconformance description should better describe how the tile is a no fit.
		Tile is a not fit.	
		Fastener MD112-1002-0305 used to install the V070-390439-001 carrier panel is too long. Note: Cannot go down one grip length per MA0101-301 specification.	Description considered sufficient.
		Unable to install FRSI plugs (MD263-0009-0001) per Step 15-13 on RSI-3-31-344 screw holes are .480 and plugs are .750 Note: see EOC05.	The nonconformance description should explain how the hole sizes were out of tolerance.
36	I-V6-410484	C&T does not have D/L frame sync lock NASA Rogers 1-3854.	The nonconformance description should have more information on what frame sync failed to lock.
37	P-V6-R124052	O/T gap of 90 exists at 395003-017/LATCH.	The nonconformance description should specify the required gap.
38	P-V6-411779	Seam interferes with spar insulator installation	The nonconformance description should state how the seam interferes with the insulator.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
39	P-V6-414552-A	All 8 solder sleeves associated with harness V070-774022-003 failed to conform to ML O303-0032.	The nonconformance description is not sufficient to determine a cause and should state how the solder sleeves failed to conform to the specification. Additionally, there is not enough information to determine the cause.
40	P-V6-409812-A	Suspect leak at System 2 return line P/N V070-586085-006.	The nonconformance description is not sufficient to determine a cause and should state why a leak is suspected.
41	P-V6-416520	Appears to be excessive play between the V070-340831-001 ring fitting and bolts, allowing MPS Helium Tank 40VV41TK10 to rotate excessively. Location Bay 10LH.	The nonconformance description should state the specification for play tolerance.
		Tank B Nut appears to be safety wired incorrectly around MD111-4024-0417 Bolt.	Description considered sufficient.
42	D-V6-419614	Four clamp screws securing coax cable do not have thread protrusion.	The nonconformance description should state the specification that was not met.
		Harness service loop not routed through clamps and is tied to coax cable without. Teflon tape protection. X=576 Y=-40 Z=380 Note: Discrepancies are located on the L/H side of the 576 bulkhead Red tags attach.	Description considered sufficient.
43	P-V6-421764	½IN. Long piece of unknown material found stuck up inside recessed pocket of APU No. 1.	The nonconformance description should provide the location of the pocket. It should also be noted that this was a foreign object debris issue.
44	M-V6-R127030	Page 1917 – Tile damage .230X.100X.040.	The nonconformance description should indicate the side or area of the tile where damage occurred.
45	D-V6-R127216	Tile has IML damage .650L X .5W X .2D.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
46	P-V6-424386	During inventory of tool box a spring was found missing on the above noted tool.	The nonconformance description should state when the spring was last known to be in place and its approximate location at that time.
47	P-V6-425037	Recorded Bay 10 Keel Gap is out of allowable tolerance.	The nonconformance description should state what the allowable tolerance is as well as what the indications are that tells them the gap is out of tolerance.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
48	D-V6-427862	During TCS blanket installation – one of four socket (lower left) needs replacement.	The nonconformance description is not sufficient to determine a cause.
49	P-V6-430069	Pad B compressed air primary indication is erratic.	The nonconformance description should indicate what is erratic about the display.
50	D-V6-R112979	The G/F noted is Prot. Ref Tile V070-396366-163/155/112/113/082/079.	The nonconformance description does not give adequate information about the nonconformance.
51	P-V6-R113052	The tile noted has a previous 330 repair over tempt 1.0L X .65W X X.125D.	The nonconformance description is not sufficient to determine a cause.
		Damage on C2 .5L X .35W X .2D Note: Combined with damage on page 1 (C3) total filler volume .180 cubic inches.	
		O/T gap of 104 exists at 199726-062 and T-seal S/B 86 max (reference P310 1).	The nonconformance description does not support the reported cause.
		O/T gap of 119 exists at 199726-062 and RCC S/B 86 max reference P-310 No. 2.	
52	D-V6-R113154	G/F recessed .20 Ref Tiles 395034-110/ 395033-212,-110/213,-111/213,-111/185.	The nonconformance description is not sufficient to determine a cause.
53	P-V6-385402	Bearing froze up at location 8 on lefthand 4 Radiator.	Nonconformance description states that the item "froze" indicating a temperature problem. The description should say "seized" and give a better description of the bearing condition.
54	D-V6-R115452	Above noted tile (in Box 6) is degraded beyond acceptable limits of ML0601-0002.	The nonconformance description is not sufficient to determine a cause and should describe the type or size of damage and the acceptable limits.
55	P-V6-R117631	Macor support is cracked on outboard end of upper split line T/B. Note: T/B is debonded to Macor support.	The nonconformance description does not give adequate information about the nonconformance to support the reported cause code.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
56	D-V6-R117996	IML damage L.9 X W.100 X D.200 Note: F/B is bonded to tile on side with noted damage.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
57	D-V6-R118118	Tile has IML damage on E-5 L.400 X W.200 X D.160.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
		Tile has damage on side wall adjacent to IML damage L.400 X W.300 X D.150.	
58	P-V6-R118359	Cannot fabricate the pressure pad for above noted tile. MPP106M319M25 requires .080 deflection between 2 & 3 PSI. Current foam in stock does not meet this requirement.	The nonconformance description should describe the deflection of the foam and the psi value achieved.
59	P-V6-393587	Above blanket is discolored. Ref. V30609 Attn. Boeing.	The nonconformance description should describe the discoloration and its cause.
60	P-V6-R112873	Tile OML damage approx. .200" X .080" X .060" tile .66" thick.	The nonconformance description should indicate the side or area of the tile where damage occurred.
		Tile OML damage approx. .125" X .100 X .060.	
61	D-V6-R113033	Ames gap filler protrudes. 394033-234 to -339.	The nonconformance description should indicate the side or area of the tile where damage occurred.
62	D-V6-R113093	Tile has degraded P207 on S-1.	The nonconformance description should indicate the side or area of the tile where damage occurred.
63	D-V6-R113758	Screed filet seal on FWD end degraded.(L-18).	The nonconformance description is not sufficient to determine a cause and should describe the condition of the seal (for example cracking, split, etc.).

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
64	P-V6-381096	The minimum running torque could not be achieved for 2 of 4 (FWD PORT and STBD) fasteners securing the port ceiling pallet (Ref V070-337808 ANDM072-660008).	The nonconformance description is not sufficient to determine a cause and should state why the minimum torque could not be achieved and if thread damage occurred or was noticed. The description should also indicate what values were achieved.
65	D-V6-R115678	Tile has excessive movement in cavity.	The nonconformance description should better describe the tile movement.
66	D-V6-R117263	Above noted tile (Box 6) is degraded beyond limits of ML0601-0002.	The nonconformance description should state what limit has been exceeded and explain the extent of the damage.
67	P-V6-390898	LT-80 tape is debonded on inner sides of panel. Suspect corrosion under and around taped areas. Note: inspection per OMI V6045 revealed "no corrosion."	Description considered sufficient.
		Unable to maintain ¼ inch overlap of LT-80 tape around ID plate on RH FRONT spar.	The nonconformance description is not sufficient to determine a cause and should explain why the overlap cannot be maintained.
		Several locations require koropon touch up prior to tape application.	Description considered sufficient.
68	D-V6-392193	The following locations noted on continuation sheet have bad nut plates Note: This DR covers spar fittings less carrier panel attach points 9, 10, 11, and 12 See continuation sheet for locations.	The nonconformance description is not sufficient to determine a cause and should describe why the nut plates are "bad."
		Left Hand 9 Upper Outbd Fwd (Anchor).	
		Left Hand 9 Upper Inbd Fwd.	
		Left Hand 9 Lower Inbd.	
		Left Hand 9 Lower Outbd (Anchor).	
		Left Hand 10 Upper Inbd Fwd.	
		Left Hand 10 Lower Outbd (Anchor).	
		Left Hand 11 Upper Inbd Fwd.	
		Left hand 11 Upper Inbd Aft.	
		Left Hand 11 Upper Outbd Fwd (Anchor).	
		Left Hand 11 Upper Outbd Aft (Anchor).	
		Left Hand 11 Lower Inbd.	

