“Mind the Gap(s)” Decommissioning’s Critical Link to Operating License Extensions

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U.S. Nuclear Regulatory Commission
Status report on harvesting aged materials

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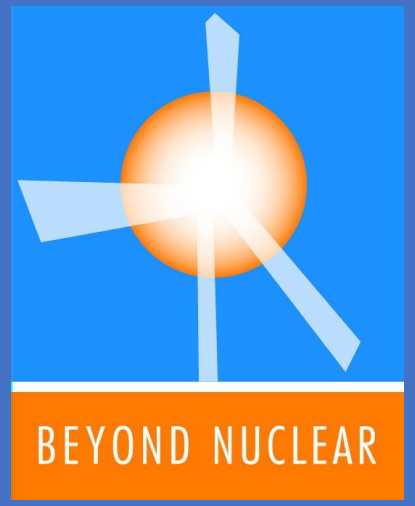


“You can’t manage what you can’t measure”

Red Rusty Boric Acid Deposits on Vessel Flange (12RFO)

Irradiation-Assisted Stress Corrosion Cracking is but one known age-related degradation mechanism with safety-critical “*technical knowledge gaps*” in understanding how such phenomena attack the materials in safety-related reactor systems, structures and components.

“Age Management” is more safety-critical with recurring 20-year operating license extensions

- 92 units in the U.S. operating fleet;
- 78 units with initial license renewals (40-60 yr.);
- 6 units approved for second renewals (60-80 yr.);
- 9 units under NRC review for second renewals;
- 5 units in line for second or “subsequent” renewal;
- February 24, 2022, Commission Orders roll back the Subsequent License Renewal’s 20-year extensions for Turkey Point 3&4 and Peach Bottom 2&3 pending NRC rulemaking on environmental review;
- NRC has suspended review of Supplemental Environmental Impact Statements until the new rule is codified for qualification

NRC / DOE LABORATORY INTERAGENCY AGREEMENT

"The biggest challenges for the NRC and the industry will be addressing the major technical issues for this second 'subsequent' license renewal (SLR) beyond sixty years."

- **Reactor pressure vessel (RPV) neutron embrittlement;**
- **Irradiation assisted degradation (IAD) of reactor internals and primary components;**
- **Concrete and containment degradation;**
- **Electrical cable qualification and condition assessment**

NRC: Decommissioning is an "opportunity" to verify license extension safety reviews

