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10 CFR 50
10 CFR 51
10 CFR 54

August 16, 2013

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

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 NRC Request for Additional Information, dated August 1, 2013, related to the Limerick Generating Station License Renewal Application

Reference: 1. Exelon Generation Company, LLC letter from Michael P. Gallagher to NRC Document Control Desk, "Application for Renewed Operating Licenses", dated June 22, 2011
2. Letter from Richard A. Plasse (NRC) to Michael P. Gallagher (Exelon), "Requests for Additional Information for the Review of the Limerick Generating Station, Units 1 and 2, License Renewal Application (TAC Nos. ME6555, ME6556)", dated August 1, 2013

In the Reference 1 letter, Exelon Generation Company, LLC (Exelon) submitted the License Renewal Application (LRA) for the Limerick Generating Station, Units 1 and 2 (LGS). In the Reference 2 letter, the NRC requested additional information to support the staff's review of the LRA.

Enclosure A contains the response to this request for additional information.

Enclosure B contains updates to LRA Sections A.2.1.29 and B.2.1.29.

License Renewal Commitment 29 is modified as shown in Enclosure C. There are no other new or revised regulatory commitments contained in this letter.

If you have any questions, please contact Mr. Al Fulvio, Manager, Exelon License Renewal, at 610-765-5936.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 08-16-2013

Respectfully,

Michael P. Gallagher
Vice President - License Renewal Projects
Exelon Generation Company, LLC

Enclosures: A: Response to Request for Additional Information
B: Updates to affected LGS LRA sections
C: LGS License Renewal Commitment List Change

cc: Regional Administrator – NRC Region I
NRC Project Manager (Safety Review), NRR-DLR
NRC Project Manager (Environmental Review), NRR-DLR
NRC Project Manager, NRR- DORL Limerick Generating Station
NRC Senior Resident Inspector, Limerick Generating Station
R. R. Janati, Commonwealth of Pennsylvania

Enclosure A

Response to Request For Additional Information Related to the Buried and Underground Piping and Tanks Program Associated with the LGS License Renewal Application (LRA)

RAI B.2.1.29-4

RAI B.2.1.29-4

Background:

During the review of the license renewal application (LRA), the staff was developing license renewal interim staff guidance (LR-ISG), LR-ISG-2011-03, "Changes to the Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program (AMP) XI.M41, 'Buried and Underground Piping and Tanks.' " The staff issued the final LR-ISG on August 2, 2012, while the Safety Evaluation Report (SER) with open items was issued on July 31, 2012 and the final SER was issued on January 10, 2013. By letter dated June 17, 2013, LRA Sections A.2.1.29 and B.2.1.29 were amended to address the changes that were incorporated into LR-ISG-2011-03.

Issue:

The staff reviewed the changes as indicated in the June 17, 2013, amendment and has the following issues:

1. LRA Section B.2.1.29 states that direct inspections of buried piping are not required because of the preventive and mitigative measures included in the program. However, this was based in part because GALL Report, Revision 2, AMP XI.M41, "Buried and Underground Piping and Tanks," Table 4a, "Inspections of Buried Pipe," did not include any recommendations for inspecting buried nonsafety related systems. The circulating water and plant drainage systems are within the scope of license renewal and are nonsafety related. While these systems are coated and buried in acceptable backfill, only the circulating water system is cathodically protected. LR-ISG-2011-03, Table 4a, no longer distinguishes between code class safety related, hazmat, and nonsafety related piping; therefore, all in-scope piping is subject to the inspection recommendations of Table 4a. In addition to the recommended number of inspections in Table 4a, LR-ISG-2011-03, Section 4.b.vi, states, "[t]able 4a inspection quantities are for a single-unit plant. For two-unit sites, the not to exceed (NTE) inspection quantities are increased by 50 percent. For a three-unit site, the NTE inspection quantities are doubled."

   LRA Section B.2.1.29, Enhancement No. 5 states training requirements for the coatings inspector for the visual inspections of underground service water piping. Given that there are no planned buried piping inspections, there is no corresponding statement for buried piping. The staff recognizes that most, if not all, of the plant drainage system is buried in controlled low strength material backfill and, therefore, a coating inspector would not necessarily be required to inspect the pipe if the excavations only involve exposing the controlled low strength material backfill.

