

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

In the Matter of) Docket Nos. 50-266 & 50-301-SLR
NextEra Energy Point Beach, LLC)
(Point Beach Nuclear Plant, Units 1 and 2,) April 26, 2021
Subsequent License Renewal Application))
)

* * * * *

**PHYSICIANS FOR SOCIAL RESPONSIBILITY WISCONSIN'S MOTION
TO AMEND CONTENTION 2 (IN DEQUATELY TESTED REACTOR
COOLANT PRESSURE BOUNDARY)**

Now comes the Petitioner, Physicians for Social Responsibility Wisconsin ("PSR WI"), on its behalf and also on behalf of its members, by and through counsel, and pursuant to 10 C.F.R. § 2.309(c)(1), moves to amend Contention 2 in the particulars set forth below.

INTRODUCTION

On March 23, 2021, PSR WI filed a Petition to Intervene in this proceeding in which it propounded Contention 2, which states:

Point Beach's continued operation violates 10 CFR Part 50, Appendix A, Criterion 14 because the reactor coolant pressure boundary has not been tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture, and the aging management plan does not provide the requisite reasonable assurance.

PSR WI now seeks to amend Contention 2 to incorporate newly-discovered information, to-wit, a letter dated March 22, 2021 from the Electric Power Research Institute to the Document Control Desk of the U. S. Nuclear Regulatory Commission, the subject of which is "Potential Non-Conservatism in EPRI Report, BWRVIP-100, Rev. 1- , 3002008388 and Impacted BWRVIP Reports." The letter was docketed in Docket MS as ML21084-164 on April 2, 2021 and

presented new information that was not available prior to April 2, 2021. A complete copy of the letter is annexed hereto and incorporated herein by reference. The new information in the EPRI letter provides a new and additional basis for Contention 2.

B BACKGROUND

Petitioner PSR WI's expert witness for Contention 2 is Arnold Gundersen, who has more than 50 years of experience in Nuclear Engineering.¹ Contention 2 addresses the phenomenon of "neutron embrittlement," whereby neutron radiation from inside a nuclear power plant's core gradually weakens the structural integrity of the metallurgy, making it so brittle that it is catastrophically vulnerable to Pressurized Thermal Shock (PTS). Neutron embrittlement can be problematic because if embrittlement becomes extensive, the dense metallic nuclear reactor can shatter like glass and cause a Class 9 radiological accident, the worst nuclear catastrophe category.²

Mr. Gundersen stated in his original, March 23, 2021, Declaration, and PSR WI correspondingly has pleaded in its Petition, that in recent years, the NRC has systematically removed conservative calculational aspects of the embrittlement process to allow continued operation by not removing coupons/capsules from reactor pressure vessels in order to metallurgically analyze and develop actual data on the true state of embrittlement. One of the most-embrittled reactor vessels in the country is Point Beach Unit 2. Analysis of capsules/coupons from that reactor, as well as other embrittled reactors should be conducted in order to

¹Mr. Gundersen's *curriculum vitae* is attached to the Declaration of Arnold Gundersen ("Gundersen Declaration") previously filed in this proceeding.

²"Declaration of Arnold Gundersen, Nuclear Engineer" (Gundersen Declaration) at ¶¶ 7.4.1, 7.4.4.

assess whether to allow the Point Beach reactors to continue operations. For decades, the NRC has not required Point Beach and its cohorts to examine available coupons/capsules, which has deprived the NRC and the public of significant scientific data on which to justify continued reactor operations – or their termination.

Mr. Gundersen’s opinion expressed in March was as follows:

As the US nuclear fleet ages, the NRC has systematically removed conservative calculational aspects of the embrittlement process to allow continued operation. The NRC has not incorporated the actual data from coupons in the remaining five worst atomic power reactors in the U.S. to be used for the embrittlement analysis applied to NextEra’s Point Beach reactors to allow their continued operation. Instead of evaluating Point Beach’s specific metallurgy, the NRC has allowed Point Beach and its cohorts to use analytical techniques that ignore the data from sample coupons it could readily test.

Additionally, there is no scientific basis by which the Point Beach reactors should continue operating unless there is a complete physical analysis of the coupons from its reactors and the five other reactors that are its embrittled cohorts.³

Therefore, I conclude that Point Beach’s continued operation violates 10 CFR Part 50 Appendix A, Criterion 14.⁴

Criterion 14 requires that “[t]he reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.”

