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United States Nuclear Regulatory Commission

Reactor Vessel Material Surveillance Programs

May 19, 2020

Public Meeting

Purpose

- Share recent experiences with implementation of Reactor Vessel Material Surveillance Programs

- Solicit external stakeholder feedback based on these experiences

Overview

- Background
- NRC Guidance
- Recent Experiences
- Summary
- External Stakeholder Feedback

Background - Appendix H

- Appendix H to 10 CFR Part 50 established in 1973 to monitor reactor vessel integrity due to its "special importance to safety"
  - Requires monitoring via periodic withdrawal and testing of surveillance capsules
    - References ASTM E185-82, "Standard Practice for Conducting Surveillance Tests For Light-Water Cooled Nuclear Power Reactor Vessels," as the latest edition

Background - ASTM E185-82

- Recommended number of capsules and withdrawal schedule based on 32 Effective Full Power Years (EFPY) (i.e., 40 years)
  - Does not explicitly address more than 32 EFPY
  - Last capsule 1-2 times End of Life fluence and "may be held without testing following withdrawal"
  - Later editions (e.g., 2002) identify need for additional surveillance for extended plant operation

Background – Updated ASTM Standards

- Considered incorporating more recent standards into Appendix H (i.e., 2016 edition)
  - Large number of conditions to offset some new requirements (i.e., no corresponding benefit to public health and safety and the environment)
  - Public meeting on June 2017
    - Stakeholders supported retaining ASTM E185-82 and limited revisions to Appendix H to 10 CFR Part 50
  - Staff pursued limited-scope Direct Final Rule – (SRM-COMSECY-18-0016)
    - Heat-Affected Zone Specimens
    - Tensile Specimens
    - Correlation Monitor Materials
    - Thermal Monitors
    - Reporting Requirements

NRC Guidance

- Guidance in the Standard Review Plan (Section 5.3.1 of NUREG-0800)
  - "The material surveillance program criteria of ASTM E-185 cited in 10 CFR Part 50, Appendix H, is predicated on an assumed 40-year reactor vessel design life. For those applicants proposing a facility with greater than a 40-year design life, the criteria of ASTM E185 must be supplemented to provide for monitoring of the reactor vessel materials for the entire reactor vessel design life"
- 60-year reactor designs have incorporated an additional capsule to account for the "extra" 20-year design life
  - Advanced Passive 1000 (AP1000)
  - Advanced Boiling-Water Reactor (ABWR)
  - Economic Simplified Boiling-Water Reactor (ESBWR)
  - Advanced Power Reactor 1400 (APR1400)