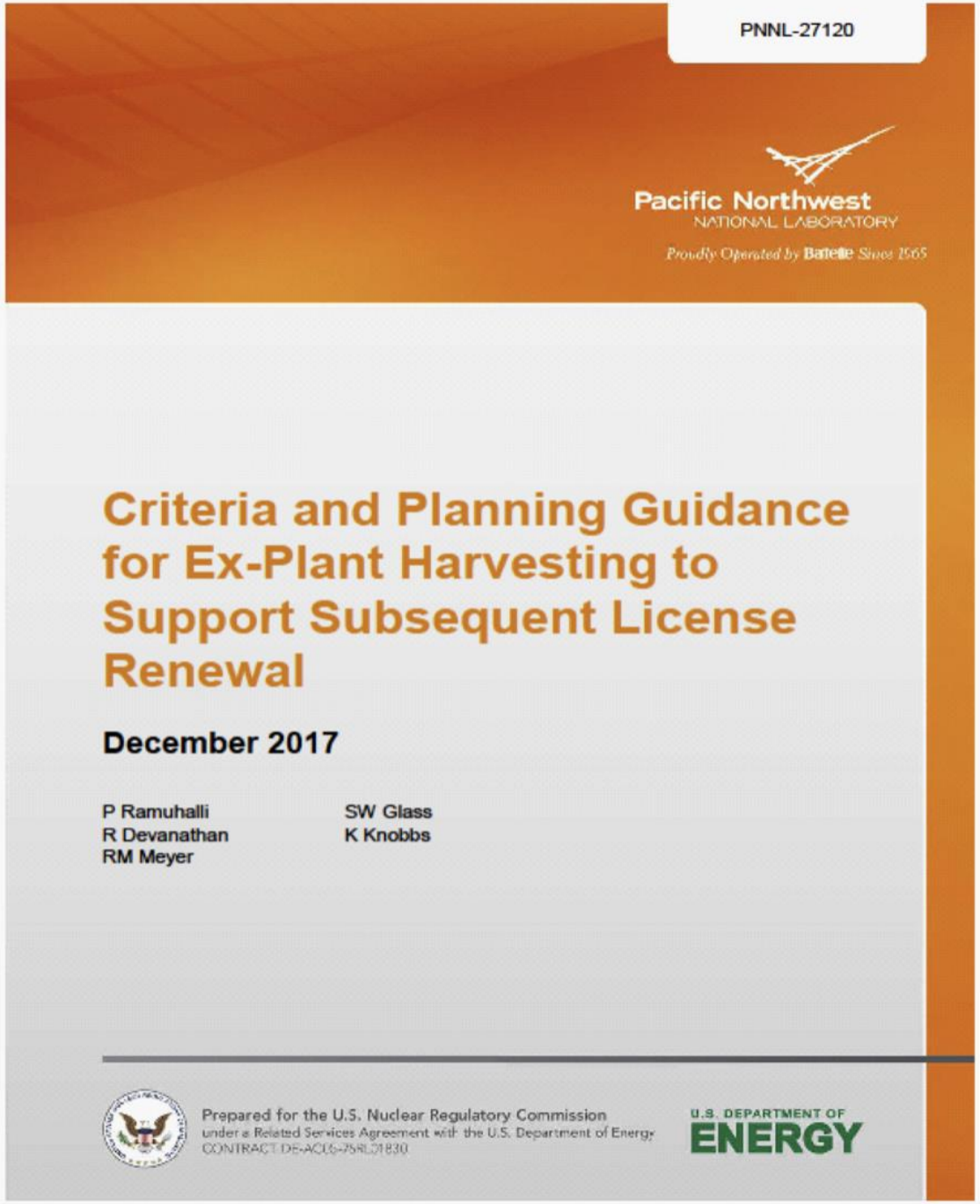
- **Develop a long range strategy for the timely acquisition of age degradation information for metals, weld materials, internals, concrete and electrical cable**
- **… *"but has been very difficult or impossible to obtain from the operating fleet."***
- **There is a need to harvest and analyze "*experiential real-world*" materials from decommissioning nuclear power plants**
- **Identify the "*technical gaps*" in knowledge and understanding of age degradation into the projected 60- to 80-yr relicensing period.**

[NRC-HQ-60-15-T-0023, NRC contract w/ PNNL, 09-04-2015, FOIA 2018-000831]

NRC/PNNL agreement language for a "Strategic Approach for Obtaining Material and Component Aging Information"

- **PNNL shall identify and document "*information and technical gaps*";**
- **In "*identifying gaps*", PNNL shall include industry practices endorsed by NRC with respect to addressing degradation & the assurance of retention of design margins during license extension period (60 to 80);**
- **PNNL shall recommend experimentation and analytical model development;**
- **"*deliverables shall be in the form of technical letter reports*" (TLR)**

[NRC-HQ-60-15-T-0023, NRC contract w/ PNNL, September 4, 2015, FOIA 2018-000813]



