UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

September 8, 1995

NRC GENERIC LETTER 88-20, SUPPLEMENT 5: INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS FOR SEVERE ACCIDENT VULNERABILITIES

Addressees

All holders of operating licenses (except those licenses that have been amended to possession-only status) or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to (1) notify addressees of modifications in the recommended scope of seismic reviews that are performed as part of individual plant examinations of external events (IPEEEs) for the focused-scope and full-scope plants and (2) provide guidance to licensees who wish to voluntarily modify their previously committed seismic IPEEE programs.

Background

On June 28, 1991, NRC issued Generic Letter 88-20, Supplement 4, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, 10 CFR 50.54(f)," (Reference 1), and NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities: Final Report," (Reference 2). The generic letter requested all licensees to perform an IPEEE to find plant-specific vulnerabilities to severe accidents caused by external events and report the results to NRC. Section 4.1 of Reference 1 and Chapter 3 of Reference 2 address the seismic portion of the IPEEE. The lists of review level earthquakes (RLEs) and the review scope defined by the staff for all U.S. sites are presented in Appendix 3 of Reference 1. Plants in the central and eastern U.S. have been assigned to appropriate review categories (plant bins) primarily according to a comparison of available seismic hazard results.

The hazard results used in the binning process included those published in 1989 by Lawrence Livermore National Laboratory (LLNL) (Reference 3) and the Electric Power Research Institute (EPRI) (Reference 4). NRC established the bins because of the large inherent uncertainties in the probabilistic estimation of seismic hazard (Appendix A to Reference 2). Using this approach, the staff compared the relative seismic hazard of the 69 central and eastern U.S. plant sites, and assigned each plant to one of four bins for the seismic margins method (Reduced-Scope, 0.3g Focused-Scope, 0.3g Full-Scope, and 0.5g bin). Two plants in the 0.5g bin have committed to perform a seismic probabilistic risk assessment (PRA) and have performed the assessment.

Description of Circumstances

In 1994, based on a re-elicitation of LLNL ground-motion and seismicity experts, the staff published revised seismic hazard results in NUREG-1488 (Reference 5). The new LLNL mean hazard estimates are lower than the 1989 LLNL results but higher than the EPRI estimates. The Nuclear Energy Institute (NEI), based on these revised hazard estimates, advocated that most *focused-scope* plants should instead perform *reduced-scope* studies as part of the seismic IPEEE (Reference 6). NEI also stated that each licensee is responsible for proposing the most cost-effective program to satisfy the seismic IPEEE request consistent with the level of seismic hazard at the specific site. Seven licensees have informed NRC of their intent to revise their IPEEE commitments.

These developments prompted NRC to revisit systematically the seismic IPEEE program rather than to deal with each licensee individually. The staff stated its intent to review LLNL's revised seismic hazard estimates and to determine if it is appropriate to revise the seismic IPEEE scope in Information Notice 94-32, "Revised Seismic Hazard Estimates," (Reference 7). The staff also stated in Reference 7 that licensees who have not completed the seismic portion of the IPEEE may continue with their programs and submit their completed IPEEE based on References 1 and 2.

NRC contracted with Energy Research, Inc. (ERI) to do a seismic revisit study to determine whether consideration of the new LLNL seismic hazard estimates (1) would significantly change the original binning results and (2) would warrant adjusting the seismic scope and guidelines of the seismic IPEEE review. The latter effort would also require the determination of how the scope should be modified and the justification of such modifications. ERI completed the study and submitted two reports in September 1994 (References 8 and 9). The staff held a public workshop on October 21, 1994, to discuss these reports, present comments from a peer review group, determine issues to be addressed, and solicit public input for developing the staff position on the seismic scope modification. The transcript of the workshop is available in Reference 10.

NRC issued a draft of this supplement for public comment in January 1995 and received written comments from seven organizations. This supplement includes changes resulting from the resolution of these public comments. Comments on draft Supplement 5 and the staff's resolution of the comments will be made available in the Public Document Room.

Discussion

The staff evaluated the ERI reassessment reports, the peer review group's comments, the NEI white paper (Reference 6), and comments received at and after the workshop. The staff concludes that (1) licensees may use the revised LLNL seismic hazard estimates instead of the 1989 LLNL seismic hazard estimates in the seismic PRA and (2) the scope of the seismic IPEEE may be modified for all focused-scope and full-scope plants by eliminating the need

to calculate the capacity of certain generally rugged components or certain site effects that would not be significant sources of contributors to seismic severe-accident risk or would not result in cost-beneficial improvements. The justification for this reduction in the seismic review scope is that the perceived seismic hazard estimates and associated risks have decreased. However, the examination process for the modified seismic IPEEE remains the same process described in Supplement 4 to Generic Letter 88-20 and NUREG-1407.

