

Note to requester: Attachment to this email record is immediately following. This same email record was released in full, and forwarded without its attachment, in the second interim response. This record also addresses the first bullet in your 5/19/2020 letter.

**From:** Purtscher, Patrick  
**Sent:** Fri, 7 Sep 2018 17:54:12 +0000  
**To:** 'Ramuhalli, Pradeep'  
**Cc:** Hiser, Matthew  
**Subject:** DMLR Specific Comments on PNNL-27120-pr nrc 9-7-18\_w-PTP\_add-ons.docx  
**Attachments:** DMLR Specific Comments on PNNL-27120-pr nrc 9-7-18\_w-PTP\_add-ons.docx

Here is a copy of your report with all of our comments. We think this addresses the NRR comments and we hope it will be relatively easy for you to review, accepting those changes that you agree with. Where you don't agree, highlight them for our further discussion.

The one main comment I had that is not noted in each case is the rating or ranking that is present, mainly in Tables 1 through 4. It should be clearly noted where those values come from, some were from EMDA and others were from the author's assessment of the criteria in each table. Clearly the final assessment at the bottom of each table is TBD by each organization that is considering harvesting, given their own set of priorities.

Pat

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli	SW Glass
R Devanathan	K Knobbs
RM Meyer	

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)



(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**



Note to requester: Attachments to this email record are immediately following. This same email record was released in full, and forwarded without its attachments, in the second interim response.

**From:** [Brady, Bennett](#)  
**To:** [Purtscher, Pat](#)  
**Cc:** [Oesterle, Eric](#)  
**Subject:** MDLR comments on PNNL's Guidelines for Harvesting Materials for SLR  
**Date:** Tuesday, March 20, 2018 5:19:23 PM  
**Attachments:** [DMLR Specific Comments on PNNL-27120.docx](#)  
[DMLR General Comments on PNNL -27120.docx](#)

---

Pat

Following your request, I asked eight of our technical review staff to review and provide comments on PNNL's technical letter report on harvesting materials. Attached are general comments on the report and specific comments that I have compiled in redline/strikeout version of the report itself. Some of the comments are repetitious of comments made by other reviews. I have tried to group similar comments together. When you have had a chance to review them, please see me if you have any questions. I will try to answer your questions or get you to the right reviewer.

In spite of the rather negative comments on this report, we continue to believe that the Materials Harvesting Project will be in valuable in the future as the NRC deals with aging plants and needs an organized approach for selecting materials for harvesting with the increased availability of sources.

Bennett

*Bennett M. Brady*

Senior Project Manager

Division of License Renewal

Office of Nuclear Reactor Regulation

O 11 – D8

301-415-2981

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli      SW Glass  
R Devanathan      K Knobbs  
RM Meyer

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
~~with~~With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

### **GENERAL COMMENTS ON PNNL-27120**

- In a meeting with the Director of DMLR, George Wilson, he recommended that the information or criteria for harvesting to be captured on the sample to be harvested include an estimate of the cost of the material, including the cost of shipping it from the source to the research facility and the cost of storing the sample for later use.
- He also suggested that priority be given in the following order to:
  - Domestic sources
  - International sources where the research would be done in collaboration with other research organizations (such as the Haldon Reactor projects) with the results and cost to be shared
  - Other international sources

- This report is very misleading about the need for and impact of data from harvesting efforts. In particular, this report cites the following:

[REDACTED] (b)(5)

This statement is flat wrong. The issuance of the GALL-SLR and the SRP-SLR reports provides (b)(5) without any additional information from harvesting. And, SLR could proceed without any information from harvesting in the future.

- The roles/benefits of data from harvested materials are:
  - Confirmation of the current GALL-SLR approaches for aging management.
  - The potential to reduce margins if the data from harvested materials indicate such a possibility.
- The form, function, and characteristics of the “information tools” in section 5 should be reconsidered by NRC staff, both RES and NRR. The description provided is very ambitious and may not have clear benefits to either harvesting activities or plant regulation.
- From the UNR, NRR was expecting the project to provide a database of potential components with specific materials and potential sources of components and guidance on determining the selection of materials to be harvested. Section 5 appears to go beyond that which may be difficult in times of reduced budgets and staff.
- The report (or follow-on work) could provide a substantial benefit by identifying harvesting efforts over the last 30 plus years, not just those since 2010. Such a review will greatly aid in the technical “lessons learned” from past harvesting

efforts and help to identify those areas with true holes in harvested data in a comprehensive manner.

