From: "BENNETT, STEVE A" <SBENNE2@entergy.com>
To: Tom Alexion <twa@nrc.gov>
Date: 7/16/03 1:42PM
Subject: Input for L-3 call

see attached

Steve Bennett
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479-858-4626
Pager: 479-890-3323

Mail Envelope Properties (3F158E8C.4E0 : 10 : 29920)

Subject: Input for L-3 call
Creation Date: 7/16/03 1:42PM
From: "BENNETT, STEVE A" <SBENNE2@entergy.com>

Created By: SBENNE2@entergy.com

Recipients
nrc.gov
owf4_po.OWFN_DO
TWA (Thomas Alexion)

Post Office	**Route**
owf4_po.OWFN_DO	nrc.gov

Files	**Size**	**Date & Time**
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Expiration Date:	None
Priority:	Standard
Reply Requested:	No
Return Notification:	None
Concealed Subject:	No
Security:	Standard

DRAFT

FOLLOW-UP REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO ENTERGY'S RESPONSE TO THE NRC REQUEST FOR CLARIFICATION OF HANDLING HEAVY LOADS FOR THE ARKANSAS NUCLEAR ONE (ANO) SPENT FUEL CRANE 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 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 OBE conditions by meeting normal Code allowables, while components designed for II/I only need 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 as 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 were increased as a result of the analytical methods applied to calculation of loads imposed by the L-3 crane, 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, 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, and it was confirmed that the current qualifying analyses considered both the structure self-weight and the seismic 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 SRSS of three directions of loading). In the specific case of load sharing between bents, this refinement leads to an analysis that is more accurate and technically justified, 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. Ederer is required to provide Entergy with the maximum extent of load motion and peak kinetic energy of the load following a drive train failure, which is in turn used as the basis for the necessary structural evaluations. In Appendix B, Position C.2.b to 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, as 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:

The discussion of impact loads on page four states that a "20% increase factor assumed in Attachment 1 will not be used..." Attachments to the calculation were not included in the transmittal, which may have left it unclear as to what factor was being eliminated. Attachment 1 more clearly identifies that the 20% increase factor was not an impact factor, but rather an additional 20% margin that was added to preliminary loads to reduce the probability of rework being required as the design progressed. Now that final loads are known, inclusion of this additional 20% margin is no longer required. Impact factors are still considered in the design, as discussed in more detail below.

A. Vertical Impact

The vertical impact values for the design of the runway girder are based on CMAA 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)
$= 0.064 < 0.10$ min.

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

Also, 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 L-3 Crane used at ANO.

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

B. Horizontal Impact

The horizontal impact value for the design of 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. This value agrees with the AISC recommended total value of 20% equally distributed among two runway girders, i.e. 10% to each runway girder, whose lateral stiffness are same as is the case with the ANO runway girders.

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

C. Maximum Wheel Load

Revision 1 of the runway girder design calculation No. 61 in the previous (February, 2003) submittal is based on a maximum wheel load of 208 kips transmitted by Ederer as a not to exceed (NTE) value which in turn was based on a preliminary set of weights for the L-3 crane and associated components. Therefore, a 20% increase was applied by Ederer to the maximum computed wheel load of 173.5 kips to account for future variations (Ref. Attachment 1, Calc.61, Rev. 1). The final runway girder design omitted the above conservative 20% increase for impact load calculations since there is no increase in the 265 kips lifted load which is the most contributing load for the crane system design and since no reduction was taken in the maximum wheel load of 208 kips used for design of the runway girder.

However, the final maximum wheel load contained in Attachment 4 of Calc. 61, Rev. 2 for bridge girder design is based on the as-built crane and component weights which is 172 kips. This is slightly less than the preliminary load of 173.5 kips. Therefore, omitting the 20% increase factor from final calculations for impact loads calculation is acceptable. Therefore, the runway girder design has more margin than shown in Revision 1 of the calculation since a 20% larger than actual wheel load was used to compute normal stresses.

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