From:	Wu, Angela
To:	Tony Banks
Cc:	Paul Aitken; Eric A Blocher; Rogers, Bill
Subject:	Surry SLRA - Clarification Call for 3rd Round RAI - TRP 14 (Buried Piping)
Date:	Wednesday, September 18, 2019 8:55:00 AM
Attachments:	014 Surry Buried Pipe 3rd Round RAIs Allik Holston.docx

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Tony,

I would like to schedule a clarification call today to discuss the two draft 3rd round RAIs attached for TRP 14 (Buried Piping). Could you please let me know what time is best for your staff?

We will also be expecting an addition 3rd round RAI for TRP 33 (Selective Leaching) today so ideally, we can have the call on both subjects at once. I will share that RAI with you once I receive it.

Thanks!
Angela

Surry TRP 014 Buried Pipe 3rd Round RAIs - Allik

Regulatory Basis

10 CFR 54.21(a)(3) requires an applicant to demonstrate that the effects of aging for structures and components will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation. One of the findings that the staff must make to issue a renewed license (10 CFR 54.29(a)) is that actions have been identified and have been or will be taken with respect to managing the effects of aging during the period of extended operation on the functionality of structures and components that have been identified to require review under 10 CFR 54.21, such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis. In order to complete its review and enable making a finding under 10 CFR 54.29(a), the staff requires additional information in regard to the matters described below.

RAI B2.1.27-1b

Background:

SLRA Section B2.1.27, "Buried and Underground Piping and Tanks," states that the Buried and Underground Piping and Tanks program is an existing program that, following enhancement, will be consistent with NUREG-2191, Section XI.M41, "Buried and Underground Piping and Tanks."

The response to RAI B2.1.27-1a, dated September 3, 2019 (ADAMS Accession No. ML19253B575), states that the installation of a cathodic protection system for the balance of buried steel piping has been determined to not be justified based on six considerations. A summary of each consideration is provided as follows:

1. Buried fire protection system piping does not require cathodic protection based on being installed consistent with preventive measures identified in NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances," and monitoring the activity of the jockey pump.
2. A cathodic protection system will be installed for protection of the 24-inch service water piping at the low level intake structure 5 years before entering the subsequent period of operation.
3. Soils at the site are not extremely conducive to pipe corrosion, as evidenced by direct inspection results of piping to date and 2012 and 2018 soil analysis results, which indicate soil in the vicinity of buried components within the scope of subsequent license renewal (SLR) to not be aggressive corrosive environments (i.e., not appreciably or severely corrosive).
4. Buried piping exterior surfaces are coated and wrapped, and surrounded with engineered fill to protect the piping from various forms of environmental attack.
5. Of the buried piping within the scope of SLR, only a few self-revealing issues have been discovered, including emergency diesel generator (EDG) fuel piping leaks in 1987 and 1994, a two-inch auxiliary feedwater piping leak in 2004, and a 10-inch condensate piping leak in 2011. These piping segments have been replaced, rerouted (not buried) or repaired. Since full implementation of NEI 09-14, "Guideline for the Management of

Underground Piping and Tank Integrity," no additional loss of intended function due to external degradation has been identified for buried piping within the scope of SLR.

6. With the exceptions of buried fire protection system piping, 24-inch service water piping at the low level intake structure, and EDG fuel oil piping, the remaining buried carbon steel piping within the scope of SLR is concentrated in a small congested area and will not receive cathodic protection based on challenges associated with adding cathodic protection, which include the following considerations: (a) piping systems and tanks are connected to the plant grounding system and are laid out in various directions and depths; (b) there are nearby buildings and structures that can affect stray currents; (c) the current density required to polarize a mixed metal system consisting of copper and iron to an adequate potential necessary to protect the ferrous portion of the system may be 10 to 20 times as high as that required to protect an isolated ferrous piping system; and (d) installing a cathodic protection system in the small congested area could result in unintended consequences, such as stray current corrosion and coating disbondment.