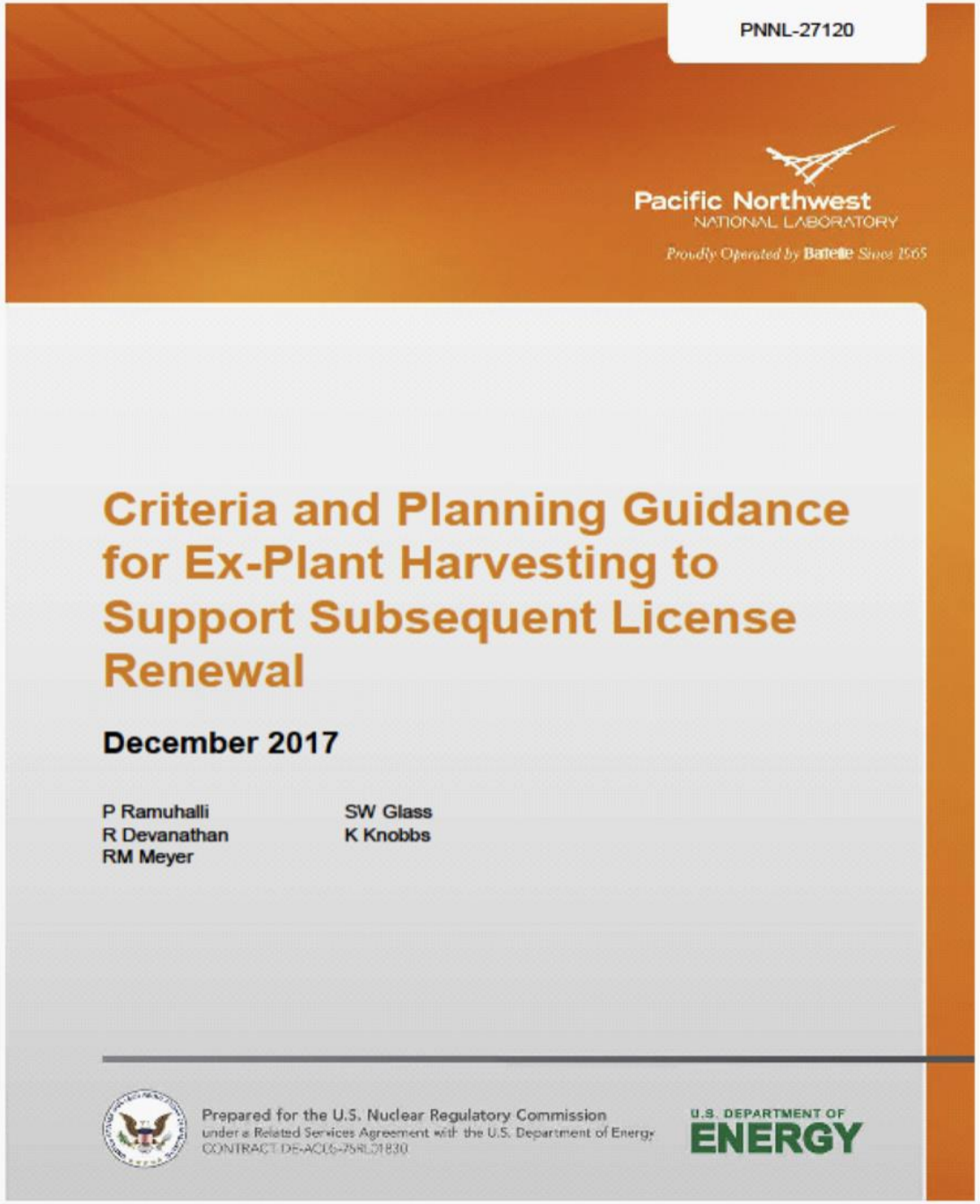
Technical Letter Report excerpts (PNNL-27120), posted Dec. 2017

Technical knowledge "gaps" cited 60 times

"Further, a number of technical gaps have been identified in the understanding of degradation growth in specific materials."

"Harvested materials can be used to address critical knowledge gaps in two areas;
1) calibration and validation of current accelerated testing procedures; and
2) assessment of combined effects of thermal aging, coolant effects and neutron irradiation."