The EPRI letter has prompted Mr. Gundersen to provide a Supplemental Declaration (attached). In it, he states:

At some point during 2020, the Electric Power Research Institute (EPRI) became aware of errors in the computer codes its members use to predict the neutron embrittlement of components inside US nuclear reactors. EPRI determined that these embrittlement codes are not accurate and are under-predicting the extent of embrittlement damage to reactor components within the atomic reactor cores.

Underpredicting the damage from neutron embrittlement is definitely “non-

³*Id.* at ¶ 7.8.2.

⁴*Id.* at ¶ 7.8.3.

conservative” and may create serious safety flaws if left unchecked.

EPRI and the NRC met in private for a confidential meeting held on February 17, 2021. At that meeting, EPRI informed the NRC of its concerns about the newfound embrittlement errors in the EPRI computer code.

EPRI mailed a formal letter to the NRC on March 22, 2021, informing the NRC that it had found severe errors in one or more of its computer codes used to calculate neutron embrittlement to core internal structures.⁵

The EPRI letter was filed in the NRC Public Document Room (PDR) on April 2, 2021. I became aware of EPRI’s letter several days later.

The EPRI letter is terse at only two pages plus five pages of attachments. Moreover, EPRI’s brevity hides most of the problems it discovered under the secrecy cloak of “proprietary” material. Even with its secrecy cloak, the letter clarifies that numerous embrittlement documents are hidden from public scrutiny. While hiding most of the embrittlement problems as “proprietary,” the EPRI letter also hints at significant flaws identified in analytical computer codes in use since 2016.

According to the EPRI letter:

*BWRVIP-100, Rev. 1- , published in 2016, was developed to support the evaluation of in-service flaws in BWR core shrouds. It provides fracture toughness relationships as a function of neutron fluence for BWR core shrouds. Research was carried out from 2016 to 2020 to obtain additional fracture toughness data on irradiated stainless steels with an emphasis on weld metal. **preliminary evaluation of results from this testing program, as well as the results of other applicable testing programs, indicates that the relationships published in BWRVIP-100, Rev. 1- are non-conservative in the fluence range from 5E20 n/cm2 to 3E21 n/cm2 when considering the newly acquired weld metal data...***

*As a consequence of this Transfer of Information, the **BWRVIP-235 software should not be used going forward to evaluate flaws in the weld region** of reactor internals where the accumulated fluence is greater than 5E20 n/cm2 (E>1MeV).*

*Recipients should evaluate their use of these EPRI products to determine if any flaw evaluations could be impacted, **possibly resulting in either a reduction in structural margins or changes in inspection frequencies** (Emphasis added).*

According to EPRI’s letter, this particular revision of the flawed EPRI

⁵https://www.nrc.gov/docs/ML2108/ML21084_164.pdf

embrittlement code has been applied since 2016. However, analyses on real-world irradiated samples in 2020 proved that the analytical code was faulty and underestimated embrittlement damage at reactors for at least five years.

The EPRI letter confirms several key concerns I identified previously in my first declaration concerning the embrittlement obstacle at Point Beach:

Mathematical modeling of neutron embrittlement is prone to errors and is frequently incorrect, creating unsafe conditions.

There is no substitute for using frequent real-world material samples to determine the actual degraded condition of a reactor's internals subject to high neutron fluence levels.

Point Beach does not have an adequate number of physical samples for NextEra to periodically sample to determine if its core internal structures will remain safe in the extended license period of 60 to 80 years.

These particular real-world embrittled samples EPRI used to assess its code came from Boiling Water Reactors. Yet, the letter's dire warning highlights my expert concern submitted in my first declaration. With my professional experience in nuclear reactor non-destructive inspection testing, I opine that the physical specimens and coupons at Point Beach may indeed identify that embrittlement calculations made at Point Beach are not conservative. Moreover, without testing the physical specimens and coupons at Point Beach, NextEra is severely risking public safety.

High neutron fluence levels similar to those identified by EPRI in the BWRs it examined are already present in the internal core structures at Point Beach. After operating for only 20 years, Point Beach realized this neutron fluence damage to internal core structures when it replaced almost 200 baffle-former bolts during the 1990s.

That replacement of almost 200 baffle-former bolts occurred more than 20 years ago, yet I cannot find any record that the baffle-former plates themselves have been tested and were replaced if warranted. Testing the baffle-former plates, which are known to have undergone high neutron fluence, should have been undertaken by NextEra at Point Beach.

Therefore, the warning in EPRI's letter is directly applicable to the existing and projected conditions of the internal core structures at Point Beach.

Finally, EPRI's letter supports and amplifies my concerns previously submitted in my first declaration and reinforces my conclusion that the Point Beach vessel and internals sampling program is inadequate.