2. LRA Section B.2.1.29 states that inspection locations for underground piping would be based on susceptibility to degradation and consequences of failure. Given that there are no planned buried piping inspections, there is no corresponding statement for buried piping. LR-ISG-2011-03, Section 4.b.iii, as well as GALL Report AMP XI.M41, state that buried pipe system inspections should be based on risk.

3. LR-ISG-2011-03, Section 2.a.iv, states that, if cathodic protection is not provided, a 10-year search of plant-specific operating experience (OE) should be conducted to determine if adverse conditions have occurred in the impacted systems. Given that the plant drainage system is not cathodically protected, this 10-year search should be conducted. The search should include components that are not in scope if they are constructed from similar materials and buried in a similar environment. In addition, LR-

ISG-2011-03, Section 2.a.iii, states that a basis should be provided for why cathodic protection is not provided during the period of extended operation.

4. LR-ISG-2011-03, Table 6a, "Cathodic Protection Acceptance Criteria," footnote 2, states that the 100 mV polarization criterion is limited to electrically-isolated piping sections or areas of grounded piping where the effects of mixed potentials are shown to be minimal. The amended Enhancement 7 states, in part, "[i]n performing cathodic protection surveys, only the -850mV polarized potential criterion for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness, unless the -100mV polarization criterion can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured." While the staff recognizes that buried coupons, electrical resistance probes, or placement of reference cells can be used as effective means to detect corrosion rates or localized effectiveness of cathodic protection, the program does not state details such as what industry consensus documents will be used to install the devices (e.g., NACE Standard TM0169, ASTM G1, ASTM G16, ASTM G 46.), device placement, coupon characteristics, analysis of device results (e.g., how pitting rates versus general corrosion rates will be differentiated), how acceptance criteria will be established, and how many inspections of buried pipe will occur during the time period when the effectiveness is indeterminate (e.g., if a coupon is used, it will take several years for the actual pitting or general corrosion to proceed beyond nominal thickness measurements of the coupon).

Request:

1. State the number of inspections that will be conducted per unit on in-scope buried plant drainage system piping during each 10-year period starting 10 years prior to the period of extended operation. Revise LRA Sections B2.1.29 and A.2.1.29 accordingly. Alternatively, state the basis for why inspections would not be conducted.

   State whether all of the buried in-scope plant drainage system piping is buried in cementitious backfill. For portions of the system not buried in controlled low strength material backfill, or for inspections where exposure of the coating is performed in lieu of inspecting surrounding controlled low strength material backfill, state whether the direct excavated inspections of the coatings of these systems will be conducted by a NACE- or EPRI- qualified individual. Revise LRA Sections B2.1.29 and A.2.1.29 accordingly.
2. State whether the inspection locations selected for the buried in-scope plant drainage system piping will be based on risk, or state that basis for not doing so.
3. State the results of a 10-year search of plant-specific operating experience related to the plant drainage system. State the basis for why cathodic protection will not be provided for this system during the period of extended operation.
4. Respond to the following:
   a. State which industry consensus documents will be used to install and use the corrosion rate monitoring devices or reference electrodes.
   b. State the acceptance criteria for general and pitting corrosion rates when using electrical resistance probes or coupons.
   c. State how many inspections of buried pipe will occur during the time period when the cathodic protection effectiveness is indeterminate.
   d. If coupons will be used, respond to questions 5 through 7.

5. Describe the corrosion coupon characteristics, including:
   - The type of coupon to be used (e.g., free-corrosion coupon, polarized and native coupon pair, gravimetric, electrical resistance probe).
   - Whether the coupons will be coated with an intentionally embedded holiday (e.g., pitting rates would be expected to be higher at a holiday versus bare metal buried coupon).
   - The surface condition (e.g., presence of scale and corrosion products, surface finish) of coupons.
   - The composition of the coupon compared to the pipe (e.g., chemical composition and microstructure).
6. Describe the coupon placement, including:
   - How coupon locations will be selected so that they will be representative of the cathodic protection conditions at the point of interest (i.e., not receiving preferential or diminished protection compared to the piping system of interest).
   - The number of coupons that will be buried for each linear length of buried pipe.
   - Coupon size and orientation with respect to the pipe, for example, how close both in distance and elevation the coupons will be installed to the pipe; and whether coupon will be perpendicular or parallel with the pipe.
   - The length of time coupons will allow to be buried.
   - How many years the coupons will be buried prior to accepting results.
   - For a given portion of pipe, how will the impact of localized soil parameters, such as soil resistivity, soil chemistry, moisture content, temperature and microbiological activity, be considered.
   - How voids in the backfill will be avoided when installing coupons.
   - How seasonal variability will be accounted for on soil characteristics: (e.g., cyclic wetting and drying can be more corrosive than soils that are constantly wet, diffusion of oxygen into the soil).
7. Describe the analysis of coupon results, including:
   - What guidance will be used regarding coupon cleaning, corrosion rate calculations, and data reporting.
   - How pitting rates versus general corrosion rates will be differentiated.

