November 12, 2003

MEMORANDUM TO: J. E. Dyer, Director
Office of Nuclear Reactor Regulation

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

SUBJECT: PROPOSED RECOMMENDATIONS FOR GENERIC ISSUE (GI)-186, "POTENTIAL RISK AND CONSEQUENCES OF HEAVY LOAD DROPS IN NUCLEAR POWER PLANTS"

The Office of Nuclear Regulatory Research (RES) has completed the technical assessment of GI-186. This memorandum transmits our analysis recommendations to address the GI-186 technical assessment observations in accordance with Management Directive (MD) 6.4, "Generic Issues Program." The technical assessment and basis for all follow-on recommendations is documented in NUREG-1774, "A Survey of Crane Operating Experience at U.S. Nuclear Power Plants from 1968 through 2002," dated July 2003.

On September 11, 2003, RES briefed the ACRS on our technical assessment of GI-186, and proposed recommendations. In a letter to Dr. William D. Travers, dated September 24, 2003, the ACRS concurred with our recommendations and conclusions. Our recommendations were previously discussed with John Hannon of your staff and include the following:

(1) Evaluate the capability of various rigging components and materials to withstand rigging errors (e.g., absence of corner softening material, acute angle lifts, shock from load shifts, and postulated human errors). As appropriate, issue necessary guidelines for rigging applications.

(2) Endorse ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)" for Type I cranes as an acceptable method of qualifying new or upgraded cranes as single-failure-proof. As appropriate, issue guidance endorsing the standard.

(3) Reemphasize the need to follow NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," Phase I guidelines involving good practices for crane operations and load movements. Continue to assess implementation of heavy load controls in safety-significant applications through the Reactor Oversight Process.

The basis for each recommendation is summarized in the Attachment.

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An additional technical assessment recommendation to evaluate the need to establish standardized load drop calculation methodologies for heavy load drops was based on inconsistent load drop analyses performed by licensees. The technical assessment of GI-186 observed that calculational methodologies, assumptions, and predicted consequences of heavy load drops varied greatly from licensee to licensee for very similar accident scenarios. To address this recommendation, RES will contact appropriate code committees to request that they evaluate the need to establish standardized load drop calculation methodologies for heavy load drops at nuclear power plants.

As the ACRS noted, the evaluation of operating experience indicates that operating events during heavy load movements do not pose a high nuclear plant safety risk because of the low drop frequency. Therefore, new requirements on a generic basis could not be justified as a cost beneficial safety enhancement nor as actions necessary for adequate protection. Nevertheless, enhancements to existing NRC guidance, as indicated by the recommendations, would address many of the issues identified by the survey of operating experience.

In support of the NRC Strategic and Performance Goals, the agency has adopted several parameters to measure the results of its efforts. These measures include limiting the annual number of events (summed over all operating plants) which could be considered precursors to severe accidents, limiting the annual number of radiation overexposures to personnel, and limiting the annual number of releases of radioactive material to the environment. Crane accidents have the potential to result in all three of these types of events. The operational experience and human performance insights contained in the technical assessment of GI-186 (NUREG-1774) can be used to enhance the control of heavy loads to reduce the likelihood of crane accidents, particularly those that have the potential to release radioactive material. In addition, another performance goal is to increase public confidence in the agency's ability to maintain safety. Although many crane accidents had little or no potential to release radioactive material, these events may have a negative effect on the public's confidence. It should be noted that even though heavy load movements do not pose a high nuclear plant safety risk on a generic basis, the number of below-the-hook events have increased substantially in the last decade when compared to the previous decade.

Attachments: As stated

cc w/att.:
C. Paperiello, DEDMRS

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# Proposed Recommendations for GI-186

(1) Evaluate the capability of various rigging components and materials to withstand rigging errors (e.g., absence of corner softening material, acute angle lifts, shock from load shifts, and postulated human errors). As appropriate, issue necessary guidelines for rigging applications (NRR).

Basis: The potential exists for significant load drop accidents to occur in the event of rigging failures. Many of these events could occur in spite of equipment defense- in-depth such as the application of single-failure-proof cranes. For the period 1968 through 2002, there were 47 below-the-hook or rigging events at nuclear power plants. All three very heavy load drops (loads greater than 30 tons) were the result of synthetic rigging failures caused in large part by human errors. During the last decade (1993-2002) there were 33 below-the-hook events which represented an increase of 230 percent when compared to the previous decade, concurrent with an increase in the number of operating units by 9 percent. While none of these events led to radiation exposures, 17 involved load drops, and 10 resulted in equipment damage.

(2) Endorse ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)" for Type I cranes as an acceptable method of qualifying new or upgraded cranes as single-failure-proof. As appropriate, issue guidance endorsing the standard (NRR).

Basis: ASME NOG-1 received ANSI approval in October 1998, and contains much more specific design information than does NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants," in explaining design criteria for single-failure-proof cranes. NUREG-0554, and NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," provide current NRC guidance for what constitutes design requirements for single-failure-proof cranes (NUREG-0554), and what modifications are required to upgrade an existing crane to a single-failure-proof classification (Appendix C of NUREG-0612). Both of these documents have been interpreted differently by licensees and vendors. It is also not clear what "credit" could be given by the NRC to licensees that had modified cranes to make them more reliable and failure proof, when making very heavy load movements over safety-related equipment, if the crane did not meet all of the design criteria of NUREG-0554 or Appendix C of NUREG-0612. Although single-failure-proof cranes share many common design features (e.g., dual reeving, redundant limit switches, and redundant brakes), the remaining criteria for declaring a crane as single-failure-proof have been inconsistently applied. Crane manufacturers also stressed that NUREG-0554 is ambiguous in some areas, and that clarification or changes also need to be made to NUREG-0612.

(3) Reemphasize the need to follow NUREG-0612, “Control of Heavy Loads at Nuclear Power Plants,” Phase I guidelines involving good practices for crane operations and load movements. Continue to assess implementation of heavy load controls in safety-significant applications through the Reactor Oversight Process (NRR).

Basis: Failure to follow accepted crane operating good practices, designed to reduce the likelihood of a major crane accident affecting the power plant or the public, is viewed as a major contributor to past and future crane accidents. These good practices are contained in Section 5.1.1 of NUREG-0612 (often referred to as Phase I Guidelines) and include guidance for establishing safe load paths, procedures for load handling operations, operator training, lifting device requirements, routine crane inspections, and crane design criteria. The human error rate for crane operating events has significantly increased, and for the last several years, between 70 and 80 percent of reported crane events have involved human errors. A significant reduction in the number and severity of crane events could be achieved through greater adherence to existing program guidance. Major program implementation weaknesses included; failure to follow procedures, load path violations, failure to test equipment prior to use, and system alignment issues during load movements.