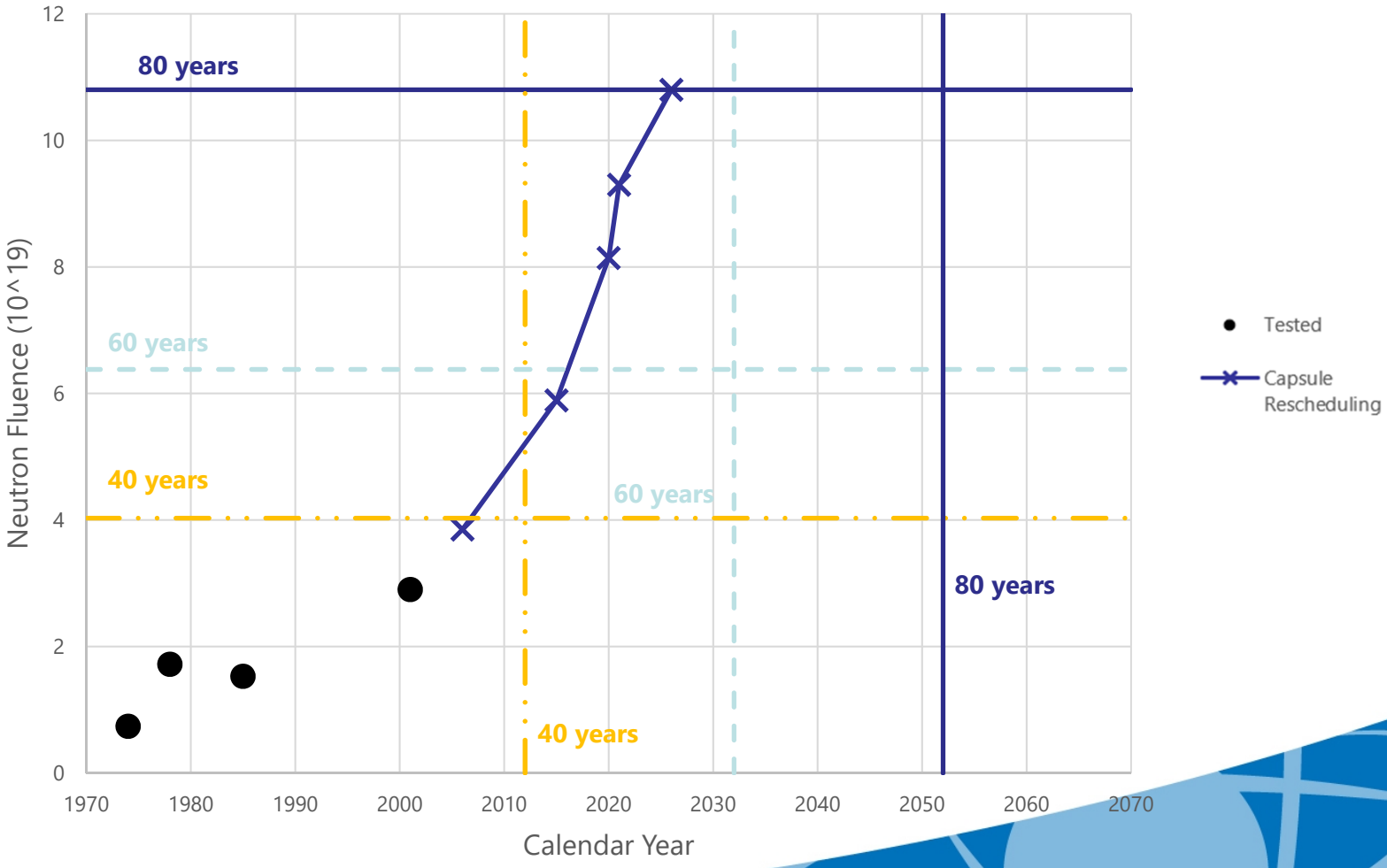
NRC Guidance - License Renewal

- Limitations in Appendix H to 10 CFR Part 50 addressed using license renewal guidance
  - Additional capsules may be needed for periods of extended operation
    - One capsule with neutron fluence greater than RPV end-of-license fluence
- Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report – Final Report (NUREG-2191):
    - Unnecessary to withdraw capsule if surveillance data for 80-years of operation is already available
    - Don't redirect or postpone already scheduled capsule withdrawals for the purposes of attaining projected 80-year neutron fluences