- The word “gap” is overused in the report – 63 times.
- Consider a different word choice instead of “technical gap” which has a pejorative connotation of no knowledge or no basis for regulatory decisions.

- Many statements of “fact” are presented without attribution – these should have references to support them. As an example, there should be a reference cited in Section 3.4.4, item 6, which states [REDACTED]

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

Similarly in the second paragraph of section 3.4.1, the statement

should be supported by a reference.

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

- Page 3, 2<sup>nd</sup> full paragraph – Text states that [REDACTED]

(b)(5)

(b)(5)

This is incorrect as the GALL/GALL-SLR reports are predominantly based on lessons learned from plant operating experience and review of license renewal applications. Note that the first GALL report (Rev. 0) was issued in 2000 and PMDA was not issued until 2007. It would be correct to state that [REDACTED]

(b)(5)

(b)(5)

This context should be added to other places in the report as well.

- The NRR technical staff did a review of the five volumes of EMDA and noted any new issues or component types of materials that were not in GALL 2. These items were all viewed by the expert panels and dispositioned as to whether they should be included in GALL-SLR. They did no review the PMDA as the EMDA authors had reviewed the PMDA tables and updated them in the EMDA.
- Harvesting components is GREAT and getting more data/information is a nice to have. But there are places in the report that seem to indicate/imply that without this information from harvesting that going into SLR is a concern. I am not sure this is the correct messaging, considering the NRC just issued the GALL-SLR and SRP-SLR.
- Throughout the report, the tone seems to be that harvesting activities NEED to be performed otherwise failure of components will lead to unsafe operation of plants. I disagree with this notion – the whole premise of aging management is to inspect/manage so that issues are detected before they happen or early



enough before there is a loss of intended function of a component. The inspection/aging management is normally commensurate with how much we know about the material and degradation. For example - If we know less – there should be more inspections. If we know more –inspections may not need to be as frequent.

- The report is full of statements that could lead a reader to believe that we have an inadequate basis for the GALL-SLR Report and by extension, we should not be issuing renewed licenses for plants in the [redacted] time frame. I am confident that this is not the authors' intent. The report either needs to be significantly toned down in regard to knowledge gaps or we need to include the basis for why we are moving forward with SLR in light of knowledge gaps. (b)(5)

- I get what the authors are trying to state. However, if I was an intervener, I would use this document to shutdown SLRAs. I did not see any “robust” text in the report that tempered the words or put them into a context that we are confident in the means of managing aging effects for the four classes of SSCs of concern (e.g., concrete, cables). For example, this statement: [redacted] (b)(5)

(b)(5)

(b)(5)

If this is our basis for why the GALL-SLR Report is adequate, it's pretty weak compared to the below underlined sentences. Further, the same paragraph goes on to state, [redacted] (b)(5)

(b)(5)

(b)(5)

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

- In the Abstract, the author states:

[redacted] (b)(5)

How did we issue the GALL-SLR Report with technical gaps and how are we going to be able to issue a renewed license if there are technical gaps to reaching a reasonable assurance conclusion?

- On page 2, the second full paragraph, the author states



(b)(5)



For the first underlined sentence, does this mean that we won't have [redacted] (b)(5)

(b)(5) [redacted] In that case, how can we issue  
(b)(5) a renewed license for [redacted] years before the testing is completed? Will we  
generate license conditions to restrict how far into the SPEO a licensee can  
operate before the testing is complete? This statement is too broad. For the  
second underlined sentence, should I infer that the [redacted] (b)(5)

(b)(5) [redacted]

- The next paragraph says

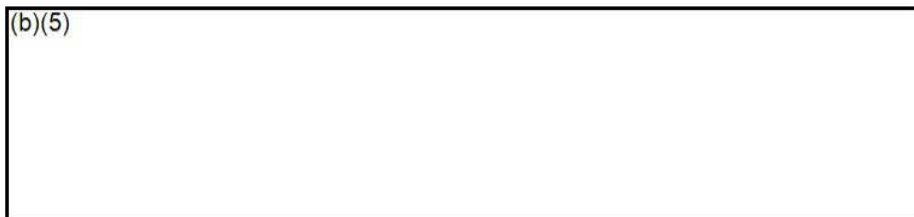
(b)(5)



Similar comment to the above, are these knowledge gaps addressed in the applicable GALL-SLR AMPs, with compensatory measures in place?

- The first paragraph in section 3.3 page 5 states:

(b)(5)



This provides another good example of the report stating that we lack sufficient information to understand failure mechanisms.

