NRR-PMDAPEm Resource

From: Dave Lochbaum <DLochbaum@ucsusa.org>
Sent: Wednesday, September 21, 2016 11:08 AM
To: Poole, Justin
Subject: [External_Sender] UCS comments on Seabrook's ASR license amendment request
Attachments: 20160921-sb-ucs-nrc-asr-lar-comments.pdf

Hello Justin:
Attached is a PDF with our comments on the license amendment request recently submitted by Seabrook to address its ASR degradation within the current licensing basis.
I've used hyperlinks in the PDF for cited sources. Some NRC staffers have experienced problems with linked PDFs not getting through the NRC's cyber firewalls. Other NRC staffers have not encountered this problem. If you have a problem, let me know and I can send along a PDF without the links.
Thanks,
Dave Lochbaum
UCS

Hearing Identifier: NRR_PMDA
Email Number: 3136

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From: Dave Lochbaum

Created By: DLochbaum@ucsusa.org

Recipients:
"Poole, Justin" <Justin.Poole@nrc.gov>
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[Union of Concerned Scientists

ucsusa.org Two Brattle Square, Cambridge, MA 02138-3780 t 617.547.5552 f 617.864.9405
1825 K Street NW, Suite 800, Washington, DC 20006-1232 t 202.223.6133 f 202.223.6162
2397 Shattuck Avenue, Suite 203, Berkeley, CA 94704-1567 t 510.843.1872 f 510.843.3785
One North LaSalle Street, Suite 1904, Chicago, IL 60602-4064 t 312.578.1750 f 312.578.1751

September 21, 2016

Justin Poole
Project Manager, Seabrook Station
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Seabrook License Amendment Request on Concrete Degradation

Dear Mr. Poole:

By letter dated August 1, 2016 (ADAMS ML16216A250), NextEra Energy Seabrook LLC (NextEra) submitted a license amendment request seeking Nuclear Regulatory Commission (NRC) approval of proposed revisions to the current licensing basis for concrete degradation due to alkali-silica reactor (ASR).

The Union of Concerned Scientists (UCS) has been monitoring the ASR issue at Seabrook over the past few years and sees a revision to the current licensing basis as a necessary step going forward. At the request of C-10, I reviewed the license amendment request to evaluate whether this essential step is an effective part of the resolution to this problem.

As detailed in the enclosure to this letter, it appears the license amendment request does not adequately address the possible adverse safety consequences that concrete degradation due to ASR can cause. For the past two years, I have served on the Community Action Panel (CAP) created by the Tennessee Valley Authority (TVA) for the startup of Watts Bar Unit 2. A senior manager from TVA's Fossil & Hydro Division attended one of the CAP meetings to brief us on the Boone Dam seepage issue. He also spoke about TVA's overall program for monitoring conditions at dams. When a fellow CAP member mentioned reading newspaper accounts about problems at the Chickamauga Dam, the TVA senior manager explained that those problems resulted from ASR that caused the lengthy dam to "grow" by four to five feet. The TVA senior manager hastened to point out that the ASR did not affect the structural integrity of the dam or compromise its safety margins. As the US Army Corps of Engineers explained, the ASR problem affected the gates in the 60-foot by 360-foot lock that allows boat traffic to navigate the Tennessee River past the dam. ASR causes concrete to expand. Concrete expansion affected the alignment of the lock at the Chickamauga dam and impeded the operation of its gates. The lock is being replaced to resolve the ASR-caused problem.

This concrete example illustrates the inadequacy of the license amendment request—it covers the potential effect of ASR on the structural integrity of buildings but fails to ensure that ASR effects will not cause collateral safety consequences. Just as Chickamauga Dam remained structural sound despite its ASR affliction but had its locks compromised, Seabrook's buildings may not be undermined by ASR but other safety components may be or become compromised.

Expansion due to ASR could result in a hole drilled through a concrete wall becoming smaller. Depending on the extent of the expansion, a pipe passing through that hole could be crimped and

overstressed. ASR can cause adjacent buildings to "move" relative to each other as expansion moves concrete walls differently. Relative motion has already failed a seismic gap seal between the containment enclosure building and containment building at Seabrook. The license amendment request describes extensive measures in place and planned to ensure that ASR does not compromise the structural integrity of concrete buildings. For example, the measures include periodic monitoring for ASR degradation with formal evaluations required when expansion exceeding a threshold is detected. It neither describes comparable measures that ensure pipes, ductwork, conduits, and other components passing through or connected to concrete buildings are not compromised by ASR nor justifies how the structural integrity measures and associated limits bound potential damage to pipes et al.