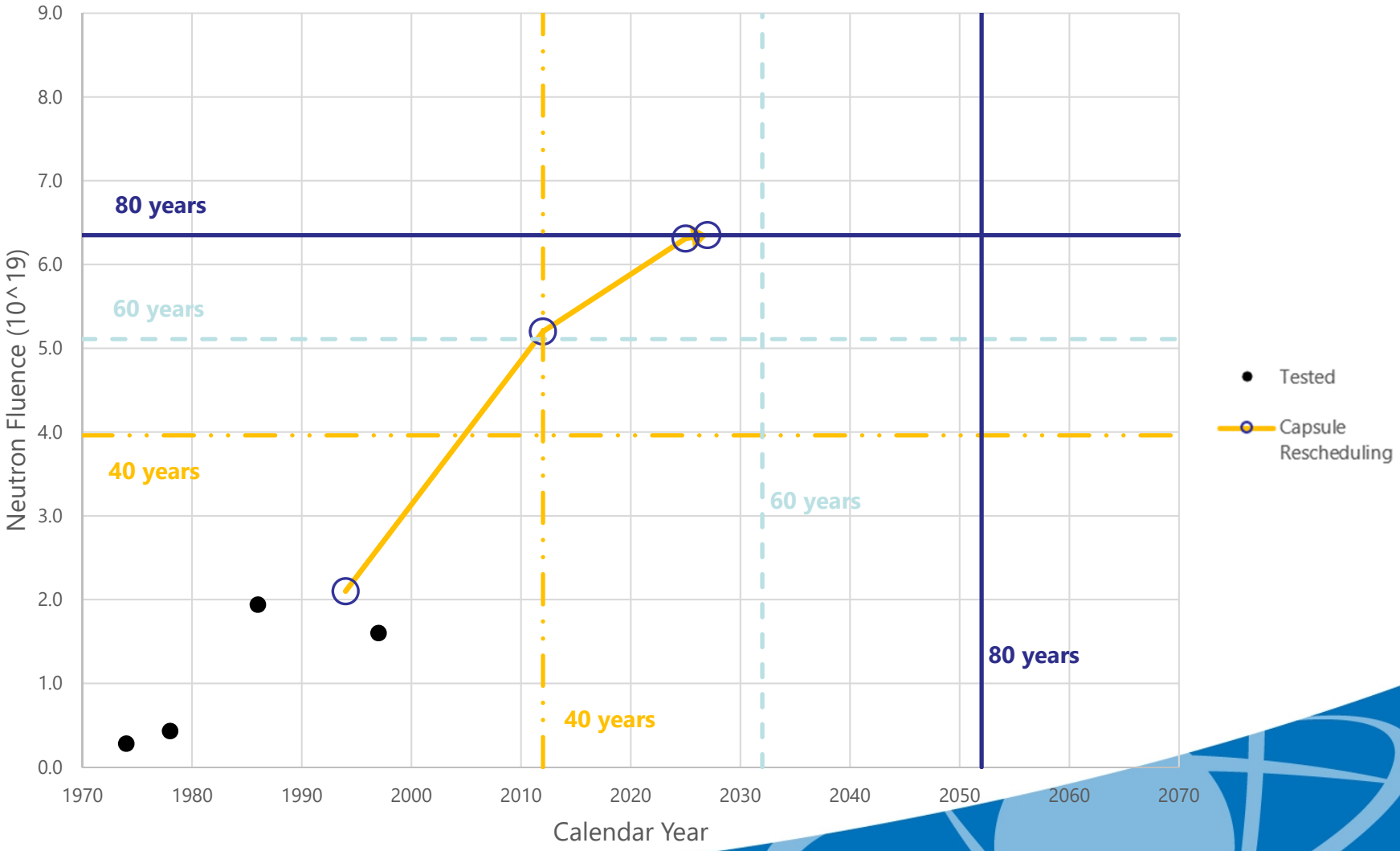
Recent Experiences

- Pressurized Water Reactor (PWR)
  - Turkey Point Units 3 and 4
  - Surry Power Station Units 1 and 2
- Boiling Water Reactor (BWR)
  - BWR Vessel & Internals Project (BWRVIP) Integrated Surveillance Program (ISP) for Subsequent License Renewal (SLR)
  - Peach Bottom Units 2 and 3

