Commonwealth Edison
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Downers Grove, Illinois 60515

March 23, 1994

Mr. William T. Russell, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn. Document Control Desk

Subject: Reduced Seismic Criteria at Commonwealth Edison Nuclear Facilities

Byron Station Units 1 and 2
NPF-37/66; NRC Docket Nos. 50-454/455
Braidwood Station Units 1 and 2
NPF-72/77; NRC Docket Nos. 50-456/457
Zion Station Units 1 and 2
DPR-39/48; NRC Docket Nos. 50-295/304
Dresden Station Units 2 and 3
DPR-19/25; NRC Docket Nos. 50-237/249
Quad Cities Station Units 1 and 2
DPR-29/30; NRC Docket Nos. 50-254/265
LaSalle Count Station Units 1 and 2
NPF-11/18; NRC Docket Nos. 50-373/374

Dear Mr. Russell:

Attached you will find Commonwealth Edison's response to the Nuclear Regulatory Commission on "Seismic Loading for Evaluation of Temporary Conditions in Nuclear Power Plants".

CECo believes there is a sound technical basis to justify the use of the reduced seismic criteria for evaluating temporary conditions in our plants, including; temporary rigging, lead shielding, scaffolding, freeze plugs, and temporary alteration of supports or boundary conditions. Not withstanding, we recognize the concern that the NRC identified with the specific application of the criteria in the operability evaluation of the failed snubber at our LaSalle County Station. CECo is taking action to ensure proper application of this methodology at our nuclear sites.

Specifically, CECo is creating a Technical Information Document (TID) to provide generic procedural and technical guidance for evaluating safety related systems, structures, and components (SSC) for seismic effects when the SSC is subject to a temporary condition. These requirements are to ensure that temporary conditions are evaluated consistently and conservatively, and that temporary conditions are well documented.

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The criteria, as documented in the attachment, does not represent a "PRA" probabilistic assessment, but rather a sound technical extension of the code allowable seismic accelerations within tightly prescribed and controlled time limitations. The approach was developed to provide us with a more rigorous analytical basis for evaluating temporary plant conditions to supplement the use of engineering judgment. CECo also expects that any results obtained from applying the reduced seismic criteria would be bounded by a full seismic analysis.

Given this, CECo would welcome the opportunity to discuss our technical basis and limited scope of use of the reduced seismic criteria in a meeting to be scheduled at your direction and convenience. To prepare for our discussion, CECo has performed a preliminary review of current applications of the reduced seismic criteria at all six of our nuclear stations. Based upon that review, we believe that the safety significance of any potential non-conservatism is minimal.

To the best of my knowledge and belief, the statements contained in this document are true and correct. In some respects, these statements are not based on my personal knowledge, but on information furnished by other CECo employees, contractor empoloyees, and/or consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

Please address any further comments or questions regarding this matter to this office.

Respectfully

Irene Johnson
Licensing Operations Supervisor
Commonwealth Edison Company

attachmment

cc: G. F. Dick, Byron Project Manager - NRR
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C. Y. Shiraki, Zion Project Manager - NRR
J. F. Stang, Dresden Project Manager - NRR
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Office of Nuclear Facility Safety - IDNS

COMMONWEALTH EDISON COMPANY RESPONSE TO NUCLEAR REGULATORY COMMISSION ON "SEISMIC LOADING FOR EVALUATION OF TEMPORARY CONDITIONS IN NUCLEAR POWER PLANTS (SLTC)"

BACKGROUND

Plant maintenance and modification activities often require erection of temporary structures, attachments or imposition of temporary loadings on safety related systems or equipment. The applications may consist of temporary rigging, lead shielding, storage of equipment, scaffolding, freeze plugs, and temporary alteration of supports or boundary conditions. In order to assure adequacy of the structure or component and maintenance of licensing commitments an assessment of such conditions needs to be made. For such assessments, treatment of short term loads were not defined or limited in the plant design basis. Depending on the magnitude, duration and repeatability of the load, judgements are made on the assessment. A technical basis for the frequent engineering judgements that are made to assess temporary conditions had not been established within the industry. This issue is now being addressed by the ASCE Nuclear Energy Committee and the North Carolina State University Research Group based on the expressed industry need to establish a consistent method for seismic assessment of short term conditions. Commonwealth Edison Company has already established such controlled procedures to assess these conditions of short duration for seismic loading on its nuclear power plants, as described in the following, to provide additional confidence in these assessments.