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
		Left Hand 11 Lower Outbd (Anchor).	
		Left Hand 12 Upper Inbd Aft.	
		Left Hand 12 Upper Outbd Fwd (Anchor).	
		Left Hand 12 Lower Inbd.	
69	P-V6-393638	Above blanket is damaged beyond repair Ref V34249.	The nonconformance description should include details about the damage and why it is beyond repair.
70	P-V6-395227	V070-794302 EOF25 SH4 shows routing of new wires in W86H02, Run 6 exist-ing W/T through the first clamp at XO750. They should exit at third clamp.	The nonconformance description should specify whether the routing was performed to specification.
71	P-V6-396550	KB3913 braze failed visual inspection, MD273-0029-1228 tee to V070 6345 10-039 tube.	The nonconformance description is not sufficient to determine a cause and should state how the braze failed visual inspection.
72	P-V6-378530	Seal is torn at connector location 50P523 Note: Seal located in Aft shop OPF2.	The nonconformance description does not give adequate information about the nonconformance.
73	D-V6-R113156	Noted G/F end is compressed no longer fills gap .40L .030 Gap Ref tile 395033-209/-210.	The nonconformance description is not sufficient to determine a cause.
74	P-V6-380607	Fastener hole cracked to edge of panel.	The nonconformance description does not give adequate information about the nonconformance.
75	D-V6-R114038	The above noted tile in Block 6 has degraded or potential to degrade theP368 repair during flight. This DR is being generated from restricted WAS TLP01-A0035. End Note: Tile is to be removed and replaced.	The nonconformance description does not give adequate information about the nonconformance.
		Replacement tile is a no-fit.	The nonconformance description should better describe how the tile is a no fit.
		During preparation for second attempt of bond verification on tile V070-396171-249, entire OML coating came off during OML tape removal. First pull of 90.0 lb record.	Descriptions considered sufficient.
		The V070-396171-249 tile was processed as a TPS-203 when it should have been processed as a P-317.	
76	D-V6-R115337	IML damage on S4 1.3X.45X.250.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
		The 395055-094 tile on S-3 extends into the -205 cavity of the same array.	Description considered sufficient.
77	D-V6-R117225	IML damage .400 L X .200 W X .060 D.	The nonconformance description is not sufficient to determine a cause and does not give adequate information about the nonconformances. Should indicate the side or area of the tiles where damage occurred.
		IML damage .800 L X .200 W X .060 D.	
78	P-V6-391746	Blanket worn beyond repair.	The nonconformance description should explain why damage is unrepairable.
79	P-V6-390684-A	Antenna cover (V070-310276-006) surface is damaged.	The nonconformance description is not sufficient to determine a cause and should list the type and location of damage.
80	P-V6-393506	Above blanket is damaged beyond repair Ref. V10049.	The nonconformance description is not sufficient to determine a cause.
81	D-V6-R119658	The above noted tile has IML damage .5 X .16 X .2.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
82	P-V6-396751	On connector 56V77W1P13 backshell set screw is stripped. Unable to tighten or loosen set screw. X = 1355, Y = 15, Z = 295.	Description considered sufficient.
		Connector 56P13 has damaged insertion slot No. 52 X = 1355 Y = 15 Z = 295.	Damaged connector most likely indicates a Workmanship issue.
		The following wires have excessive gap between the insulation and the crimp per spec for connector 56P13 - M13C26, 2B160C26, 2B162C26, M12C26, 4F210A26, 4F15A26 X = 1355 Y = 15 Z = 295.	Description considered sufficient.
83	D-V6-R120179	Above noted tile has IML damage that is, .400 L X .150 W X .200 D	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
84	D-V6-R120784	IML damage; located at Side 2 and 3 dimensions of damage L-8.500"W-.400"D-.150"	The nonconformance description is not sufficient to determine a cause.
		Sidewall of Side No. 2 which was a shave has a degraded area approx L-1.9 X W-.900 X D-.090.	The nonconformance description is not sufficient to determine a cause and should indicate the side or area of the tile where damage occurred.
		Section of RTV repair missing approx L 1.0 X W.500 X D.090.	The nonconformance description is not sufficient to determine a cause.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
		IML gap to L.E. elevon carrier panel is too small, preventing the installation of design pillow gap filler.	Description considered sufficient.
85	D-V6-R120966	NC pattern for the above noted cavity is a no-fit.	The nonconformance description should better describe how the tile is a no fit.
86	P-V6-R121470	NC pattern for the above noted cavity is a no-fit.	The nonconformance description should better describe how the tile is a no fit.
		The V070-395010-259 tile is ID as TPS-203 B. should be ID as P-317.	Description considered sufficient.
87	P-V6-403174	3/8 inch crack present at MR STR-3-15-4087 location of previous repair.	The nonconformance description should state what work authorization document was used for the previous repair and if the repair and current nonconformance are related.
88	P-V6-403442	The V070-339281-001 duct support does not align with the V070-613781-008 duct installation.	The nonconformance description should describe how the support does not align.
		Step 20-3 Page 20-5 will locate match drilled holes in or very close to the V070-333429-001 strut web radius. Note: Per Boeing, new hole will not enter radius. Not constraint to proceed EPR tie-in with STR Manager.	Description considered sufficient.
89	D-V6-R122417	The above noted tile has an under tolerance gap on Side 2. R/H side.	The nonconformance description should state the minimum gap tolerance and what the current tolerance is.
		During prefit per Step 5.4.5 of TPS 221 above noted tile did not pass Burke impression.	Description considered sufficient.
90	D-V6-R122735	Damage 1.1 W X 1.0 L X .4 D, MFWD-3-31-7278 upgraded to DR.	The nonconformance description should indicate the side or area of the tile where damage occurred.
91	P-V6-406355	Hole No. 1 has thread marks depth = .01360 width = .0217 radius = .0033.	The nonconformance descriptions should describe the appropriate specifications.
		Hole No. 1 is also elongated. Hole is 0.3128 X 0.3196.	
		Hole No. 3 has thread marks depth = 0.0020 width = .0095 radius = .0052.	
		Hole No. 3 is also elongated. Hole is 0.2574 X 0.2593 (calibration number Y31228) QC Note: See attached drawing for location of hole numbers.	