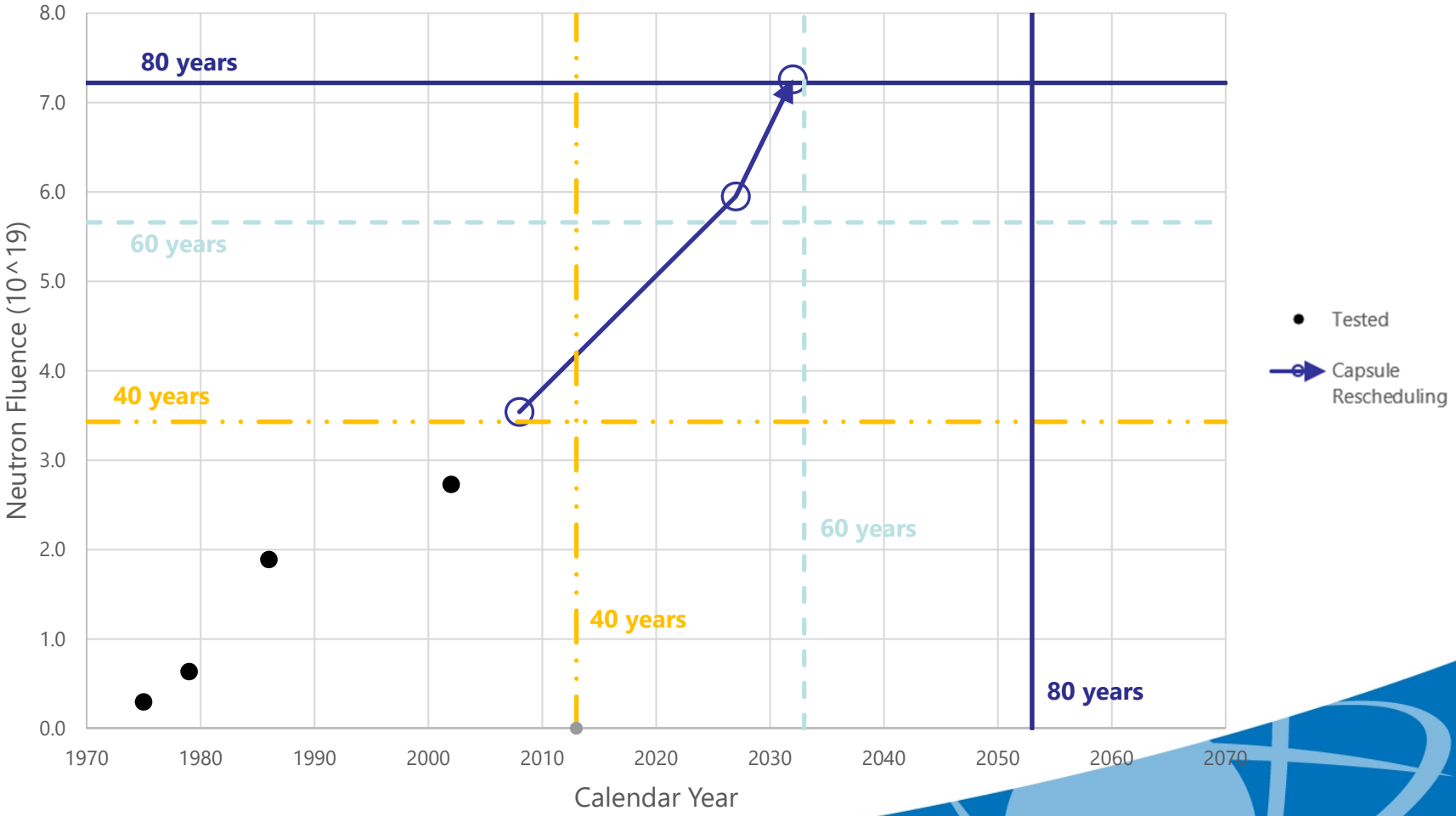
Turkey Point Units 3 and 4 Capsule Schedule



Surry Power Station Unit 1 Capsule Schedule



Surry Power Station Unit 2 Capsule Schedule



BWRVIP ISP for SLR

- BWRVIP-321* is currently under NRC review
- Methodology involves irradiating, reconstituting, and testing previously-tested ISP capsule materials, as necessary
  - Ensure that any BWR pursuing SLR will have appropriate surveillance data available for its representative materials in a timely manner
  - Implementation of BWRVIP-86, Rev 1-A** (ISP for license renewal) remains unchanged

* BWRVIP-321: BWR Vessel and Internals Project, Plan for Extension of the BWR Integrated Surveillance Program (ISP) Through the Second License Renewal (SLR) – (ADAMS Accession Number - ML19071A248)

** BWRVIP-86, Rev. 1-A: BWR Vessel and Internals Project, Updated BWR Integrated Surveillance Program (ISP) Implementation Plan – (ADAMS Accession Number - ML131760082)

Peach Bottom Atomic Power Station Units 2 and 3

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- Peach Bottom is participating in BWRVIP ISP
  - BWRVIP-86, Revision 1-A (ISP for license renewal)
- Aging Management Program enhanced to be consistent with GALL-SLR
  - Withdraw and test one capsule per unit
- Separate from the coordinated effort of the BWRVIP (i.e., BWRVIP-321)

Summary

- Currently, Appendix H is well-suited to address surveillance requirements for initial 40 years of plant operation
- 60-year reactor designs incorporate an additional capsule beyond ASTM E185-82
- To allow flexibility, license renewal has addressed surveillance needs through the use of guidance

External Stakeholder Feedback

- Implications of repeated rescheduling of capsule withdrawals
- Potential enhancements to Regulatory Framework