

Revised Supplemental Second License Renewal (SSLR) Capsule Irradiation Schedule

OPEN SESSION – NON-PROPRIETARY

BWRVIP-NRC Meeting
February 3, 2022



Purpose

- Discuss the need to revise SSLR Capsule irradiation schedule defined in BWRVIP-321-A
 - Revise total irradiation period from 10 to 12 years
 - Irradiate all SSLR Specimen Groups defined in BWRVIP-321-A for the entire 12-year period (Rather than intermediate removals of specific Groups)
- Determine format in which revised irradiation schedule should be submitted to the NRC
- Identify options for expedited NRC approval of revised irradiation schedule

Background

- BWRVIP-321-A documents the plan for meeting ISP requirements through 80 years of operation (SLR) for the US BWR fleet (NRC approval obtained in 2020 with no Limitations or Conditions)
- Plan calls for installation of a single SSLR capsule in a host plant (attached to the core shroud OD) to obtain needed catch-up fluence to support 80 years of operation for the U.S. fleet
- BWRVIP-321-A provides a plan for irradiation of 23 packets contained in 3 Groups (Groups 1, 2 and 3)
 - Groups 1 and 2 require much less catch-up fluence than does Group 3
- BWRVIP-321-A proposed several potential irradiation periods depending on the flux that could be attained in the host plant
 - These irradiation schedules ranged from 2-10 years depending on Group and flux that could be attained
 - BWRVIP-321-A indicates that the NRC will be informed of which irradiation schedules would be followed prior to capsule insertion

Background (continued)

- Peach Bottom (PB) Unit 3 has been selected as the Host plant
- An analysis has been completed to determine the single fuel cycle flux profiles and fluence projections that can be expected for each Group and fuel type (GNF-2 and GNF-3) in PB Unit 3 beginning in the Fall of 2023 (planned SSLR capsule insertion date).
- The analysis indicates that it will require 12 years to attain the needed catch-up fluence for Group 3.
 - Accordingly, NRC approved irradiation schedules in BWRVIP-321-A are not suitable
- The first 2-year cycle will contain GNF-2 fuel assemblies and the remaining 5-year cycles (also scheduled as 2-year fuel cycles) will contain GNF-3 fuel assemblies on the periphery of the core.
 - Note: The neutron flux from GNF-3 fuel is significantly lower than from GNF-2 fuel

Flux and Fluence requirements

- Per BWRVIP-321-A, the distance from the inside surface of the packets to the core shroud has been chosen to ensure that the maximum neutron flux will not exceed $4.39E10$ n/cm²-s.
 - Selected distance will nominally result in a flux of $3.99E10$ n/cm²-s
 - Allows for a RAMA Code flux prediction uncertainty of +/- 10%.
- Per BWRVIP-321-A, a minimum target catch up fluence is defined for each Group
- The minimum catch-up fluence attained (at negative end of uncertainty range) must exceed the minimum required catch-up fluence.

Proposed Revised Irradiation Schedule

- Irradiate all three Groups for the entire 12-year period (2023-2035)
 - At the minimum end of flux uncertainty range sufficient fluence will be attained by the Charpy specimens to meet catch-up fluence requirements for all Groups
 - At the maximum end of the flux uncertainty range the flux will not exceed $4.39 \text{ E}+10 \text{ n/cm}^2\text{-s}$ at the OT radial position of the specimens
 - At the maximum end of the flux uncertainty range, no specimens will receive a total accumulated fluence exceeding $1.33 \text{ E}19 \text{ n/cm}^2$
 - This value is consistent with end of SSLR fluence values for BWR vessel materials and is well below PWR fluence levels at 80 years of life
 - Accordingly, exposure beyond plant specific BWR fluence targets will not have unexpected results

Summary

- BWRVIP-321-A defines the catch-up and total $\frac{1}{4}T$ target fluence requirements for each of the 23 packets to be irradiated in the SSLR capsule
- The packets are arranged in Groups 1, 2 and 3
- Groups 1 and 2 require significantly less catch-up fluence than does Group 3
- A plant-specific analysis has been completed to determine the single fuel cycle flux profiles and fluence that can be expected for each Group for each fuel type (GNF-2 and GNF-3) in PB Unit 3 beginning in the Fall of 2023.

Summary (continued)

- The analysis indicates that 12 years (2023-2035) will be required to attain the needed catch-up fluence for Group 3 whereas only 2 to 4 years is required for Groups 1 and 2.
- 12-year exposure of all three Groups would result in additional fluence (relative to plant unique target fluence levels) for Group 1 and 2 specimens
 - However, these higher exposure (total accumulated fluence) levels are consistent with those that must be attained by similar materials in other BWR vessels (unusual results not expected) and are well below PWR fluence levels for 80 years of life
- 12-year exposure of Groups 1, 2 and 3 will be completed in 2035, well before any U.S. BWR reaches the end of their potential subsequent license renewal period of extended operation.

NRC Review/Approval

- BWRVIP requests an expedited review of revised irradiation schedule
 - Capsule design and fabrication efforts are underway
 - Irradiation schedule impacts inputs and project planning
- BWRVIP proposes that an approach similar to that used for recent Duane Arnold capsule be used
 - Final Duane Arnold capsule withdrawn 7 years early
 - Letter sent to NRC requesting approval of early withdrawal with a supporting tech basis
 - NRC approved via letter – Turnaround time was ~2 months
- Are there faster or simpler methods?
 - Is there an option for NRC to provide verbal approval prior to written approval?

A blue-tinted photograph of four people, two men and two women, standing together. They are dressed in professional attire, including lab coats and a hard hat. The text 'Together...Shaping the Future of Energy™' is overlaid in white on the image.

Together...Shaping the Future of Energy™