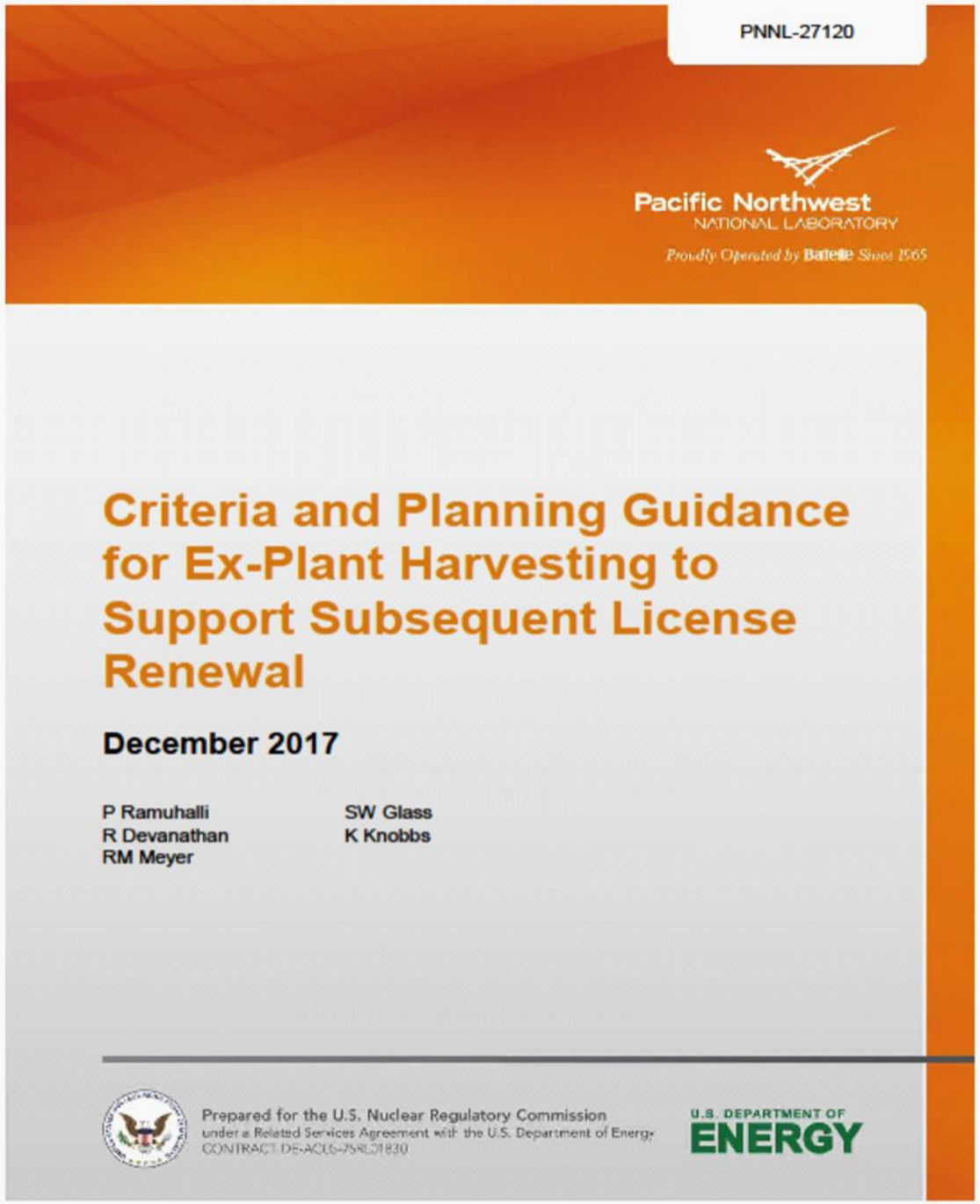
"Harvested materials can be used to address technical gaps related to crack initiation susceptibility and crack growth rates."



PNNL-27120 Recommendations

"Many of remaining questions regarding degradation of materials will likely require a combination of laboratory studies as well as other research conducted on materials sampled from plants (decommissioning and operating)." **[Summary]**

"Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require harvesting materials from reactors." **[2.0 Nuclear Plant Materials Harvesting]**



"General Comments" by NRC staff Nuclear Reactor Regulation/ Division of License Renewal

"The word 'gap' is overused in the report—63 times."

"How do we issue the GALL-SLR **(Generic Aging Lessons Learned-Subsequent License Renewal)** ***with technical gaps and how are we going to be able to issue a renewal license if there are technical gaps in reaching a reasonable assurance conclusion?"***

"I get what the author (PNNL) is trying to state. However, if I were an intervener I would use this document to shutdown SLRA **(Subsequent License Renewal Applications)."**

NRC/ NRR/ DLR “General Comments” continued…

“The phrase ‘real world’ should be replaced with more accurate terminology, for example, ‘in-service condition,’ ‘service aging,’ or ‘operating reactor service time’ depending on the context. Otherwise, it implies that current guidance is not based on relevant data/knowledge.”

