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10 CFR 50.90

December 20, 2007

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Limerick Generating Station, Units 1 and 2
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: Response to Request for Additional Information
Technical Specifications Change Request -Type A Test Extension

References:

1) Letter from P. B. Cowan (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, dated February 20, 2007

2) Letter from P. B. Cowan (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, dated September 14, 2007

3) Letter from P. B. Cowan (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, dated October 18, 2007

4) Letter from P. J. Bamford (U. S. Nuclear Regulatory Commission) to C. G. Pardee (Exelon Generation Company, LLC), dated December 13, 2007

In the Reference 1 letter, Exelon Generation Company, LLC (EGC) requested an amendment to Appendix A, Technical Specifications, of Facility Operating License Nos. NPF-39 and NPF-85. The proposed change modifies Technical Specifications (TS) 6.8.4.g, "Primary Containment Leakage Rate Testing Program." Specifically, the proposed change will revise TS 6.8.4.g to reflect a one-time extension of the containment Type A Integrated Leak Rate Test (ILRT) from 10 to 15 years. This one-time extension will require the Type A ILRT to be performed no later than May 15, 2013 (Unit 1) and May 21, 2014 (Unit 2).

In the Reference 2 and 3 letters, EGC responded to requests for additional information. Attached is our response to a request for additional information discussed in the Reference 4 letter.

There are no commitments contained in this letter.

If any additional information is needed, please contact Tom Loomis at (610) 765-5510.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 20th of December, 2007.

Respectfully,

Pamela B. Cowan
Director, Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Attachment: 1) Response to Request for Additional Information

cc: S. J. Collins, Administrator, Region 1, USNRC
S. Hansell, USNRC Senior Resident Inspector
P. Bamford, Project Manager, USNRC
R. R. Janati, Commonwealth of Pennsylvania

ATTACHMENT 1

Technical Specifications Change Request -Type A Test Extension
Response to Request for Additional Information

ATTACHMENT 1
Technical Specifications Change Request -Type A Test Extension
Response to Request for Additional Information

QUESTION:

In Section 4.4 titled "Containment Inspections" in Attachment 1 of the LAR, it is stated that during the most recent Unit 1, American Society of Mechanical Engineers (ASME) Code, Section XI, Subsection IWE, examinations, "One (1) recordable indication of a pit in the suppression pool steel liner was isolated from further corrosion by performing a qualified coating repair. The remaining wall thickness under this pit was greater than the required design minimum wall thickness. Previously, one other less severe pit was similarly isolated." In order to help the NRC staff understand the nature of the pitting degradation and its management, please provide the following information.

1) The extent, depth, location/environment and root cause of these pits in the suppression pool liner of Unit 1, the corrective actions taken and evaluations performed that deemed them to be acceptable. Explain how the required design minimum wall thickness was determined. What actions are being taken to monitor these indications to ensure that there is no further deterioration of degradation and explain why ASME Code, Subsection IWE, augmented examinations are not required?

RESPONSE:

Two spot corrosion locations on the Unit 1 suppression chamber immersion phase liner have been recoated. When recoated, the pits were measured as 119 mils deep (in 1R11 (Spring 2006), located in a floor panel) and 71 mils deep (in 1R07 (Spring 1998), located in a wall panel). The coating repair effectively isolates the bare steel substrate from both water and oxygen by establishing a tight bond with the substrate and adjacent tightly adhered coating. This arrests the progression of corrosion. Subsequent inspections would detect a failure of the repair coating to arrest corrosion because the corrosion products are greater in volume than the substrate, which would result in cracks, blisters or delamination of the repair coating. The expansion of the material under the repair coating would create pressure that causes excessive strain in the coating material.

The Limerick containment is a Mark II containment design. The cylindrical suppression chamber portion of the containment structure was constructed with reinforced concrete over 6 feet thick at the walls and 8 feet thick at the base slab. The entire concrete pressure vessel was lined with welded ¼ inch thick mild carbon steel, ASTM A285 Grade A plates. The suppression chamber portion of the liner is coated with a sacrificial inorganic zinc protective coating.

The cause of the pitting is generalized corrosion due to permeation of water through portions of the protective coating and depletion of the sacrificial zinc. Recoating the pit prevents additional corrosion because metal is no longer in contact with the water. This area will be inspected during the next inspection of the submerged space as required in the Limerick Specification NE-101, "Specification For Coating and Liner Inspection and Coating Repair of the Suppression Chamber at Limerick Generating Station Units 1 and 2".