<u>Exelon Response</u>

1. The Limerick Generating Station (LGS) in-scope Plant Drainage System piping performs a drainage function for the Safety Related Service Water System (SRSW) valve pits and for the main, safeguard, and auxiliary transformer dikes.
   - As described in UFSAR Section 3.4.1.1, the SRSW System valve pits are equipped with nonsafety-related drain pipes which direct seepage water into the normal waste drainage system. These drains are in scope for 10 CFR 54.4(a)(2) as they perform a protective feature in the event of any water entering the pits.

- The drain pipes associated with the transformer dike areas drain liquids to the normal waste drainage system. As described in UFSAR Appendix 9A, Section 9A.3.1.2, Item 65, Branch Technical Position CMEB 9.5-1 for fire protection requires that outdoor oil-filled transformers have oil spill confinement features, or drainage away from buildings. Although these drains are in scope for an (a)(3) fire protection intended function, the drains are an additional feature as the dikes themselves are sufficient for oil-filled transformer spill confinement.

Both the SRSW System valve pit drains and main, safeguard, and auxiliary transformer dike drains are at atmospheric pressure, and experience intermittent water flow. External corrosion (even through-wall) would not impact the ability of the drains to remove water. Additionally, the drains are constructed of cast iron which, as discussed further in this response, is a corrosion resistant material.

The in-scope Plant Drainage System piping is cast iron, which is a corrosion resistant material. Because of the free graphite content of cast iron, an insoluble graphitic layer of corrosion products is left behind in the process of corrosion. These corrosion products are very dense, adherent, have considerable strength, and form a barrier against further corrosion. In tests of severely corroded cast iron pipe, the graphitic corrosion products have withstood pressures of several hundred pounds per square inch although corrosion had actually penetrated the pipe wall (reference the *Cast Iron Soil Pipe Institute article dated 2/4/2011, www.cispi.org.*) The Plant Drainage System piping is backfilled in a controlled low strength material (CLSM), as discussed further in this response. CLSM has been proven to be noncorrosive or minimally corrosive. Additionally, resistivity, pH and chloride testing have been performed on the CLSM at LGS and the results confirm that these materials have mild or low corrosivity.

The Plant Drainage System piping is coated and backfilled in a controlled low strength material (CLSM). Backfill may also be concrete or material in accordance with ASTM D448-08, per plant specifications. Five excavations of the Plant Drainage System were performed at LGS since June of 2012 and all were found in their specified fill material. Resistivity measurements were taken of the backfill material around the pipe and were greater than 10,000 ohm-cm, which indicates low corrosivity.

Eleven excavations of other plant system piping were performed at LGS since October of 2010 in various locations. All of the excavations confirmed that the piping was in fillcrete in accordance with plant specifications. The condition of the fillcrete was found to be in very good condition and was analyzed for pH and chlorides. The measured pH was 10.4 and chlorides were less than 40 ppm. The high pH is the result of hydroxyl ions and alkalis present in the pore solutions in the CLSM microstructure; not from dissolved salt, which is consistent with the low chloride levels. High pH pore solutions have been well documented to result in stable, protective, passivating oxide films on iron products (reference K. Folliard, L. Du, D. Trejo, C. Halmen, S. Sabol and D. Leshchinsky, *Development of a Recommended Practice for Use of Controlled Low-Strength Material in Highway Construction,* National Cooperative Highway Research Program Report 597 (2008). The results of the pH and chloride testing further support that the fillcrete material

at LGS has low corrosivity and, therefore, provides additional corrosion protection of the piping.

In addition, as discussed in Exelon's response to item #3 below, there is no adverse operating experience at LGS concerning external corrosion of Plant Drainage System piping.

If in-scope piping is excavated for any reason and coating is exposed, inspection of the coating will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course.