The most significant comments and concerns with respect to reducing the scope of the IPEEE seismic review which were raised at and after the workshop and the associated resolutions are summarized in Attachment 2.

The opinions expressed by certain utilities represented at the public workshop, showed that the guidance provided in GL 88-20, Supplement 4, and in NUREG-1407 is being interpreted in an unintended manner. For instance, certain utilities interpreted NUREG-1407 as needing a minimum number of seismic margin capacity calculations (i.e., high confidence of low probability of failure). The NRC staff wants to reemphasize that the guidance in the generic letter and NUREG-1407 does not preclude the use of well-based expert judgment and efficient approaches that minimize the effort of conducting an IPEEE. In GL 88-20, Supplement 4, the staff stated:

> "The application of the above approaches involves considerable judgement with regards to the requested scope and depth of the study, level of analytical sophistication, and level of effort to be expended."

The detailed guidelines presented in NUREG-1407 do not preclude use of this type of judgment. The use of judgment is further recognized in NUREG-1407 in connection with the importance of the peer review. Discussions at the workshop indicated that some utilities did use such judgment, within the framework of the current guidance as discussed, to reduce the cost of IPEEEs.

Modified Scope of Seismic Examination

The methods originally described and guidelines described in NUREG-1407 fulfill Supplement 4 to GL 88-20. However, the results of the revised LLNL seismic estimates indicate that the perceived seismic hazard has been reduced for most plant sites in the central and eastern U.S. Accordingly, NRC proposes reducing the scope of the seismic IPEEE programs for licensees as follows:

(1) Licensees Performing a Seismic PRA

The licensee can use the higher of the mean (arithmetic) seismic hazard estimates from the revised LLNL (Reference 5) or EPRI studies.

(2) Focused-Scope Plants

The seismic capacities for reactor internals and soil-related failures need not be evaluated for the seismic IPEEE. Modifying the scope of the seismic IPEEE for focused-scope plants in this manner will make these evaluations equivalent to those for the reduced-scope plants, with additional evaluations of a few known weaker, but critical, components or items. The rationale for retaining the evaluations of these critical components is provided in Attachment 1.

(3) Full-Scope Plants

The seismic IPEEE need not include an evaluation of seismic capacities for reactor internals. Soil-related failures should still be evaluated, but only for safety-related supporting systems and equipment that are founded on soil whose function might be affected by liquefaction or general instability of the soil. The licensee may also need to evaluate the potential for such postulated soil failures or their consequences. Reference 11 contains guidance for such evaluations; a review of appropriate design and construction records is adequate.

The staff is aware of recent observations of cracks associated with reactor internals at some plants. The NRC issued GL 94-03 (ref. 12) which requested BWR licensees to inspect their core shrouds by the next outage and to justify continued safe operation until inspections could be completed. The staff has concluded in all cases that licensees have provided sufficient evidence to support continued operation of their BWR units to the refueling outages in which shroud inspections or repairs have been scheduled. ASME Code structural margins, as required by 10CFR50.55a, have been maintained in all core shrouds examined to date. In addition, the industry BWR Vessel and Internals Project has proactively been addressing internal cracking and developing evaluation criteria, inspection methods, as well as repair and mitigation methods for all BWR reactor internals. The NRC proposes to conduct research regarding the synergistic effects of multiple cracking in one or more internals components (ref. 13). The research will consider seismic loading as a part of the program. Therefore, eliminating this item will not detract from the IPEEE. The remaining scope is the same as that outlined in Supplement 4 to GL 88-20 and NUREG-1407. The staff reviewed discussions at the workshop, public comments on the draft Supplement 5, and other information and has taken the position that using appropriate judgment as allowed in the generic letter and NUREG-1407 and eliminating detailed evaluations for soil-related failures and reactor internals that may not lead to cost-beneficial improvements will maintain the integrity of the IPEEE process while reducing cost. However, regardless of the category assigned to the plant, a careful and thorough seismic walkdown remains the key element in examining seismic vulnerability.

Requested Information

Licensees of focused-scope and full-scope plants who voluntarily choose to do seismic IPEEEs using the modified procedures described above must inform NRC in writing of their intent to do so. If the revised submittal schedule differs from schedules previously committed to, the new proposed schedule must be included in the response. NRC will schedule meetings with the licensee, if requested, to discuss subjects raised by licensees and to give necessary clarifications.

