

NRC Pre-Submittal Meeting

Byron Unit 2 LAR for One-Time Deferral of Steam Generator Inspections

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Agenda

- Background
- Byron Unit 2 TS Requirement (TS 5.5.9.d.3)
- Degradation Mechanisms Summary
- Byron Unit 2 Historical Secondary Side and Foreign Object Search and Retrieval (FOSAR) Activities
- COVID-19 Pandemic Risk for Byron Unit 2
- COVID-19 Risk and Potential Mitigation Measures During Byron Unit 2 SG Inspections
- License Amendment Request Development
- Timeline for Submittal
- Closing Remarks
- Attachments

Background

- License Amendment Request (LAR) due to uncertainty of specialty vendor work force availability and to limit risk of exposure to site, supplemental workers, and the local community resulting from COVID-19 pandemic for upcoming Byron Unit 2 Outage (B2R22)
- TS 5.5.9.d.3 requirement: 100% bobbin inspection of all 4 SGs tubes and 50% Array/+Point™ inspection scope of specific locations identified as susceptible to cracking potentially not detectable by the bobbin probe is required for B2R22
- Requesting one-time change to Byron TS 5.5.9.d.3 requirements to defer all SGs inspections by one outage (i.e., from October 2020 to April 2022 (~18 months))

Byron Unit 2 TS Requirement (TS 5.5.9.d.3)

- Current TS wording:
 - “For Unit 2, after the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections)...”
- Proposed TS Change (Mark-up):
 - “For Unit 2, after the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections), with the exception that each SG is to be inspected during the third refueling outage in B2R23 following inspections completed in refueling outage B2R20...”
 - Delay of one additional cycle will result in ~52 EFPM interval between SG inspections.

Byron Unit 2 TS Requirement (TS 5.5.9.d.3) (continued)

- Note: The 72 EFPM inspection period will be extended by no more than 3 EFPM to complete 100% scope in the period, as permitted by TS 5.5.9.d.3.
- Not requesting change to any other TS requirements or deviations from NEI/EPRI “Mandatory” or “Needed” requirements or relaxation of any Structural Integrity Performance Criteria.

Degradation Mechanisms Summary

- Anti-Vibration Bar Wear
 - Affects all Westinghouse Alloy 600TT SGs
 - Slow, predictable growth rate (Avg ~0.4%TW/EFPY)
 - Tubes not plugged until 40%TW TS limit is reached
 - Over last 7 operating cycles, have plugged 7 tubes (avg 1 tube per cycle) for AVB wear. At last inspection after 2 cycles, plugged 2 tubes for AVB wear.
 - Likelihood of this type flaw failing Condition Monitoring (CM) after 1 additional operating cycle is very low.
- Tube Support Wear (Quatrefoil and Baffle plate)
 - Affects only 15 tubes, deepest in-service is 34% TW
 - Low growth rate and only 1 tube plugged at last 2 inspections.
 - Likelihood of this type flaw failing CM after 1 additional operating cycle is very low.

Degradation Mechanisms Summary (continued)

- Foreign Object (FO) Wear
 - No new FO wear reported in B2R20 at Top of Tubesheet or in Preheater Section after 2 cycles. All FOs which could cause significant wear were removed in B2R20.
 - Eight new FO wears reported in B2R20 due to FOs lodged in quatrefoil tube support openings after 2 cycles.
 - FOs are generally considered no longer present when eddy current is performed and indications do not grow. If FO is still present, tube is plugged at any TW%.
 - Deepest recent occurrence was 35% TW after 2 cycles but very small diameter; therefore no structural concern.
 - CM limit for these flaws is 62.7% TW.
 - Likelihood of this type flaw failing CM after 1 additional operating cycle is very low.

Degradation Mechanisms Summary (continued)

- Potential Degradation Mechanisms (not observed at Byron Unit 2)
 - ODSCC in potentially high stress (2-sigma) tubes
 - 39 potentially high stress tubes remain in service
 - Higher susceptibility at tube supports or at a low voltage ding (freespan)
 - In 2014 and 2017, completed “clean” inspections of all 39 tubes using Array probe (TSPs) and +Point™ probe (dents/dings)
 - ODSCC in non-high stress tubes (dent, ding, freespan)
 - ODSCC/PWSCC at the top of tubesheet expansion transitions and sludge pile
 - PWSCC within the tubesheet expansion region
 - PWSCC in Row 1 and Row 2 U-bend region
 - ODSCC/PWSCC at pre-heater baffle plate expansion transitions
 - Pitting

Byron Unit 2 Historical Secondary Side Activities

- Steam Drum observed degradation – FAC wear on Primary Moisture Separators
 - Trended since 2005. No through wall penetration expected until after 2027
- Preheater/Waterbox Observed degradation –
 - 2004: 2A SG Waterbox Cap Plate – 3 backing bars were found missing on cap plate. Note: 90 periphery tubes were preventatively plug in the 2A SG to allow continued operation, with a modification to contain the remaining backing bars (ML042260202)
 - 2017: 2C SG Waterbox Cap Plate – One backing bar was found missing from the Cap Plate and was found/removed from the preheater during FOSAR. Note: 91 periphery tubes were preventatively plug in the 2C SG to allow continued operation (ML18095A116)

Note: Extent of condition – 2B SG had no Cap Plate modifications (no cut outs) and the 2D SG had the cut out re-installed without the use of backing bars.
- Upper bundle – minor quatrefoil blockage
 - No measurable impact on SG levels or tube support wear initiation or growth
- Soft Chemical Cleaning and Sludge Lancing in 2017 –
 - Removed 3,132 lbs.