LRA Appendix A.2.1.29 and Appendix B.2.1.29 are revised as shown in Enclosure B. LRA Table A.5 item 29 is revised as shown in Enclosure C.

2. The plant drainage system piping will not be excavated as justified in the response to request #1.

3. A review of the operating experience at Limerick Generating Station Units 1 and 2 from January 1, 2000 through April 21, 2010 was performed to support the development of the aging management reviews prepared for the license renewal application. An additional review was performed from April 22, 2010 through August 1, 2013. These reviews identified 615 condition reports for both the in-scope and not in-scope portions of the Plant Drainage System. No adverse conditions were identified for buried piping external surfaces.

   The plant drainage piping does not require additional external corrosion control, such as cathodic protection, for the following reasons:

   a. Lack of adverse plant-specific operating experience.

   b. Corrosion-resistant cast iron material construction operated at atmospheric pressure.

   c. Coating in accordance with Table 1 of NACE SP0169-2007.

   d. Backfilled with concrete, CLSM (fillcrete) or material in accordance with ASTM D448-08. Backfill verified via excavations to be in good condition.

   e. Recent testing of the backfill indicates a high resistivity, low corrosion environment.

   f. External corrosion (even through-wall) would not impact the ability of the drains to remove water.

4. The 100mV criterion is removed from commitment 29, item 7 and revised to state that only the polarized potential criterion will be used to determine cathodic protection effectiveness. LGS has copper/copper sulfate electrodes (CSEs) and zinc reference electrodes, therefore Commitment 29, item 7 is revised to allow for the use of other standard reference electrodes in accordance with NACE Standard RP0285-2002, Section 5.3 Table 1. This eliminates the need to answer questions 4-7.

   LRA Appendix A.2.1.29 and Appendix B.2.1.29 are revised as shown in Enclosure B. LRA Table A.5 item 29 is revised as shown in Enclosure C.

Enclosure B
LGS License Renewal Application Updates

Notes:

- To facilitate understanding, portions of the original LRA have been repeated in this Enclosure, with revisions indicated.
- Existing LRA text is shown in normal font. Changes are highlighted with ***bold italics*** for inserted text and ~~strikethroughs~~ for deleted text.

As a result of the response to RAI B.2.1.29-4 provided in Enclosure A of this letter, LRA Sections A.2.1.29 and B.2.1.29 are revised as follows:

A.2.1. 29 BURIED AND UNDERGROUND PIPING AND TANKS

The Buried and Underground Piping and Tanks aging management program will be enhanced to:

7. Modify the yearly cathodic protection survey acceptance criterion to meet NACE SP0169-2007 standards and add a statement that if negative polarized potential exceeds -1100mV relative to copper/copper sulfate electrode an issue report will be entered into the corrective action program. In performing cathodic protection surveys, ~~only~~ the ~~-850mV~~ polarized potential criterion ***of -850mV for copper/copper sulfate reference electrodes (CSEs) will be used to determine cathodic protection system effectiveness.*** ~~for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness., unless the -100mV polarization criterion can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured.~~ ***Other standard reference electrodes may be substituted for the CSEs; however their voltage measurements must be converted to the CSE equivalents in accordance with NACE RP0285-2002.***

8. Whenever pipe is excavated and damage to the coating is significant and the damage was caused by non-conforming backfill, an extent of condition evaluation should be conducted to ensure that the as-left condition of backfill in the vicinity of observed damage will not lead to further degradation. ***Visual inspection of coatings will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course***.

B.2.1.29 Buried and Underground Piping and Tanks

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

7. Modify the yearly cathodic protection survey acceptance criterion to meet NACE SP0169-2007 standards and add a statement that if negative polarized potential exceeds -1100mV relative to copper/copper sulfate electrode an issue report will be entered into the corrective action program. In performing cathodic protection surveys, ~~only~~ the ~~-850mV~~ polarized potential criterion ***of -850mV for copper/copper sulfate reference electrodes (CSEs) will be used to determine cathodic protection system effectiveness.*** ~~for steel piping will be used for acceptance~~

~~criteria and determination of cathodic protection system effectiveness, unless the -100mV polarization criterion can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured.~~ ***Other standard reference electrodes may be substituted for the CSEs; however their voltage measurements must be converted to the CSE equivalents in accordance with NACE RP0285-2002.*** **Program Elements Affected: Preventative Actions (Element 2), Detection of Aging Effects (Element 4) and Acceptance Criteria (Element 6)**

