August 14, 2003

Dr. John Larkins, Executive Director
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: PROPOSED REGULATION AND GUIDANCE DEVELOPMENT RECOMMENDATIONS FOR GENERIC ISSUE 186, "POTENTIAL RISK AND CONSEQUENCES OF HEAVY LOAD DROPS IN NUCLEAR POWER PLANTS"

Dear Dr. Larkins:

The Office of Nuclear Regulatory Research (RES) has recently completed the technical assessment of Generic Issue (GI) 186, "Potential Risk and Consequences of Heavy Load Drops in Nuclear Power Plants." In accordance with Management Directive 6.4, "Generic Issues Program," RES recommends the development of regulation and guidance. The attached recommendations and technical basis (NUREG-1774, "A Survey of Crane Operating Experience at U.S. Nuclear Power Plants from 1968 through 2002," issued in July 2003) for the RES recommendations is provided for your comment and feedback.

Our objective is to meet with the ACRS to present our assessment of GI-186 resolution. The attached NUREG-1774 contains several important observations that were used in the development of recommendations that we would like the ACRS to focus on. These observations include the strengths and weaknesses exhibited by crane operating experience and programmatic control of heavy load movements at U.S. nuclear power plants:

(1) The human error rate for crane operating events has significantly increased during the last several years; between 70 and 80 percent of reported crane events have involved human errors.

(2) Load drops while operating the spent fuel pool crane (representing over half of the load drop events) were largely fuel assembly drops caused by grapple operation or human errors which posed no safety issue.

(3) Load drops while operating mobile and other cranes (representing almost half of the events) have occurred outside of safety-related areas.

(4) The number of below-the-hook crane events (mainly rigging deficiencies or failures) has greatly increased during the last decade.

(5) There were inconsistent load drop calculation methodologies and consequences.

(6) There have been no Accident Sequence Precursor (ASP) events for the period 1985 through 2002 that involved a crane.

(7) There have been 10 loss of power events caused by crane operation from 1968 through 2002, nine of which were caused by mobile cranes.

(8) There have been 30 crane events involving either a fuel assembly drop or damage to a fuel assembly caused by handling; however, none of the events resulted in radiation exposure or risk to personnel.

(9) Of the estimated 54,000 very heavy load lifts at operating plants since the issuance of NUREG-0612, “Control of Heavy Load at Nuclear Power Plants,” three very heavy load drops were identified. These three very heavy load drop events occurred as a result of human error, and ultimately rigging deficiencies, and not because of crane deficiencies.

(10) The criteria for single-failure-proof crane classification has been inconsistently applied.

(11) There have been 29 NRC generic communications that have involved load movements at U.S. nuclear power plants dating back to 1976.

The meeting with the ACRS provides us with an opportunity to integrate into the resolution process ACRS comments and insights prior to making final our recommendations. The attached proposed recommendations have been discussed with NRR. In accordance with Management Directive 6.4, we will provide NRR with our final recommendations on resolution following our meeting with the ACRS.

Sincerely,

/RA/

Farouk Eltawila, Director
Division of System Analysis
and Regulatory Effectiveness
Office of Nuclear Regulatory Research

Attachments: As stated

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Regulation and Guidance 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.

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.

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 Load 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 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.

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. Appendix C to NUREG-1774 provides the results of a DOE study of hoisting and rigging incidents occurring between 1993 and 1996. The DOE study indicates that approximately 94 percent of hoisting and rigging incidents were caused by human error. Two major contributors included inattention to detail, which accounted for 56 percent of the incidents, and not following procedures, which accounted for 28 percent of the incidents. Appendix E to NUREG-1774 provides the results of Navy crane operating experience from 1995 to 1999. This study indicated that human factors or human errors were the leading causes of Navy crane issues. For example, improper operation, improper rigging, and procedure failure accounted for approximately 88 percent of crane issues.

(4) Evaluate the need to establish standardized load drop calculation methodologies for heavy load drops.

Basis: Calculational methodologies, assumptions, and predicted consequences varied greatly from licensee to licensee for very similar accident scenarios. Accurate load drop analysis is essential, since each licensee uses load drop calculations to determine transport height restrictions which are referenced in their heavy load lift procedures. Load height restrictions contained in NUREG-0612 should also be consistent with conservative load drop analysis results. Load drop analyses also determine locations where other measures besides load height restrictions are necessary (e.g., impact limiting devices, interlocks to prevent crane motion over certain areas, or employment of single-failure-proof handling systems).