Issue:

The staff's issues with each of the six considerations is as follows:

1. The staff does not have an issue with this consideration.
2. The staff does not have an issue with this consideration.
3. GALL-SLR Report AMP XI.M41 recommends that soil corrosivity testing can be used to guide inspection quantities (i.e., moving between Preventive Action Categories E to F, both of which are based on a cathodic protection system being available), but not as a singular technical basis for why cathodic protection is not necessary. The RAI responses have not provided a sufficient basis for why soil which is "not extremely conducive to pipe corrosion" precludes the need to provide cathodic protection. The staff notes that even mildly corrosive soil could result in a loss of pressure boundary function in the absence of cathodic protection if there are localized areas where coatings were not installed properly, were missing, or have degraded due to aging.

   Based on a review of *Protecting a Pipeline When Its Coating Has Aged*, the expected life of coal tar enamel or asphalt enamel coatings for buried pipelines is 20 to 30 years. The staff recognizes that there will be variability in the actual rate of degradation of these coatings; however, over an 80-year period, it would be expected that some degree of loss of coating integrity will occur (particularly in light of the examples of plant-specific coating degradation as noted in the audit report (ADAMS Accession No. ML19128A079)).
4. GALL-SLR Report AMP XI.M41 recommends cathodic protection, external coatings, and quality backfill for buried steel piping. Providing external coatings and quality backfill does not preclude the need to provide cathodic protection.
5. Replacing, repairing, or rerouting buried piping where self-revealing issues (e.g., leaks) have been identified is not an adequate basis for not installing cathodic protection. Buried steel piping that has not experienced leaks would be just as susceptible to buried steel piping that has experienced leaks unless a technical basis is provided for why they are not representative of each other (e.g., material composition, degradation mechanisms, coatings, soil conditions).

In addition, the statement that "no additional loss of intended function due to external degradation has been identified for buried piping within the scope of SLR" does not address if recent operating experience has identified precursors to loss intended function (e.g., pinhole leaks), which would also be relevant to the staff's review.

6. The challenges noted are generic issues related to the design of cathodic protection systems at nuclear power plants (e.g., majority of current will flow to the copper grounding grid, buried piping is often located in congested areas, shielding effects from structures and other buried piping, cathodic overprotection can result in coating disbondment). The response does not specifically address why providing cathodic protection for buried steel piping (other than buried fire protection system piping, 24-inch service water piping at the low level intake structure, and EDG fuel oil piping) is impractical.

The staff recognizes that the decision to modify the plant to install cathodic protection always rests with the licensee. However, in regard to this application, sufficient evidence has not been provided to demonstrate that external corrosion control is not required. None of the four recommended preventive action categories in AMP XI.M41, Table XI.M.41-2, "Inspection of Buried and Underground Piping and Tanks," are applicable (Category D) or sufficient (Categories, C, E, and F). Alternative inspection quantities and frequency have not been proposed.

Request:

Given that the staff is assuming that cathodic protection will not be installed on systems other than 24-inch service water piping at the low level intake structure, and EDG fuel oil piping (as noted above the staff has no further questions in regard to cathodic protection of the fire water system piping), state the quantity and frequency of buried piping inspections that will be conducted commencing 10 years prior to the subsequent period of extended operation. Provide the basis for the quantity and frequency.

RAI B2.1.27-2b

Background:

The response to RAI B2.1.27-2a dated September 3, 2019 (ADAMS Accession No. ML19253B575) states the following:

- Consistent with NUREG-2191, Section VII.C1, cracking and loss of material aging effects of the concrete 96-inch inlet circulating water piping exposed to a raw water environment are managed by the Open Cycle Cooling Water (OCCW) System program. Implementing procedures for the OCCW System program manage the aging of the concrete 96-inch inlet circulating water piping exposed to a groundwater environment by referencing and using applicable portions of the Structures Monitoring program.
- One hundred percent of accessible surfaces are visually inspected on a periodic frequency. Exposed portions of the below grade concrete are inspected when excavated for any reason.
- The March 2019 Structures Monitoring program groundwater sample results at the three locations in the vicinity of the concrete 96-inch inlet circulating water piping confirm a nonaggressive groundwater environment.

