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0CAN070305

July 21, 2003

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Arkansas Nuclear One - Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6
Response to NRC Request for Additional Information on Handling Heavy Loads for Arkansas Nuclear One's Spent Fuel Crane

References:
1. Entergy letter dated February 24, 2003, *Proposed License Amendment for Increase in Handling Heavy Loads for Arkansas Nuclear One's Spent Fuel Crane* (0CAN020307)
2. Entergy letter dated March 25, 2003, *Response to NRC Request for Additional Information on Handling Heavy Loads for Arkansas Nuclear One's Spent Fuel Crane* (0CAN030303)
3. Entergy letter dated June 30, 2003, *Response to NRC Request for Clarification of Handling Heavy Loads for Arkansas Nuclear One's Spent Fuel Crane* (0CAN060303)

Dear Sir or Madam:

As discussed in Reference 1, Entergy Operations, Inc. (Entergy) requested NRC approval of a proposed license amendment for Arkansas Nuclear One (ANO), Units 1 and 2 for the spent fuel crane (L-3 crane). The proposed amendment is requested for movement of loads up to the newly rated 130-ton capability for the single failure proof L-3 crane. The NRC staff provided requests for additional information during their review process to which Entergy responded on March 25, 2003 (Reference 2). Since the initial license amendment request and RAI response, Entergy performed further review of the design basis for the L-3 crane. As a result, Entergy upgraded the seismic design basis for the crane to design standards commensurate with new and modified structures. The results of the L-3 crane design upgrade were provided to the NRC in a letter dated June 30, 2003 (Reference 3).

On July 14, 2003, Entergy received a request for additional information (RAI) from the Mechanical and Civil Engineering Branch based on the new design basis. The responses to this RAI are contained in the Attachment to this submittal.

There are no new commitments being made in this letter. If you have any questions or require additional information, please contact Steve Bennett at 479-858-4626.

A001

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 21, 2003.

Sincerely,

CGA/SAB

Attachment:
Response to NRC Request for Additional Information on ANO Spent Fuel Crane Heavy Load Lifts

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Attachment

0CAN070305

Response to NRC Request for Additional Information on ANO Spent Fuel Crane Heavy Load Lifts

Response to NRC Request for Additional Information on ANO Spent Fuel Crane Heavy Load Lifts

Mechanical and Civil Engineering Branch (EMEB)

NRC RAI 1 The response to EMEB RAI-3 in Attachment 1 of the June 30, 2003, supplemental letter states, "Acceptance criteria are focused on assuring that the crane will hold and not drop the load which allows use of less restrictive acceptance criteria than a Category 1 component." Identify the specific criteria that you consider as less restrictive.

Response:

As noted in our submittal, Section 2.5 of NUREG-0554, *Single-Failure-Proof Cranes for Nuclear Power Plants*, provides the seismic design guidance for single failure proof cranes. This section states:

> *...the crane should be designed to retain control of and hold the load, and the bridge and trolley should be designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event. If a seismic event comparable to a safe shutdown earthquake (SSE) occurs, the bridge should remain on the runway with brakes applied and the trolley should remain on the crane girders with brakes applied.*
>
> *The crane should be designed and constructed in accordance with regulatory position 2 of Regulatory Guide 1.29, "Seismic Design Classification." The MCL 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.*

Components designed to Category 1 requirements would meet the more restrictive requirements of regulatory position 1 of Regulatory Guide 1.29, which requires that the components "be designed to withstand the effects of the SSE and remain functional." The absence of a requirement to remain functional, and the specific criteria which may be used to potentially accept seismic overstresses depending on the consequences of that overstress, are less restrictive. Additionally, Seismic Category 1 components are required to demonstrate margin under operating basis earthquake (OBE) conditions by meeting normal Code allowables, while components designed for II/I only need to show that failure will not occur under the more severe SSE conditions.

NRC RAI 2 The response to EMEB RAI-5 in Attachment 1 states, "Although a full response spectrum or time history analysis of the structure was not performed, both historical and current analyses calculated the first mode of the structure and used it to determine appropriate seismic accelerations." Discuss your justification for this simplification in the calculation by identifying the conservatism built into the employed methodology.