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
92	P-V6-406675	Vent screen crushed/deteriorated. L/H Number 3 Outboard Lower. Red tag attached.	The nonconformance description is not sufficient to determine a cause and should describe how the vent screen was crushed or deteriorated.
93	P-V6-409032	Rub strip has active corrosion at outer edges on bonded side, V070-298114-010, FN 1 (was item 11 of STR-3-A0425).	Descriptions considered sufficient.
		Rub strip has active corrosion at outer edges on bonded side, V070-298114-010, FN 2 (was item 12 of STR-3-A0425).	
		Rub strip has active corrosion at outer edges on bonded side, V070-298114-009, FN 3 (was item 13 of STR-3-A0425).	
		Rub strip has active corrosion at outer edges on bonded side, V070-298114-009, FN 4 (was item 14 of STR-3-A0425).	
		Rub strip has active corrosion at outer edges on bonded side, V070-298114-009, FN 5 (was item 15 of STR-3-A0425).	
		V070-298114-009 (Find Number 5) is to long by .200.	
		During inspection of bond, it was noted that locations 3 and 4 had voids in the bond.	The nonconformance description is not sufficient to determine a cause and should indicate the area of the bond where void exists.
		During further inspection of rub strip it was noted that F/N 5 has a void in the bond line.	The nonconformance description is not sufficient to determine a cause.
94	P-V6-410710	Liner retainer interferes with longeron bridge bay 13 LH.	The nonconformance description should describe how the liner retainer interferes with the bridge bay.
95	P-V6-411295	Insulator screen degraded with insulator material showing.	The nonconformance description should describe the degradation and size of material showing.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
96	P-V6-411956	Supply line elbow V566-454001-106 installed not per print.	The nonconformance description should specify the current configuration of the elbow and the drawing number or specification on how the elbow should be installed.
97	P-V6-412995-A	Internal corrosion.	The nonconformance description should state what type of corrosion was present.
98	P-V6-413892	Number 2 has voids under WB-MICRO-TAU.	The nonconformance description should provide item description.
99	P-V6-415890-A	Incorrect bend on tube on flex hose end.	The nonconformance description is not sufficient to determine a cause and should describe how the flex hose is bent and how it should be bent.
100	P-V6-416591	Right main gear shock assy was pressurized with out of calibration GSE.	The nonconformance description should state that the GSE (ground support equipment) was out of calibration or not calibrated since the date that was listed on the calibration sticker.
101	D-V1-011308	During surveillance, noticed 2 holes greater than .125" in outer layer of TCS blanket. Location YO-46 XO 979.50 Bay 7 LH BWT red tag attached near blanket.	The nonconformance description does not give adequate information about the nonconformance.
102	P-V6-R125846	Above noted tile has interference fit to adjacent spar tiles. (L/H Lower less #4).	The nonconformance description should describe the interference and what is causing it.
		Above noted tile has mislocated SIP.	The nonconformance description should explain how the strain isolation pad was dislocated.
		An out of tolerance gap of 90 exists at the 199706-060 to 199706-062 intersection (S/B no greater than 85).	The nonconformance description does not give adequate information about the nonconformance.
103	D-V6-R126199	Tile has IML damage on E-5 1.0X.25 damage extends under SIP. Ref. C/P V070-395964-011.	The nonconformance description should describe damage in 3-Dimensional terms.
104	P-V6-420719	Battery pack shelf life has expired.	The nonconformance description should state how long the item's shelf life had been expired.
105	D-V6-421479	Inboard half rub seal retaining ring has 2 bolts and numerous screws with no thread protrusion showing.	The nonconformance description should provide thread protrusion dimensions, locations of the screws, and the number of screws lacking protrusion.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
106	D-V6-R126580	Gap filler between above noted tile and V070-391041-056 is breached.	The nonconformance description should better describe how the gap filler is breached.
107	M-V6-R126716	Page 1413 - tile damage .60X.10X.10.	The nonconformance description should indicate the side or area of the tile where damage occurred.
108	P-V6-419537-A	Measurement V51P0371A reads lower limit. S/B greater than 300 PSIA.	The nonconformance description is not sufficient to determine a cause.
109	D-V6-423493	Raised metal scratch on mating surface of MJCA No. 2.	The nonconformance description should state if any perturbations are allowed. The descriptions should also state the size of scratch and what are the consequences of the scratch (for example, not allowing a solid mate with the mating surfaces).
110	P-V6-R127256	O/T recession of -300 exists @ 199742-066/199740-056/T-seal (S/B -200 max).	Descriptions considered sufficient.
		O/T recession of -300 exists @ 199742-006/199740-056/191026-215 (S/B -200 max).	
		Tadpole gap filler suspect bonded to RCC on O/B side of panel.	
		Tadpole gapfiller bonded to spar tile, paper says to tadpole to horse collar.	The nonconformance description should specify the location of the nonconformance.
111	M-V6-R127568	Page 1432 - Tile repair L.200X W .150X D .030	The nonconformance description should indicate the side or area of the tile where damage occurred.
112	P-V6-425480	There is a small area of missing topcoat/possible foam [damage] on the nose cone under the LO2 press line. (For Ref: See PR ET-120-TS-0008) S/B no missing topcoat/foam damage.	The nonconformance description does not give adequate information about the nonconformance.
113	D-V6-R128361	C-7 of the above noted tile has damage. .300 X .300 X .200.	The nonconformance description is not sufficient to determine a cause.
114	I-V6-430307	Cabin blowen dropped of line at 2033 GMT.	The nonconformance description does not give adequate information about the nonconformance.
115	D-V6-	Degraded Ames G/F between the -164/-163 tiles.	The nonconformance description should better describe the nature of the