Licensees who do not modify their seismic IPEEEs are not expected to submit any response to this generic letter supplement. Licensees who previously submitted their requests to modify their seismic IPEEEs may choose not to submit any response to this generic letter supplement; should that be the case, NRC will respond separately to their previous requests.

Requested Response

Within 60 days of the date of this generic letter, all addressees who voluntarily choose to perform seismic IPEEEs using the modified procedures described above are required to submit a response to the information requested above.

Address the required written reports, if applicable, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended, and Section 50.54(f) of Title 10 of the *Code of Federal Regulations* (10 CFR 50.54(f)).

Backfit Discussion

The evaluation required by 10 CFR 50.54(f) to justify the IPEEE information request was included in Supplement 4 to Generic Letter 88-20. This generic letter supplement only provides information that addressees may use voluntarily to reduce the scope of seismic IPEEEs using the modified procedures described above. Therefore, the generic letter does not involve backfitting concerns and no backfit analysis was prepared by the staff.

Paperwork Reduction Act Statement

The information requested herein for voluntary submittal is covered by the Office of Management and Budget Clearance No. 3150-0011, which expires July 31, 1997. The public reporting burden for this voluntary collection of information is estimated to average 20 hours for each response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this voluntary submission of information, including suggestions for reducing this burden, to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to

the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0011), Office of Management and Budget, Washington, DC 20503.

Compliance with the following request for information is purely voluntary. The following information would assist NRC in evaluating the costs and savings of responding to this generic letter supplement:

(1) the licensee staff time and costs to prepare the requested reports and documentation, and

(2) an estimate of the long-term costs or savings accruing from the response to this generic letter supplement.

If you have any questions about this matter, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Dennis M. Crutchfield

Dennis M. Crutchfield, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

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Attachments:
1. Components Needing Capacity Evaluation and Basis
2. Public Workshop Comments and Resolutions
3. References
4. List of Recently Issued NRC Generic Letters

Attachments Filed in Jacket

COMPONENTS NEEDING CAPACITY EVALUATION AND BASIS

The components and issues identified as needing evaluation and the bases for the retention are briefly described below:

(1) Relay Chatter

While preparing the original guidance in NUREG-1407, the NRC staff developed its position on the relay chatter issue after thoroughly discussing the issue with industry and evaluating the results of previous studies. The staff drastically reduced the scope of relay chatter evaluation, retaining only the identification of *bad actor*[1] relays. Since these relays are of low capacity, their identification is considered to be minimum scope for the IPEEE review. The guidance does not preclude any efficient and expeditious means of identifying these relays.

(2) Masonry and Block Walls

Probabilistic risk assessments and margin studies have demonstrated that failure of masonry or block walls may be a significant safety concern in existing nuclear power plants. The earthquake experience database and analytical evaluations of seismic fragility demonstrate that masonry and block walls without proper reinforcements are vulnerable to earthquake motion. In evaluating these walls, more lenient criteria were used; thus, the available margins beyond the safe-shutdown earthquake may not be comparable to those of other components of the plant. Therefore, in doing the seismic IPEEE review, the licensee should identify and evaluate masonry and block walls whose failure may affect safety components required for safe plant operation. The licensee should correct, if warranted, any situation that may present a significant threat to plant safety.

(3) Flat-Bottom Tanks

Earthquake experience data and analytical fragility evaluations have demonstrated that flat-bottom tanks with poor anchorage are vulnerable to earthquake ground motion. The typical failure mode of concern is buckling at the base of the tank, causing the liquid contents to escape or the tank to collapse. If a flat-bottom tank fails, it could also flood surrounding areas in the plant. Past seismic studies of nuclear power plants have designated flat-bottom tanks as low-capacity components. Such components include the refueling water storage tank and the condensate storage tank, whose failures would often significantly affect plant safety.

The identification and evaluation of flat-bottom tanks should, therefore, be included as a fundamental element of the seismic IPEEE review to correct any situation that may threaten plant safety, if warranted.

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[1] "Bad actor" relays, as described in NUREG-1407, are those low-seismic-ruggedness relays identified by USI A-46 implementation.

(4) Other Items

The licensee should also consider several other items that pertain to inadequate anchorage and bracing, adverse physical interactions, building impact, or pounding. These items include the weaker components of the diesel generators or pumps. However, the licensee's seismic review team should determine whether seismic capacities of those components need to be evaluated in the seismic review.

PUBLIC WORKSHOP COMMENTS AND RESOLUTION

All significant comments and concerns raised at and after the workshop, together with staff's response, are summarized below.

(1) Candidate plant sites for seismic scope reduction: The industry suggested that candidate sites should not be limited to focused-scope plants.

