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SUBJECT: Forwards response to NRC review of seismic analysis of DG excitation cabinet found unacceptable.

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Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Response to NRC Review of the Seismic Analysis of Diesel Generator Excitation Cabinet

References: 1) Letter from E.G. Greenman (NRC) to J.A. Zwolinski (NRR-NRC), "Request For Technical Assistance: Review of Seismic Analysis For Kewaunee Diesel Generator Excitation Cabinet", dated April 14, 1992.

2) Letter from J.A. Zwolinski (NRR-NRC) to E.G. Greenman (NRC), "Task Interface Agreement: Review of Seismic Analysis For Kewaunee Diesel Generator Excitation Cabinet", dated August 25, 1992.

3) WPSC Calculation C-10042, Anchorage Analysis of DR-101 and DR-111 Diesel Generator Excitation Cabinets, dated April 7, 1992.

A NRC memorandum dated August 25, 1992 (reference 2), describes the results of a technical review of a Wisconsin Public Service Corporation (WPSC) calculation (reference 3). The calculation addresses the seismic adequacy of the as-found anchorage configuration of the Diesel Generator Excitation Cabinets at the Kewaunee Nuclear Power Plant (KNPP). The review was performed by the staff of the NRC Office of Nuclear Regulatory Regulation (NRR) at the request of the Region III Division of Reactor Projects, as described in reference 1.

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In the memorandum, the Staff disagrees with the assumptions and conclusions stated in the calculation and states that the Staff considers the calculation to be unacceptable for demonstrating the seismic adequacy of the as-found configuration of the cabinets. Although the memorandum does not request a response by WPSC, we believe it is necessary to address the concerns identified by the Staff.

Attachment 1 of this letter provides the specific responses to the Staff's concerns, as listed in Enclosure 1 of reference 2. The responses were prepared in consultation with Stevenson & Associates, who is the primary consultant for WPSC's USI A-46 project. Stevenson & Associates is considered to be highly qualified to comment on the issues in question, since they were one of the co-authors of the Generic Implementation Procedure (GIP) developed by the Seismic Qualification Utility Group (SQUG) for resolution of USI A-46, as well as being recognized within the industry as a leading authority in the seismic analysis of nuclear plant equipment.

Based on the discussion provided in the attachment to this letter, WPSC believes that the calculation in question is acceptable for demonstrating the seismic adequacy of the DG Excitation Cabinets. WPSC appreciates the Staff's concerns and efforts to resolve this matter and trusts that the discussion provided in the attachment will resolve the Staff's concerns. During subsequent USI A-46 evaluations, WPSC will exercise additional rigor in assessing equipment operability concerns.

If there are any questions, please contact a member of my staff.

Sincerely,

C.A. Schrock

C.A. Schrock
Manager - Nuclear Engineering

GCR/jac

Attach.

cc - US NRC, Region III
Mr. Patrick Castleman, US NRC

LIC\NRC\DGCAB.WP

WPSC RESPONSE TO NRC CONCERNS

The following discussion is in response to the concerns listed in Enclosure 1 of Reference 2.

I. BACKGROUND

During the month of March, 1992, Wisconsin Public Service Corporation (WPSC) was performing a preliminary walkdown of the Kewaunee Nuclear Power Plant (KNPP) in preparation for the official USI A-46 seismic walkdowns. During this walkdown, WPSC discovered that several hex nut fasteners were missing from the cast-in-place anchorage for the Diesel Generator Excitation Cabinets. At the time of discovery, the plant was reducing power in preparation for the annual refueling outage.

One excitation cabinet had four of six hex nuts missing, and the second cabinet had two of six hex nuts missing. Shortly after the discovery, the missing hex nuts were replaced and the cabinets were restored to their intended original design configuration. It was determined that the condition had existed since original plant construction.

WPSC conservatively reported the discovery of the cabinet with four of six missing fasteners as a nonconforming condition per 10 CFR 50.72 but later withdrew the notification based on a calculation of the cabinet anchorage. The calculation concluded that the missing anchor fasteners did not significantly affect the seismic adequacy or operability of the cabinets. The calculation supported the statements listed on the excitation cabinet design drawings, which indicated that the anchor bolts were subjected to zero load in tension at design basis seismic ground acceleration levels.

Following the withdrawal of the notification, the NRC Region III Division of Reactor Projects office requested in reference 1 that the Office of Nuclear Reactor Regulation (NRR) evaluate the adequacy of the seismic analysis. On June 18, 1992 and July 7, 1992, WPSC participated in conference calls with the NRC staff in order to resolve the Staff's concerns. However, as documented in reference 2, the NRR concluded that the calculation was not acceptable and that WPSC's decision not to file a 10 CFR 50.73 Licensee Event Report (LER) may have been inappropriate. It should be clarified that Licensee Event Report 92-003 was filed as an informational LER on April 6, 1992 to address the cabinet anchorage.

II. WPSC RESPONSE TO THE NRC CONCERNS LISTED IN ENCLOSURE 1 OF REFERENCE 2.

1. Use of 5% damped in-structure response spectra.

The NRC takes exception to the fact that WPSC used 5% damped in-structure response spectra (ISRS) in determining the actual demand acceleration experienced by the cabinet rather than using only the plant design basis 1% damped ISRS. It should be noted that the calculation described in reference 3 demonstrates that the use of 1% damping produces an actual horizontal acceleration less than the value required for cabinet overturn, and therefore the conclusion of the calculation is not affected. The results are shown below in section III.