Byron Unit 2 Foreign Object Search and Retrieval (FOSAR)

Activities

- Foreign objects (FOs) based on location, size and type are evaluated, prioritized, and removed from Top of Tubesheet or preheater baffle, if required
- Last FOSAR performed in all 4 SGs in B2R20 (2017) after 2 operating cycles
 - Three (3) items removed, gasket piece, weld rod, and backing bar (2C Waterbox Cap Plate)
 - All remaining FOs (6) were analyzed to be benign (i.e., not predicted to cause appreciable wear until the next inspection)
 - These FOs consist of small wires, weld slag, screw, and sludge “rock” found on top of tubesheet and preheater baffle.
 - Three fixed, legacy objects (screw and 2 weld slag) have not caused any tube wear over 5 operating cycles for the weld slag and 2 cycles for the screw.

COVID-19 Pandemic Risk for Byron Unit 2

- January 27, 2020: Determination Public Health Emergency (PHE) Exists Nationwide (PHE renewed April 21, 2020)
- March 9, 2020: Illinois declared disaster proclamation over Coronavirus outbreak
- May 5, 2020: Governor of Illinois announced a five-phase plan to reopen the State of Illinois, using health statistics and health care capacity
 - Ogle County, the county in which Byron is located, and North-Central Region of Illinois are currently in **Phase 3** of plan
 - Current limit on gatherings is 10 people.
 - Face coverings and social distancing are required.
 - To reach the fifth and final phase, a vaccine or highly effective treatment or herd immunity would need to be established.
- Exelon is adhering to State and CDC recommendations to keep employees safe.

COVID-19 Pandemic Risk for Byron Unit 2 (continued)

- Over 190 individuals from across the U.S. required to mobilize on-site to support B2R22 steam generator inspections.
- Industry vendors are supporting overlapping outages and maintain unique and complex qualifications (e.g., in Spring 2020, a vendor had 54 quarantined individuals).
- Expertise/Specialty – No contingencies available for certain COVID-19 situations
 - Example: Inspections and subsequent actions require specialized qualifications to complete. An outbreak affecting personnel and limiting their availability after SG disassembly and inspections have started would result in not meeting the TS requirement for tube integrity/examination scope and limit ability to reassemble SGs.

COVID-19 Risk and Potential Mitigation Measures During Byron

Unit 2 SG Inspections

- Potential Mitigation Strategies –
 - Move personnel to Training Building or Vendor location.
 - Potentially offset approximately 35 individuals (of 190 supporting B2R22 SG inspections)
 - Remote Technology – Discussions with Vendor yielded no additional or new technology to improve data transmission or to conduct the SG inspections
- Mitigation Strategy Challenges –
 - Fiber running from training bldg. to containment (over 3000 ft) in need of repair and testing
 - Vendor testing data quality and speed at that distance
 - Question of Data Quality after fiber repaired

COVID-19 Risk and Potential Mitigation Measures During Byron Unit 2 SG Inspections (continued)

- Mitigation Strategy Challenges (continued)
 - Social Distancing –
 - Nature of work prevents meeting CDC recommendations for social distancing (e.g., Craft support for closure assembly / disassembly, platform construction, robot manipulations)
 - Additional mitigation strategies and PPE add time and individual effort that increase human performance and safety risk.
 - With COVID-19 pandemic, no technology or mitigation measures will allow the Byron U2 SG inspections to be performed consistent with CDC recommendations

License Amendment Request Development

- Technical justification for extending inspection intervals for cracking mechanisms in Alloy 600TT SGs was presented to NRR during a Steam Generator Task Force (SGTF) meeting held on 2/24/2020
- Byron Unit 2 will use technical approach for Alloy 600TT presented at SGTF meeting:
 - Accounts for undetected cracks, initiation of new cracks and growth of cracks over 3 operating cycles
 - Byron Unit 2 $T_{\text{Hot}} = 611^{\circ}\text{F}$, lower than “Lead Plants” so lower crack growth rates can be assumed
- Operational Assessment (OA) being performed for 3-cycle operation
 - Will address all existing and potential degradation mechanisms applicable to Byron Unit 2
 - Standard OA methods will be used for existing degradation mechanisms

Timeline for Submittal

- Submittal of LAR targeted by mid-July
 - Technical justification for 3-cycle operation
 - LAR will include OA for degradation mechanisms
 - Waterbox Backing Bar/Tab Re-evaluation for Byron Unit 2 SG 2C
- Byron Unit 2 Outage (B2R22) begins in early October
- Changes to the schedule will be communicated to NRR Project Manager
- Requested approval date will be September 1, 2020