Response: In addition to modifying the scope for focused-scope plants, the staff reduced the scope of review for full-scope plants by eliminating the evaluation of reactor internals.

(2) Use of absolute hazard or risk criteria for rebinning or sub-binning candidate sites: The comments indicated that the absolute risk criterion should play a significant role in the seismic rebinning.

Response: The staff considered absolute seismic hazard and risk criteria when it reconsidered seismic rebinning. However, the inherent uncertainty in the absolute number would affect decision making, because small variations in the core damage frequency (CDF) threshold or in the approximately calculated CDFs of candidate plants would significantly affect the binning for many plants. No consensus was reached on the specific risk criterion that should be selected for the rebinning process. Therefore, the staff did not recommend using an absolute risk criterion when determining whether to reduce the seismic scope. However, licensees may use numerical values in determining which plant-specific improvements should be implemented.

(3) Overall reduction of seismic scope for all candidate sites: The *suggested reduction* as presented in the ERI report, with the exception of reactor internals, would not reduce the scope of seismic review.

Response: Past experience has demonstrated that certain weaker components need to be retained in the IPEEE. The rationale for retaining the evaluations of those critical components and issues is provided in Attachment 1.

(4) Role of the licensee's seismic review team (SRT): Certain utilities expressed concern that the role of the licensee's SRT in decision making is not clear.

Response: The staff wants to emphasize that the SRT has an important role in determining how to implement the IPEEE program, i.e., selecting the most cost-effective and expedient approach for the IPEEE program. The importance and flexibility of the SRT has been stated clearly in the IPEEE guidance, NUREG-1407, which allows for the use of judgment and latitude in implementing the IPEEE program.

(5) Evaluation of the effects of soil-related failures: No simple or cost-effective improvements may be available for plants.

Response: Although simple or cost-effective improvements may not be available for low seismic hazard sites to deal with the effects of soil-related failures, soil-related failures are still considered to be important for relatively high seismic hazard sites in the seismic IPEEE.

Therefore, the staff concludes that the licensees of focused-scope plants may eliminate the evaluation of soil-related failures from their seismic IPEEE programs. However, to gain insight, the full-scope plants should continue evaluating the effects of soil-related failure. The evaluation effort should focus on safety-related supporting systems and equipment that are founded on soil and whose function might be affected by soil-related failures.

(6) Cost savings: The potential cost savings associated with eliminating certain evaluations described in the in the NEI white paper (Reference 6) are high.

Response: The experience gained at certain plants indicates that the potential cost savings may be substantially lower than those presented in the NEI paper. Some of the savings cited by the utility personnel can be achieved without changing scope, since NUREG-1407 allows flexibility such as in eliminating detailed evaluation of reactor internals and using an alternate approach as to *bad actor* relay assessment.

(7) Seismic capacity evaluation of reactor internals: Should the evaluation of reactor internals be eliminated?

Response: The results of a few seismic PRAs have indicated that uncracked reactor internals are inherently rugged (having seismic capacities well beyond the requested earthquake review level of 0.3g) and do not contribute significantly to the core damage frequency. However, a significant effort is involved in calculating the fragility or capacity of the reactor internal components. On the basis of earlier study results (assuming uncracked reactor internals) and the perceived reduction of seismic hazard estimates and associated seismic risk, the staff concluded that the cost of the evaluation outweighs the risk of the failure of reactor internal components and proposes to eliminate them from the examination. However, the staff is aware of recent observations of cracks associated with reactor internals at some plants.

The NRC issued GL 94-03 (ref. 12) which requested BWR licensees to inspect their core shrouds by the next outage and to justify continued safe operation until inspections could be completed. The staff has concluded in all cases that licensees have provided sufficient evidence to support continued operation of their BWR units to the refueling

outages in which shroud inspections or repairs have been scheduled. ASME Code structural margins, as required by 10CFR50.55a, have been maintained in all core shrouds examined to date. In addition, the industry BWR Vessel and Internals Project has proactively been addressing internal cracking and developing evaluation criteria, inspection methods, as well as repair and mitigation methods for all BWR reactor internals. The NRC proposes to conduct research regarding the synergistic effects of multiple cracking in one or more internals components (ref. 13). The research will consider seismic loading as a part of the program. Therefore, eliminating this item will not detract from the IPEEE.

(8) Generic seismic fragilities used in seismic rebinning: Seismic rebinning on the basis of generic seismic fragilities, as was done in the ERI's study, would result in anomalous results.

