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INFORMATION AND PROBLEM REPORT USEAGE IN

SYSTEM SAFETY ENGINEERING DIVISION

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SUMMER FACULTY REPORT
System Safety Engineering, CT - 21, Marshall Space Flight Center

Stephen J. Morrissey, Ph.D., Summer, 1990

SUMMARY
This report summarizes the findings of the problems I was asked to address during my stay. There were five basic problem or question areas. Four of the five are examined individually in the following pages, the fifth is was to provide recommendations, these are included with each of the four major problem areas.

1: EVALUATE ADEQUACY OF CURRENT PROBLEM/PERFORMANCE DATA BASE

Problem and performance identification and evaluation is defined by PRACA requirements, with each of the major system contractors having their own contractual arrangements which are also based on PRACA. Under this system, reports of problems or unusual and unexpected events or conditions come from the contractor, from acceptance/qualification testing, in-flight and post flight analyses(PFA). When problem report data is received it is evaluated for its criticality and uniqueness. If an observed problem is deemed to meet these requirements, it is entered as a problem report and enters the reporting and evaluation procedure.

1. Data Acquisition: Calspan is automating the data reporting and trending efforts. This is a relatively new project and will allow for identification of trends in data for established (previously identified) problems and for classification of newly reported problems or unusual events that do not have FMEA-CIL numbers. This effort uses the traditional data sources described above and is working to also integrate data from contractor's internal data bases.

Comments:

*This effort can be improved by more contractor cooperation in sharing their data bases, by inclusion of data derived from standard repair procedures, and by improving the communication between MSFC and contractors at other locations. Several contractors are providing excellent data from their internal data bases.

*Because of the importance of understanding the PFA problem identification methods, it is recommended that responsible individuals participate in these sessions at least once a year. This can be by live participation or by viewing the video taped activites. In a similiar fashion, individuals who are required to evaluate other systems should have exposure to the contractors actual operations. This will enhance their understanding of the physical hardware and how it is prepared, tested and evaluated.

*It has been observed that different divisions within SRM&QA are working on projects or have contractor projects that are of great interest and use to other sections. Knowledge of other

divisions projects is not totally comprehensive, and while there is no evidence of attempts to prevent other groups and divisions from knowing what is being done, communication is not as complete as it should be. It is recommended that some method of cross communication be established, perhaps a session in which each group leader gives a short presentation which outlines active projects and their groups current and future operational needs. From these discussions better understanding of each groups capabilities and needs will be possible, and a more coordinated effort result.

*The post flight analysis is primarly done by engineering personnel, and considerable experience has been gained. This experience base is now sufficiently developed so that this activity can be taken over by quality oriented rather than design oriented personnel. Such a change in orientation should improve the reviews if the knowledge and experience base gained in PFA inspections can be translated into inspection criteria possibly with an expert system. Such a shift in orientation should also allow for a better understanding and control of the variety of design waivers that exsist on any system. This inclusion of quality personnel should also facilitate problem quanitification and hazard analyses.

2. Data Evaluation-Reporting: Calspan develops a monthly report called the Open Problems List (OPL) that lists and trends problem reports that have been filed or closed during the reporting interval. These reports are grouped by system (ET, SRB, SRM), and whether the reports have been closed or are still open at the end of the reporting interval. The OPL is distributed to a variety of users to help managers and other personnel identify problems in the various systems.

An important issue has been how to deal with problem reports and hazards that do not have FMEA-CIL numbers or that are new or unique. This has been resolved by assigning problem reports without FMEA/CIL numbers a citicality of one. These reports are then grouped together and in a review session evaluated as to their apparent criticality, and assigned to project groups to develop FMEA-CIL documentation. This procedure should allow for rapid identification and entry of new hazards into the FMEA/CIL data base. In the last review of this type, 580 reports did not have FMEA/CIL numbers. Of these, 440 were considered as "non-problems", the remaining 140 have been assigned to project groups to develop FMEA analyses and related CILs. The amount of active participation by system safety in these reviews is not clear.

