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SUBJECT: CASE STUDY REPORT - SOLENOID OPERATED VALVE PROBLEMS AT U.S. LIGHT-WATER REACTORS (NUREG-1275, VOLUME 6) AEOD/C90-01

Dear Mr. Liantonio:

We have completed a case study on solenoid-operated valve (SOV) experience at U.S. light-water reactors. A copy of the case study report is enclosed for your information. This report incorporates, as appropriate, peer review comments received from you and other industry groups. A copy of a report describing disposition of all comments is available in the NRC's Public Document Room. The SOV operating experience indicates that there have been failures across the industry in quality programs associated with these components, (i.e., deficiencies in the design, application, manufacture, maintenance, surveillance testing and feedback of failure data).

The report includes over 20 representative events in which common-mode failures or degradations of SOVs affected, or had the potential to affect multiple safety systems or multiple trains of individual safety systems. The report discusses the root causes of common-mode failures and degradations that have been observed and provides recommendations to reduce the occurrence of common-mode SOV failures. The report provides an in-depth evaluation of the root causes of many SOV failures.

Common-mode SOV failures have jeopardized front-line safety systems and important support systems such as emergency ac power, auxiliary feedwater, high pressure coolant injection, and scram systems, resulting in reductions in safety margins. For example, some of the more significant common-mode SOV events discussed in the report are:

- Simultaneous common-mode SOV failures which resulted in the failure of both emergency diesel generators to start at the Perry plant
- Simultaneous common-mode failures within the scram system at Susquehanna
- Common-mode scram pilot solenoid valve failures which resulted in primary system leakage outside primary containment at Dresden
- Simultaneous common-mode failures of two SOVs and the potential failures of 58 additional SOVs in multiple systems at Kewaunee
- Simultaneous common-mode failures of MSIVs to close upon demand at Perry and Brunswick
- Simultaneous common-mode failures of SRV/ADS valves at Brunswick

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The events in which common-mode failures of SOVs have affected multiple trains of safety systems or multiple safety systems are important precursors which resulted in significant reductions in safety margins. Some actions are already in progress such as overall improvements in maintenance and specific work on air systems that should reduce some of the failures described in this report, however, further action is necessary to ensure that important plant systems function as designed.

The NRC staff is working with IEEE and has had initial discussions with ASME (O&M) to establish and improve maintenance and testing consensus standards for SOVs. We have also had formative discussions with EPRI/NMAC about participation in the development of detailed industry guidance on SOV maintenance. We are currently discussing the possibility of an SOV workshop with NUMARC. We believe that the design and application verification activities and the review of surveillance testing practices recommended in the case study should be done in concert with the IEEE, ASME, EPRI/NMAC, NUMARC and INPO activities.

We have recommended issuance of generic correspondence to cause licensees to reassess their programs associated with SOVs consistent with the lessons of this study.

In addition, we recommend an industry group such as INPO take action to improve the mechanism for communicating SOV failure data to the manufacturers, for timely detection and resolution of potential generic problems. Under separate cover, the case study report is being forwarded to other industry groups and utilities for improvement of the SOV failure feedback mechanisms.

Implementation of these efforts in consonance will assist in preventing common-mode SOV failures, and will assure that important plant equipment will satisfactorily perform their safety function.

Original signed by

Thomas M. Novak, Director  
Division of Safety Programs  
Office for Analysis and Evaluation  
of Operational Data

Enclosure: As stated

cc: Mr. K. Wenzel, Target Rock Corporation  
Mr. T. Crowley, Target Rock Corporation

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Mr. Vito Liantonio

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