

May 4, 2004

MEMORANDUM TO: Farouk Eltawila, Director  
Division of Systems Analysis and Regulatory Effectiveness  
Office of Nuclear Regulatory Research

FROM: Michael E. Mayfield, Director/*RA*/  
Division of Engineering Technology  
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"

Reference: November 21, 2003, memorandum from Farouk Eltawila to Michael E. Mayfield  
re: Proposed Recommendations for Generic Issue (GI)-186, "Potential Risk and  
Consequences of Heavy Load Drops in Nuclear Power Plants"

The referenced memorandum requested DET to evaluate the need to establish standardized load drop calculation methodologies for heavy load drops. It requested that DET contact the appropriate Standards Development Organizations (SDOs) requesting them to evaluate the need to establish standardized load drop calculation methodologies for heavy load drops at nuclear power plants.

Subsequently DET determined that the American Concrete Institute (ACI) was the appropriate SDO, and the applicable standard is ACI-349-1997, "Code Requirements for Nuclear Safety Related Concrete Structures." ACI-349-1997 is acceptable to the NRC when supplemented by the staff positions in Regulatory Guide 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)."

DET has concluded that ACI-349 as supplemented by Regulatory Guide 1.142 provides adequate criteria for the design of safety related concrete structures for heavy load drops. A detailed discussion of the DET evaluation is contained in the attachment to this memorandum.

Attachment: As stated

DISTRIBUTION: DET r/f Cherny, Graves, M. Evans, Mayfield, Flack, R. Lloyd

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## GENERIC ISSUE (GI) 186, "POTENTIAL RISK AND CONSEQUENCES OF HEAVY LOAD DROPS IN NUCLEAR POWER PLANTS"

### Request for DET Review

**DSARE Request:** Evaluate the need to establish standardized load drop calculation methodologies for heavy load drops.

**DET Response:** DET staff have reviewed Appendix F, "Load Drop Calculation Involving Heavy Loads at U.S. Nuclear Power Plants," of NUREG-1774 and have discussed with R. Lloyd of DSARE regarding the need to establish standardized load drop calculation methodologies for heavy load drops.

In November 2001 RES issued Regulatory Guide 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)," (RG 1.142). RG 1.142 endorses American Concrete Institute (ACI) code ACI 349-1997, "Code Requirements for Nuclear Safety Related Concrete Structures." The ACI 349 code is an industry consensus document and thus reflects the current state of the art and industry practices.

Regulatory Positions 10 and 11 of RG 1.142 endorse Appendix C, "Special Provisions for Impulsive and Impactive Effects," of ACI 349-1997 with certain clarifying exceptions that reflect existing review practices of the NRC staff (e.g., limits ductility ratio for some load cases and restricts the use of a dynamic increase factor for a dynamic load factor in cases where the structure is found to be responding in a static or semi-static manner to a dynamic load).

The provisions of Appendix C of ACI 349 apply to those structural elements directly affected by the impactive and impulsive loads where failure of the structural element must be precluded. Impactive loads to be considered by Appendix C of ACI 349 include, but are not limited to: 1) tornado-generated missiles, 2) fuel cask drop, and 3) other internal and external missiles. Appendix C of ACI 349 also states that design for impactive loads shall satisfy the code criteria for both local effects and for overall structural response. Local impactive effects may include penetration, perforation, scabbing and punching shear. The penetration depth and required concrete thickness to prevent perforation shall be based upon applicable formulas and pertinent test data.

In light of the requirements of Appendix C of ACI 349 and the endorsement of the ACI 349 code in RG 1.142, DET concludes that DSARE concerns about standardizing floor design criteria have been addressed. However, DET also believes that the ACI 349 code committee can benefit from knowing that some licensees who use the ACI 349 code for load drop calculations have reported varied load consequences for very similar accident scenarios. DET will inform the ACI 349 code committee about NUREG-1774, "A survey of Crane Operating Experience at U.S. Nuclear Power Plants from 1968 to 2002" and request that the code committee consider how code language could be changed to assure that users of the code apply the code criteria appropriately in the same way.

DET concludes that no written RES action is required at this time.