PREFERRED RELIABILITY PRACTICES

Problem Reporting and Corrective Action System

Practice:

A closed-loop Problem (or Failure) Reporting and Corrective Action System (PRACAS or FRACAS) is implemented to obtain feedback about the operation of ground support equipment used for the manned spaceflight program.

Benefits:

The information provided by PRACAS allows areas in possible need of improvement to be highlighted to engineering for development of a corrective action, if deemed necessary. With this system in place in the early phases of a program, means are provided for early elimination of the causes of failures. This contributes to reliability growth and customer satisfaction. The system also allows trending data to be collected for systems that are in place. Trend analysis may show areas in need of design or operational changes.

Programs Which Certify Use:

Space Shuttle Program

Center to Contact for More Information:

Kennedy Space Center(KSC)

Implementation Method:

A closed-loop system that collects, analyzes and records failures that occur is developed. Documented procedures for the analysis of failures to determine their root cause and then the establishment of effective corrective action are also developed. This aids in the prevention of future reoccurrences by elimination of problem areas in the equipment. The PRACAS

Technical Rationale:

Figure 1 illustrates the closed loop PRACAS with the necessary steps required to get full use out of such a system. This continuous loop provides the program with the opportunity to fine tune hardware reliability and performance through repeated iterations of reporting and corrective action.

KENNEDY SPACE CENTER

Problem Reporting and Corrective Action System

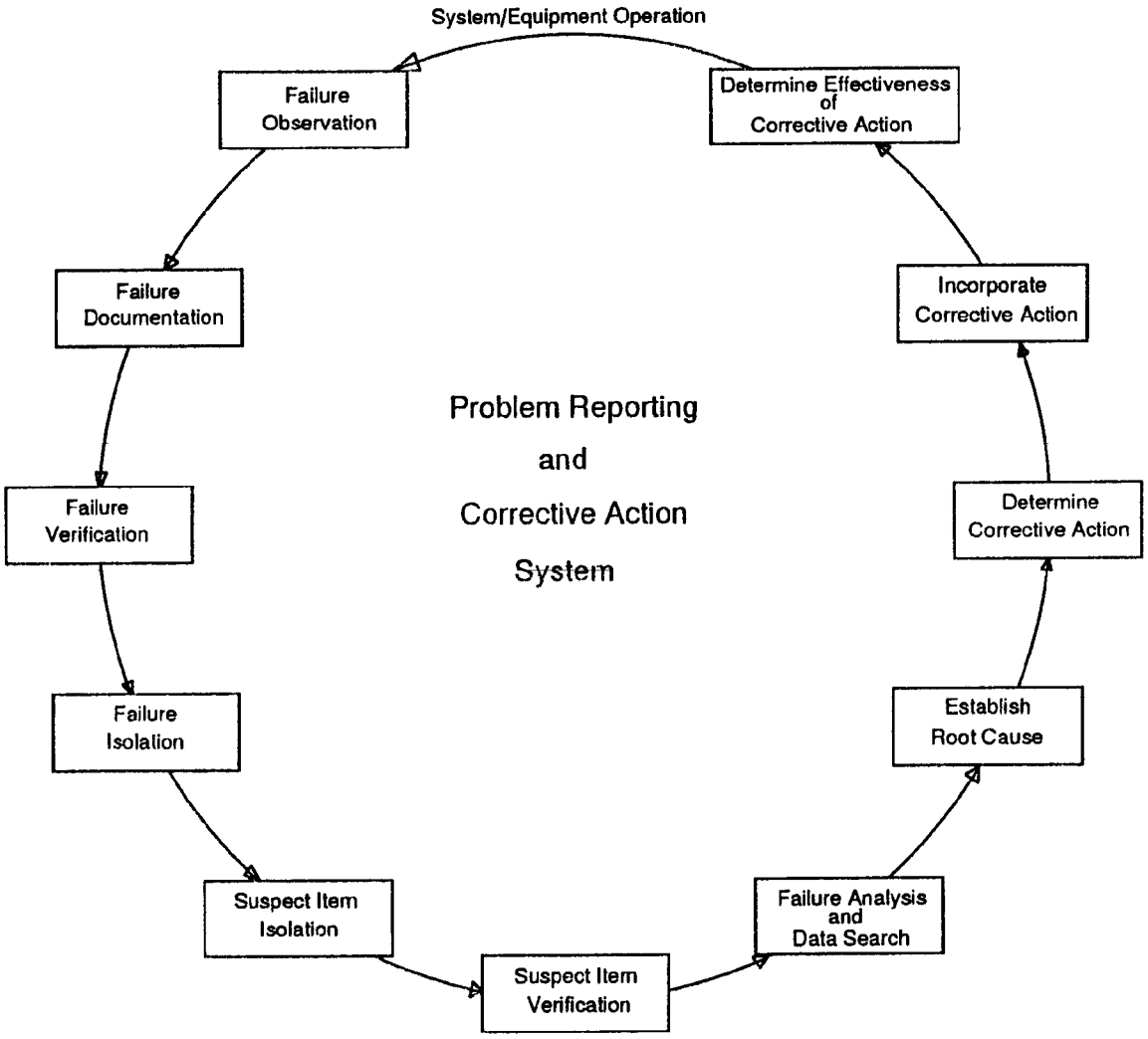

Figure 1. Closed-loop Problem Reporting and Corrective Action System

Essentially the system must provide information on:

1. What was the failure?
2. How did the failure occur?
3. Why did the failure occur?
4. How can such failures be prevented from occurring in the future?