Comments:

*A better method is needed to trace reported problems to their basic or root cause(s) so that proper counter measures or corrective designs can be developed. This includes problems that result from device/system failures, to problems that result from devices being out of tolerance, but still functioning, and human errors. This may also require better

reporting of problems arising from standard repair procedures. While this type of reporting is a sensitive issue to some contractors, this data is needed to insure proper tracking of problems. It can be argued that to provide this data would require substantial additional reporting and accounting efforts by contractors. However, this data should already be internally available to the contractors. A possible compromise would be to have contractors supply their own measure or ratio of units accepted(of some particular type) to units sent (of some particular type).

*A computerized, real time system to cross reference Hazard Reports, CIL Numbers, FMEA Numbers and problem report numbers and any waivers or proposed engineering changes needs to be implemented.

*The current system for problem reporting developed by Calspan has great protential. It should be expanded to allow the following:

1. Interactive searching of the data base by non-Calspan personnel. this is a relatively new program, this may develop naturally with maturity.
2. A survey needs to be made of SRM&QA personnel to determine what other information would be useful for presentation in the monthly OPL report.

2: EVALUATE METHODS OF PERFORMING TREND ANALYSIS

Currently there are two major efforts under way that involve trend analysis. These are Performance Trending and Problem Trending.

Performance Trending: Data from past launches is being used by ATI to develop envelopes of nominal performance. Real time data for a particular system or element across its operational time is statistically evaluated to develop templates or control chart limits describing the upper and lower values for the parameter over time that have been observed 95% of the time. These upper and lower limits provide a window within which real time values of the parameter can be plotted allowing determination of the "acceptability" of the parameter compared to past performance at that point in operational time.

Comments:

*This method has great usefulness for both real time LCC decisions and for development of test/acceptance criteria.

*This method should be expanded to allow development of multivariate plots, not just individual (sub)system responses.

*The performance envelopes developed by this method may be quite different from the "red-line" values. A method of quantifying the risk associated with observations in this region needs to be developed.

Problem Trending: is being addressed in two different ways. The first is the OPL report discussed earlier that lists problems by system and criticality, and corrective actions (if any) that have been taken in the past reporting period (typically one month). The second effort is the "problem trending report" that is issued every six months. This report uses all available current and historical data for systems, elements, and subsystems, and develops a variety of different trend analyses for these data. Analyses typically are trend reports for systems and elements, with detailed studies performed on various elements or systems according to frequency or criticality of events, and visibility. These trend analyses use graphical and statistical methods, and can be used to describe the effectiveness of design changes, or point out areas needing control. The purpose of these efforts is to provide management guidance and oversight to managers, and facilitate tracking of problems and the effectiveness of correction.

*Trending is a powerful tool to facilitate understanding and control of the systems described. However the feedback loop to insure compliance is not always present. In the trending reports there is evidence of systems or components in which design changes have been made, yet the rate of problems has not changed, and in some cases, the problem rate has increased. Trend analysis is only as good as managers choose it to be.

3: METHODS AND SOURCES OF DATA FOR PROBABLISTIC RISK ASSESSMENT

There have been substantial efforts in the area of PRA to determine basic and time dependent reliabilities for elements, systems and subsystems, and towards life cycle characterizations. Data used for these evaluations comes from the basic sources of data already identified. These analyses have been oriented towards traditional reliability studies, and their system safety impact or inputs are not totally characterized, nor have system safety inputs been sought in any systematic fashion.

Comments:

*Facilities and personnel are available to perform PRA at many different levels of complexity and sophistication. However this resource is not sufficiently recognized nor utilized as a source to develop PRA criteria for FMEA/CILs or other types of hazard analysis.

4: HOW IS RISK ASSESSMENT DOCUMENTATION UPGRADED/UPDATED?

This is currently performed by problem review boards or by individuals raising concerns and initiating these changes and modifications. Until the trending analysis efforts had been developed, this was the only way by which hazards and needed revisions could be identified. The updating of documentation is a different issue and hazard reports and CILs may often have waivers and inprocess modifications and engineering change proposals active. Keeping track of these is difficult, and

currently is performed as much by word of mouth as by formal lines of communication.

*This condition obviously needs to be improved, possibly by using a more formalized procedure which would flag hazard reports, FMEA-CILs whenever a waiver or engineering trend proposal that references them is active.