

May 16, 2000

MEMORANDUM TO: Christopher I. Grimes, Director
License Renewal Project Directorate
Division of Reactor Program Management, NRR

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FROM: Michael E. Mayfield, Acting Director
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SUBJECT: LICENSE RENEWAL ISSUE 98-0087, EVALUATION OF
CONTAINMENT TEMPERATURE PROGRAM

On April 13, 2000, members of the technical staff met to discuss a proposed resolution paper for the subject issue. The initial draft has been revised in response to comments offered at that meeting and subsequent correspondence. Based on staff discussions, we believe that the issue is now closed. The final resolution paper is attached to this memorandum.

In a meeting on March 8, 2000, the License Renewal Steering Committee and the Nuclear Energy Institute (NEI) Working Group agreed that License Renewal Issues would be addressed by the comment process on the draft "Generic Aging Lessons Learned" (GALL) report. RES is participating in resolving stakeholder comments on the draft GALL report and will assure that the staff consensus, documented in the attached resolution, is brought forth and addressed during the resolution of stakeholder comments.

Attachment: As stated

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LICENSE RENEWAL ISSUE No. 98-0087
EVALUATION OF CONTAINMENT TEMPERATURE PROGRAM

1. BACKGROUND

In NUREG-1611, "Aging Management of Nuclear Power Plant Containments for License Renewal," the staff indicated that, in order to assure adequate management for the period of extended operation, some further evaluations and inspections may be required beyond those of Subsections IWE/IWL of Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. One of those issues, cited as Item 6 in Tables 1 and 2 of NUREG-1611, is the prospect that sustained exposure to higher temperatures than considered in their design may cause degradation of concrete structures. In a letter dated November 4, 1998, the Nuclear Energy Institute (NEI) disagreed with the staff recommendation and asserted that the issue ought not to be "solely a license renewal consideration." Further clarification of the issue was provided by NEI in a letter dated October 13, 1999. That letter points out NEI's view that "...the existing SRP guidance directs the NRC reviewer to verify certain information to establish that loss of strength and modulus is not an aging effect of concern. The renewal rule does not require the application to include a justification for why specific aging effects are deemed not applicable. The application need only identify the aging effects requiring management." The letter also provides a mark-up of Section 3.4 of the draft SRP illustrating NEI's view and suggesting some editorial improvements.

2. EVALUATION

The issue, cited by the staff in NUREG-1611, is based on the concern that concrete structures subjected to temperatures in excess of 150F may not develop the long term strength expected. The American Concrete Institute Standards for design of containments (ACI 359) and for other safety related structures (ACI 349) contain identical limitations on the use of concrete if exposure to higher temperatures is contemplated. For "normal operation or any other long term period", temperatures should be limited to 150F except for local areas, such as in the vicinity of penetrations, where 200F is acceptable. These limits are consensus judgements by the Code Committees and based on limited research results and historical experience with concrete buildings. They are probably conservative and were meant to be so, given the dearth of concrete performance data at higher temperatures and the variability of field cast concrete. Although, ACI 349 and ACI 359 have been revised several times since they were first issued, there has been no attempt to revise (or liberalize) the temperature limits, probably because of the lack of adequate database to do so.

Another factor enhancing concerns about long term exposure to elevated temperature is the observation, based on experience, that strength degradation can occur over time with no surface indication. The relevant sections of NUREG-1611, Items 6 in Tables 1 (PWR Containments) and 2 (BWR Containments), contain the same discussion:

Elevated temperature results in loss of concrete strength and modulus which may not be detected by the implementation of IWL and 50.55a modification until the aging effects are so severe to result in cracking and spalling. Thus, for concrete structures that experience temperatures greater than the above specified limits, a plant specific justification should be provided.

Recent reassessments have not changed that view. Table B4 (page B-56) of NUREG-1557 , "Summary of Technical Information and Agreements from NUMARC Industry Reports Addressing License Renewal," recommends the same threshold limits. The Generic Action Lessons Learned Report, December 1999 draft, reasserts the evaluation presented in NUREG-1611 and NUREG-1557 and contains similar statements on existing aging management programs and need for further evaluation:

Aging Management Program - No mandated Aging Management Program exists. NUREG-1611 identifies the need for plant specific evaluation, if the prerequisite conditions exist. NUREG-1557 states, "No ARDM if it meets the basic (threshold) requirements."