Since the plants' temporary conditions were not originally addressed either in their FSAR or the UFSAR seismic design basis commitments, it is logical to extend the intent of the FSAR seismic design basis to address these temporary conditions also. This is accomplished by establishing specific seismic levels that are equal to or greater than the level of seismic safety as the plants' licensing commitments. This SLTC criteria provides an appropriate basis for evaluating temporary plant conditions which is consistent with that employed for permanent plant structures/equipment. Plant specific seismic hazard curves, which give annual probabilities, have been used to determine acceleration levels (less than SSE) for durations shorter than a year. These accelerations have the same probability of exceedance, within their respective duration, as SSE design basis acceleration has in one year. These accelerations have been established for the Commonwealth Edison Company Nuclear Plants to

assure maintaining the same level of safety during a seismic event as the plant licensing design basis.

MECHANICS OF APPLICATION

Prior to application of this criteria for seismic loading of short durations, Commonwealth Edison Company had performed detailed analysis in evaluation of plants' temporary conditions. In instances where these conditions could not readily be reconciled extensive resources were expended in installation of temporary modifications which consequently increased radiation exposures without a commensurate safety level benefit. The SLTC criteria supports industry wide initiatives to enhance ALARA programs and control costs without compromising plant safety conditions.

Alternatives to this approach would include:

- complete detailed engineering analysis
- develop increased allowable stresses based on the short duration
- sole reliance on engineering judgement

These alternative approaches would generally yield the same conclusion, but would increase engineering costs (except for engineering judgement case) and inhibit timely response to support station operating requirements.

Administrative controls are in place to Commonwealth Edison Company Nuclear Stations to prevent inadvertent application of this SLTC criteria i.e., short duration limits are controlled.

TECHNICAL BASIS

Temporary conditions are in place for brief periods of time. Compared to the likelihood of exposing the plant permanent installations to design-basis earthquakes (OBE and SSE), it is less likely that the plant temporary conditions will be exposed to the same intensity of earthquakes. It is clear that a rational approach to determine seismic levels coincident with temporary conditions may utilize a probabilistic approach to insure the same level of safety as for permanent installation.

The use of probability and likelihood concepts, in various forms, has long precedence in nuclear plant structural/mechanical assessments. Rules for combining individual maxima to obtain design basis loads for several conditions are developed on this basis. Examples are given below to provide a frame of reference:

- The load factors for concrete and steel design in documents such as ASCE 7-88 (formerly ANSI A58.1), Minimum Design Loads for Buildings and Other Structures, reflect the duration and probability of simultaneous occurrence of maximum loads. An example of this is not combining tornado and seismic loads (SRP 3.8.4)

- Combining seismic modal maxima on random-vibration-based rules such as SRSS and its variations (RG 1.92)

- Combining seismic directional maxima on a SRSS basis (RG 1.92), or the use of (1, 0.4, 0.4) rule for the same purpose (ASCE 4-86). This rule provides that 100% of one direction maximum is combined with only 40% of the other two direction maxima.

- Limiting Condition of Operation Action Requirements (LCOAR) durations

In the examples above, probabilistic methods have not been used directly because acceptance probability levels had not been established and because of many uncertainties that need to be quantified for direct application of probabilistic methods. However, probabilistic thinking and models have been utilized. The approach summarized below also is a similar application of probabilistic methods.

Summary of Methodology

The methodology is described in Attachment 1. The main points of the methodology are summarized below:

- To evaluate a temporary condition of prescribed short duration (t_d), typically an outage duration, an acceleration level is selected so that the probability of exceeding this acceleration in t_d equals the probability of exceeding the plant SSE in one year. This means that the likelihood (probability) of exceeding design-basis is maintained.