It is imperative and prudent for public safety with such an old and degraded reactor that NextEra determines through the physical sampling and testing of coupons if Point Beach may operate safely for the proposed extension.

Point Beach was originally designed to operate for 40 years. Its original metallurgical sampling program was established to monitor embrittlement by neutron fluence during its 40 year design life.

REQUEST FOR LEVE TO AMEND CONTENTION

• Applicable Standards

NRC regulation 10 C.F.R. § 2.309(c) allows a petitioner to amend its contentions if the presiding officer finds that the petitioner “has demonstrated good cause” by satisfying the following factors: (i) the information on which the filing is based was not previously available; (ii) the information upon which the filing is based is materially different from information previously available; and (iii) the filing has been submitted in a timely fashion based on the availability of the subsequent information. An amended contention generally is considered timely if it is filed within 30 days of the date upon which the new information became available. *Shaw REVER MOX Services* (Mixed Oxide Fuel Fabrication Facility), 67 NRC 460, 493 (2008) (“Many times, boards have selected 30 days as [the] specific presumptive time period” for timeliness of contentions filed after the initial deadline (collecting cases⁶)). There is as yet no initial scheduling order in this proceeding; Petitioner PSR WI is proceeding cautiously and staying within the customary 30-day minimum window for amendment, so this request is timely.

⁶See, e.g., *Entergy Nuclear Vermont Yankee LLC* (Vermont Yankee Nuclear Power Station), Docket No. 50-271-LR (SLBP No. 06-849-03-LR), Licensing Board Order (Initial Scheduling Order) (Nov. 17, 2006) at 7 (unpublished); *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), Docket No. 50-293-LR (SLBP No. 06-848-02-LR), Licensing Board Order (Establishing Schedule for Proceeding and Addressing Related Matters) (Dec. 20, 2006) at 7 (unpublished); *Southern Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), Docket No. 52-011-ESP (SLBP No. 07-850-01-ESP-BD01), Licensing Board Order (Prehearing Conference and Initial Scheduling Order) (May 7, 2007) at 3 (unpublished).

B. Amended and Substituted Contention

PSR WI's proposed Amended and Substituted Contention 2 follows:

Point Beach's continued operation violates 10 CFR Part 50, Appendix A, Criterion 14 because the reactor coolant pressure boundary has not been tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture, and the aging management plan does not provide the requisite reasonable assurance. The Electric Power Research Institute has recently admitted that its computer software for predicting embrittlement in boiling water reactors is "nonconservative." Physical specimens and coupons at Point Beach may indeed prove that embrittlement calculations made at Point Beach are not conservative. Without testing the physical specimens and coupons at Point Beach, NextEra is severely risking public safety.

DEMONSTRATION OF GOOD CAUSE FOR LATE FILING

PSR WI satisfies the three-prong test for good cause to file this amended contention based on new information as follows:

. The information upon which the filing is based was not previously available.

The EPRI letter was not publicly available in DMS until April 2, 2021. PSR WI could not have known about this significant admission by EPRI's that its vaunted software was nonconservative in predicting embrittlement in BWRs. This revelation significantly adds to and confirms Mr. Gundersen's expert conclusions in support of Contention 2.

B. The information upon which the filing is based is materially different from information previously available.

The unexpected EPRI admissions undermine the confidence that in recent years has elevated computerized forecasts and models as a means of projecting embrittlement above actual scientific metallurgical testing.

This new information strengthens and supplements the material issue of potential nonconservatism in computer modeling that may be undermining the aging management of the PBNP reactor vessels and internals. PBNP is storing two capsules in the spent fuel storage pool

at the reactor site, one from each unit⁷ that were removed from the reactors in 1994 and 1997, respectively, and they have not been tested. Testing now, 25 years after removal, will provide no useful data. In addition, each reactor still contains a Capsule “N” inside the two reactor units, noted as being held on “standby.”⁸ These “N” capsules should be analyzed to provide actual physical data to test NextEra’s optimistic hypotheses.

C. The amended contention has been submitted in a timely fashion based on the availability of the subsequent information.

The amended contention is being filed within 30 days of PSR WI having learned of the EPRI letter that forms the basis of the amended contention, and therefore, the amended contention is timely. *Shaw REV MOX Services, supra*, 67 NRC at 493.

CONCLUSION

For all of the reasons stated above, this Motion should be granted and supplementation and amendment of PSR WI’s Contention 2 should be allowed.