8. Whenever pipe is excavated and damage to the coating is significant and the damage was caused by non-conforming backfill, an extent of condition evaluation should be conducted to ensure that the as-left condition of backfill in the vicinity of observed damage will not lead to further degradation. ***Visual inspection of coatings will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course***. **Program Elements Affected: Acceptance Criteria (Element 6)**

Enclosure C

LGS License Renewal Commitment List Changes

This Enclosure includes an update to the LGS LRA Appendix A, Section A.5 License Renewal Commitment List, as a result of the Exelon response to RAI:

RAI B.2.1.29-4

Note: For clarity, portions of the original LRA License Renewal Commitment List text are repeated in this Enclosure. Added text is shown in ***Bold Italics*** and deleted text shown in ~~Strikethrough~~ format.

A.5 License Renewal Commitment List

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
29	Buried and Underground Piping and Tanks	Buried and Underground Piping and Tanks is an existing program that will be enhanced to: 1. If adverse indications are detected during inspection of in-scope buried piping, inspection sample sizes within the affected piping categories are doubled. If adverse indications are found in the expanded sample, an analysis is conducted to determine the extent of condition and extent of cause. The size of the follow-on inspections will be determined based on the extent of condition and extent of cause. 2. Coat the underground Emergency Diesel Generator System fuel oil piping prior to the period of extended operation. The coating will be in accordance with Table 1 of NACE SP0169-2007 or Section 3.4 of NACE RP0285-2002. 3. Perform direct visual inspections and volumetric inspections of the underground Emergency Diesel Generator System fuel oil piping and components during each 10-year period beginning 10 years prior to the entry into the period of extended operation. Prior to the period of extended operation all in scope Emergency Diesel Generator System fuel oil piping and components located in underground vaults will undergo a 100 percent visual inspection. Volumetric inspections will also be performed. After entering the period of extended operation, 2 percent of the linear length of in scope Emergency Diesel Generator System fuel oil piping and components located in underground vaults will undergo direct visual inspections and volumetric inspections every 10 years. Inspection locations after entering the period of extended operation will be selected based on susceptibility to degradation and consequences of failure. Visual inspections will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course. 4. Perform two sets of volumetric inspections of the Safety Related Service Water System underground piping and components during each 10-year period beginning 10 years prior to the entry into the period of extended operation. Each set of volumetric inspections will assess either the entire length of a run of in scope Safety Related Service Water piping and components in the underground vault or a minimum of 10 feet of the linear length of in scope Safety Related Service Water System piping and components in the underground vault. Inspection locations will be selected based on susceptibility to degradation and consequences of failure.	Program to be enhanced prior to the period of extended operation. Inspection schedule identified in commitment.	Section A.2.1.29 LGS Letter dated 2/15/12 RAI B.2.1.29-2 RAI B.2.1.29-3 LGS Letter dated 3/30/12 RAI B.2.1.29-2.1 LGS Letter dated 6/17/2013 ISG-2011-03

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		5. Specify that visual inspections of Safety Related Service Water System underground piping and components will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course. 6. Perform trending of the cathodic protection testing results to identify changes in the effectiveness of the system and to ensure that the rectifiers remain operational at least 85% of the time and cathodic protection effectiveness will be maintained greater than 80%. 7. Modify the yearly cathodic protection survey acceptance criterion to meet NACE SP0169-2007 standards and add a statement that if negative polarized potential exceeds -1100mV relative to copper/copper sulfate electrode an issue report will be entered into the corrective action program. In performing cathodic protection surveys, ~~only~~ the ~~-850mV~~ polarized potential criterion ***of -850mV for copper/copper sulfate reference electrodes (CSEs) will be used to determine cathodic protection system effectiveness.*** ~~for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness., unless the -100mV polarization criterion can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured.~~ ***Other standard reference electrodes may be substituted for the CSEs; however their voltage measurements must be converted to the CSE equivalents in accordance with NACE RP0285-2002.*** 8. Whenever pipe is excavated and damage to the coating is significant and the damage was caused by non-conforming backfill, an extent of condition evaluation should be conducted to ensure that the as-left condition of backfill in the vicinity of observed damage will not lead to further degradation. ***Visual inspection of coatings will be performed by a NACE Coating Inspector Program Level 2 or 3 qualified inspector or an individual that has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course***.		***LGS Letter dated 8/16/13 RAI B.2.1.29-4***