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MEMORANDUM TO: Raj M. Iyengar, Chief
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FROM: Jeffrey Poehler, Senior Materials Engineer */RA/*
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SUBJECT: SUMMARY OF THE MAY 19, 2020, CATEGORY 2 PUBLIC
MEETING ON REGULATORY GUIDE 1.99 REVISION 2 AND
REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM

The U.S. Nuclear Regulatory Commission (NRC) staff from the Office of Nuclear Regulatory Research (RES) and the Office of Nuclear Reactor Regulation (NRR) held a meeting on May 19, 2020, to present its findings regarding the evaluation of a potential alternative to Regulatory Guide (RG) 1.99, Rev. 2, "Radiation Embrittlement of Reactor Vessel Materials" based on the ASTM E900-15 embrittlement trend correlation, including the technical elements of the potential alternative regulatory guide, safety/risk analysis results, and fleet impact. The NRC staff requested industry and public feedback on the technical elements of the proposed alternative regulatory guide, on the interest of the industry in the potential for burden reduction with the alternative regulatory guide, and on the staff's safety/risk analysis. This meeting also discussed recent experiences in subsequent license renewal (SLR) applications with implementation of Reactor Vessel Material Surveillance Programs during extended plant operation, relative to Appendix H to 10 CFR Part 50.

The agenda, RG 1.99 key messages, RG 1.99 Rev. 2 slide presentation, and Reactor Vessel Material Surveillance Program slide presentation for the meeting are available in the NRC's Agencywide Documents Access and Management System (ADAMS) under Accession Numbers ML20140A061, ML20127H816, ML20139A030, and ML20136A043 respectively. A list of the meeting participants is enclosed.

A summary of the meeting's discussions follows by agenda topic.

1. Introduction and Opening Remarks

The NRC staff welcomed the participants and covered administrative items for the meeting. The Director of the Division of Engineering from the NRC Office of Nuclear

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Regulatory Research, Louise Lund, delivered opening remarks. She provided a brief history of the NRC staff effort to evaluate a potential alternative to RG. 1.99, Revision 2 and discussed the purpose of the staff presentation regarding the framework of a potential alternative RG, the results of fleet impact and safety/risk impact studies for a potential alternative RG. She expressed the staff interest in receiving feedback from external stakeholders regarding the RG framework presented today, safety impact/risk study results, and interest in burden reduction from a potential alternative RG 1.99. She also discussed the purpose of the NRC staff presentation regarding recent observations with the implementation of Reactor Vessel Material Surveillance Programs from the staff's review of SLR applications. She again expressed the staff's interest in receiving external stakeholder feedback on these observations

2. NRC Staff Presentation - Regulatory Guide 1.99, Revision 2 Evaluation Effort

The NRC staff presentation (ADAMS Accession No. ML20139A030) covered the motivation for the evaluation effort current underway, the framework elements of a potential alternative regulatory guide, the results of fleet impact and safety/risk analyses, implementation options, and next steps. With respect to the framework elements, the NRC staff indicated that the potential alternative RG would incorporate the embrittlement trend correlation (ETC) from ASTM E900-15. The staff also discussed its proposal for the method of using plant-specific surveillance data, margins to account for uncertainty, and default values and limitations for input variables to the ETC. With respect to the safety/risk analyses, the staff's results do not support a generic implementation of a revised RG based on risk. However, the staff indicated that there were some areas where additional information would be helpful to confirm modeled risks are low, particularly for plants where there is a large difference in embrittlement prediction between RG 1.99, Rev. 2 and ASTM E900-15. The staff asked industry if it could help provide some of this information. With respect to implementation, the staff indicated that there may be the potential for reduced burden (reducing the adjusted reference temperature [ART]) for some plants during some periods of operation with a potential alternative RG based on the framework described by the staff, which would support implementation of the RG as an optional alternative. However, the staff stated that for most licensees, the change to the potential alternative RG would result in an increase in ART.