Further Evaluation - Yes. If applicable, the applicant's aging management program to address this issue must be evaluated.

The potential losses of concrete strength and modulus, resulting from prolonged exposure to elevated temperatures, are long term effects and, thus, are especially relevant to license renewal. The concern arises only for plants at which there has been an extended period of operation at containment temperatures greater than anticipated in their design. The concern has been brought to light in NRC Information Notice No. 87-65: Plant Operation Beyond Analyzed Conditions. For plants in which the issue has to be addressed, a number of approaches (or combinations of them) can be and have been utilized. They are, in order of increasing uncertainty: (1) Direct temperature measurement at the location(s) of concern, (2) Best estimate calculation of those temperatures based on the distribution through the affected concrete sections, (3) Estimates of actual concrete properties using either standardized non-destructive tests or concrete core sampling or available research data for similar concrete, (4) Reevaluate the stresses in the structural element of concern utilizing best estimate calculations of reduced concrete properties and design load combinations.

It should be noted that the issue of higher than expected concrete temperatures is not limited to containment structures. The staff has evaluated a number of cases where the bulk water temperatures in spent fuel pools were estimated to go above the threshold limit of 150°F under certain loading conditions, and accepted slightly higher bulk temperatures for a short duration.

The draft SRP-LR contains in both Section 3.3.II.B.4, on pressurized-water reactor (PWR) containment structures, and Section 3.4.II.B.4, on boiling-water reactor (BWR) containment structures, lists of affected containment components. [Those paragraphs also contained an identical statement of the effects of temperature on prestress forces. The proposed resolution of License Renewal Issue No. 98-0048 would remove that statement from these Subsections.]

Both Sections 3.3 and 3.4 of the draft SRP-LR contain similar language in Subsection II.C.4 on Aging Management Programs for Renewal for loss of strength and modulus on potentially affected components, temperature limits and potential effects on prestress loss. NEI pointed out that the lists of potentially affected components duplicate the lists in Sections 3.3.II.B.4 and 3.4.II.B.4 and should be deleted. The NRC staff agrees. [The proposed resolution of License Renewal Issue 98-0048 would also delete the discussion of prestress forces from these Subsections.]

Both Sections 3.3 and 3.4 contain identical language in Subsections III.C.4 on Review Procedures containing a list of affected components, procedural steps for the reviewer and material about the possible effects on prestress forces. NEI commented that the lists of components are redundant with material presented in Subsections II.B.4 and should be deleted. The NRC staff agrees. [The proposed resolution of License Renewal Issue 98-0048 would also delete the discussions about prestress forces from these Subsections.] The staff does not accept NEI's suggestion to revise the review procedures. NEI's view seems to be that the issue is a new one that would require a massive review effort. In fact, the issue is a long standing one and should have been addressed in updating the plant FSAR.

Both Sections 3.3 and 3.4 contain similar language in Subsections IV.C.4 on Evaluation Findings. The NRC staff accepts NEI's suggestion that the Subsections be revised to clarify the fact that evaluations are necessary only if there is reason to believe that containment temperatures exceed those analyzed in the FSAR. [The proposed resolution of License Renewal Issue 98-0048 would also remove discussion on prestress losses.]

3. RESOLUTION

Based on the evaluation above, the staff concludes that the redundant guidance on higher temperature effects on loss of strength and modulus, proposed for Sections 3.3.II.C.4, 3.3.III.C.4, 3.4.II.C.4 and 3.4.III.C.4 and shown in the Evaluation, is unnecessary. That guidance should be deleted.

An aging management program is necessary only for those plants for which excessive temperatures have been identified. For those plants, as recommended in the Generic Action Lessons Learned Report, the applicants aging management program to address this issue must be evaluated. To assure that the experience gained to date is reflected in that aging management program, insights gained in evaluations performed in response to IN 87-65 should be considered.