April 26, 2021

/s/ Terry J. Lodge
Terry J. Lodge, Esq.
316 N. Michigan St., Suite 520
Toledo, OH 43604-5627
(419) 205-7084
Fax (419) 932-6625
tjlodge50@yahoo.com
lodgelaw@yahoo.com
Counsel for Physicians for Social Responsibility
Wisconsin, Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on April 26, 2021, I deposited the foregoing “PHYSICIANS FOR

⁷“Point Beach Nuclear Plant Units 1 and 2 Subsequent License Renewal Application” (Public Version), November 2020 (ML20329-247), p. 1208/1528 of .pdf.

⁸*Id.*

SOCIAL RESPONSIBILITY WISCONSIN'S MOTION TO REMEND CONTENTION 2 (INDEQUATELY TESTED REACTOR COOLANT PRESSURE BOUNDARY)" in the NRC's electronic docket of this proceeding and that according to the protocols of that system, it was to be automatically transmitted to all parties of record registered to receive electronic service.

/s/ Terry J. Lodge

Terry J. Lodge, Esq.

Counsel for Petitioner PSR WI

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

In the Matter of) Docket Nos. 50-266 and 50-301
NextEra Energy Point Beach, LLC) NRC-2021-0021
(Point Beach Nuclear Plant, Units 1 and 2)) April 26, 2021
)

* * * * *

**SUPPLEMENTAL DECLARATION OF ARNOLD GUNDERSEN,
NUCLEAR ENGINEER**

Under penalty of perjury, I, Arnold Gundersen, declare as follows:

1. My name is Arnold Gundersen. I am sui juris. I am over the age of 18 years old.
2. Physicians for Social Responsibility Wisconsin (PSR-WI) has retained Fairewinds Associates, Inc., of which I am an officer and employee, to review a license application to the nuclear regulatory commission to extend the licensed life of NextEra’s Point Beach nuclear reactors until they have operated for 80-years, along with the related Environmental Report for NextEra Energy Point Beach, LLC’s Point Beach Nuclear Plant, Units 1 and 2. My observations and conclusions are offered to a reasonable degree of scientific certainty based on my experience and relevant information sources.
3. This declaration supplements an earlier declaration I provided in this case on March 23, 2021.
4. My professional qualifications are identified in my CV that was provided to the parties in my original declaration. It is important to note that previously I served as a member of the Radiation Safety Committee and the Senior Vice President of an ASME Section XI nuclear reactor non-destructive inspection division of an NRC (Nuclear Regulatory Commission) licensed corporation (Nuclear Energy Services / NES division of PCC – Penn Central Corporation). The division I headed provided construction and outage-related inspection activities on nuclear reactor vessels and piping and reactor internal structures throughout the United States.
5. At some point during 2020, the Electric Power Research Institute (EPRI) became aware of errors in the computer codes its members use to predict the neutron embrittlement of

components inside US nuclear reactors. EPRI determined that these embrittlement codes are not accurate and are under-predicting the extent of embrittlement damage to reactor components within the atomic reactor cores.

6. Underpredicting the damage from neutron embrittlement is definitely “non-conservative” and may create serious safety flaws if left unchecked.
7. EPRI and the NRC met in private for a confidential meeting held on February 17, 2021. At that meeting, EPRI informed the NRC of its concerns about the newfound embrittlement errors in the EPRI computer code.
8. EPRI mailed a formal letter to the NRC on March 22, 2021, informing the NRC that it had found severe errors in one or more of its computer codes used to calculate neutron embrittlement to core internal structures.¹
9. The EPRI letter was filed in the NRC Public Document Room (PDR) on April 2. I became aware of EPRI’s letter several days later.
10. The EPRI letter is terse at only two pages plus five pages of attachments. Moreover, EPRI’s brevity hides most of the problems it discovered under the secrecy cloak of “proprietary” material. Even with its secrecy cloak, the letter clarifies that numerous embrittlement documents are hidden from public scrutiny. While hiding most of the embrittlement problems as “proprietary”, the EPRI letter also hints at significant flaws identified in analytical computer codes in use since 2016.

According to the EPRI letter):

BWRVIP-100, Rev. 1-A, published in 2016, was developed to support the evaluation of in-service flaws in BWR core shrouds. It provides fracture toughness relationships as a function of neutron fluence for BWR core shrouds. Research was carried out from 2016 to 2020 to obtain additional fracture toughness data

*on irradiated stainless steels with an emphasis on weld metal. **A preliminary evaluation of results from this testing program, as well as the results of other applicable testing programs, indicates that the relationships published in BWRVIP-100, Rev. 1-A are non- conservative in the fluence range from 5E20 n/cm² to 3E21 n/cm² when considering the newly acquired weld metal data...***

1. *As a consequence of this Transfer of Information, the BWRVIP-235 software should not be used going forward to evaluate flaws in the*

¹ <https://www.nrc.gov/docs/ML2108/ML21084A164.pdf>

weld region of reactor internals where the accumulated fluence is greater than $5E20$ n/cm² ($E > 1\text{MeV}$).