The documentation procedures should include instructions for initiating problem reports, analyzing the failure and method of providing corrective action to the design and operation of the equipment. The most important step in the process is documentation of the problem. The quality

of the document will determine the effectiveness of the PRACAS for creating an acceptable solution. Minimum documentation for the problem should include:

1. The location of the failure
2. The date and time of the failure
3. The applicable part numbers, serial numbers, model numbers
4. The operation being performed
5. The failure symptom
6. The name and number of the reporting individual(s)
7. The environment under which the failure occurred
8. The impact of the failure on hardware and personnel safety
9. For each test-related failure, a "Stress statement" on whether or not the failure induced any stress in the hardware.

A means should also be available for tabulating the failure information for determining trends and the mean-time-between-failure of the equipment. Besides being useful to design and reliability engineering, this information may also be useful to maintenance personnel for determining maintenance periodicity of the equipment already in use. Failures that require "stress statements" shall include test failures, operator induced failures, test equipment failures, environmental equipment failures, or any other problem/failures which did result in overstress, or which could have resulted in overstress, to any portion of flight hardware.

Use at KSC

The KSC PRACA System provides the means to monitor and track the health of the Space Shuttle Ground Support Equipment and identify problem areas that require further investigation. See figure 2 for the report that is used to identify and track problems at KSC. The majority of problems that are reported deal with component failures. However, any other condition that results in the system or equipment not meeting the requirements that were specified is also reported (corrosion, out-of-calibration, etc.).

The PRACA system incorporates the following features:

- Tracking - The system encompasses the reporting, documentation, analysis and initiation of corrective actions relative to nonconformances detected during ground processing operations that are associated with flight systems, ground support equipment and facilities.

- Recurrence Control - The system provides a recurrence control function which is directed toward ensuring that specific problems or failures do not reoccur.

- History - The system maintains historical data that supports ongoing problem resolution, trend analysis and recurrence control activities. This historical problem data is needed to support reliability, maintainability, and availability analysis.