The staff noted specific information that would assist in clarifying the risk aspects associated with RG 1.99, Rev. 2. One area of interest is to gain an understanding of the controls and procedures that are in place to prevent plants from operating on or near the licensed pressure-temperature (P-T) limits. These may include operating limits imposed by other systems such as steam generator tubesheet limits and operational band for residual heat removal systems. Another area is the actual cooldown rates for leak tests in BWRs.

Finally, the staff discussed the next steps for the RG evaluation effort which include a decision on whether to proceed with developing an alternative regulatory guide, considering feedback from industry. The staff mentioned that it would welcome further discussions with industry on this topic.

3. NRC-Industry Discussion - Regulatory Guide 1.99, Revision 2 Evaluation Effort

Several industry commenters described some of the additional system and operational constraints that prevent plants from operating near or on the licensed P-T limits. These include low-temperature overpressure protection (LTOP) systems/setpoints and residual heat removal

(RHR) system limitations at low temperatures, and steam generator tubesheet limits at high temperatures.

Some description of cooldowns and other limiting factors will be in a technical report (MRP-437/BWRVIP-328) which should be issued shortly, and will be publicly available. The report will have appendixes with descriptions of the limitations and controls that prevent operation on or near the licensed P-T limits. Several commenters anecdotally described rates for actual BWR leak test cooldowns as being less than the 40 °F/hour rate modeled by the staff.

With respect to event frequency of operating on licensed P-T limits, industry brought up previous work by the NRC in the Branch Technical Position (BTP) 5-3 closure memo and asked why these frequencies were inadequate for the staff evaluation. The NRC staff responded that the BTP 5-3 event frequencies were mainly focused on LTOP events, and some plant-specific information, and the staff wants to broaden its understanding and go beyond the LTOP regime.

One industry commenter brought up the possibility that a lower minimum temperature limit (from 525 °F to 523 °F) in the alternative RG could potentially allow a power increase for some plants which would be an economic benefit for some plants.

One industry commenter suggested that requiring a larger margin might be a way to allow the E900-15 ETC to be used for applications below the minimum temperature limitation proposed by the staff. The staff responded that it could consider this. Industry commented that some work documented in the E900-15 technical basis could be helpful in this regard.

One comment suggested the staff should consider allowing credit in the form of a reduced margin for well-behaved surveillance data. The staff indicated that it was open to considering this.

Several industry commenters expressed concern about a lack of available data for certain chemistry parameters needed for the ASTM E900-15 ETC, specifically manganese (Mn) and phosphorus (P), particularly for “extended” beltline materials. The staff responded that these values appear to be available for most 40-year beltline materials, based on information submitted by licensees in responses to Generic Letter 92-01. The staff also emphasized that these parameters are secondary effects on the calculation of the embrittlement shift, so that the use of conservative default values for Mn and P does not result in a large increase in the calculated embrittlement shift. Several members of industry stated that licensees have not generated Mn and P values, and that some NSSS vendors have limited data, but these values tend to be based on ASTM standards and not test results. Industry further stated that certified material test reports (CMTRs) are usually available for very limited locations in the vessel, and that most nozzles and (extended beltline) materials do not have CMTRs.

Industry stated with regards to an alternative RG using E900, it was not clear that there would be any improvements to safety or decrease in cost, that there are costs for determining margins, to re-publish the P-T limits, and to train the staff.

With respect to the use of surveillance data, industry asked if the procedure proposed by the staff would allow the use of sister plant data. The staff responded that it did not evaluate sister plant data when it performed the consistency checks on the available surveillance data, but that it expected if this was done it would result in more materials passing the tests. Specifically, the staff suggested that use of E900-15 to adjust sister-plant data may provide more accurate results than with RG 1.99, Rev. 2.

With respect to the staff's FAVOR analysis, there were several comments related to the evaluation of 1/4T flaw by the staff being inappropriate due to the perceived extremely low likelihood of the existence of such a flaw, or that the staff should consider the low likelihood of such a flaw in its through-wall cracking frequency (TWCF) calculations. The staff noted that this was one reason why results were presented as conditional probabilities and not TWCF. The staff also noted that a postulated 1/4T flaw constitutes the current level of safety as embodied by the ASME Code, Section XI, Appendix G methodology.