- The procedure is implemented using annual seismic hazard curves from both LLNL with NRC sponsorship and EPRI/SOG studies. From each hazard curve, a probability of exceeding the plant design basis in one year is inferred. This same inferred probability is used to obtain acceleration for the duration of interest. Equation 5 and Figure 2 of Attachment 1 show the construction. The approach uses the same probability model to obtain duration-dependent hazard curves that both LLNL and EPRI/SOG studies used to obtain the annual hazard curves.

- The procedure is relatively insensitive to the specific hazard curve used (see comparison in Table 1 of Attachment 1). This is because the procedure depends on the shape of the hazard curve rather than on its absolute ordinate.

- Because of the availability of annual hazard curves, the approach lends itself to conveniently producing quantitative information to control evaluation of the temporary conditions at a station.

- Temporary conditions are evaluated for the determined duration - dependent accelerations using FSAR allowables, i.e., component allowables are not increased.

- The following case is provided as an example of the procedure application. Consider SSE evaluation for Braidwood Nuclear Station for a temporary condition duration equal to two months. The peak horizontal SSE ground acceleration for Braidwood is 0.2g. (As a matter of interest the OBE acceleration is 0.10g.)

  The following figure (Figure 2 of Attachment 1) shows determination of relevant peak ground motion value for this case using EPRI/SOG median hazard curve. The solid curve in this figure is the annual hazard curve. The dotted curves are the hazard curves for several temporary durations, constructed from the annual hazard curve.

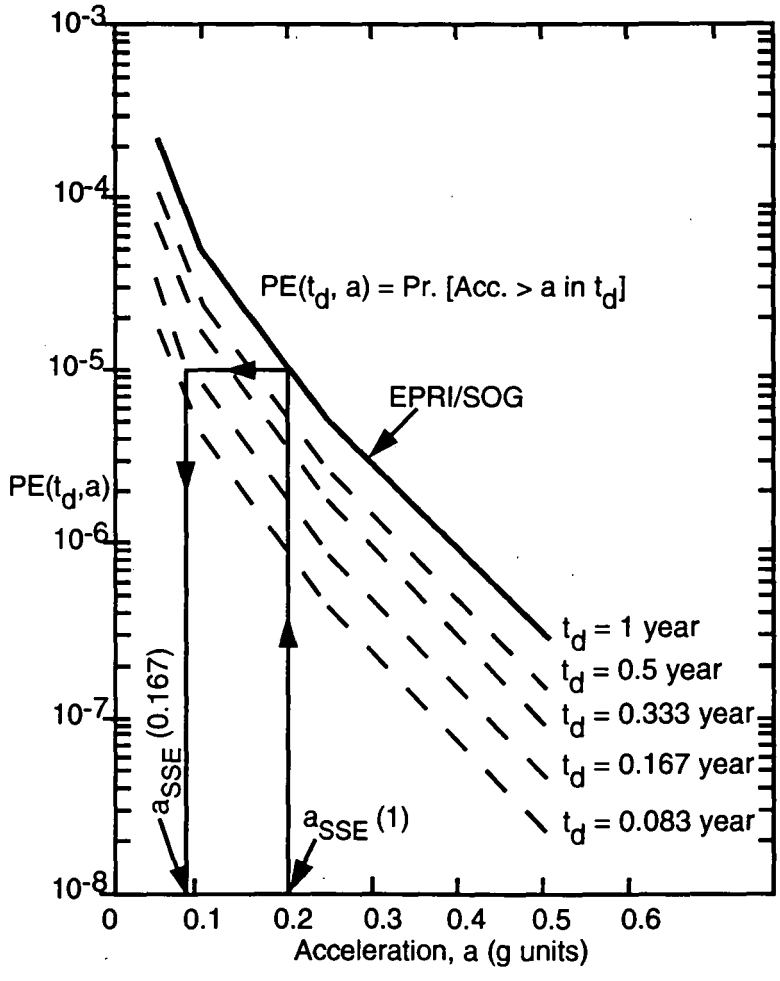

Figure 2. Duration-dependent hazard curves for EPRI/SOG curve in Figure 1 and construction of a_{SSE} (t_d) Using a_{SSE} (1).

