

August 6, 2002

MEMORANDUM TO: Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

FROM: Ashok C. Thadani, Director */RA/ by Ashok Thadani*
Office of Nuclear Regulatory Research

SUBJECT: HUMAN PERFORMANCE CHARACTERIZATION IN THE REACTOR
OVERSIGHT PROCESS

In your March 17, 2000, memorandum "User Need Support for Risk-Informed Oversight Process – Supplement to Memorandum Dated April 21, 1999," you described needs for research related to the monitoring and assessment of human performance in the Reactor Oversight Process (ROP). The assumption of the ROP is that the effects of human performance on plant safety are largely reflected in the plant performance indicators and inspection findings of the ROP. The user need memorandum asked us to test this assumption by characterizing the extent to which the influence of human performance on plant safety is likely to be accounted for through the current performance indicators and inspection areas of the reactor oversight process. The memorandum also asked RES to characterize the impact of any adverse effects of human performance on plant safety that are not accounted for through the reactor oversight process, and then to recommend potential changes to the oversight process or the regulatory framework to address these impacts.

The attached NUREG/CR-6775, "Human Performance Characterization in the Reactor Oversight Process," dated March 2002, describes the analyses conducted and results in detail. In general, the research found that the ROP has the potential to capture important human performance issues through a combination of baseline inspections, supplemental inspections, and performance indicators.

The basis for the findings in this report is a comparison of the elements of the ROP to the results of an analysis of risk significant (greater than $1.0E-5$) accident sequence precursor (ASP) events over a 5-year period that was reported in NUREG/CR-6753 (attached). These ASP events all occurred prior to the inception of the ROP. The comparison was thus a retrospective analysis of archival information. In NUREG/CR-6753, the ratio of latent to active errors contributing to events was 4:1, which is consistent with the ROP inspections findings of 3:1. The profile of human performance deficiencies found in both the ROP and the NUREG/CR-6753 studies includes procedures, configuration management, and corrective action programs (CAPs). The NUREG/CR-6753 study also found deficiencies in design and maintenance areas. The most prevalent human error categories that were found in that study were: Design and Design Change Work Practices (81 percent), Maintenance Practices and Maintenance Work Controls (76 percent), Operations (54 percent), Corrective Action Program (41 percent), Procedures and Procedures Development (38 percent), and Management and Supervision

(30 percent). These percentages do not add to 100 percent because more than one error category could be included in a given event. Other prevalent influences that cut across these error categories were communications factors and training for personnel other than operators. Though the study identified strengths of the ROP, it also identified several areas where RES believes there is potential for improvement. These are:

(1) The study found that latent human error conditions were reported three times more frequently than active human errors in inspection reports and four times more frequently in the ASP analysis. This is reflected in the Design and Maintenance error categories. An alternative selection and statistical sampling strategies could be developed and evaluated to determine whether the likelihood of identifying additional latent human errors can be increased. These may be the most difficult errors to detect because they may lay dormant for long periods of time and not become important until that piece of equipment is called upon during some procedure. Many believe that the equipment-based PIs include the effects of these latent errors. However, the detection of latent errors could be enhanced by developing additional inspection guidance under the maintenance rule. RES could develop and evaluate alternative selection and sampling strategies to determine the potential for detecting additional latent errors and the viability of modifying the strategies now used.

(2) The findings from the study show the importance of CAPs. Operating event reviews indicate that deficiencies identified in licensee CAPs, but not acted upon, contributed to 41 percent of events. For example, recurrence of circuitry failures, seal failures, safety valve re-seating failures, and repetitive diesel generator failures to start contributed to events even though these problems had been identified in the CAP. More recently, the vessel head degradation at Davis-Besse is another example of how recurrent failures for which thorough root cause analyses are not performed or completely understood and addressed can lead to significant problems. In light of these problems it should also be noted that twenty percent of the operating events reviewed evidenced failure of utilities to respond to industry notices regarding equipment defects or the need for modified work practices.

Therefore, RES suggests that a more systematic approach to applying risk and performance methods to the CAP be developed to enhance the human performance aspect of the ROP. Current ROP inspection guidance instructs inspectors to consider risk insights and risk importance in selecting corrective action deficiencies for review from the licensee's CAP, but provides limited guidance on how to accomplish this. Therefore, we recommend a more structured approach that would include both the application of risk and performance methods to the licensees' CAP.

Key elements of such an approach would include:

- the use of risk and performance insights to establish corrective action item priorities
- the combined and overall impact of backlogged items in the CAP
- the potential for common cause failure of specific items being tracked in the CAP
- recurrent failures and their root causes
- trending and assessment of small changes over long periods of time.

(3) Communication factors were influential in many of the events studied. These issues could be more directly assessed by applying guidance based on NUREG-1545, "Evaluation Criteria for Communications-Related Corrective Action Plans" and parts of another recent RES publication, NUREG/CR-6751, "The Human Performance Evaluation Process: A Resource for

Reviewing the Problem Identification and Resolution of Human Performance Problems" (attached).

(4) The procedures area is currently addressed indirectly through several inspection protocols and the Operator Requalification SDP and directly through supplemental inspection procedures for quality and adherence. These protocols and procedures should be periodically reviewed to determine if they are effective in identifying procedure deficiencies.

(5) Though Management and Supervision have been shown to be contributors to events, the Commission directed the staff not to pursue new work in this area until sufficient evidence is developed to serve as a technical basis for modifying this policy. We should discuss whether there is sufficient basis now to develop a position for Commission consideration.

This report was discussed at a human factors coordination meeting among management and staff of RES/DSARE and NRR/DIPM on May 8, 2002.

The findings described in the draft NUREG/CR and the RES recommendation for enhancement to the ROP are consistent with the NRC strategic performance goals (NUREG-1614, Vol. 2) as follows:

Maintaining Safety – This research provides continuing evidence that NRC's reactor oversight program generally accounts for the effects of human performance as a cross-cutting issue. Enhancements can be made to the licensees' CAPs which would help to maintain safety.

Making NRC Activities more Effective, Efficient, and Realistic – Research findings related to risk-informing the CAP reviews would make the ROP and PRA/HRA assessments more effective by focusing resources on an area that contributes most significantly to operating events.

Attachments: As stated

Reviewing the Problem Identification and Resolution of Human Performance Problems" (attached).

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