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
	R113050	Degraded Ames G/F between the -164/-165 tiles.	degradation.
		Filler bar between 193006-164 and 165 tile has Cat 3 charring. Also someF/B appears to be missing.	The nonconformance description should specify the location of missing filler bar, state why is it missing, and describe the condition of the remaining filler bar.
116	P-V6-R113864	Previous OML shave is degrading.	The nonconformance description is not sufficient to determine a cause and should describe the type of degradation (crumbling, draining, charring, etc.).
		Due to previous splash, suspect N.C. data is a no fit.	The nonconformance description should better describe how the tile is a no fit.
		Tile noted above did not pass waveness criteria.	The nonconformance description should specify the criteria for tile waviness.
		Above noted tile has a jog on side 4 which creates a potential flow path.	Descriptions considered sufficient.
		Above noted tile IML exhibits whitespots within filler bar seal zone and is not uniformally grey.	
		O.T Step of +50 exists at 391017-373/-302 S/B +30 max.	
		O.T Step of -57 and O/T gap of 72 exists at 391017-373/-305 S/B -40 max.	
117	D-V6-R115445	Above noted tile (in box 6) is degraded beyond acceptable limits of ML0601-0002.	The nonconformance description is not sufficient to determine a cause.
118	D-V6-R117626	Insert hole is mislocated.	The nonconformance description should state the appropriate specification or drawing number.
119	D-V6-R117666	New damages adjacent to previous damage out of MDR tolerances S-2/E-3 previous damage L 3.3 XW 1.2 XD .125 damage 1 L.200 XW .100 XD .100 damage 2 L .500 XW .300 XD .100.	The nonconformance description is not sufficient to determine a cause.
		Depth of damage and filler volume exceed repair limitations.	
120	P-V6-393573	Above blanket damaged beyond repair Ref-V31504.	The nonconformance description should explain the damage and why it is beyond repair.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
121	D-V6-R119764	Damage on Side 1 L 2.65 X W1.45 X D.030.	The nonconformance description is not sufficient to determine a cause and should better describe the damaged area.
		Damage on Side 1 is not applicable to TPS-277 per the requirements and limitations damage is deeper than 0.30 inch (Approx. 140 inch).	Descriptions considered sufficient.
		Above noted tile has out of tolerance gaps as follows S3 0 gap S5 0 gap at IML S6 80 gap at OML gaps ATR tapered and tile has SIP installed.	
		Above noted tile has been shaved per process 321 and now has O/T resultant gaps as follows: S-5 = 60/80 S-6 = 10 at IML.	
		Above noted tile has been shaved per process TPS-321 and now has O/T gaps as follows. S-6=0.020 at IML and 0.100 at OML.	
		OML coating separated from tile 2.90L X 2.25W X .060 deep during BV.	The nonconformance description should better explain the step where the coating separated.
		Tile did not achieve min load required is 80 lbs S/B 148 lbs to 154.0 lbs. Ref OMI ID MISC-794-0289 MR.	Descriptions considered sufficient.
		OML Coating separated from tile when the tape was removed is 1.4L X .8W X .07D. Eng Update: Total filler volume using a traced mylar pattern of the damage and the CAD SIP area method totals 0.1279 IN 3. IN combination with Item 6, which wsa re-evaluated using the same method, the filler volume equals 0.437 IN 3.	
122	P-V6-R120430	Tiles noted below underhang the structure adjacent to the NLGD. V070-391040-296"0.200 V070-391040-294"0.0200 V070-391040-299 02.00" V070-391040-301 0.250" V070-391042-138 0.200."	The nonconformance description is not sufficient to determine a cause.
123	D-V6-R120817	Above noted tile does not have correct delta lip on S-2.	The nonconformance description does not give adequate information about the nonconformance.
124	D-V6-400786	Preload screw pad cap is damaged and partially detached, S/B crimped over end of preload screw.	The nonconformance description should better explain the damage and detachment.
125	D-V6-R121068	NC pattern for the above noted cavity is a no-fit.	The nonconformance description should better describe how the tile is a no fit.
126	P-V6-401342	Sleeve connecting the right hand tree trunk to IDP No. 4 is kinked.	The nonconformance description is not sufficient to determine a cause.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
127	P-V6-402020	Suspect corrosion on tape of strut.	The nonconformance description does not give adequate information about the nonconformance.
		Suspect corrosion on welds and strut.	
		Broken tape on strut. L/H Number 3 conical seal.	
128	D-V6-R121997	Above tile has an IML damage on S-2.5L X .2W X .2D	The nonconformance description does not give adequate information about the nonconformance.
129	D-V6-R122216	The above noted tile has extensive sidewall and IML damage that exceeds acceptable criteria.	The nonconformance description is not sufficient to determine a cause and should specify the acceptable criteria.
		NC-Patterns is a no-fit.	The nonconformance description should better describe how the tile is a no fit.
130	P-V6-405900	Flex hose to tank D GN2 interface is approx 1 1/2" to 2" too long	The nonconformance description is not sufficient to determine a cause.
131	P-V6-407005	Discrepant temp sensor	The nonconformance description does not give adequate information about the nonconformance.
132	P-V6-R123195	The above noted tile has numerous degraded damages.	The nonconformance description does not give adequate information about the nonconformance.
		O/T gap of 114 exists at 199718-068 and T-Seal S/B 86 max Reference P-310 No. 1.	
		O/T gap of 116 exists at 199718-068 and RCC S/B 86 max Reference P-310 No. 2.	
		O/T gap of 110 exists at 199718-068 and 199720-062 S/B 85 max Reference P-310 No. 3.	
133	P-V6-415224	Blanket cannot be adequately grounded per design.	The nonconformance description should reference the proper design specifications.
134	M-V6-R126570	Page 1402-tile damage.350X.100X.030.	The nonconformance description should indicate the side or area of the tile where damage occurred.
135	P-V6-421733	NAS1057W3-100 spacer and NAS1003-18A bolt are too long and cannot be installed due to interference with spar fitting.	Description considered sufficient.
		Nutplate element attached to V070-190876-001 insulator plug is damaged.	The nonconformance description is not sufficient to determine a cause.

No.	PRACA Report Number	Reported Nonconformance Description	NASA OIG Analysis of Nonconformance Description
136	M-V6-R127024	Page 1422 - Tile damage .2 X .55 X .05.	The nonconformance description does not give adequate information about the nonconformance. Dimensions are confusing and nondescript. The damaged area of the tiles should also be specified.
137	D-V6-R127181	Above noted tile has IML damage on E6 .3L X .2W X .05D.	The nonconformance description does not give adequate information about the nonconformance.
138	D-V6-R127731	Possible flow path exists LW L/H 1.	The nonconformance description is not sufficient to determine a cause and should state why a possible flow path is suspected.

SUMMARY OF PRIOR AUDITS AND ASSESSMENTS

The table below summarizes prior audits and assessments of the SSP PRACA process and system. NASA, contractor officials, and independent groups performed the audits and assessments during the last 6 years.

Report Title and Date	Findings, Recommendations, and NASA Response
SIAT, "Report to Associate Administrator, Office of Space Flight," March 7, 2000	**Findings:** The Team reported that the SSP PRACA system is difficult to use, contains inaccurate, incomplete, and inconsistent data, and lacks adequate data tracking and traceability. Additionally, the Team found trending of data difficult and concluded that critical information could be lost or ignored due to poor reporting requirements and processing procedures. Overall, the Team reported that these deficiencies preclude the system's effective use as a decision support tool. **Recommendations:** The Team made a number of recommendations. The recommendations were intended to clarify the information in the system, verify that the data in the system was reliable, update the reporting requirements, and modernize the system hardware and software. **NASA Response:** NASA performed a statistical sample of the information contained in the PRACA system to check the system for errors. In addition, a review of the program-level requirements was conducted. Finally, NASA stated that the PRACA system was being updated with a Web-based interface to allow for easier access to nonconformance data.

Report Title and Date	Findings, Recommendations, and NASA Response
Human Exploration and Development of Space Independent Assurance Assessment Report, "Orbiter Contractor Furnished Equipment (CFE) Problem Reporting and Corrective Action (PRACA) Requirements Compliance," July 12, 2002	**Findings:** The assessment team reported that USA's contract provides for incentive to minimize workmanship and process escape errors reported at Kennedy. Specifically, the report states that use of the Workmanship cause code or classification of nonconformances as a process escapes "can affect USA's award fee and technician incentive bonus." As a result, the assessment team reported that there are many examples from the Kennedy PRACA data set of the "avoidance of coding that reflects on personnel performance." The assessment team concluded that "there may be some valid explanations of how these discrepancies occur, but suffice to say USA should be provided incentive to accurately code nonconformances." **Recommendations:** The assessment team recommended that the SSP should (1) add award fee criteria to the USA contract to provide incentive to correct and effect accurate coding of nonconformances regardless of cause and (2) assign the responsibility for accurate nonconformance report coding to a group that is periodically audited. The assessment team also recommended that the overall coding of all problem reports and corrective action reports should be subjected to a full audit by Safety, Reliability, and Quality Assurance to correct discrepancies and facilitate analysis and trending functions. Finally, the assessment team recommended that "NASA regain the management of the PRACA system." **NASA Response:** The Orbiter Project Office responded by stating it would review the issue of PRACA coding at Kennedy and the potential of performing additional audits of the coding and reporting process. Also, the Orbiter Project Office stated that it would monitor current PRACA databases and coding activities. However, based on the current program scope and definition of roles and responsibilities between the contractor and government entities, the office did not view regaining PRACA system management as a reasonable action. Additional comments relating to activities at Kennedy were to be made available at the September 2002 Space Shuttle Vehicle Engineering Office Strategic Council meeting, which never occurred due to the Columbia accident.

