UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 25 1991

MEMORANDUM FOR: Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

FROM: Edward L. Jordan, Director
Office for Analysis and Evaluation
of Operational Data

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

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 and action. This report incorporates, as appropriate, peer review comments. The operating experience indicates that there have been failures across the industry in quality programs associated with SOVs (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.

My 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 feasibility of an SOV workshop with NUMARC. I 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 and my staff will continue to support this effort consistent with agreements we work out with you.

We recommend that the NRC issue appropriate generic correspondence to cause licensees to reassess their programs associated with SOVs consistent with the lessons of this study. The content of any generic communication should address (1) the compatibility of SOV design and plant operating conditions, (2) the adequacy of plant maintenance programs, (3) fluid contamination, (4) SOV surveillance testing practices, and (5) compliance of SOVs used in safety-related applications with quality assurance requirements associated with manufacturing, procurement, installation and maintenance. I view the issue of correcting SOV problems affecting safety-related equipment as an issue of compliance with the licensing basis, and GDC 1 and 4. Recognizing that each operating plant has on the order of a thousand SOVs in safety-related applications, plant specific remedial actions will have to be prioritized. We are prepared to assist you in this approach.

In addition, we recommend an industry group take action to improve the mechanism for communicating SOV failure data to the manufacturers, for timely detection and resolution of potential generic problems. We are prepared to meet with industry groups such as NUMARC or INPO regarding this matter. Under separate cover, the case study report is being forwarded to industry groups, utilities and manufacturers 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:
E. L. Jordan

Edward L. Jordan, Director
Office for Analysis and Evaluation
of Operational Data

Enclosure: As stated

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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. Timely action is necessary to ensure that important plant systems function as designed, to provide adequate protection to the health and safety of the public.

My 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 feasibility of an SOV workshop with NUMARC. I 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 recommend that you take action to assure that for safety-related applications, licensees: (1) verify the compatibility of SOV design and plant operating conditions, (2) verify the adequacy of plant maintenance programs, (3) ensure that SOVs are not subjected to fluid contamination (e.g., instrument air), (4) review SOV surveillance testing practices, and (5) verify that SOVs used in safety-related applications have been manufactured, procured, installed, and maintained commensurate with their safety functions. Recognizing that each operating plant has on the order of a thousand SOVs in safety-related applications, plant specific remedial actions will have to be prioritized. We are prepared to assist you in this approach.

In addition, we recommend an industry group take action to improve the mechanism for communicating SOV failure data to the manufacturers, for timely detection and resolution of potential generic problems. We are prepared to meet with industry groups such as NUMARC or INPO regarding this matter. Under separate cover, the case study report is being forwarded to industry groups, utilities and manufacturers 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.

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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. Appropriate action is necessary to ensure that important plant systems function as designed, to provide adequate protection to the health and safety of the public.

We recommend that you take action to assure that for safety-related applications, licensees: (1) verify the compatibility of SOV design and plant operating conditions, (2) verify the adequacy of plant maintenance programs, (3) ensure that SOVs are not subjected to fluid contamination (e.g., instrument air), (4) review SOV surveillance testing practices, and (5) verify that SOVs used in safety-related applications have been manufactured, procured, installed, and maintained commensurate with their safety functions. In addition, we recommend an industry group 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 industry groups, utilities and manufacturers for improvement of the SOV failure feedback mechanisms.

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Implementation of these programs in parallel to close the SOV operating experience feedback loop will assist in preventing common-mode SOV failures, and will assure that important plant equipment will satisfactorily perform their safety function.

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