A safety-related design analysis, prepared for Exelon by Structural Integrity Associates, established the maximum allowable wall metal loss criteria. Exelon selected a less severe metal

loss threshold for applying a localized coating repair to arrest further metal loss. This analysis took into consideration the size and spacing between corrosion sites and the surrounding wall thickness. The analysis addressed two degradation conditions:

- General Corrosion
- Pitting Corrosion

The principal design code/standard for the suppression pool liner plate for $\leq$ ¼ inch thick liner plate is ASME Section VIII, Division I, 1968 Edition with Winter 1969 Addenda. The principal design code/standard for the suppression pool liner plate > ¼ inch thick, which was only used in local areas requiring additional strength, is ASME Section III, Division I, Class 2 Components, 1968 Edition with Winter 1969 Addenda. Liner plate welding conformed to the requirements of Part UW of ASME Section VIII, Division I, 1968 Edition with Winter 1969 Addenda. The following exceptions apply: Strains from self-limiting loads in liner plate and anchors, and displacements from self-limiting loads of the anchors were limited to the allowable values in ASME Section III, Division 2, 1975 Edition. Stresses in the liner plate and anchors from mechanical loads were checked in accordance with ASME Section III, Division 1, 1974 Edition, Subsections NE and NA, Appendix I. The capacity of the liner plate anchorage is limited by the concrete pull-out load for the applicable service level as specified by ACI 318, "Building Code Requirements for Reinforced Concrete," 1971 Edition.

Load combinations used for the evaluation of the liner were the same as those used for the concrete containment. However, the acceptance criteria were based on allowable strain levels rather than on stress levels, for global loads. The basis for this is that the liner is not relied upon to resist loads, and must be able to withstand the strains experienced by the concrete. The original liner design and the more recent liner corrosion acceptance criteria analysis are consistent in this approach.

General Corrosion

General corrosion refers to uniform corrosion (degradation) of the entire pool liner at the same time. In essence, this leads to a uniform reduction of thickness of the entire pool liner. The acceptance criteria used to address general corrosion is consistent with the original design basis of the suppression pool liner. Three basic criteria were used for the acceptance criteria of the non-degraded liner (original thickness):

- Strain in the liner should be less than the allowable strain of 5,000 μin/in.
- Liner should not buckle under negative pressure loading.
- The load carrying capacity of the anchorage system should be adequate.

These same criteria were used and the original evaluation was re-performed assuming various levels of degradation of the pool liner, using the degraded thickness in lieu of the original thickness, to determine if the three success criteria were met. The strain due to the reduced thickness of the liner was determined by pseudo-elastic means similar to the original design basis calculation. The buckling evaluation was performed such that the load carrying capacity of the anchorage system was not exceeded due to the application of lateral loads on the liner. The conclusion was that from the general corrosion point of view, the liner thickness could be as low as 0.12 inch, or 120 mils (i.e., metal loss of 0.13 inch from nominal 0.25 inch original thickness) and still meet the allowable strain of 5,000 μin/in without the possibility of buckling and the anchorage system remaining intact.

Pitting Corrosion

Pitting corrosion was not evaluated as part of the original design basis of the pool liner and, therefore, an evaluation methodology was developed to address this degradation mechanism. This becomes an issue when very local areas have degradation which results in the thickness of the liner being below the acceptable thickness for general corrosion discussed above. The evaluation was performed to determine the depth and diameter combination of a local pit that will meet the reinforcement rules in ASME Code Section III, Division 1, Subsection NE, 1974 Edition since, as discussed above, the stresses in the liner were originally checked in accordance with the requirements of this Subsection. In essence, the reinforcement rules allow missing material from the pit to be compensated by the excess material in the surrounding area adjacent to the pit within the limits of reinforcement. The reinforcement rules of NE-3334 of the ASME Code were used to determine the combination of pit depths and pit diameters, and also spacing between adjacent pits that would meet the reinforcement requirements.

For pits of the typical identified size and surrounding wall thickness, the threshold for applying a coating repair is 125 mils deep and for a pit to require a repair is 187.5 mils deep. These are the criteria for pits up to 12.5 inches in diameter with a surrounding wall thickness greater than 175 mils. Neither of the identified pits that were recoated or any other pits exceed the threshold for a coating repair.

For larger areas, greater than 12.5 inches in diameter, Exelon selected a threshold of 62.5 mils of metal loss for applying a coating repair. This is conservative considering the general corrosion acceptance criteria of 130 mils of metal loss described above for general corrosion.