2. *Recipients should evaluate their use of these EPRI products to determine if any flaw evaluations could be impacted, **possibly resulting in either a reduction in structural margins or changes in inspection frequencies [Emphasis Added]**.*
11. According to EPRI's letter, this particular revision of the flawed EPRI embrittlement code has been applied since 2016. However, analyses on real-world irradiated samples in 2020 proved that the analytical code was faulty and underestimated embrittlement damage at reactors for at least five years.
12. The EPRI letter confirms several key concerns I identified previously in my first declaration concerning the embrittlement obstacle at Point Beach:
 - 12.1. Mathematical modeling of neutron embrittlement is prone to errors and is frequently incorrect, creating unsafe conditions.
 - 12.2. There is no substitute for using frequent real-world material samples to determine the actual degraded condition of a reactor's internals subject to high neutron fluence levels.
 - 12.3. Point Beach does not have an adequate number of physical samples for NextEra to periodically sample to determine if its core internal structures will remain safe in the extended license period of 60 to 80 years.
13. These particular real-world embrittled samples EPRI used to assess its code came from Boiling Water Reactors. Yet, the letter's dire warning highlights my expert concern submitted in my first declaration. With my professional experience in nuclear reactor non-destructive inspection testing, I opine that the physical specimens and coupons at Point Beach may indeed identify that embrittlement calculations made at Point Beach are not conservative. Moreover, without testing the physical specimens and coupons at Point Beach, NextEra is severely risking public safety.
14. High neutron fluence levels similar to those identified by EPRI in the BWRs it examined are already present in the internal core structures at Point Beach. After operating for only 20 years, Point Beach realized this neutron fluence damage to internal core structures when it replaced almost 200 baffle-former bolts during the 1990s.
15. That replacement of almost 200 baffle-former bolts occurred more than 20 years ago, yet I cannot find any record that the baffle-former plates themselves have been tested and were

replaced if warranted. Testing the baffle-former plates, which are known to have undergone high neutron fluence, should have been undertaken by NextEra at Point Beach.

16. Therefore, the warning in EPRI's letter is directly applicable to the existing and projected conditions of the internal core structures at Point Beach.
17. Finally, EPRI's letter supports and amplifies my concerns previously submitted in my first declaration and reinforces my conclusion that the Point Beach vessel and internals sampling program is inadequate.
18. It is imperative and prudent for public safety with such an old and degraded reactor that NextEra determines through the physical sampling and testing of coupons if Point Beach may operate safely for the proposed extension.
19. Point Beach was originally designed to operate for 40 years. Its original metallurgical sampling program was established to monitor embrittlement by neutron fluence during its 40 year design life.
20. Currently, Point Beach is licensed to operate for 60 years. Point Beach has applied to extend its current 60-year license for an additional 20 year period to create a total of 80 years for the continued proposed operation of the Point Beach reactor. Yet, Point Beach never had enough samples placed in the original core to support an 80 year license.

2021/04/26

Dated 2021/04/26

Arnold Gundersen

Arnold Gundersen

2021-030 _____ BWR Vessel & Internals Project (BWRVIP)

(via e-mail)

March 22, 2021

Document Control Desk
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Attention: Hipolito Gonzalez

Subject: Potential Non-Conservatism in EPRI Report, BWRVIP-100, Rev. 1-A,
3002008388 and Impacted BWRVIP Reports

Reference: 1. BWRVIP-100, Revision 1-A: BWR Vessel and Internals Project, Updated
Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core
Shrouds. EPRI, Palo Alto, CA: 2016. 3002008388.
2. BWRVIP-235: BWR Vessel and Internals Project, Structural Analysis
Software for BWR Internals, DLL Version 3.1. EPRI, Palo Alto, CA: 2009.
1018251.
3. 10 CFR Part 21 – Transfer of Information Notice – Potential Non-
Conservatism in EPRI Software, BWRVIP-235, 1018251, February 19, 2021.
4. Update Regarding 10 CFR Part 21 Transfer of Information Notice – Potential
Non-Conservatism in EPRI Software (BWRVIP-235) and Inspection and
Evaluation Guidance for the BWR Core Shroud (BWRVIP-76 Revision 1-A,
BWRVIP-76 Revision 2, and BWRVIP letter 2016-030)