Problem Reporting and Corrective Action System

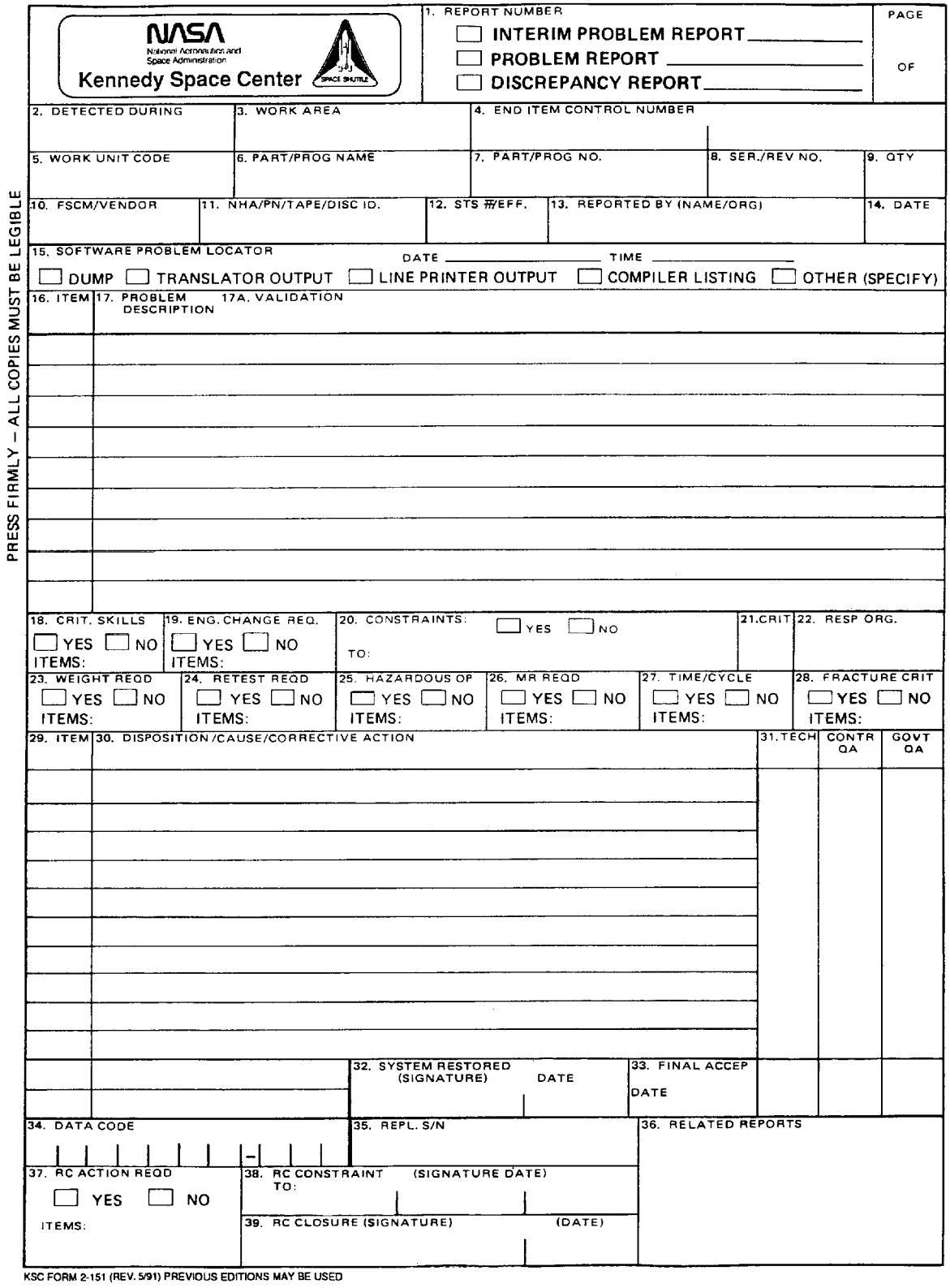

Figure 2. KSC Problem Tracking Form

Problem Reporting and Corrective Action System

- NASA Centers - The system provides on-line visibility of the nonconformance data to other NASA Centers. Johnson Space Center and Marshal Space Flight Center can view the data on-line. Extracts of data are also provided to JSC for input to the PCAS (Program Compliance Assurance and Status) System.

- Batch Report - The system provides for the generation of batch reports on demand, weekly and/or monthly.

- Security - The system provides access control that ensures that only authorized personnel may write to the database and then only to areas in which authority has been established. Query capability of the system is available to valid users at any time.

- Automated Management Document Control System (AMDCS) - The system provides for the automatic transfer of nonconformance report data to AMDCS when final acceptance data is entered.

- Ad Hoc Reports - The system provides for the generation of ad hoc reports using a user-friendly language. It also provides for the user to save ad hoc report specification for later use. These reports are needed for specific trend and failure reports.

- Document Accountability Control System (DACS) - The PRACAS utilizes the DACS for document tracking by attaching a bar-code symbol to each PRACA report. As the report is routed through the closure process the bar-code symbol is scanned at each stop. The location of the report can then be determined by query of DACS.

- Disposition/Causes/Corrective Action - The system identifies all actions associated with troubleshooting, remedial action, cause identification, recurrence control and unexplained problem resolution. Trouble shooting and remedial action steps are documented.

- Critical Items - The system identifies the criticality of the failure mode of the problems encountered. A Critical Items List (developed from a Failure Modes and Effects Analysis) is maintained in the database and the criticality code is entered based on the part number.

- Failure Analysis - The system identifies if failure analysis is required and provides the data for the analysis.

- Orbiter Thermal Protective System - The system provides for the documentation and disposition of the Orbiter Thermal Protective System nonconformances. This includes a diagram showing the location on each tile of the nonconformance.

- Corrective Action Assistance Request - The system supports addition, modification and retrieval of the Corrective Action Assistance Requests.

Problem Reporting and Corrective Action System

- Formatted Problem Report - The systems provides for the formatted problem report to be printed on local printers.

- Status - The system provides real-time status visibility of open and closed nonconformances and constraining nonconformances. It identifies whether the nonconformance is a constraint to further test or precludes the performance of any sequence in the work document.

- Search and Retrieval - The system provides for interactive search and retrieval which can be displayed on a terminal or, if large volume of data, sent to a printer.

- Number Generation - The system provides for automatic number generation for the nonconformance documents. The automatic number generator can be turned off as is the case when the nonconformance reports that are initiated when the system is not available are entered in the system.

- Real-Time - The system supports testing operations and closeouts with real-time status information.

- Other Useful Information - The system contains other useful information such as part numbers, serial numbers, end item control numbers, next higher assemblies, FSCM (Federal Supply Code for Manufacturers), STS (Space Transportation System) #/effectivity, when failure is detected and operational document, including document type and number of the operation being performed, name of the technician, government quality assurance and contractor quality assurance who accepted the completion of the work. Other information such as, the need for critical skills, the need for retest and the system restore date are provided.

Related Practices:

Problem Failure Reporting Procedures, PD-ED-1250.
Problem/Failure Report Independent Review/Approval, PD-AP-1304.
Risk Rating of Problem/Failure Reports, PD-AP-1305.

References:

1. **Reliability Engineering for Electronic Design**, Norman F. Fuqua, Marcel Dekker, Inc. 1987, pp. 322-325.
2. Lockheed Space Operations Company, Standard Practice Instruction, Problem Reporting and Corrective Action (PRACA) System - QA-001(3)K.