Augmented Inspections

Section IWE-3510.1 states that the owner shall define acceptance criteria for visual examination of containment surfaces. Based on the analysis discussed above for pits of the typical identified size and surrounding wall thickness experienced at Limerick Generating Station (LGS), Units 1 and 2, the established visual examination acceptance criteria for containment surfaces, which is also the threshold for applying a coating repair, is 125 mils deep and the threshold for a pit to require a repair is 187.5 mils deep.

If a pit were to exceed the acceptance criteria specified by the owner, Section IWE-3122.3(b) requires the pit that is accepted by an engineering evaluation to be reexamined in accordance with Table IWE-2500-1, Category E-C, "Containment Surfaces Requiring Augmented Examination". LGS, Units 1 and 2 do not have any pits that are deeper than the established visual examination acceptance criteria for containment surfaces of 125 mils; therefore, no pits are required to be reexamined as Category E-C items.

QUESTION:

2) Provide information of the nature, extent, depth, locations/environment and cause of other pitting degradation indications that have been previously found, if any, on the suppression pool liners of both Units 1 and 2 and how they are being managed.

RESPONSE:

Unit 1

- Unit 1 was inspected in the most recent two refueling outages: 1R10 (2004) and 1R11 (2006), partial inspection in each outage.
- The suppression pool liner is ¼ inch ASTM A-285, Grade A, carbon steel plate with an inorganic zinc primer coating. This is a sacrificial coating system that will gradually be depleted, over time, by corrosion of the zinc. Once the zinc is depleted in a given location, the steel liner is exposed and subject to corrosion at that location.
- The steel liner is experiencing some minor corrosion and pits have been identified. The table below presents a summary of quantitative inspection observations.
- The majority of corrosion on wall panels is within "tiger-striping" at all elevations.

Table 1 Unit 1 Suppression Pool Liner Pit Depths			
Depth	Number of Pits on the Wall	Number of Pits on the Floor	Comments
50 - 60 mils	4	3	
61 - 70 mils	4	1	
71 – 80 mils	4	1	One pit on wall re-coated in 1R07
81 – 110 mils	0	0	
111 – 120 mils	0	1	Pit re-coated in 1R11

Unit 2

- Unit 2 was last inspected in 2R05 (1999).
- The next Unit 2 suppression pool liner inspection is scheduled for 2R10 (2009).
- The design and construction of the Unit 2 containment, including the suppression pool liner, are the same as described above for Unit 1.
- A technical evaluation was completed that concluded the corrosion rate on Unit 2 should be similar to the corrosion rate observed on Limerick Unit 1 and other similar BWRs (based on similar materials and water chemistry). The Limerick Generating Station, Unit 2 suppression pool was filled with water approximately 4 years after Limerick Generating Station, Unit 1.
- The steel liner is experiencing some minor corrosion and pits have been identified. The table below presents a summary of quantitative inspection observations.

Table 2 Unit 2 Suppression Pool Liner Pit Depths		
Depth	Number of Pits on the Wall	Number of Pits on the Floor
40 – 50 mils	0	9
51 - 60 mils	0	3
61 - 70 mils	0	1
71 – 80 mils	0	0

The station schedules the inspection of the submerged areas of the liner to be completed prior to the time when a pit depth is expected to exceed the coating repair threshold. The method used for scheduling the inspections is a Preventative Maintenance (PM) task that is scheduled every 4 years. The station performs a technical evaluation to establish a corrosion rate that is applied to the known pits to determine the expected pit growth. The PM task may be deferred if the expected pit depth remains below the coating repair threshold in the outage following the outage in which the PM task is presently scheduled.

Inspection results are evaluated in accordance with the Limerick Generating Station Maintenance Rule (10CFR50.65) Implementation Program. The Program ensures the primary containment liners, including its coating system, are capable of fulfilling their intended safety functions. Inspections are performed at a frequency sufficient to monitor the condition of the liner and coating against established goals so as to provide reasonable assurance that the associated safety functions will be fulfilled.

Limerick Generating Station has been actively participating in and continues to actively participate in Electric Power Research Institute and Boiling Water Reactor Owners Group activities associated with containment coatings condition assessment and suppression chamber immersion coatings.

Based on the design and construction of the reinforced, integral, concrete pressure vessel containment, it is believed that the small corrosion sites in the suppression pool liner are being effectively managed. The inspection program described above provides reasonable assurance that the leak-tight integrity of the suppression pool liner is maintained.