Response: The staff concurs that seismic rebinning solely on the basis of generic seismic fragilities could result in anomalous results, since such items as the plant design basis and vintage of the plant may not be appropriately included. For instance, plants located at the same site were put in different bins (Salem and Hope Creek), and the plants near the New Madrid area were placed in the modified-scope bin. These observations contributed to the staff's decision to eliminate the use of an absolute risk criterion in the seismic scope modifications.

(9) Information exchange through a workshop on lessons learned from IPEEE: Information exchange workshop on IPEEE lessons learned was suggested.

Response: An information exchange workshop on IPEEE lessons learned to discuss the experience gained about more practical or efficient ways of carrying out the seismic IPEEEs (e.g., with respect to the relay chatter issue) would benefit both industry and staff. The staff will consider holding such a workshop in the future.

REFERENCES

[1] U.S. Nuclear Regulatory Commission, Generic Letter 88-20, Supplement No. 4, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities -- 10 CFR 50.54(f)," June 1991.

[2] NRC, NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," Final Report, June 1991.

[3] NRC, NUREG/CR-5250, "Seismic Hazard Characterization of 69 Nuclear Power Plant Sites East of the Rocky Mountains," January 1989.

[4] Electric Power Research Institute (EPRI), NP-6395-D, "Probabilistic Seismic Hazard Evaluation at Nuclear Plant Sites in the Central and Eastern United States: Resolution of the Charleston Issue," April 1989.

[5] NRC, NUREG-1488, "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains," April 1994.

[6] Letter from W. Rasin (NEI) to A. Thadani (NRC), "NEI White Paper, 'Justification for Reduction in IPEEE Program Based on Revised LLNL Seismic Hazard Results,'" April 5, 1994.

[7] NRC IN 94-32, "Revised Seismic Hazard Estimates," April 29, 1994.

[8] Energy Research, Inc. (ERI) Report (ERI/NRC 94-502), "A Proposed Approach to Seismic Scope Re-assessment for Individual Plant Examination of External Events (IPEEE)," Final Draft, September 1994

[9] ERI/NRC 94-504, "Approaches for Proposed Modifications of Seismic IPEEE Guidelines for Focused-Scope Plants," Final Draft, September 1994.

[10] NRC Transcript, "Workshop in Seismic IPEEE Revisit," October 21, 1994.

[11] EPRI NP-6041, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," October 1988.

[12] NRC Generic Letter 94-03, "Intergranular stress Corrosion Cracking of Core Shrouds in BWR Reactors," July 25, 1994.

[13] NRC memorandum from W. Russell to E. Beckjord, "NRR User Need Request for Support of Resolving Problem of Stress Corrosion of Reactor Vessel Internal Components," December 2, 1994.

LIST OF RECENTLY ISSUED GENERIC LETTERS

Generic Letter	Subject	Date of Issuance	Issued To
95-07	PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES	08/17/95	ALL HOLDERS OF OLs (EXCEPT THOSE LICENSES THAT HAVE BEEN AMENDED TO POSSESSION-ONLY STATUS) OR CPs FOR NPRs.
95-06	CHANGES IN THE OPERATOR LICENSING PROGRAM	08/15/95	ALL HOLDERS OF OLs (EXCEPT THOSE LICENSES THAT HAVE BEEN AMENDED TO A POSSESSION ONLY STATUS) OR CPs FOR NPRs.
95-05	VOLTAGE-BASED REPAIR CRITERIA FOR WESTINGHOUSE STEAM GENERATOR TUBES AFFECTED BY OUTSIDE DIAMETER STRESS CORROSION CRACKING	08/03/95	ALL HOLDERS OF OLs OR CPs FOR PRESSURIZED WATER REACTORS (PWRs).
92-01, REV. 1, SUPP. 1	REACTOR VESSEL STRUCTURAL INTEGRITY	05/19/95	ALL HOLDERS OF OLs (EXCEPT THOSE LICENSES THAT HAVE BEEN AMENDED TO POSSESSION-ONLY STATUS) OR CONSTRUCTION PERMITS FOR NPRs.
95-04	FINAL DISPOSITION OF THE SYSTEMATIC EVALUATION PROGRAM LESSONS-LEARNED	04/28/95	ALL HOLDERS OF OLs OR CPs FOR NPRs.
95-03	CIRCUMFERENTIAL CRACKING OF STEAM GENERATOR TUBES	04/28/95	ALL HOLDERS OF OLs OR CPs FOR PRESSURIZED WATER REACTORS (PWRs).

OL = OPERATING LICENSE
CP = CONSTRUCTION PERMIT
NPR = NUCLEAR POWER REACTORS

the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0011), Office of Management and Budget, Washington, DC 20503.

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orig /s/'d by DMCrutchfield

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