We expect that the NRC will not approve this license amendment request until its deficiencies are corrected.

Sincerely,

David A. Lochbaum
Director, Nuclear Safety Project
Union of Concerned Scientists
PO Box 15316
Chattanooga, TN 37415
423-468-9272, office
dlochbaum@ucsusa.org

Enclosure: as stated

UCS Comments on the ASR License Amendment Request

What is ASR?
MPR Associates was hired by NextEra to evaluate the potential affect of ASR on the structural integrity of concrete buildings at the site. In its report, MPR Associates wrote:

> *NextEra Energy has identified the presence of pattern cracking typical of Alkali-Silica Reaction (ASR) in multiple Seismic Category I structures at Seabrook Station. ASR can be explained simply as the reaction between silica from the aggregate and alkali constituents in the cement or the pore solution. This reaction produces a gel that expands as it absorbs moisture. Expansion of the gel exerts tensile stress on the concrete resulting in cracking. ASR cracking may degrade the mechanical properties of the concrete necessitating an assessment of the adequacy of the structures and supports anchored to the structures.*

ASR is a chemical reaction between the constituents of concrete. Water causes the gel formed by the reaction to expand. Expansion can cause concrete to crack, creating paths for water to contact more of the gel.

What Factors Affect ASR?
In a letter dated March 30, 2012, to the NRC, NextEra wrote that:

> *The expansion, cracking, and performance of ASR-affected concrete is greatly influenced by internal and external restraints unique to the geometry, reinforcement pattern, boundary conditions, and applied loads of a particular structure (i.e. structural context).*

The amount of silica in the aggregate and the concentration of alkali in the cement were controlled as concrete was made and poured. But tolerances for these amounts contribute to the uniqueness of specific geometries. In addition, concrete walls and floors have varying exposures to water. Concrete foundations may be immersed in groundwater having certain chemical properties. Exterior concrete may be wetted by rain and snow having different chemical properties. Interior concrete in one area may be exposed to high humidity while concrete in other interior areas may experience considerably lower humidity.

What Areas at Seabrook Might be Subject to ASR?
In a letter dated May 16, 2012, to the NRC, NextEra listed areas of the plant potentially subject to ASR degradation:

- "*Containment Building (including equipment hatch missile shield)*
- *Containment Enclosure Ventilation Area*
- *Service Water Cooling Tower including Switchgear Rooms*
- *Control Building*
- *Control Building Make-up Air Intake Structures*
- *Diesel Generator Building*
- *Piping (RCA) Tunnels*
- *Main Steam and Feed Water East and West Pipe Chase*
- *Waste Processing Building*
- *Tank Farm*
- *Condensate Storage Tank Enclosure*
- *Emergency Feed Water Pump House Building, including Electrical Cable Tunnels and Penetration Areas (Control Building to Containment)*
- *Fuel Storage Building*
- *Primary Auxiliary Building including RHR Vaults*

- *Service Water Pump House*
- *Service Water Access (Inspection) Vault*
- *Circulating Water Pump house Building (below elevation 21'-0)*
- *Safety Related Electrical Manholes and Duct Banks*
- *Pre-Action Valve Building*
- *Miscellaneous Non-Category I Yard Structures*
    - *SBO Structure - Transformers and Switch Yard foundations*
    - *Non-Safety-Related Electrical Cable Manhole, Duct Bank Yard Structures foundations*
    - *Switchyard and 345 KV Power Transmission foundations*
- *Non-Category I Structures*
    - *Turbine Generator Building*
    - *Fire Pump House*
    - *Aboveground exterior tanks 1-FP-TK-35-A, 1-FP-TK-3 5-B, 1-FP-TK-36-A, 1 -FP-TK-36-B and 1 -FP-TK-29 foundations.*
    - *Fire Pump House Boiler Building*
    - *Non Essential Switchgear Building*
    - *Steam Generator Blowdown Recovery Building*
    - *Intake & discharge Transition Structures*"

As Figure 1 shows, virtually all the buildings within the protected area for Unit 1 is susceptible to ASR degradation. It is far from a problem confined to only affecting one wall in one building.