Response:

Conservatisms present in the structural analysis must be judged using criteria consistent with the original design and licensing basis. If the structure had been originally designed using the same methodology applied to other Seismic Category II structures, then the analysis would have considered a static seismic acceleration of only 0.05g, which would meet the requirements for Seismic Category II structures and provide reasonable protection against structural collapse under seismic conditions. By calculating the first mode of the structure and applying the acceleration of that first mode, the building was designed for an acceleration of approximately 0.6 g, which is much more than the Seismic Category II requirement. Additionally, loads imposed on the structure by the L-3 crane were increased as a result of the analytical methods applied, including most notably the increases in loads to account for possible multi-mode response of the upgraded crane. Tornado loads were also considered in the design of the structure and still control in the design of certain members. These methods provide a high degree of confidence that the intent of Regulatory Guide 1.29, position C.2 has been satisfied.

NRC RAI 3 It is stated in response to EMEB RAI-5, Attachment 1, that, "The new analyses considered the structure self-weight (original analyses considered only the seismic loads from the crane and the lifted load), which was greater than the structure self-weight." Confirm that the new analyses also considered the seismic loads from the crane and the lifted loads in addition to the structure self-weight.

Response:

Applicable calculations were reviewed, which confirmed that the current qualifying analyses considered both the structure self-weight and the seismic and lifted loads from the crane. In the vertical direction, this directly includes the lifted load. In the horizontal direction, the suspended load does not contribute a horizontal component to the lateral load because the period of oscillation is long, but the suspended load does increase the horizontal frictional loading on the wheels by delaying the onset of slippage.

NRC RAI 4 It is stated in response to EMEB RAI-5, Attachment 1, that, "Seismic loads to the bent frame included loads from the L-3 crane; however, the entire load was originally applied to one bent at a time and no credit was taken for load sharing between adjacent bents. New analysis shares the load between multiple bents." Explain how load sharing between adjacent bents would lead to conservative results.

Response:

The statement in question appeared in a section that listed several refinements incorporated into the most recent analyses. Most of those refinements would lead to results that were either more conservative than the original methods (e.g., consideration of self-weight; increased accelerations applied to L-3), or in some manner more consistent with the current "state-of-the-art" and regulatory expectations (e.g., consideration of the square root sum of the squares of three directions of loading). In the specific case of load sharing between bents, this refinement leads to an analysis that is more consistent with state-of-the-art approaches, but not necessarily more conservative, than if load sharing had not been considered.

NRC RAI 5 It is stated in proposed Amendment 19 to the Safety Analysis Report, page 9.6-34 (Attachment 2 to the June 30, 2003, supplemental letter), that, "An analysis was performed on the 3-foot, 6-inch thick reinforced concrete relay room ceiling slab, located below the cask travel path between column lines A2 and C2. The analysis was performed to demonstrate that a postulated cask drop would not damage any safety-related equipment located in the relay room. The analysis followed an energy absorption method. The energy input to the relay room ceiling slab was based on a 260 kip cask weight, 92-inch cask diameter and a drop height of one inch. This considers that the main hoist is designed such that the maximum load motion following a single wire rope failure is less than 1.5 feet and the maximum kinetic energy of the load will be less than that resulting from one inch free fall of the maximum critical load." Provide the basis for the criterion that the maximum kinetic energy of the load will be less than that resulting from one inch free fall of the maximum critical load.

Response:

This criterion is based on the crane design features, and is a design input that derives from the Ederer topical report, EDR-1, *eXtra Safety And Monitoring (X-SAM) Cranes*. Section III.E.4 and Appendix E of EDR-1 provides the basis for the maximum extent of load motion and peak kinetic energy of the load following a drive train failure, which in turn is used as the basis for the necessary structural evaluations. In Appendix B, Position C.2.b of the topical report, Ederer states: "The main hoist was designed such that the maximum vertical load motion following a drive train failure is less than 1.5 foot and the maximum kinetic energy of the load is less than that resulting from one inch of free fall of the maximum critical load."

NRC RAI 6 Attachment 6 to the June 30, 2003, supplemental letter, ANO Calculation No. 61 Rev. 2, "Fuel Building Cask Crane Runway Girds and Support," page 3B, says, "The runway was evaluated for 80% of lateral loads from Trolley based on its extreme location near one end of crane bridge in combination with 50% of the loads resulting from bridge dead loads." Provide justification for the 50% reduction in the bridge dead load.

Response:

The wording was not intended to suggest a reduction in loads since there is no reduction in the total bridge dead load considered. The crane bridge dead loads are distributed along its length and therefore, one-half (50%) of the total dead load is supported at each end where the runway girders are located.