EPRI stated that some of the information requested by the staff is documented in a technical report, *Assessment of the Effect of Small Inner Surface Flaws on ASME Section XI Appendix G Pressure-Temperature Limits (MRP-437 and BWRVIP-328)*, to be published in May, 2020.

4. Public Comment - Regulatory Guide 1.99, Revision 2 Evaluation Effort

Beyond Nuclear asked if industry can provide certain information to help the staff refine the risk analysis. Beyond Nuclear also asked if the industry and NRC looked at forensic harvesting to help with risk analyses. The NRC staff replied that it has a good materials harvesting program to look at a lot of different materials issues. Beyond Nuclear asked about the degree of collaboration between NRC and groups such as PWROG and BWROG, and whether the NRC is trying to get materials from decommissioning plants. The NRC staff responded that the NRC looks at all opportunities both in US and abroad and continues to have strong interest in obtaining materials from decommissioning plants. Beyond Nuclear then commented that, in its opinion, there are "competing agendas" between getting more information versus dismantling plants quickly.

5. NRC Staff Presentation – Reactor Vessel Material Surveillance Program

The NRC staff's presentation (ADAMS Accession No. ML20136A043) focused on sharing recent experiences that have been observed with the implementation of reactor material surveillance programs. The NRC staff began its presentation by providing background information associated with Appendix H to 10 CFR Part 50 and NRC guidance for developing and implementing material surveillance programs, including guidance for license renewal and SLR.

The NRC staff proceeded to share its experiences associated with review of the SLR applications for Turkey Point, Surry Power Station, Peach Bottom Atomic Power Station and the Boiling Water Reactor Vessel and Internals Project (BWRVIP) Integrated Surveillance Program. In each instance, the staff highlighted the practices being implemented with regard to obtaining surveillance data during plant operation. Specifically, for Turkey Point and Surry Power Station, the NRC staff identified the instances in which the licensee withdrew and tested surveillance capsules. The NRC also noted the occasions these licensees rescheduled the withdrawal and testing of the same surveillance capsule for the purposes of attaining higher neutron fluences to support license renewal and then SLR. The graphs presented by the NRC staff showed that these licensee rescheduled capsule withdrawals without obtaining surveillance data in the intervening time. Next, the NRC explained that the BWRVIP's approach for SLR involves the irradiating, reconstituting, and testing of previously-tested integrated surveillance program capsule materials. This approach ensures that any BWR pursuing SLR will have appropriate surveillance data available for its representative materials in a timely manner. Finally, the NRC explained that for Peach Bottom Atomic Power Station, the licensee enhanced its Reactor Vessel Material Surveillance Aging Management Program to be consistent with the

recommendations of NRC license renewal guidance. This enhancement involves the withdrawal and testing a surveillance capsule for each unit.

At the conclusion of the NRC staff's presenting, external stakeholder feedback was requested. Specifically, feedback related to implications of repeated rescheduling of capsule withdrawals and potential enhancements to the Regulatory Framework was requested.

6. NRC-Industry Discussion – Reactor Vessel Material Surveillance Program

Three members of the industry provided comments during this portion of the public meeting.

The first member of industry indicated that the repeated capsule rescheduling for Surry Power Station Units 1 and 2 meets the intent of ASTM E185 with regard to the neutron fluence (i.e., between one and two times the end-of-life neutron fluence). The NRC responded by asking if the original 40-year program was designed for 60, 80 or 100 years, would the number of capsules for the surveillance program be the same as the 40-year program. The member of industry indicated that no additional capsules would have been added because the number of capsules in the surveillance program is based on the expected material properties of the reactor vessel, which would be unchanged. The NRC responded by indicating in that situation, the capsule schedule and withdrawal time of the capsules would be spread out and at different times or fluence levels to span the expected the 60 or 80 design life. This member of industry also indicated that, beyond plant-specific surveillance data, the plants incorporate new information as it becomes available, such as sister-plant data. The NRC responded by stating that although this is accurate, the use of sister-plant data is only applicable to a limited number of situation for the fleet in the United States. Finally, this member of industry indicated that for Surry Power Station Units 1 and 2, the surveillance capsule will be tested prior to reaching 60 years of life to ensure that the materials properties for 80 year life of the vessel is known with certainty and reactor vessel is safe before the plant starts operation for SLR

The second member of industry stated that for Turkey Point Units 3 and 4, one of the capsule rescheduling was due to an industry effort that was coordinated with the NRC and he cited MRP-326, "Coordinated PWR Reactor Vessel Surveillance Program Guidelines." The NRC staff responded that it understood that one of the four rescheduling was due to this coordinated effort.