How Does the License Amendment Request Seek to Manage ASR?
The license amendment request outlines a multi-phased approach intended to prevent ASR degradation from compromising the structural integrity of key buildings at Seabrook. The phases include initial and recurring walkdowns to identify concrete potentially degraded by ASR, baseline and follow-up measurements to quantify the extent of ASR degradation, and formal evaluations when modest amounts of expansion due to ASR are found of the potential effects on concrete properties and on components embedded in the concrete (e.g., reinforcing bars, anchor bolts and plates, etc.).

As indicated in NRC Inspection Report 50-443/2012-010 dated August 9, 2013, the NRC helped NextEra increase the scope of what it monitored for ASR increase the frequency of when it performed this monitoring:

> *Based in part on NRC observations, NextEra issued Revision 3 to the SMP*[Structures Monitoring Program] *on April 30, 2013. The SMP enhancements are: 1) the addition of periodic (every 30 months) combined crack indexing (CCl) measurements at 72 discrete locations identified as Tier ll (Acceptable with Deficiency) areas (CCl values between 0.5 mm/m* [millimeter per meter]*and 1.0 mm/m, or crack widths greater than 0.2 mm, but less than 1.0 mm) to collect quantitative information on the progression of ASR expansion/degradation (this monitoring was being performed, but not documented in the SMP); and, 2) inclusion of the periodic groundwater sampling program for monitoring of chemical attributes detrimental to concrete structures.*

How Does the License Amendment Request Inadequately Manage ASR?
The license amendment request focuses on managing ASR degradation to prevent concrete expansion from undermining the structural integrity of key buildings at Seabrook. Preventing such an outcome is certainly essential.

But ASR degradation could potentially damage safety-related components (e.g., pipes, conduit, and ductwork for emergency systems that penetrate concrete walls) without compromising structural integrity. The license amendment request does not include sufficient measures to protect against collateral damage caused by ASR.

For the past two years, I have served on the Community Action Panel (CAP) created by the Tennessee Valley Authority (TVA) for the startup of Watts Bar Unit 2. A senior manager from TVA's Fossil & Hydro Division attended one of the CAP meetings to brief us on the upriver Boone Dam seepage issue. He also spoke about TVA's overall program for monitoring conditions at dams. When a fellow CAP member mentioned reading newspaper accounts of problems at the Chickamauga Dam, the TVA senior manager explained that those problems resulted from ASR that caused the lengthy dam to "grow" by four to five feet. The TVA senior manager hastened to point out that the ASR did not affect the structural integrity of the dam or compromise its safety margins. As the US Army Corps of Engineers explained, the ASR problem affected the gates in the 60-foot by 360-foot lock that allows boat traffic to navigate the Tennessee River past the dam. ASR causes concrete to expand. Concrete expansion affected the alignment of the lock at the Chickamauga dam and impeded the operation of its gates. The lock was replaced to resolve the ASR-caused problem.

Enclosure 2 to the license amendment request was a July 2016 report by MPR Associates on ASR at Seabrook. The report's table of contents is provided as Figure 2. Section 6.5, "Effect of Structural Deformation," is the only portion of the report that might address collateral damage to safety-related components caused by ASR degradation. But this two-paragraph, half-page section covers whether restrained ASR-induced concrete expansion could undermine structural integrity; not whether structural deformation due to ASR-induced concrete expansion could adversely affect safety-related components.

Attachment 1 to the license amendment request contains existing Updated Final Safety Analysis Report (UFSAR) pages marked up by NextEra to reflect the measures being undertaken to manage ASR degradation. Measures intended to protect against concrete expansion due to ASR damaging safety-related components are described in the final paragraph of proposed UFSAR Section 3.8.4.7.2:

> *Although the observed strains due to ASR are of very small magnitude and adequately monitored by CCI and extensometers, over large distances and with the right building geometry, they can result in discernable dimension changes in a structure. Additional monitoring of this relative displacement potential and its impact to plant systems and components is included in the ASR Monitoring Program. Specifically, monitoring includes identifying signs of relative displacement or building deformation (e.g., fire seal displacement, seismic gap width changes, pipe/conduit misalignments at penetrations or between adjacent structures, bent or displaced pipe/conduit and supports, doorway*

misalignments). Critical building geometry locations where the potential for deformation is likely will be monitored for displacement via location-specific techniques.