Surry TRP 014 Buried Pipe 3rd Round RAIs - Allik

GALL-SLR Report AMP XI.M20, “Open-Cycle Cooling Water,” states that for buried OCCW system piping, the aging effects on the external surfaces are managed by GALL-SLR Report AMP XI.M41.

GALL-SLR Report AMP XI.M41 recommends the following:

- Periodic inspections for the external surfaces of buried cementitious piping.
- As an alternative to visual examination of piping external surfaces, at least 25 percent of the in-scope piping constructed from the material under consideration is internally inspected by a method capable of precisely determining pipe wall thickness.
- Soil corrosivity testing as a factor when determining piping inspection quantities (e.g., moving between Preventive Action Categories E to F for buried steel piping).

Various GALL-SLR Report AMPs (e.g., AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”) state that for situations where the similarity of the internal and external environments are such that the external surface condition is representative of the internal surface condition, inspections of either the internal or external surfaces of the component may be credited for managing the effects of aging for the other surface. The GALL-SLR Report does not state that raw, brackish, or seawater environments are representative of a soil environment.

As noted by the staff in RAI B2.1.27-1a (ADAMS Accession No. ML19217A358), buried cementitious piping is not provided with an external coating. GALL-SLR Report AMP XI.M41 recommends external coatings for buried cementitious piping.

Concrete Pressure Pipe - Manual of Water Supply Practices states the following:

- Chloride ions in sufficient concentration can destroy the passivation of steel embedded in concrete and initiate corrosion if oxygen is also present at the steel surface. For corrosion to continue, the oxygen at the steel surface must be replenished. Lines continuously submerged in seawater do not experience damaging corrosion despite chloride concentrations in excess of 20,000 ppm due to the extremely low rate of oxygen diffusion through the mortar coating.
- Concrete cylinder pipe buried in soils with significant water soluble chloride concentrations **must be evaluated differently** [emphasis added] than pipe continuously submerged in fresh water or seawater.

Issue:

1. GALL-SLR Report AMP XI.M41 recommends periodic (i.e., not opportunistic) inspections for buried cementitious piping. Piping being inaccessible is not an adequate basis for not performing periodic inspections recommended in GALL-SLR Report Table XI.M41-2.
2. GALL-SLR Report AMP XI.M41 recommends that as an alternative to visual examination of piping external surfaces, at least 25 percent of the in-scope piping constructed from the material under consideration is internally inspected by a method capable of precisely determining pipe wall thickness (e.g., ultrasonic examinations for steel piping). Visual inspections of piping are not capable of precisely determining pipe wall thickness.
3. GALL-SLR Report AMP XI.M41 uses soil corrosivity testing as a factor when determining piping inspection quantities, not as a basis for eliminating all periodic inspections.

4. The staff seeks clarification regarding why the internal environment of brackish water and the external soil environment are representative of one another. Based on the staff's review of the GALL-SLR Report and *Concrete Pressure Pipe - Manual of Water Supply Practices*, these environments should be evaluated differently.
5. Recent industry operating experience at a station revealed a significant failure of prestressed concrete cylinder piping exposed to an underground environment. The principal cause of the failure was breakdown of the mortar layer external to the prestressed wires, corrosion of the prestressed wires and internal steel cylinder, reduction of strength of the pipe, and then a local rupture.

Request:

State the basis for:

a) Why the environments of brackish water and soil are representative of one another, specifically as it relates to degradation of external surfaces of the cementitious piping.

b) Why opportunistic inspections, in lieu of periodic inspections, are appropriate for buried cementitious piping.

c) The number and frequency of external visual inspections that will be conducted on buried cementitious piping, including the basis.

References.

- *Concrete Pressure Pipe - Manual of Water Supply Practices, M9* (3rd Edition). American Water Works Association (AWWA), 2008
- NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances." Quincy, Massachusetts: National Fire Protection Association. 2010.
- *Protecting a Pipeline When Its Coating Has Aged*. *Materials Performance* Magazine. Larsen, Kathy Riggs. January 2017 Edition, page 24.