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Based on the annual curve, the probability of exceeding 0.2g in one year is about 1×10^{-5}. At this same probability level, the corresponding 2 month hazard curve ($=t_d=0.167$ year) yields an acceleration value of 0.092g. Therefore, horizontal SSE floor spectra can be scaled down by the factor $0.092 \div 0.2 = 0.46$, and used with other present load effects to compare against the UFSAR, and the SSE allowables to complete the required temporary load evaluation for an affected component.

If the median annual hazard curves from 1989 LLNL studies were used instead of the EPRI/SOG curve discussed above, the corresponding acceleration is 0.084g. This leads to a floor spectra scale factor of $0.084 \div 0.2 = 0.42$ rather than 0.46 from the EPRI/SOG curve.

- The procedure also lends itself to quantitatively defining a very short duration limit (hours) for not considering seismic as a load case. This quantitative evaluation provides additional assurance for commonly used (industry wide) engineering assumptions. Rather than stating that the probability of occurrence of design basis acceleration during these very short durations is too small, which requires defining the acceptable probability level specifically, the procedure determines a duration such that the acceleration (which has the same probability of exceedance for this short duration as the probability of exceedance of SSE in one year) within that duration is acceptably small. A 0.02g acceleration with justification is used for this purpose (see Attachment 1). In this case, the results do depend on whether EPRI/SOG curves or LLNL curves are used. As a practical matter, the smaller of the limit values determined from the EPRI/SOG and LLNL curves are adopted for use.

PRELIMINARY REVIEW COMMENTS ON APPROACH

The SLTC criteria is currently under review by 3rd party industry experts.

The approach summarized here and provided in detail in Attachments 1 and 2 and has undergone peer reviews in preparation for presentation in the following conferences:

- PVP94 - ASME Pressure Vessels and Piping Division Conference, June 19-23, 1994, Minneapolis, MN (Attachment 2)

- 5NCEER - Fifth U.S. National Conference on Earthquake Engineering, July 10-14, 1994, Chicago, IL (Attachment 1)

The reviewers have considered that the approach is technically correct and a viable means for addressing a current industry issue. Additionally, a slightly expanded

version of the paper is being presented in APC94 to make the industry aware of this approach.

INDUSTRY APPLICATIONS

This procedure has been utilized to assess seismic design for temporary conditions at the Commonwealth Edison Company Nuclear Stations including Byron, Braidwood, Dresden, LaSalle, Quad Cities and Zion. The applications for which this procedure has been used include: temporary rigging, temporary lead shielding, scaffolding, addition of temporary mass to piping such as valve blocks and temporary alteration of supports or boundary conditions.

This procedure has been used in similar applications by Consumers Power Corporation at Palisades Station. In addition there are other utilities that are actively pursuing application of reduced seismic accelerations in assessing temporary conditions, and providing additional confidence to commonly performed engineering judgements.

Conclusion

Considering the fact that earthquakes and their magnitudes or intensities are random events, Seismic Loading for Temporary Conditions (SLTC) criteria enables the engineer to estimate with a reasonable degree of confidence, the accelerations in safety assessment for these short durations. Commonwealth Edison Company's Nuclear Plants are located in a low seismic intensity zone in the United States. The assumptions used in this approach are in conformance with conclusions obtained thus far and are representative of seismicity level in this particular area.

With implementation of this criteria Commonwealth Edison Company has enhanced the control of temporary conditions while maintaining plant safety and achieving ALARA and cost control goals.

ATTACHMENTS

1. Seismic locking Evaluation of Temporary Conditions in Nuclear Power Plants, presented at Fifth U.S. National Conference on Earthquake Engineering July 10-14, 1994, Chicago, IL

2. Evaluation of Temporary Loads, Approach to Justify Hanger Loads with Less Effort, presented at the PVP 1994 ASME Pressure Vessels & Piping Division Conference, Minneapolis, MN, June 19-23, 1994.

3. Dr. R. P. Kennedy Assessment (LATER)

4. Dr. A. Cornell Assessment (LATER)