On February 17, 2021, during an information exchange between NRC management and industry materials issues program leadership, the NRC was made aware of a potential non-conservatism in Boiling Water Reactor Vessel and Internals Project (BWRVIP) guidance on fracture toughness values for evaluation of irradiated stainless steel reactor internals components. This guidance is contained in EPRI report BWRVIP-100, Revision 1-A [1]. It was subsequently determined that, although BWRVIP-100, Revision 1-A was not prepared under EPRI's 10 CFR 50 Appendix B nuclear quality assurance (NQA) program, the report had been incorporated into another EPRI product (BWRVIP-235 [2]) that was prepared under EPRI's NQA program. As such, a 10 CFR Part 21 Transfer of Information Notice [3] was sent to EPRI members on February 19, 2021. That transfer of information notice is being provided for your information as **Attachment 1** to this letter.

Together . . . Shaping the Future of Electricity

CHARLOTTE OFFICE

1300 West W.T. Harris Boulevard, Charlotte, NC 28262-8550 USA • 704.595.2000 • Customer Service 800.313.3774 • www.epri.com

On March 19, 2021, EPRI issued an update to the original transfer of information notice [4]. This update revised a recommended action in the original notice and informed recipients of additional impacted documents that were identified during EPRI's extent of condition review. The updated transfer of information notice is also being provided for your information as Attachment 2 to this letter. Please note however that the attachments to the update transfer of information notice contain EPRI proprietary information and are not being provided at this time.

If you have any questions or need further assistance, please contact Nathan Palm by telephone at 724-288-4043 or by e-mail at npalm@epri.com.

Sincerely,

Handwritten signatures of Nathan Palm and Timothy Hanley.

Nathan Palm, EPRI BWRVIP Program Manager
Timothy Hanley, Exelon, BWRVIP Chairman

c: Robert Carter, EPRI
Wynter McGruder, EPRI
Robert Villegas, EPRI
Drew Odell, Exelon
Steve Richter, Energy Northwest
Hipolito Gonzalez, USNRC
David Rudland, USNRC
Allen Hiser, USNRC



February 19, 2021

Subject: 10 CFR Part 21 – Transfer of Information Notice – Potential Non-Conservatism in EPRI Software, BWRVIP-235, 1018251

Dear Sir/Madam:

References:

1. BWRVIP-235: BWRVIP-235: BWR Vessel and Internals Project, Structural Analysis Software for BWR Internals, DLL Version 3.1. EPRI, Palo Alto, CA: 2009. 1018251.
2. BWRVIP-100, Revision 1-A: BWR Vessel and Internals Project, Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds. EPRI, Palo Alto, CA: 2016. 3002008388.

This letter is a formal Transfer of Information notification under 10 CFR Part 21.21(b) of a deviation in products supplied by EPRI. EPRI has insufficient information as to the basic product's actual use to determine if the condition described below represents a defect reportable under 10 CFR Part 21. Recipients of this letter should evaluate the condition pursuant to 10 CFR Part 21.21 (a) to determine if it could represent a substantial safety hazard, were it to remain uncorrected.

Identified Problem

BWRVIP-235, named DLL 3.1 [1], is a software code for evaluating flaws in BWR core shrouds and reactor internal piping components that was prepared under EPRI's 10 CFR Appendix B nuclear quality assurance (NQA) program. DLL 3.1 incorporates the methodologies specified in BWRVIP-100, Rev. 1-A [2] for the evaluation of flaws in irradiated core shroud materials. BWRVIP-100, Rev. 1-A was not prepared under EPRI's NQA program.

BWRVIP-100, Rev. 1-A, published in 2016, was developed to support the evaluation of in-service flaws in BWR core shrouds. It provides fracture toughness relationships as a function of neutron fluence for BWR core shrouds. Research was carried out from 2016 to 2020 to obtain additional fracture toughness data on irradiated stainless steels with an emphasis on weld metal.¹ A preliminary evaluation of results from this testing program, as well as the results of other applicable testing programs, indicates that the relationships published in BWRVIP-100, Rev. 1-A are non-conservative in the fluence range from $5E20$ n/cm² to $3E21$ n/cm² when considering the newly acquired weld metal data. Specifically, the lower bound fracture toughness of 50 ksi-√in specified in BWRVIP-100, Revision 1-A may be reached at a fluence of $5E20$ n/cm² as opposed to the previously defined threshold of $3E21$ n/cm². This non-conservatism extends to the analysis methods contained in DLL 3.1 for evaluating flaws in irradiated core shroud materials, thus necessitating this 10 CFR Part 21 Transfer of Information.