Report Title and Date	Findings, Recommendations, and NASA Response
Internal Kennedy audits led by NASA, SAIC, and USA personnel, August 13, 2002 April 16, 2003 June 20, 2003	**Findings:** NASA, SAIC, and USA Quality Engineering personnel who performed the audits reported that, despite the fact that USA personnel are aware of established requirements, cause codes and other data in the PRACA system are often inaccurate, open problem reports which are highly subject to change are used to compile USA's performance measurement metrics, and reported data often does not comply with established requirements. **Recommendations:** Although the audit teams provided their findings to SSP management at Kennedy, they did not make formal recommendations. **NASA Response:** Corrective actions could not be identified.
Columbia Accident Investigation Board Report, Volume I, August 2003	**Findings:** The Board concluded that the PRACA system and WebPCASS are marginally effective decision tools. According to the Board's report, the system is too time-consuming and cumbersome, and only trained employees are capable of using WebPCASS effectively. The Board also reported that the PRACA system is incomplete. For instance, in the case of foam strikes on the orbiter's Thermal Protection System, which led to the Columbia accident, only those strikes that were declared "in-flight anomalies" were added to the PRACA system, which masked the full extent of the foam debris trends. **Recommendations:** The CAIB did not make any recommendations specific to the PRACA system. **NASA Response:** Since there were no recommendations specific to the PRACA system, a response from NASA was not required.

Report Title and Date	Findings, Recommendations, and NASA Response
Government Mandatory Inspection Point Independent Assessment Team Final Report, January 22, 2004	**Findings:** The Team found that the Kennedy data set of the PRACA system is not complete or accurate due inconsistent and incorrect use of cause codes. According to the Team, there is a perception that reported errors will be used to discipline USA technicians or quality control personnel who missed the error. Overall, the Team found that trend analysis, structured process monitoring, and procedural compliance verification are not being performed by the Kennedy quality assurance workforce and are limited overall. **Recommendations:** The Team recommended that Kennedy develop, document, and implement a comprehensive quality assurance program that includes trending and analysis, audits, process mapping, process monitoring, mandatory assurances, process validation, training, and material review for the Space Shuttle elements themselves and the contractor's quality assurance program. In addition, the Team recommended that the SSP, "Develop a culture where workers are encouraged to report mistakes, knowing the reports will be used to reduce the root cause of mistakes and not to punish the worker making the mistake." **NASA Response:** Corrective actions are still in progress, although the Kennedy Space Shuttle Safety and Mission Assurance organization has already made many improvements, such hiring additional personnel and increasing their oversight of USA activities.

Report Title and Date	Findings, Recommendations, and NASA Response
NASA Headquarters Office of Safety and Mission Assurance Audit of USA Ground Operations at Kennedy Space Center, October 2004	**Findings:** The audit team made several observations regarding data in the PRACA system. Such observations included incorrect and unclear cause codes, insufficient problem descriptions on source documents which may lead readers to incorrect conclusions as to the cause of reported nonconformances, and insufficient technical rationale used to resolve reported nonconformances. Overall, the audit team concluded that the PRACA system was overly cumbersome. **Recommendations:** The Office of Safety and Mission Assurance recommended that USA (1) review, update, and clarify instructions and ensure that nonconformance report problem descriptions are clearly stated and that cause codes accurately reflect the actual cause of a nonconformance; (2) ensure proper training is provided to system users; (3) reevaluate current nonconformance tracking and processes to ensure that work is logically tied together; (4) ensure nonconformances are resolved using specific technical calculations and/or analysis and (5) perform detailed analysis and breakdown of nonconformance data that is relevant and useful for workforce process improvement. **NASA Response:** The Office of Safety and Mission Assurance made the following statement in its report: "The observations noted during the audit represented the personal opinion of the auditor(s) and are for information only. Since they do not violate a documented requirement and/or are out of scope, no action is required, although they may be utilized toward process improvements. Observations are not an official part of this audit and are not kept in the official audit file." According to USA, NASA officials never formally tasked USA with correcting the reported observations. Therefore, no corrective actions were taken.

Report Title and Date	Findings, Recommendations, and NASA Response
Part 1 of the NESC Report from the "Independent Technical Assessment of SSP Recurring Anomalies," January 19, 2005	**Findings:** The NESC reported that the PRACA system suffers from a variety of problems that limits its effectiveness for proactive trending and analysis. Some of the issues identified by the NESC include a general lack of consistency and completeness in reported data, an unexpectedly high number of Kennedy nonconformance reports that are classified as "open," and difficulties in performing effective searches of the system. Also, the NESC observed that many PRACA nonconformance reports did not "carry enough detail to make the actual cause of any given problem clear," and many nonconformances were attributed to "operational degradation," even in systems with no moving parts or hardware that could be expected to degrade with time. In some cases, according to the NESC, the Operational Degradation cause code was applied to problems that occurred due to handling or human error (i.e., workmanship). Finally, the NESC reported that established processes do not provide Program management routine visibility into the success of any given corrective action. **Recommendations:** The NESC recommended that the SSP (1) identify changes to the PRACA system to correct discrepancies and improve the system's usefulness as a trending tool, (2) review nonconformances reported as "open" and ensure proper processing, (3) review the application of nonconformance criticality coding and correct inconsistencies, and (4) implement a closed-loop process for tracking and providing SSP management direct visibility into the effectiveness of corrective actions. **NASA Response:** The SSP Safety and Mission Assurance Office responded by stating that the Orbiter PRACA data set has been cleaned-up to correct inaccuracies that did not require engineering buyoff, such as spelling errors. However, the corrections that need to be made to improve data usefulness require Engineering Review Board approval. An effort is underway to determine what data can be corrected and whether it is worth the cost to do so. The SSP has also initiated training to ensure that future data entered into the PRACA system is correct, and a new SNC system is being developed that will help ensure that data entered into the system has a much higher probability of being correct. Regarding the number of "open" nonconformance reports, processing of reports is prioritized based on flight and available resources. Some nonconformance reports relate to hardware that may never fly again, therefore, these items are low a priority and may remain "open" for an extended period of time. Finally, while a closed-loop corrective action system would be beneficial, the SSP has determined that it is not cost effective to develop and implement such a system at this point. The SSP Safety and Mission Assurance Office recommended instead that the new Constellation Program in NASA's Exploration System Mission Directorate develop and implement a closed-loop corrective action system.

Report Title and Date	Findings, Recommendations, and NASA Response
Return to Flight Implementation Plan, SSP Action 15, June 3, 2005	**Findings/Recommendations:** NASA's Return to Flight team concluded that, while clarification of the PRACA system requirements is needed, the implementation of those requirements is the area with the largest opportunity for improvement. The team identified issues with the implementation of the PRACA process that indicate misinterpretations of definitions, resulting in misidentification of problems and noncompliance with tracking and reporting requirements. **NASA Response:** The Return to Flight team reported that NASA and its contractors will provide ongoing training to ensure that all SSP elements and support organizations understand the PRACA system and are trained in entering data. Also, NSTS 08126 has been updated to clarify PRACA process and system requirements. Finally, WebPCASS has been updated to include flight software, payload in-flight anomalies, and Mission Operations Directorate anomalies. The team reported that, "These changes will be incorporated in a phased approach. The goal is to have a single nonconformance tracking system."

MANAGEMENT COMMENTS

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

August 1, 2006

Reply to Attn of: Space Operations Mission Directorate

TO: Assistant Inspector General for Auditing

FROM: Associate Administrator for Space Operations

SUBJECT: Management Response to OIG's Draft Audit Report, "Space Shuttle Program Problem Reporting and Corrective Action Process at Kennedy Space Center Needs Improvement" (Assignment No. A-05-024-00)

The Space Operations Mission Directorate, Exploration Systems Mission Directorate, Space Shuttle Program, and Kennedy Space Center have reviewed the subject audit and provide herewith our consolidated comments. We would also like to acknowledge that an extension was granted to allow time for a thorough review during an especially busy time for the Space Shuttle Program, and for the teleconference held July 13, 2006, to discuss the audit findings and recommendations.