The use of the 5% damping in the calculation was intended to demonstrate that the cabinet had an additional margin of safety according to GIP guidelines. Since WPSC was conducting a preliminary USI A-46 walkdown, it was considered reasonable to use the guidelines contained in the GIP, since the guidelines are based on extensive experience data of equipment response. However, since the preliminary walkdown conducted was not an official USI A-46 walkdown, presenting only the results using 1% damping would have been more conservative, but not necessarily more realistic.

2. Validity of the 5.2 Hz fundamental cabinet frequency estimate.

The cabinet natural frequency was conservatively estimated to be 5.2 Hz, based on a 1971 calculation performed by Western Engine Company. The 5.2 Hz estimate was based on a calculation of the natural frequency of the static exciter chassis located within the cabinet. Because of the significant amount of mass that the high voltage and low voltage chassis contribute to the total mass of the cabinet, Western Engine felt it was prudent to calculate the natural frequency of the chassis and compare the results to the cabinet frequencies obtained by shake table tests performed by Gaynes Testing Laboratories. In the Gaynes Test Report, the lowest cabinet side-to-side and front-to-back natural frequency was determined to be 6.2 Hz. The lowest top-to-bottom natural frequency was determined to be 5.0 Hz. Based on these results, estimating the cabinet natural frequency at 5.2 Hz seems reasonable.

In Enclosure 1 of reference 2, the NRC expresses concern with the methodology and assumptions used in the 1971 Western Engine calculation, and suggests that the masses of the low voltage and high voltage chassis should have been combined to obtain a "system frequency". In doing so, a lower estimate of chassis frequency would have been obtained. WPSC does not feel it is necessary to pursue further discussions concerning the Western Engine calculation. Since the shake table tests conducted by Gaynes Testing Laboratories confirm that the cabinet

natural frequency is in the range of 5 to 6 Hz, the use of 5.2 Hz in the WPSC calculation is considered both reasonable and conservative.

3. Cabinet vertical acceleration.

The NRC is correct in stating that the vertical acceleration value used in the calculation should have been 0.14 instead of 0.07. However, this change has a minor effect on the outcome of the calculation, as shown in Section III.

4. Location of neutral axis for cabinet overturn.

Based on Stevenson & Associates extensive work and rigorous calculations of base anchorages, it can be demonstrated that the neutral axis is essentially always near a cabinet edge. Overturning moments and restoring moments are always calculated assuming tipping about a cabinet edge, or within an inch of the edge. Given that the cabinet base is constructed of 3 x 3 x 1/4 angle iron, and given that the cabinet is well constructed with adequate reinforcement, it is reasonable to assume the cabinet base is rigid. Therefore, the calculational assumption of full depth of moment arm "d" is reasonable and accurate.

5. Cabinet sliding and vibratory motion.

This issue involves the question of the cabinet sliding or bouncing causing vibrations which can induce spurious relay action. Since the demand acceleration is less than the restoring moment acceleration, the cabinet will not lift. With regard to sliding, the demand acceleration can be shown to not exceed the concrete-steel interface coefficient of friction, which will not be less than 0.3 and could be as high as 0.55. Sliding forces could not plausibly overcome frictional forces.

The sliding issue was not addressed in the calculation since the cast-in-place anchors extended up through the base of the cabinet, thus preventing any significant horizontal movement. In addition, two of the six hex nuts were in place, and were fully engaged and appeared tight against the cabinet base angle iron. Given this configuration and the effect of frictional forces as described above, it is reasonable to conclude that the cabinet would not bounce or slide during a design basis earthquake. As such, the structural integrity of the cabinet was not significantly degraded and the possibility of cabinet vibration inducing spurious relay action is not considered to be a credible scenario requiring further evaluation in this particular analysis. Any essential relays in the cabinet will be fully evaluated during implementation of the official USI A-46 program at KNPP.

III. IMPACT OF CALCULATIONAL CHANGES

If the changes listed above were incorporated into the calculation, it can be shown that the revisions would not alter the final conclusion of the calculation.

1. As shown in the original calculation, the use of 1% damped ISRS rather than 5% damped ISRS for determining the actual horizontal acceleration demand experienced by the cabinet results in an increase of the actual demand from 0.11 g to 0.24 g.

2. The use of 0.14 g vertical acceleration instead of 0.07 g reduces the value of the maximum horizontal acceleration to induce eabinet overturn from 0.31 g to 0.29 g, which is of minor importance.

The result of these two changes demonstrates that the actual horizontal acceleration is still less than the acceleration required for cabinet overturn (0.24 g $<$ 0.29 g), and the conclusion reached in the calculation is still valid. It should be noted that additional conservatism still exists in the calculation, in that no credit is taken for the two hex nuts that were in place and the effects of the friction forces between the cabinet base and concrete floor were conservatively discounted.

WPSC acknowledges that certain assumptions and justifications used in the calculation could have been better documented. It is important to note that the calculation was intended to be a simplified analysis to demonstrate the seismic adequacy of the cabinet, by showing that the cabinet was not in danger of overturn during a seismic event. The original cabinet design and construction drawings support this conclusion by stating that the cabinet anchors are subject to zero tension during design basis accelerations. The calculation was not intended to be a detailed analytical effort to prove that the existing configuration was adequate for the remainder of plant life.

It is also important to reinforce that it was not WPSC's intent to have this calculation misconstrued as a method of outlier resolution according to all the caveats and guidelines contained in the GIP. The references to the GIP criteria in the calculation were made to enable WPSC to present more realistic conclusions and use current earthquake experience data in characterizing equipment response. It was not WPSC's intent to use the GIP in a "piecemeal manner" as stated by the NRC.

We hope this response alleviates the Staff's concerns.

Greg Ridder
Nuclear Engineer
WPSC

Walter Djordjevic
Vice President
Stevenson & Associates