¹ Prior evaluations of fracture toughness data published in BWRVIP-100 did not distinguish between base metal, HAZ and weld, and were considered to be appropriately conservative.

Together . . . Shaping the Future of Electricity

10 CFR Part 21 – Transfer of Information Notice – Potential Non-Conservatism in EPRI Software, BWRVIP-235, 1018251

February 19, 2021

Page 2

Recommended Actions

1. As a consequence of this Transfer of Information, the BWRVIP-235 software should not be used going forward to evaluate flaws in the weld region of reactor internals where the accumulated fluence is greater than $5E20$ n/cm² ($E > 1\text{MeV}$).
2. Recipients should evaluate their use of these EPRI products to determine if any flaw evaluations could be impacted, possibly resulting in either a reduction in structural margins or changes in inspection frequencies, specifically those components having an accumulated fluence in the range of $5E20$ n/cm² to $3E21$ n/cm².
3. If BWRVIP-100, Rev. 1-A was implemented without the use of BWRVIP-235, the specific requirements associated with this 10 CFR Part 21 Transfer of Information may not be applicable. However, the potential non-conservatism of BWRVIP-100, Rev. 1-A would still need to be evaluated.

Corrective Actions to Be Taken by EPRI

The BWRVIP will be working with its members to address the potential non-conservatism associated with BWRVIP-235 and BWRVIP-100, Rev. 1-A, which may include future revisions to these EPRI products. In the interim, these products have been removed from www.epri.com and are no longer available for download.

If you have any technical questions, please contact Bob Carter at bcarter@epri.com or 704-595-2519 or Nathan Palm at npalm@epri.com or 724-288-4043.

If you have received this letter, it is because our records indicate that you or a staff member in your organization have received BWRVIP-235. If this is incorrect, then please promptly provide this correspondence to the correct staff in your organization and notify Robert Villegas at rvillegas@epri.com or 704-595-2787.

Sincerely,

Rick Way
Quality Assurance Manager
1300 West WT Harris Blvd, Charlotte NC 28262
704-595-2679 (w) - 980-228-7613 (c)
rway@epri.com

c: R. Baranwal
S. Swilley
K. Edsinger
N. Palm



March 19, 2021

Subject: Update Regarding 10 CFR Part 21 Transfer of Information Notice – Potential Non-Conservatism in EPRI Software (BWRVIP-235) and Inspection and Evaluation Guidance for the BWR Core Shroud (BWRVIP-76 Revision 1-A, BWRVIP-76 Revision 2, and BWRVIP letter 2016-030)

Dear Sir/Madam:

References:

1. 10 CFR Part 21 – Transfer of Information Notice – Potential Non-Conservatism in EPRI Software, BWRVIP-235, 1018251, February 19, 2021.
2. BWRVIP-235: BWR Vessel and Internals Project, Structural Analysis Software for BWR Internals, DLL Version 3.1. EPRI, Palo Alto, CA: 2009. 1018251.
3. BWRVIP-100, Revision 1-A: BWR Vessel and Internals Project, Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds. EPRI, Palo Alto, CA: 2016. 3002008388.
4. BWRVIP-76, Revision 1-A: BWR Vessel and Internals Project: BWR Core Shroud Inspection and Flaw Evaluation Guidelines. EPRI, Palo Alto, CA: 2015. 3002005566.
5. BWRVIP-76, Revision 2: BWR Vessel and Internals Project: BWR Core Shroud Inspection and Flaw Evaluation Guidelines. EPRI, Palo Alto, CA: 2014. 3002003095
6. BWRVIP Letter 2016-030, Core Shroud Off-Axis Cracking Interim Inspection & Flaw Evaluation Guidance, March 4, 2016.

EPRI recently provided a 10 CFR Part 21 Transfer of Information Notice [1] regarding a potential non-conservatism in BWRVIP-235 [2], which is a software code that was developed under EPRI's 10 CFR Appendix B nuclear quality assurance (NQA) program. This notification was necessitated by the identification of potential non-conservatisms in BWRVIP-100, Revision 1-A [3] that were incorporated into BWRVIP-235. For reference, BWRVIP-100 Revision 1-A was not developed under EPRI's NQA program and does not formally require reporting under 10 CFR Part 21 except that information from this product was used in other EPRI products that were produced under EPRI's NQA program, including BWRVIP-235. The purpose of this letter, as an update to reference [1], is to:

- Revise a recommended action in [1] concerning BWRVIP-235 [2].
- Inform recipients of additional impacted documents that were identified during EPRI's extent of condition review.