The enclosure provides results of our detailed review with actions taken or on-going to support the audit findings and recommendations. In areas where we have non-concurred with the findings or recommendations, we have provided information to substantiate that non-concurrence. If you have any questions regarding this response, please contact the audit liaison representative, Ms. Gail Gabourel, at 202-358-1462 or Mr. Bill Hill at 202-358-0571.

William H. Gerstenmaier

Enclosure

cc:
HQ/Associate Administrator, Exploration Systems Mission Directorate
HQ/Director, Management Systems Division
JSC/MA/Manager, Space Shuttle Program
KSC/Director

Management Response to OIG's Draft Audit Report,
"Space Shuttle Program Problem Reporting and Corrective Action Process at Kennedy Space Center Needs Improvement"
(Assignment No. A-05-024-00)

Introduction:

The Space Shuttle Program (SSP) endorses ongoing scrutiny of our safety and quality reporting systems and processes by the Office of the Inspector General (OIG). We feel these independent reviews, along with those performed by institutional safety and mission assurance (S&MA), are critical to ensuring the continued integrity of our safety practices. The OIG report on the Kennedy Space Center (KSC) Problem Reporting and Corrective Action (PRACA) system highlighted some areas in which the Program and KSC can make improvements, and in which the Program will take steps to implement changes. However, the overall findings and recommendations contained in the OIG audit report do not appear to be adequately informed by a clear understanding of the architecture of the Space Shuttle Program's total PRACA system, of which the KSC PRACA system is only one part. Further, the report does not distinguish among the responsibilities of the SSP Design Center— such as the Orbiter Project at Johnson Space Center (JSC)— and the processing activities performed by KSC Launch and Landing (Shuttle Processing). The Shuttle Program acknowledges that our requirements, as documented in NSTS 08126, do not aid in clarifying this distinction; we will endeavor to update those requirements to more accurately represent the Program's intent, and the operational reality which reflects that intent. Our commitment to do this is captured in the response to Recommendation 1, below.

As a result of this misunderstanding of the intent of the KSC PRACA system, the OIG recommendations seek to impose requirements intended for the Design Center on KSC Shuttle Processing. The KSC PRACA database is intended to document nonconformances observed during vehicle processing, document the remedial action taken to correct the nonconformance, and continue vehicle processing. The PRACA items are then reviewed by a board to determine which are "reportable" to the design center. Those reportable items requiring further action or root cause analysis are forwarded to the appropriate Project Office and Center Institutional S&MA for review and action. For instance, Orbiter issues are forwarded to the Orbiter Project, JSC S&MA, and propulsion issues are forwarded to Marshall Space Flight Center (MSFC) and the appropriate project or element for review and action. Only GSE issues are reported to and reviewed at KSC. Per NSTS 08126 requirements, the cognizant project then transfers the reportable items into a separate database. NSTS 08126, paragraph 3.3, reads: "Design element/project offices are responsible for transferring PRACA reportable problems into their design element/project PRACA database and ensuring reports are accurate and complete."

The primary purpose of performing (root) cause analysis is to implement corrective or preventive actions that will eliminate or reduce the likelihood of the recurrence of the problem. The purpose of most problem reports (PRs) written at KSC is to perform remedial action: i.e., fix the specific problem indicated for a specific unit. The Design Center, in this case JSC, is responsible for identifying the root cause and determining what, if any, action is necessary to prevent its recurrence. As a result, the cause codes in KSC PRACA are not always the same as those assigned after a root cause analysis is performed by the Design Center. This apparent discrepancy does not in fact impact the performance of the KSC PRACA system in its key task: tracking Shuttle processing issues at KSC. The causes identified by the Design Center analysis are captured in the web-based Program

Compliance Assurance and Status System (WebPCASS), which is the database used by the Shuttle Program and United Space Alliance (USA) in tracking and trending overall Shuttle vehicle risks associated with reported problems.

Recommendations:

Recommendation 1: The Director of Kennedy Space Center should direct the Center's Safety and Mission Assurance Office to review and revise S00000-6-3, "Nonconformance/ Problem Reporting and Corrective Action (PRACA) Data Code Manual," Revision M, March 2005, to provide more precise and useful descriptions and examples to assist NASA and United Space Alliance personnel in assigning nonconformance cause codes

Concur with Comments:

While we concur that the cause codes definitions could be improved, we do not believe the problem to be as severe as this audit reports. In reviewing the 186 nonconformance reports identified with questionable cause codes listed in Appendix E, we question the "Most Likely Cause Code" chosen by the OIG auditors. Although there is not always one correct cause code due to the overlap of the 34 cause codes, we believe that the majority of the 186 reviewed are correct as identified in PRACA. (See example below)

Example

> Item 1 on page 24 (P-V6-R120083) lists a tile bond verification test that failed due to (9) Materials Deficiency/Degradation. The OIG wrote that the most likely cause was (4) workmanship. The bond verification test is performed by applying a vacuum between a GSE chuck and the face of the tile. By pulling on the chuck/tile combination they can verify that the tile is securely bonded to the vehicle. A common problem is for the tile to have small surface imperfections (due to flight wear and tear) that create problems with holding a sufficient vacuum. When the vacuum is insufficient, the chuck will pull free before the tile has been pulled to its specified amount. A cause code of (9) Materials Deficiency/Degradation is perfectly acceptable because the tile surface likely had degraded enough to prevent a good vacuum seal. There is nothing in the report to indicate that the test was performed incorrectly.

To address the OIG's concern of using the "Workmanship" cause code, there are over 69,000 PRs in the KSC PRACA database with the "Workmanship" cause code "4" indicated; review of the data indicates that it is the third most common cause code. These statistics alone would tend to indicate there is not an implied threshold for reporting of workmanship errors. Additionally, there is no record of any negative input from NASA pertaining to workmanship errors that would discourage the use of the "Workmanship" cause code.

Differences in interpretation were also found in Appendix F, which lists those items the OIG believes have insufficient nonconformance descriptions. Since the purpose of the KSC IPR/PR/DR system is to perform remedial action, the problem descriptions are written to provide a description of the symptom or observed condition as compared to the required characteristic or design criteria ("is" versa "should be"). Other information useful in identifying the nonconformance such as location or part markings is typically included in other blocks. Although there is no requirement for USA to identify the cause of the nonconformance in the description block, 61 of the 138 nonconformance descriptions (44 percent) were identified in this audit as insufficient due to "descriptions not

sufficient to determine the cause." We believe most of the 138 nonconformance descriptions to be sufficient as reported in PRACA.

NASA KSC S&MA will review S00000-6-3, "Nonconformance/Problem Reporting and Corrective Action (PRACA) Data Code Manual," Revision M, March 2005 for possible revision, including possibly adding clarifying statements in the definition section and using examples. However, there may be difficulties in establishing clear examples that do not unintentionally limit or exclude cause codes from viable circumstances. Because the establishment of a single cause code is sometimes subjective, the addition of guidance on how to handle situations where multiple cause codes may apply will be considered. Even with further clarification and examples, the application of cause codes will remain a subjective activity. Without a detailed and successful failure analysis there is no way to determine if a cause code for a specific PR is "correct" or "incorrect."