“Big picture, I think that the entire report needs to be scrubbed for text that points to gaps and if issued we will need a stronger basis for why we will grant renewed licenses before the harvesting and testing is completed.”

“General Comments” by technical staff NRC/ NRR/ Materials/ DLR regarding PNNL-27120, March 20, 2018, (NRC FOIA 2018-000831)

“Consider a different word choice instead of ‘technical gap’, which has a perjorative connotation of no knowledge or no basis for regulatory decisions.”

“General Comments” by technical staff NRC/ NRR/ Materials/ DLR regarding PNNL-27120, March 20, 2018, (NRC FOIA 2018-000831)

August 23, 2018 (PNNL technical letter report public since December 2017), an exchange of emails between NRC Office of Research staff:

“I agree that the use of ‘gap’ needs to be scaled back even more. In a few places I’ve been replacing ‘gap’ with ‘issue.’”

Reply,

“I still think ‘technical issue” would raise the same concern from NRR as ‘technical gap’. It should be OK to use ‘technical gap’ for pre-GALL-SLR documents, but not after that.”

[NRC FOIA 2018-000831]

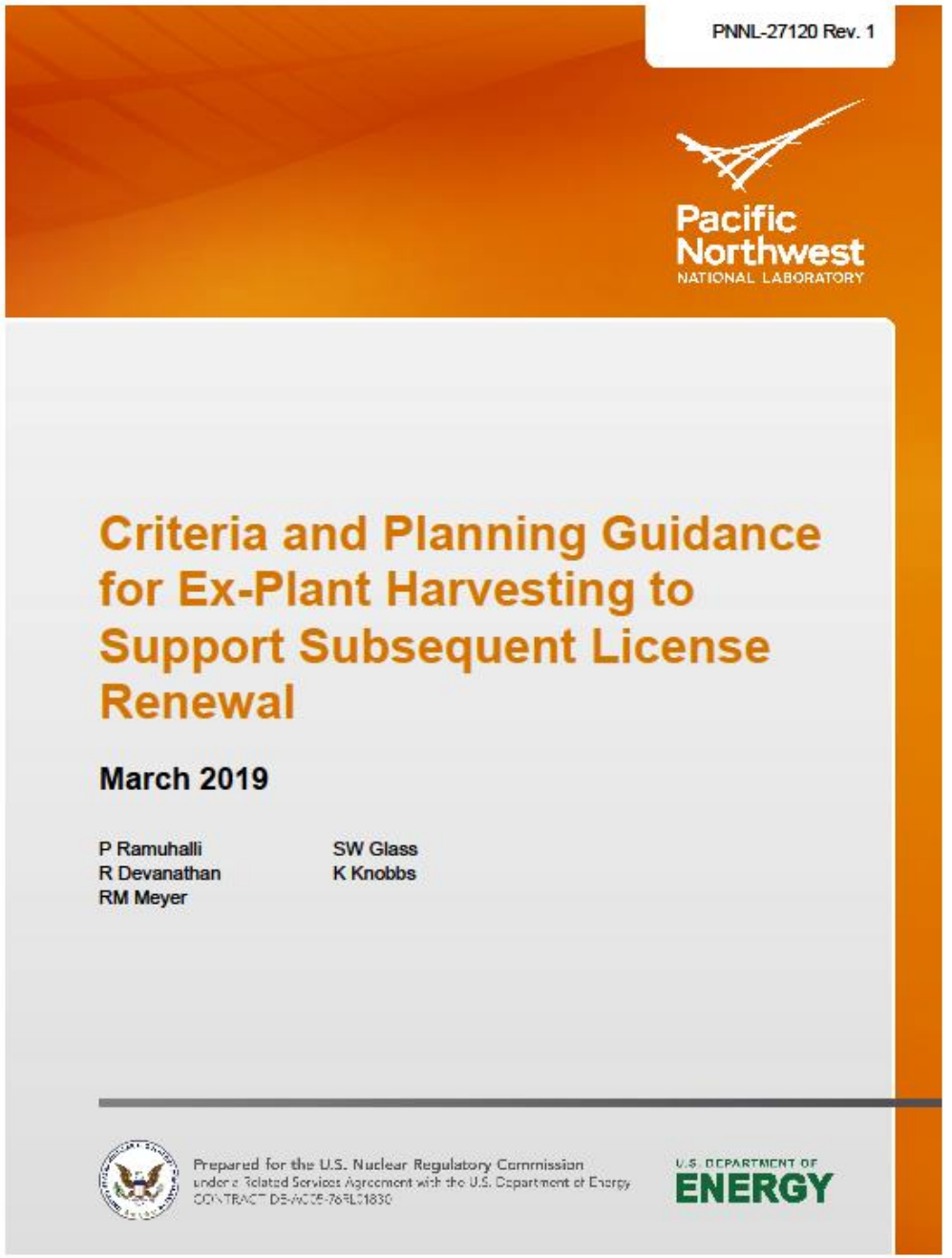
The original Technical Letter Report (TLR) was publicly released December 2017 on three government websites:

- **PNNL**
- **DOE Office of Scientific and Technical Information (OSTI)**
- **IAEA International Nuclear Information System (INIS)**

<u>September 2018</u> NRC removes TLR;

<u>April 2019</u> NRC publishes "*scrubbed*" revision (PNNL-27120 Rev. 1);

NRC provides no commentary on deleting PNNL recommendations to "*require*" harvesting/analysis and <u>how or if</u> the scrubbed "*technical gaps*" were scientifically closed or merely erased.



Should NRC “require” harvesting?

“Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require harvesting materials from reactors.”

[PNNL-27120, December 2017, p.16 of 52]

“Where available, such benchmarking can be performed using surveillance specimens exposed to field conditions during the course of operation of the reactor. However, surveillance specimens are often limited to critical components such as the RPV, and do not exist for components in other locations in a plant. In such cases, benchmarking of laboratory tests may be achieved by harvesting materials from reactors.”

[PNNL-27120 Rev. 1, March 2019, p.11 of 41]

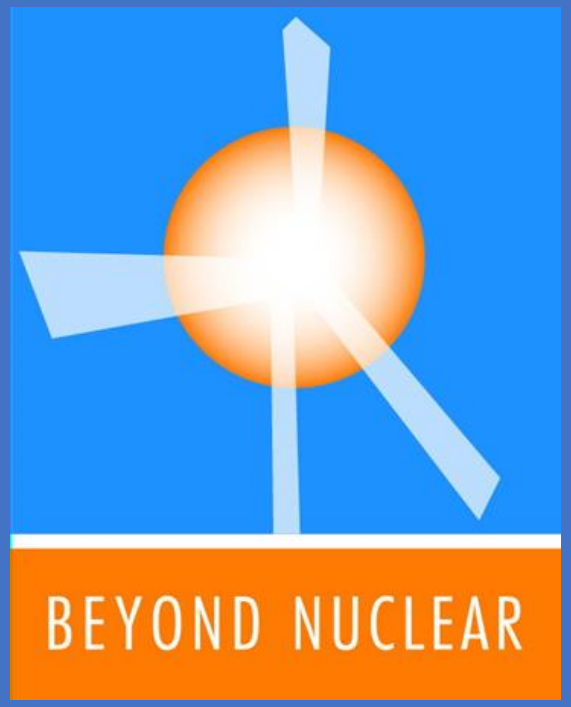
Some takeaways in the public interest

Prompt decommissioning is broadly favored to “SAFSTOR”. NRC should avoid more missed strategic opportunities to perform autopsies prior to burial and destruction of scientific evidence

Strategic harvesting of “high-priority” aged material samples must be planned and coordinated with the stages of dismantlement

Extreme license extensions cannot reasonably proceed absent Verification & Validation of the material science needed to close “high-priority” technical knowledge gaps in age-related degradation mechanism management

As industry currently benefits from recurring license extensions Congress and the NRC should increase operating license fees to sufficiently fund strategic harvesting at decommissioning sites for laboratory analysis



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