NRC RAI 7 In reference to page 4 of ANO Calculation No. 61, Rev. 1, provide justification for the reduction in the vertical and horizontal impact values provided in the previous submittal.

Response:

Calculation 61, page 4, of both the initial and more recent submittals states that a "20% increase factor assumed conservatively in Attachment 1 will not be used for impact load determination..." This statement is a reference to Attachment #1 to Calculation 61. Since attachments to the calculation were not included in the transmittal, it was unclear as to what factor was being eliminated. Attachment 1 was a transmittal letter from Entergy to Sargent & Lundy (S&L) that forwarded preliminary wheel loading values provided by Ederer in order that S&L structural calculations could be performed in parallel with ongoing design work by Ederer. In that letter, wheel loading was based on three factors: 1) Live load of 130 tons or 265,000 lbs when including the lower block weight, 2) Estimated dead load of the new trolley, and 3) Approximate dead load of the crane components. Consideration of these three factors led to a preliminary estimate of the wheel load as 173.5 kips. This value was then multiplied by 1.2 to yield 208 kips as the design value that S&L was instructed to use. Thus, the 20% increase factor was not an impact factor, but rather an additional 20% margin that was added to preliminary wheel loads to reduce the probability of rework being required as the design progressed. Now that the final wheel load is known (~172 kips), as calculated by Ederer per Attachment 4 to Calculation 61 and is less than the preliminary wheel load (173.5 kips), inclusion of this additional 20% margin is no longer required. See item C on the next page for more maximum wheel load discussions.

A. Vertical Impact

The vertical impact values for the design of the runway girder are based on Crane Manufacturers Association of America (CMAA-70) which recommends a minimum value of 10% for the crane dead loads and 15% for the hoist (lifted) loads. The design impact values are based on the maximum trolley/hoist speed and are computed based on the equations specified by CMAA, Article 3.3.2.1.1.4.

Maximum crane operating speeds from EDERER 130 Ton X-SAM Trolley are:

Main Hoist Speed = 4 fpm
Trolley Speed = 28 fpm
Bridge Speed = 25 fpm

Using a maximum design speed of 28 fpm for the dead loads,

$V_{imp\_DL} = 0.05+(28 \text{ fpm}/2000)$ (formula derived from CMAA 3.3.2.1.1.4.1)
$= 0.064 < 0.10$ minimum

$V_{imp\_LL} = 0.005 \times 4 \text{ fpm}$ same as used in the bridge girder design calculations performed by Ederer in Ref. 27 of Calculation No. 61.
$= 0.02 < 0.15$ minimum.

Also, American Institute of Steel Construction (AISC) Manual of Steel Construction specifies an impact value of only 10% for both crane dead loads and lifted loads for pendant-operated cranes like the L-3 crane used at ANO.

Therefore, vertical impact values of 0.10 for crane dead loads and 0.15 for lifted loads based on CMAA are appropriate.

B. Horizontal Impact

The horizontal impact value for the design of the runway girder is based on ASME NOG-1-2002, Article 4133, *Rules for Construction of Overhead and Gantry Cranes*. The horizontal load is induced by acceleration or deceleration of the trolley wheels on the rails and is taken as 10% of the trolley and maximum lifted load. This is consistent with the bridge girder design calculations performed by Ederer in Ref. 27 of Calculation No. 61. The horizontal impact loads are also consistent with the AISC Manual of Steel Construction, which recommends a total value of 20%. Since the lateral stiffness of the two ANO runway girders is the same, this load is equally distributed (i.e. 10% to each runway girder).

Therefore, 10% impact factor used for the runway design in the horizontal direction is adequate.

C. Maximum Wheel Load

Earlier calculations were based on an estimated wheel load of 173.5 kips, which had been increased by 20% to yield a design value of 208 kips. The purpose of this 20% increase was to provide a "Not To Exceed" (NTE) value for preliminary design purposes, so that work by a subcontractor (Sargent & Lundy) could proceed in parallel with work by Ederer. The final runway girder design (Calc 61, page 4) did not include the above conservative 20% increase for impact load calculations since the final load of 172 kips was known. In the final calculations, in some locations a more conservative value for wheel loading (>172 kips) is used based on earlier estimates, but in no case is the load used less than would result from consideration of the as-built component weights and the lifted load of 130 tons.

In summary, impact loading is still considered using appropriate values; only the additional 20% factor that was used during preliminary designs to account for future changes has been eliminated. Since these calculations are now final, elimination of this additional 20% is appropriate.