Closing Remarks

- LAR for Unit 2 one-time SG inspection deferral is based on the previously discussed technical approach for Alloy 600TT
- Operational Assessment will address all existing and potential degradation mechanisms to support 3-cycle operation
- With COVID-19 pandemic, no technology or mitigation measures will preclude the need for Byron U2 SG amendment for B2R22

Attachment A – Byron Unit 2 SG Design/Operating Parameters

Four (4) Westinghouse Model D-5 Steam Generators, recirculating U-bend Steam Generators with pre-Heater

Tube Information:

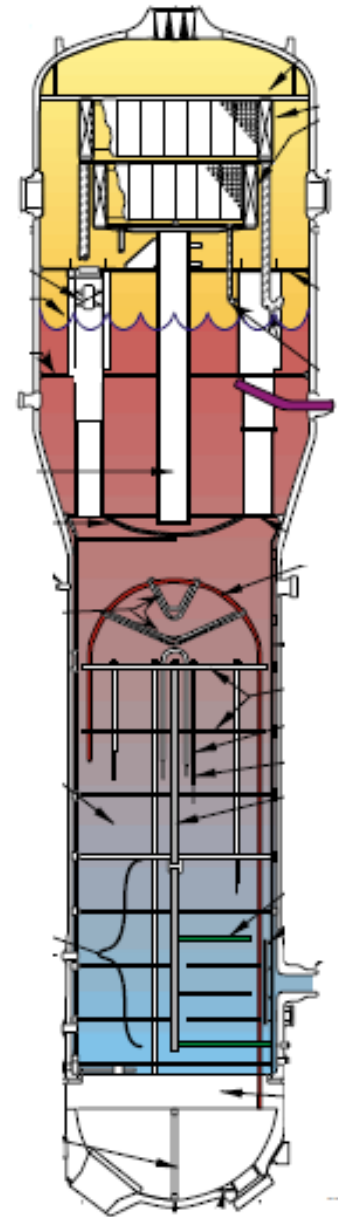
- Number of Tubes per SG: 4,570
- Tube Material: Alloy 600TT
- Nominal OD and Thickness: 0.750" x 0.043"

Tube Support Plate (TSP) Information:

- TSP Material: SS
- TSPs quatrefoil broached (TSPs drilled in preheater regions)
- Tubes hydraulically expanded full length of the Tubesheet

Normal Operating Parameters:

- NOP (Primary) = 2250 psia
- NOPD = 1385 psid
- $T_{\text{Hot}} = 611^{\circ}\text{F}$
- Operating Cycle Length = ~18 months
- SG EFPY at October 2020 Outage = 29.9



Attachment B – Byron Unit 2 Tube Plugging to Date

Byron Unit 2 Tube Plugging Through B2R20					
	SG A	SG B	SG C	SG D	Total
No. Tubes Plugged prior to B2R20	156	142	74	41	413
No. Tubes Plugged during B2R20	3	0	92	1	96
Total No. Tubes Plugged through B2R20	159	142	166	42	509
Percent Tubes Plugged	3.48%	3.11%	3.63%	0.92%	2.78%
Allowable Percent Tubes Plugged	5%	5%	5%	5%	5%

Attachment C – Byron B2R20 (2017) Indications by Degradation Mechanism

Degradation Mode	SG A	SG B	SG C	SG D	Total
AVB Wear	259	402	293	191	1145
Quatrefoil TSP Wear	0	5	5	4	14
Drilled Baffle Wear	0	2	1	2	5
Foreign Object Wear	8	12	3	6	29
Dent/Ding ODSCC in a High Stress Tube	0	0	0	0	0
TSP ODSCC in High Stress Tubes	0	0	0	0	0

Attachment D –

Byron Unit 2 Historical Secondary Side Activities

	SG	B2R13	B2R14	B2R15	B2R16	B2R17	B2R18	B2R19	B2R20	B2R21	B2R22 (Planned)
Steam Drum Inspection	A	X	--	--	X	--	X	--	X	--	--
	B	X	--	--	X	--	--	--	--	--	X
	C	X	--	--	--	--	--	--	X	--	--
	D	X	--	--	--	--	X	--	--	--	X
Preheater/Waterbox	A	--	--	--	--	--	X	--	--	--	X
	B	--	X	--	--	--	--	--	X	--	--
	C	--	--	X	X	--	--	--	X	--	--
	D	X	--	--	--	--	X	--	--	--	X
Upper Bundle TSP 08/11	B	X	X	--	X	--	X	--	X	--	X
Sludge Lance/FOSAR	A/B/C/D	X	X	X	X	X	X	--	X	--	X

Attachment E –

Byron Unit 2 Loose-Part Detection System (LPDS)

- Byron has 2 channels per SG in accordance with Technical Requirements Manual (TRM) 3.3.d, which requires 1 of 2 channels Operable
 - The Byron Unit 2 LPDS system is fully operable