KSC strives to maintain quality and consistency in PRACA PR data entry through training and through a system of checks and balances using NASA Quality Engineering (QE), USA QE, and USA Engineering to update cause codes as new or better data becomes available. Finally, in an effort to ensure consistency in coding, the final review of PRs is limited to two specifically identified Quality Control personnel.

During the response to this recommendation it became clear that there are different interpretations of KSC's requirements from NSTS 08126 rev J. There may be a need to write a Change Request (CR) to clarify the program level requirements on KSC. For example, there is no clear definition of the purpose of the cause code at a Problem Report (PR) level. The primary purpose of performing (root) cause analysis is to implement corrective or preventive actions that will eliminate or reduce the likelihood of the recurrence of the problem. The purpose of most PRs written at KSC is to perform remedial action, i.e., fix the specific problem indicated for a specific unit. The Design Center is responsible for identifying the root cause and the need for corrective actions.

Corrective Actions:

1) Review the cause code definitions listed in S00000-6-3 and either recommend revision or provide rationale why revision is not needed. The use of examples will also be considered. This review is to be completed by November 13, 2006. A revision change to S00000-6-3 will be implemented January 1, 2007, if necessary.

2) The SSP will update NSTS 08126 to better define the requirements and organizational responsibilities of the Design Center and the vehicle processing center. The update will delineate those actions and information required by the processing center for remedial problem reports (PRACA). The update will also delineate those actions and information required to ensure that reportable problems are appropriately transferred to and dispositioned at the design center. The Program and its JSC, MSFC, and KSC stakeholders will review the requirements in NSTS 08126 and provide a recommendation for updates to the Space Shuttle Management Integration Office by November 3, 2006. A CR based on this recommendation will be submitted to the SSP Requirements Control Board (PRCB) by December 1, 2006.

For closure, your office will be provided a copy of the CR with a projected closure date of February 2007.

Recommendation 2: The Director of Kennedy Space Center should direct the Center's Safety and Mission Assurance Office and Shuttle Processing Directorate to revise the Space Shuttle Program quality and surveillance plans, to require Kennedy Space Shuttle Division Quality Engineering and Process Assurance personnel and Space Shuttle Systems Engineers to review the accuracy of cause codes, sufficiency of nonconformance descriptions, and compliance with data tracking and trace-ability requirements as they conduct routine surveillance of United Space Alliance's problem reporting and corrective action activities.

Non-concur:

For NASA Quality Engineering (QE) and Process Assurance, processes are already in place to perform this function. Recent section meetings have been held to help ensure consistent reviews by all personnel.[1]

The Material Review Board (MRB) Review Process defined in KDP-P-3625, Rev. Basic, states that the NASA QE will verify the problem description is clear, accurate, and verify the probable cause of the discrepancy is clear. In addition, the database and checklist used during MR review have those same requirements.

Process Assurance personnel perform a Paper Sampling Program according to KDP-P-3618. This program involves sampling closed discrepancy reports (DRs) and PRs with a checklist. The checklist criteria applicable to problem description and cause codes are listed below.

DR Checklist Criteria:

6. Problem Description (Block 13) reflects disposition Findings (Block 21)
   - Verify all problems listed in block 13 have been worked.
   - Verify all problems worked in disposition have been recorded in block 13.

Note: There is no check for the cause in the DR checklist.

PR Checklist Criteria:

6. Problem Description Block 13 reflects disposition Findings (Block 21)
   Verify all problems in block 13 have disposition and all problems worked in block 21 have been reported back in block 13.

8. Conclusion/Summary (block 21) contains a Probable Cause Statement
   Verify the Summary Conclusion in block 21, last page, has a Probable Cause Statement.

As stated above, the application of cause codes is a very subjective activity. Without a detailed and successful failure analysis there is no way to determine if a cause code for a specific PR is "correct" or "incorrect." The cause code can be changed at any time based on the availability of new or better data. For example, if a NASA QE requests a change to a cause code prior to approval by the MRB, it still may be changed by other boards/personnel prior to closure.

USA provides their own oversight of the PR process by performing subsequent reviews. USA Engineering verifies the cause code when adding the summary and conclusion, and Quality Control performs a final review verification/change of the cause code after closure. To help maintain consistency the final review is limited to two specifically identified Quality Control personnel.

We request closure of this recommendation based on the above rationale.

[1] Compliance with data tracking and traceability requirements is assumed to refer to the USA hyper linking requirements and is addressed in the response for Recommendation 3.

Recommendation 3: The Manager, Space Shuttle Program should ensure that United Space Alliance complies with hyper linking requirements contained in USA000383, "PCASS Reports and Query Replacement Project (WebPCASS) Functional Requirements Document (FDR)," Revision E June 30, 2005, and USA000399 "Web Based Program Compliance Assurance and Status System (WebPCASS) Detailed Requirements and Design Document Specification (DRDS)," Revision D, July 31, 2005

Concur with Comments:

USA is compliant with the existing requirements for hyper linking referenced in the above recommendation. We believe that the recommendation is based on a misunderstanding of the USA requirements. The root of the misunderstanding appears to stem from the following quote on page 2 of the audit report: "Personnel from the SSP design elements, projects, contractors, subcontractors, and vendors are to use WebPCASS to document nonconformances and corrective actions and ensure related nonconformance reports and Corrective Action Assistance Requests (CAARs) are hyperlinked to one another to allow for easy analysis and retrieval of related data." This is an inaccurate statement. The process in use is described below.

To address this comment and clarify that personnel use the individual databases that support WebPCASS, not WebPCASS itself, to document nonconformances, etc., the phrase "use the individual databases that comprise the SSP PRACA system and support WebPCASS" (page 2) replaces "are to use WebPCASS" (in the draft report).

WebPCASS is part of the Advanced Data Acquisition and Management (ADAM) Data Warehouse. Users do not and cannot enter Nonconformance and Corrective Action data into WebPCASS. It is a "read only" database. All data contained in the PRACA data sets within the Data Warehouse are transferred and loaded from the various PRACA transactional source systems and data entry is performed (documented) in the transactional source systems.

The KSC PRACA system is the software application used to document the nonconformances cited in the audit report. Once evaluated, a corrective action is documented in the KSC CAAR system, and referenced back to the associated original nonconformance in KSC PRACA through the nonconformance number used as the root for the CAAR number. The KSC PRACA data set within WebPCASS hyperlinks to related PRACA within KSC CAAR, JSC Corrective Action Record, MSFC Problem Action Center (PAC), and Shuttle Image Management System (for imaging). On a nightly basis, WebPCASS gathers all modified data from these systems and loads it into the WebPCASS data warehouse tables for viewing.

The current software program for KSC PRACA does not allow for linking multiple PR numbers to a single CAAR number. Since there can be multiple PR's associated to one CAAR, the default value in the WebPCASS PR display, "There were no associated KSC CAAR reports found," can be misleading.

There is not a NASA requirement related to hyper linking; USA meets its existing hyper linking requirements, which are contained in USA000383 and USA000399. These requirements, when referring to KSC PRACA, state: "The system should provide hyperlinks where available." The KSC Shuttle PRACA system is a combination paper and electronic system. By its very nature, the electronic system lags the paper documents by some period of time.

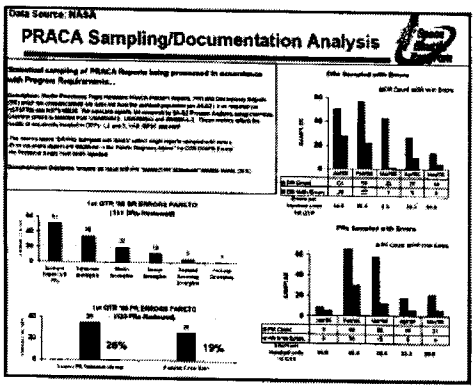
We request closure of this recommendation based on the above rationale.

