

January 30, 2004

Mark A. Peifer
Site Vice President
Duane Arnold Energy Center
Nuclear Management Company, LLC
3277 DAEC Road
Palo, IA 52324-0351

SUBJECT: DUANE ARNOLD ENERGY CENTER - SUPPLEMENT TO SAFETY
EVALUATION FOR AMENDMENT NO. 251 REGARDING REACTOR
BUILDING CRANE (TAC NO. MB8003)

Dear Mr. Peifer:

On May 16, 2003, the U.S. Nuclear Regulatory Commission (NRC) issued Amendment No. 251 to Facility Operating License No. DPR-49 for the Duane Arnold Energy Center in response to your application dated March 11, 2003. The amendment added a paragraph to the operating license authorizing the licensee to revise the Updated Final Safety Analysis Report by deleting the notation that the NRC does not endorse the reactor building crane as single-failure-proof. The NRC's letter of May 16, 2003, also forwarded a copy of the safety evaluation supporting the amendment.

The enclosure provides revised pages for the safety evaluation. The revision adds a new paragraph regarding your conformance with NUREG-0554, "Single Failure Proof Cranes For Nuclear Power Plants" in that your analysis assumed that the lifted load and lower load block are decoupled from the bridge and trolley with respect to horizontal earthquake accelerations. You have addressed the basis for this assumption by letter dated January 7, 2004. As noted in the new paragraph, the NRC staff has assessed your assumption and finds the swinging load effects to be negligible. The NRC staff finds your assumption that the lifted load and lower load block may be decoupled from the bridge and trolley with respect to the horizontal accelerations reasonable and acceptable.

This revision to the safety evaluation does not affect the NRC staff's conclusion that you have performed acceptable seismic analyses for the crane and its supporting structure, the NRC staff's acceptance of the reactor building crane as being single-failure-proof for handling loads up to 100 tons, or the associated change to the operating license.

M. Peifer

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Please use the enclosed revised pages numbered 5, 6, and 7 (new) to replace pages numbered 5 and 6 of the safety evaluation forwarded May 16, 2003.

Sincerely,

/RA/

Darl S. Hood, Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-331

Enclosures: Revised Pages 5 and 6 and new page 7 of
Safety Evaluation for Amendment No. 251

cc w/encls: See next page

Please use the enclosed revised pages numbered 5, 6, and 7 (new) to replace pages numbered 5 and 6 of the safety evaluation forwarded May 16, 2003.

Sincerely,

/RA/

Darl S. Hood, Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-331

Enclosures: Revised Pages 5 and 6 and new page 7 of
Safety Evaluation for Amendment No. 251

cc w/encls: See next page

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the bridge is required to remain on the runway with brakes applied, and the trolley is required to remain on the runway with the crane girders with brakes applied. The pendulum and swinging effects due to seismic and other operational loads, including the maximum critical load (MCL), are to be considered in the seismic design of these crane components.

In its letter of December 21, 2001, the licensee stated that it had installed the Ederer X-SAM single-failure-proof crane trolley system and that a seismic analysis had been performed to check the design of the crane girders for the increased loadings imposed by the trolley upgrade. The NRC staff reviewed the licensee's analysis for the OBE and the SSE to determine if the reactor building crane would remain on its runway with the brakes applied and retain and hold the load under such conditions. The NRC staff agrees with the licensee that the crane would retain and hold the load under these conditions because the safety devices of the X-SAM main hoist, as accepted by the NRC staff, protects against dropping the load under these conditions. In addition, Section 9.1.4.4.4 of the UFSAR states that the reactor building with its entire lifting system is designed to Seismic Category 1 criteria as described in Section 3.8 of the UFSAR. Therefore, the bridge and trolley will remain on their respective runways because they have been designed to withstand the effects of seismic events as described in the UFSAR.

In its seismic analyses for the reactor building crane, forwarded by letter dated December 21, 2001, the licensee made the assumption that the lifted load and lower load block are decoupled from the bridge and trolley with respect to horizontal earthquake accelerations. As a result of this assumption, the effect of the pendulum and swinging loads were not incorporated into the load combinations presented in the licensee's amendment request. Section 2.5, "Seismic Design" of NUREG-0554 states that "The MCL (maximum critical load) plus operational and seismically induced pendulum and swinging load effects on the crane should be considered in the design of the trolley, and they should be added to the trolley weight for the design of the bridge." The staff was unclear whether the assumption to ignore the effects of the swinging load was established based on an engineering determination of their insignificant contribution to the overall lateral seismic design loads. In a telephone conference during the NRC staff's review of the amendment request, the licensee indicated to the staff that it had considered the effects from horizontal seismic excitation on the swinging load, and had determined that these effects were insignificant. The staff found the licensee's explanation to be reasonable and, at that time, did not feel the need to include a discussion of these effects in its SER since the licensee's assessment was consistent with the provisions of NUREG-0554. However, since issuance of Amendment No. 251, the NRC staff has determined that the SER accompanying the amendment should be supplemented to ensure proper documentation of the judgement exercised by the licensee, and the basis for the staff's agreement with that judgement. Therefore, the NRC staff requested the licensee to document the basis for its conclusion regarding the effects from the horizontal seismic excitation on the swinging load. In response to this NRC staff request, the licensee stated in a letter dated January 7, 2004, that:

The fundamental building frequency of the reactor building structure is much higher than that of the crane/load system. The response spectra for the building peak at a period of less than 1/3 second. An informal review of the crane/load system indicates that the shortest expected period would be greater than 3 seconds. Therefore, the horizontal seismic forces exerted on the suspended load would have no appreciable effect on the crane or the building structure.

The NRC staff has verified in an independent analysis that, as the licensee states above, the fundamental period of the crane/load system is indeed much larger than that for the reactor building. Furthermore, from its examination of DAEC's safe shutdown earthquake (SSE) spectra, the NRC staff finds that the horizontal seismic excitation above a natural period of 1 second is insignificant (less than 0.1g). Therefore, the largest dynamic responses of the reactor building, crane, and supporting structure resulting from the input seismic ground motion would be at periods that are much lower than the natural period for the swinging load, implying that the load would not be excited by the building motion. Of further concern is the possibility that the motion of the reactor building, crane, and supporting structure during an earthquake is significant enough that the load does not remain directly below the crane. However, the largest spectral displacement from the DAEC SSE is only 4 inches at a natural period of 10 seconds. In addition, structural amplification of these long period ground motions at the elevation of the crane at 200 feet above the foundation is not likely to be significant. A natural period of 10 seconds corresponds to an 80-foot long pendulum (a possible configuration at a boiling-water reactor facility), and a 4-inch displacement at this length would add a negligible amount to the horizontal forces acting on the crane. Thus, the NRC staff concludes that the swinging load effects on the crane are negligible and that the licensee's assumption that the lifted load and lower load block are decoupled from the bridge and trolley with respect to horizontal earthquake accelerations is appropriate. On this basis, the licensee's conformance with the provisions in Section 2.5 of NUREG-0554 in the seismic analyses is acceptable.

The NRC staff's review of the crane girder diaphragm plates led the NRC staff to question DEACs acceptance of a three-percent overstress condition in the plates. In a letter dated December 4, 2001, in response to the NRC staff's request for additional information concerning the crane girder diaphragm plates, the licensee stated that it had completed a material certification records search for the diaphragm plates. The records search for the diaphragm plates indicated that the minimum material yield strength was greater than that used in the original calculation. Increasing the yield strength to reflect the material certification for the crane girder diaphragm plates resulted in acceptable design load bearing stress. Therefore, the reactor building bridge crane is robust enough to support the increase loading from the new trolley configuration with a lifted load under SSE and OBE conditions.

Based upon its review of the licensee's evaluation, the NRC staff agrees that the components of the upgraded crane at DEAC satisfy the seismic guidelines of NUREG-0554. The licensee's analysis demonstrates that the reactor building crane's capability to withstand a seismic event is within acceptable limits. Therefore, the new trolley and hoist and the existing bridge will safely perform their intended function of retaining an MCL of 100 tons under OBE and SSE conditions. The licensee's commitments to continue to meet the Phase I guidelines, combined with increasing the handling system reliability to meet the single-failure-proof guidelines of NUREG-0612, Appendix C, and NUREG-0554, provides reasonable assurance that handling of heavy loads at DEAC will be performed in a safe manner. Therefore, the NRC staff recognizes the reactor building crane as being single-failure-proof for an MCL of 100 tons.

3.3 Conclusion

Based upon the preceding discussion, including the NRC staff's assessment of the licensee's clarification regarding conformance of the assumption in the seismic analysis with Section 2.5 of NUREG-0554, the NRC staff concludes that the licensee's proposal to credit DAEC's reactor

building crane as single-failure-proof in Section 9.1.4.4.5 of the UFSAR satisfies the guidelines of NUREG-0612, NUREG-0554, and is consistent with the NRC staff's acceptance of EDR-1 (P)-A. On the basis of its review, the NRC staff finds that the licensee has performed acceptable seismic analyses for the crane and its supporting structure. The NRC staff further finds that the licensee's NUREG-0612 Phase I commitments, in addition to meeting NUREG-0554 seismic guidelines, provide adequate defense-in-depth to maintain safety during heavy load handling operations at DEAC. Accordingly, the NRC staff recognizes and accepts the DAEC reactor building crane as being single-failure-proof for handling loads up to 100 tons. Therefore, the proposed change to the UFSAR is appropriate.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Iowa State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATIONS

This amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluent that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (68 FR 18278). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The NRC staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: G. Hatchett
J. Ma
D. Hood

Date: May 16, 2003