This scant information is inadequate to properly manage damage to safety-related components caused by concrete expansion due to ASR. The concrete monitoring program entails baseline measurements and periodic follow-up measurements with mandated formal evaluations when modest (1 millimeter) concrete expansion is detected. But the monitoring program briefly mentioned in UFSAR Section 3.8.4.7.2 lacks comparable specificity, and hence reliability. For example, absent baseline data, workers will be challenged to identify displacements, deformations, and misalignments until they have progressed to the patently obvious degree—quite different from detecting concrete expansion of a mere millimeter.

This is not to suggest that the individuals conducting these walkdowns are inept. They are as competent as the individuals monitoring concrete expansion; in fact, many are likely the very same individuals. But whereas the concrete monitors are provided baseline measurements and specific threshold values that trigger formal assessments, this other monitoring lacks comparable aides and will remain inadequate until inspection guidance and acceptance criteria comparable to that developed for concrete expansion monitoring is developed.

For example, without baseline data, workers will be hard-pressed to differentiate between displacements and misalignments recently caused by ASR-induced concrete expansion and those introduced during initial construction or subsequently resulting from routine wear and tear.

Furthermore, the formal evaluations triggered by modest detection of concrete expansion account for the stress caused by ASR in addition to stresses from seismic motion and accident conditions. Deformations, displacements, and misalignments—even if detected—could be accepted as-is based upon incomplete consideration of all current design and licensing bases conditions.

How Must the License Amendment Request Fully Manage ASR?

The measures in the license amendment request to prevent ASR-induced concrete expansion from undermining the structural integrity of key buildings at Seabrook must be complemented by comparably detailed and robust measures to prevent concrete expansion from impairing safety functions of components connected to or passing through the walls and floors of the key buildings. Workers conducting walkdowns must be given answer keys for the tests they are administering; otherwise, the effort is merely exercise.

How Could ASR Impair Safety-Related Components?

Picture a hole bored through a concrete wall to allow a pipe for a safety-related system to pass. That pipe could transport makeup core cooling water from an emergency core cooling system, supply fuel oil to an emergency diesel generator, or provide numerous other essential safety functions. Consider concrete expansion due to ASR of only two-thirds of the modest amount that triggers formal assessments. If the concrete expansion is uniform in the vicinity of the pipe penetration, the hole's diameter has been reduced by more than the modest amount requiring formal assessment. The smaller hole may, or may not, squeeze the pipe depending on the configuration. Even if squeezed, the pipe may not be stressed to the point of failure. But its

safety margin could be reduced such that the loads imposed during an earthquake or under accident conditions cause it to rupture.

Imagine a ventilation pipe or duct passing through the concrete walls of adjacent buildings. Consider ASR-induced concrete expansion of both walls only three-quarters of the modest amount that triggered formal assessments. The expansion is in the downward direction for one building and in the upward direction for the other. Isolation valves and dampers are typically located as close to walls as possible to minimize the chance that a pipe or duct rupture degrades barrier integrity. The relative movement of the two buildings, although small, could distort the pipe or duct causing misalignment that prevents the valve or damper from closing. Periodic tests, like stroke-time testing, would reveal gross misalignment problems. But the tests could miss smaller misalignment problems that, when combined with factors like seismic motion or forces from design pressure/temperature under accident conditions, could prevent closure.