Recommendation 4: The Manager, Space Shuttle Program should coordinate with United Space Alliance to ensure that the award fee includes a performance metric based on the accuracy of nonconformance reports.

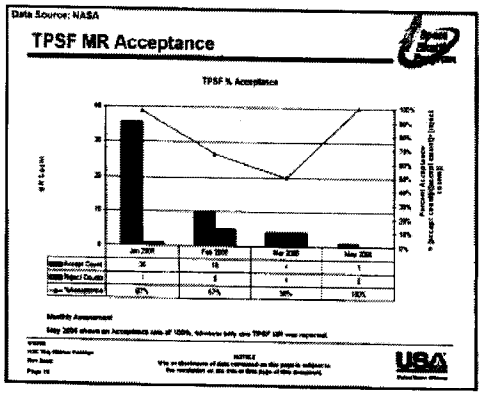
Concur with comments:

Metrics to measure this issue already exist and are flowed into the Award Fee process as appropriate. Monthly metrics which include this type of information are reviewed by NASA Quality Assurance for positive or negative trends. This information may result in changes to areas of emphasis and affect the assessment of USA strengths/weaknesses which are used to determine award fees. The following metrics were included in the May 2006 Shuttle Processing NASA/USA Audits, GO, IDS, IL, TPSF SSP Quality Metrics SSP Preventive/Corrective Action Report.

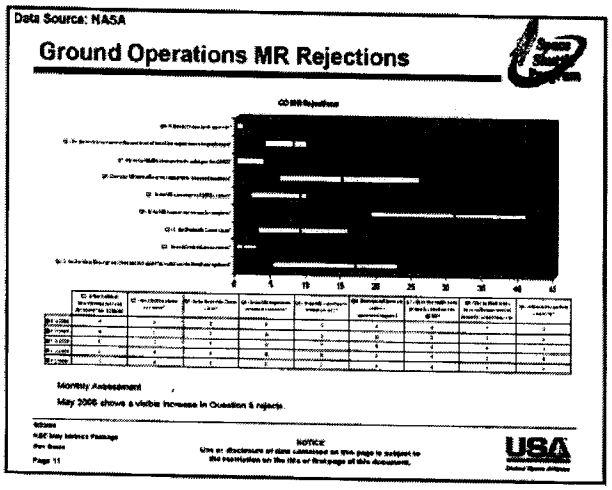
1. **PRACA Sampling/Documentation Analysis:** A statistical sampling of PRACA (DR and PR) reports is conducted by NASA PAs. Errors found in problem descriptions, probable causes, and other areas are reported.



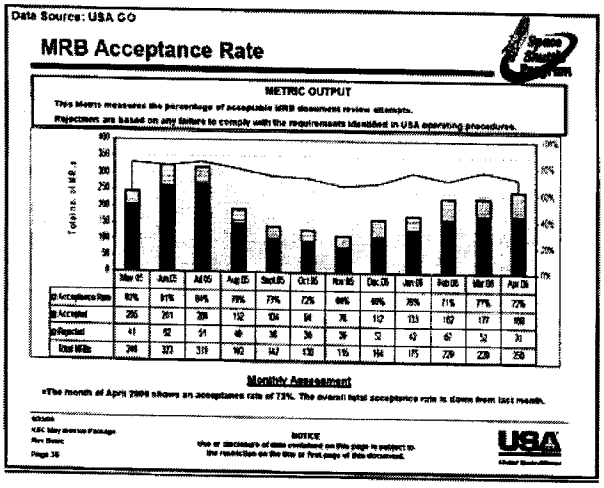
2. **MR Acceptance for TPSF, Ground Operations, and NSLD:** This metric is a comparison of the number of TPSF MRs accepted vs. the total number reviewed by NASA QE. Similar metrics exist for Ground Operations and NSLD.



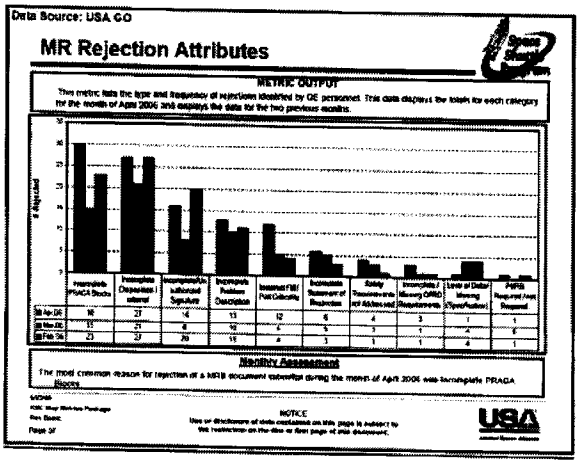
3. **MR Rejections for Ground Operations, TPSF, and NSLD**: This metric is a review of all NASA QE MR Rejections. The metric reviews nine potential causes including "Is the Problem Description clear and accurate?" and "Is the Probable Cause clear?" Similar metrics exist for TPSF and NSLD.



4. **MRB Acceptance Rate**: This metric measures the percentage of acceptable MRB document review attempts by USA QE. Rejections are based on any failure to comply with requirements.



5. **MRB Rejection Attributes:** This metric lists the type and frequency of rejections identified by USA QE personnel. This metric displays the totals for each month and the data for the 2 previous months. Incomplete Problem Description is one possible reason for rejection.



We request closure of this recommendation based on the above rationale.

Recommendation 5: The Associate Administrator, Exploration Systems Mission Directorate should ensure that the teams working on the problem reporting and corrective action process and system(s) that will support NASA's new human and robotic exploration programs and projects contain, at a minimum, members of the management, user, safety, and quality assurance communities. In addition, those teams should consider the findings and recommendations presented in this report, develop specific life-cycle goals for the problem reporting and corrective action process or system(s), and develop requirements designed to meet those goals.

Concur:

NASA Constellation Safety and Mission Assurance office has undertaken a comprehensive activity to improve PRACA reporting process and tools for Exploration Systems Mission Directorate (ESMD) systems. There are two teams (Methodology and System) that are working together to ensure this activity is a success. The Methodology team includes members from across the agency to address the PRACA reporting process. A methodology document, in which we are planning changes to address many of the Columbia Accident Investigation Board (CAIB) report findings, is in work.

The System team includes members from ARC, JSC, MSFC, KSC, Jet Propulsion Laboratory, and NASA Headquarters. The IG SSP PRACA Audit, CAIB, CAIB/Diaz, and Shuttle Independent Assessment Team reports were all considered in developing the Information Technology system requirements. The NASA Engineering and Safety Center (NESC)-led PRACA Taxonomy Working Group and the NESC-led Space Shuttle and International Space Station (ISS) Recurring Anomalies Working Group reports were used. Also, internal Space Shuttle and ISS methodology documents and lessons learned were studied. An external review of the Space Shuttle PRACA system was undertaken by an ARC-led team in 2000; the final report produced from this assessment was also considered.

The future PRACA tool will address many of the concerns mentioned in the IG report. The SSP and ISS community are strong participants on both teams, so that lessons learned from these programs can be incorporated. The PRACA methodology and system requirements will be reviewed at the Constellation Systems Requirement Review in August 2006. The PRACA requirements are planned to be baselined by December 2006.

We request that this recommendation be closed upon issuance of the final report based on actions taken and planned.

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