Together . . . Shaping the Future of Electricity

10 CFR Part 21 – Amended Transfer of Information Notice – Potential Non-Conservatism in EPRI Software, BWRVIP-235, 1018251

March 19, 2021

Page 2

BWRVIP-235

The original Transfer of Information Notice [1] stated that BWRVIP-235 software should not be used going forward to evaluate flaws in the weld region of reactor internals where the accumulated fluence is greater than $5E20$ n/cm² ($E>1$ MeV). EPRI has concluded that, as long as acceptable workarounds are implemented, BWRVIP-235 may continue to be used to evaluate flaws in the weld

region of reactor internals where the accumulated fluence is greater than $5E20$ n/cm² ($E>1$ MeV). Acceptable workarounds are provided in Attachment 1.

Additional Impacted Documents

As described in Reference 1, a preliminary evaluation of results from fracture toughness testing conducted since 2016 indicates that the relationships published in BWRVIP-100, Rev. 1-A are non-conservative in the fluence range from $5E20$ n/cm² to $3E21$ n/cm². Specifically, the lower bound fracture toughness of 50 ksi- $\sqrt{\text{in}}$ specified in BWRVIP-100, Revision 1-A may be reached at a fluence of $5E20$ n/cm² as opposed to the previously defined threshold of $3E21$ n/cm². While performing an extent of condition review, EPRI has determined that three additional EPRI products are also impacted by the potential non-conservatism in BWRVIP-100. These are BWRVIP-76, Revision 1-A [4], BWRVIP-76, Revision 2 [5], and BWRVIP Letter 2016-030 [6].

BWRVIP-76, Revision 1-A [4] and BWRVIP-76, Revision 2 [5] provide criteria for inspection of BWR core shroud welds and the evaluation of flaws found that may be identified while performing these inspections. The methods and acceptance criteria contained in [4, 5] have been determined to use the potentially non-conservative fracture toughness values contained in BWRVIP-100, Revision 1-A. Therefore, BWRVIP-76, Revision 1-A and BWRVIP-76, Revision 2 cannot be used¹, in their entirety, as written. Attachment 2 contains details of the specific impacted elements of BWRVIP-76, Revision 1-A along with recommended actions.

BWRVIP letter 2016-030 contains interim guidance for the evaluation of off-axis cracking identified in BWR core shroud welds. Off-axis flaws are those flaws that are not oriented parallel to the weld. BWRVIP letter 2016-030 contains acceptance criteria for off-axis flaws and it has been determined that these acceptance criteria were developed using the potentially non-conservative fracture toughness values contained in BWRVIP-100, Revision 1-A. Attachment 3 contains details of the specific impacted elements of BWRVIP letter 2016-030 along with recommended actions.

¹ For clarity, BWRVIP-76, Rev. 1 was prepared under EPRI's 10 CFR 50 Appendix B program and has been approved for implementation by the U.S. NRC. BWRVIP-76, Rev. 2 was not prepared under EPRI's 10 CFR 50 Appendix B program and has not been approved by the U.S. NRC and further states in Section 1.4 that the inspection recommendations in this report shall not be implemented immediately upon issuance of the report. However, since BWRVIP-76, Rev. 2 does contain criteria from BWRVIP-100, Rev. 1-A, it is included with this update.

10 CFR Part 21 – Amended Transfer of Information Notice – Potential Non-Conservatism in EPRI Software, BWRVIP-235, 1018251

March 19, 2021

Page 3

Corrective Actions to Be Taken by EPRI

The BWRVIP is working with its members to address the potential non-conservatism associated with BWRVIP-235, BWRVIP-76, Rev. 1-A, BWRVIP-76, Rev. 2 and BWRVIP letter 2016-030, along with BWRVIP-100, Rev. 1-A that may result in future revisions to these EPRI products. In the interim, these products have been removed from www.epri.com and are no longer available for download.

If you have any technical questions, please contact Bob Carter at bcarter@epri.com or 704-595-2519 or Nathan Palm at npalm@epri.com or 724-288-4043.

If you have received this letter, it is because our records indicate that you or a staff member in your organization have received BWRVIP-235, BWRVIP-76, Rev. 1-A, BWRVIP-76, Rev. 2 and/or BWRVIP letter 2016-030. If this is incorrect, then please promptly provide this correspondence to the correct staff in your organization and notify Robert Villegas at rvillegas@epri.com or 704-595-2787.

Sincerely,

Rick Way
Quality Assurance Manager
1300 West WT Harris Blvd, Charlotte NC 28262
704-595-2679 (w) - 980-228-7613 (c)
rway@epri.com

c: R. Baranwal
S. Swilley
K. Edsinger
N. Palm