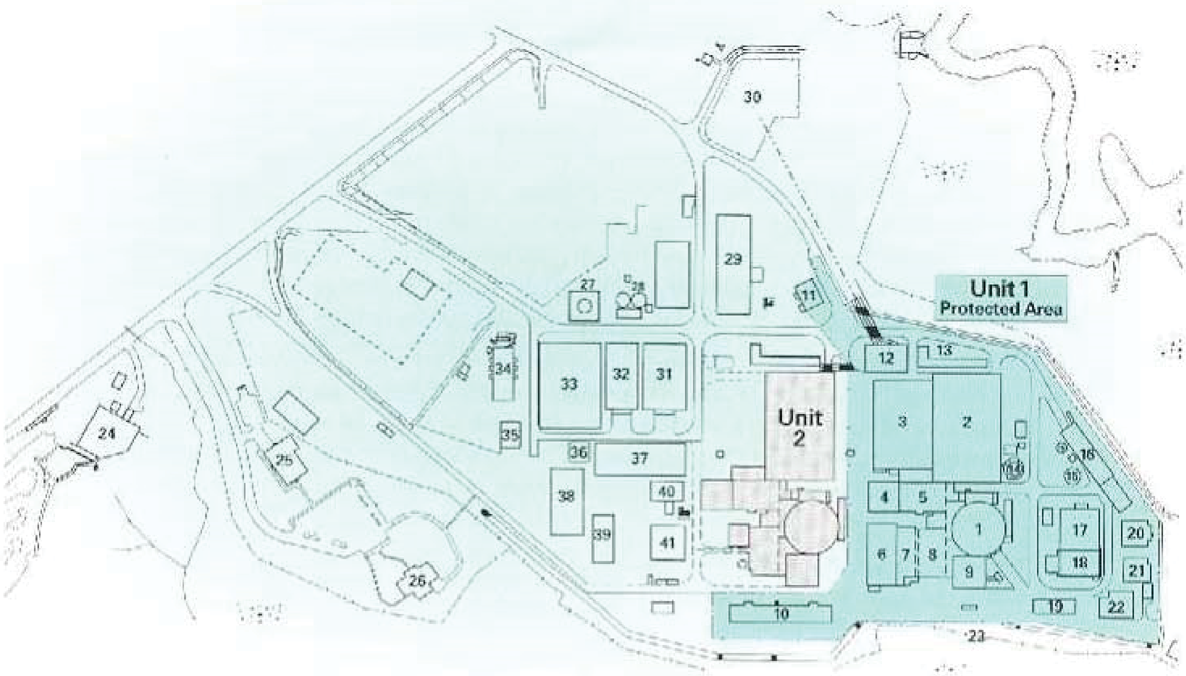
Consider hole drilled through the concrete floor of a room containing tanks and equipment for collecting and processing highly contaminated water. Any contaminated water overflowing a tank or leaking from a worn valve gasket enters the floor drain for transport to an appropriate collection tank rather than unmonitored and uncontrolled release to the environment. Consider concrete expansion due to ASR considerably greater than the modest amount that triggers formal assessments. This expansion is overlooked because this floor is not within the concrete being monitored. The expansion puts pressure on the weld connecting the vertical drain pipe to an elbow to a horizontal pipe run to the collection tank. Radioactively contaminated water flows into the floor drain and then into the ground through the failed weld.

What Should the NRC Do with the License Amendment Request?

Seabrook is vulnerable to concrete degradation due to ASR. It is imperative that ASR be properly managed to prevent concrete degradation from compromising safety margins at the plant. But ASR management is within the current licensing basis for Seabrook. The license amendment request seeks NRC's approval for measures being undertaken to manage ASR effects. Therefore, a license amendment issued by the NRC is necessary to incorporate proper ASR management measures into Seabrook's current licensing basis.

Due to the issues described above, the license amendment request has deficiencies. But rather than denying the license amendment request and sustaining Seabrook's continued operation without an NRC-approved ASR management program, the NRC should endeavor to have NextEra rectify the deficiencies so as to be able to issue a license amendment that fully and effectively establishes proper measures for ensuring that ASR does not compromise safety margins.

Figure 1: Map of Seabrook Site Showing Buildings Monitored for ASR Degradation



STATION STRUCTURES

1 Containment Building
2 Turbine Building
3 ~~Administration Building~~
4 Diesel Generating Building
5 Control Building
6 Waste Process Building
7 Tank Farm
8 Primary Auxiliary Building
9 Fuel Storage Building
10 Cooling Tower
11 ~~Security Building~~
12 Switchyard
13 Transformer Area
14 Condensate Storage Tank
15 Demineralized Water Tanks
16 ~~Maintenance Building~~
17 Circulating Water Pump House
18 Service Water Pump House
19 ~~Rad Water Storage Building~~
20 Intake Structure
21 Discharge Structure
22 ~~Chlorination Building~~
23 ~~Seawall~~
24 ~~General Office Building~~
25 ~~Training Center~~
26 ~~Science & Nature Center~~
27 Fuel Oil Storage Tank
28 Fire House Pump and Tanks
29 ~~Operation's Support Building~~
30 345 Kv Termination Area
31 ~~Warehouse No. 1~~
32 ~~Warehouse No. 2~~
33 ~~Warehouse No. 3~~
34 ~~Equipment Maintenance Shop~~
35 ~~Siren Maintenance~~
36 ~~Fire Protection~~
37 ~~Pipe Shop~~
38 ~~Hi-Rise Office Building~~
39 ~~General and Specialty Training Dept.~~
40 ~~Weld Shop~~
41 ~~Electrical Shop~~

Figure 2: Table of Contents from MPR Associates July 2016 Report on ASR at Seabrook

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