The third member of industry requested a status of the Direct Final Rule related to Appendix H to 10 CFR Part 50, specifically as associated with the surveillance capsule reporting requirements. The NRC responded by indicating that the Direct Final Rule was not the subject of the public meeting, but indicated that the Direct Final Rule is with the Commission as of May 8, 2020.

7. Public Comment – Reactor Vessel Material Surveillance Program

Beyond Nuclear provided comments regarding the importance of harvesting materials from decommissioning plants. The commenter indicated that there are several opportunities within the United States due to plants recently starting decommissioning efforts. Beyond Nuclear then commented that, in its opinion, there are "competing agendas" between getting more information versus dismantling plants quickly.

The NRC staff replied that it has a materials harvesting effort exploring many different materials issues and that the NRC looks at all opportunities both in the United States and abroad. The NRC reiterated that it continues to have a strong interest in obtaining materials from decommissioning plants and that this interest in harvesting materials is a balance between increasing technical knowledge and the high costs associated with harvesting components.

8. Closing Remarks

The NRC staff concluded the meeting with closing remarks from Bob Caldwell, the Deputy Director of the Division of New and Renewed Licenses from the NRC Office of Nuclear Reactor Regulation. The NRC staff were thanked for their presentation and all participants were thanked for the discussion and insight. The NRC staff encouraged participants to submit any feedback on the format of this meeting.

Enclosure:
As stated

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SURVEILLANCE PROGRAM

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**U.S. Nuclear Regulatory Commission Category 2 Public Meeting to Discuss Regulatory
Guide 1.99 Revision 2 and 10 CFR Part 50 Appendix H**

May 19, 2020

Participant List

Full Name	Affiliation
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Michael Benson	NRC
Jana Bergman	Sciencetech/Curtiss-Wright
Scott Boggs	NextEra
Jeremy Bowen	NRC
Bob Caldwell	NRC
Bob Carter	EPRI
Sarah Davidsaver	AREVA
Jonathan DeLaune	TVA
Matt DeVan	Framatome
David Dijamco	NRC
Robin Dyle	EPRI
Marjorie Erickson	PEAI
Carolyn Fairbanks	NRC
Amy Freed	EPRI
Brian Frew	GE
Ron Gamble	Sartrex
Krishan Garg	PSEG Nuclear
Lauren Gibson	NRC
Joe Gillespie	NRC
Hipolito Gonzalez	NRC
Matthew Gordon	NRC
Dan Green	TVA
Tim Griesbach	SIA
Gawatha Haliburton	TVA
Brian Hall	Westinghouse
Beth Haluska	Dominion Energy
Tim Hardin	EPRI
Allen Hiser	NRC
Raj Iyengar	NRC
Heather Jackson	SIA
Ron Janowiak	Exelon
Joel Jenkins	NRC
Mark Kirk	PEAI
Shawn Kleinsmith	GE
Tatsuro Kobayashi	TEPCO
Christopher Koehler	Xcel Energy
Elliot Long	EPRI
Louise Lund	NRC
Ben Mays	Westinghouse
Wynter McGruder	EPRI
Joseph Messina	NRC
Timothy McClure	NPPD

Ashok Nana	Framatome
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Nathan Palm	EPRI
Jeffrey Poehler	NRC
Pat Purtscher	NRC
Sampath Ranganath	XGEN Engineering
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Daniel Shapiro	NRC
Todd Sherman	Entergy
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Soly Soto Lugo	NRC
Tadasuke Tanabe	TEPCO
Charles Tomes	Dominion Energy
Robert Tregoning	NRC
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Chris Wax	EPRI
Tyler Whaley	Ameren
Dan Widrevitz	NRC
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