- The GALL report is the NRC staff's generic evaluation of the acceptable aging management for the period of extended operation based on the technical basis developed in the EMDA and PMDA.

I do not believe that the EMDA and PMDA present the complete technical basis for the GALL-SLR report. We issued an entire NUREG 2221 which provides the complete technical bases for the technical bases for all the changes that were made in the GALL 2 and SRP Revision 2. Before beginning the revision of the GALL and SRP, the NRR staff reviewed the EMDA reports to see if there were any new issues that needed to be addressed for SLR. The staff did not review the PMDA as the EMDA was an update and expansion of the PMDA and the PMDA only addressed operation to 60 years.

(b)(5) • Table 1, 8<sup>th</sup> row, GALL-SLR, [REDACTED]

(b)(5) • Table 2, 8<sup>th</sup> row, GALL-SLR, [REDACTED]

(b)(5) [REDACTED]

- What data would be sought from the harvested material and how would it be used to inform aging management? An example could be cast austenitic stainless steel (CASS) from RV internals. The data sought are fracture toughness of CASS material subject to both irradiation and thermal aging at the same time. The use of this data could be to perform flaw evaluations if cracks are ever found in CASS components, or flaw tolerance evaluations to determine the appropriate interval for inspections, or to avoid inspection altogether.
- Are there any mitigating factors for the degradation mechanism? For example, for CASS in RV internals, maybe fracture toughness is not so important since CASS is known to be very resistant to stress corrosion cracking initiation. Without an active cracking mechanism, fracture toughness data are less important. So this would tend to lower the priority of harvesting CASS from RV internals.
- The report doesn't always do an adequate job of distinguishing between age-related degradation mechanisms, failure mechanisms, and intended functions. In addition, after reading some of the statements in the PNNL report, I come away with the impression the report sets the tone that, if the RES/PNNL recommended harvesting and supplemental testing activities are performed, the results of those activities would be (by themselves) sufficient to ensure reasonable assurance of component structural integrity intended functions. Instead, the results of such studies only provide additional insights into how a given age-related degradations mechanisms is occurring and progressing, and possibly how a component would fail. The harvesting activities and supplement studies (by themselves) would not constitute a sufficient basis for drawing conclusions on reasonable assurance of

component structural integrity or component intended function(s). That would need to be done by each licensee as part of its design and licensing basis.

- One thing to note is that the report refers back to the Office of Research's (RES) PMDA and EMDA studies for SLR, in which RES made recommendations on some of the areas NRR/DLR (before we turned into DMLR) would need to focus on when going through its GALL-SLR (NUREG-2191) and SRP-SLR (NUREG-2192) update efforts. When we started our efforts in late 2014 to perform the updated guidance reviews, we were instructed by our management team to review the EMDA recommended actions to see if we agreed with the actions RES was recommending. From a historical perspective, it is important to point that the staff did not always agree with the RES's PMDA / EMDA recommended actions for updating the GALL-SLR and SRP-SLR reports. For your knowledge, the Technical Basis Report for the SLR updates provides the technical bases for the changes we incorporated into NUREG-2191 and NUREG-2192, NUREG-2221 and NUREG-2222 from the prior versions of the reports (NUREG-1801, Revision 2 and NUREG-1800, Revision 2).



Note to requester: Attachment to this email record is immediately following. This same email record was released in part, and forwarded without its attachment, in the second interim response.

**From:** Ramuhalli, Pradeep  
**Sent:** Thu, 21 Jul 2016 16:14:07 +0000  
**To:** Purtscher, Patrick;Hiser, Matthew;Knobbs, Katie  
**Cc:** Hull, Amy  
**Subject:** [External\_Sender] RE: RRIM  
**Attachments:** Draft.docx

Patrick, Matt,

Attached is a draft document for discussion later today.

---

With best regards,

Pradeep Ramuhalli, PhD  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)

-----Original Appointment-----

**From:** Ramuhalli, Pradeep  
**Sent:** Tuesday, July 12, 2016 7:50 AM  
**To:** Ramuhalli, Pradeep; 'Purtscher, Patrick'; Hiser, Matthew (Matthew.Hiser@nrc.gov); Knobbs, Katie  
**Cc:** Hull, Amy  
**Subject:** RRIM  
**When:** Thursday, July 21, 2016 10:00 AM-11:00 AM (UTC-08:00) Pacific Time (US & Canada).  
**Where:** Skype Meeting

All,

Apologies – I have been incommunicado for a couple of weeks. I'd like to set up a conference call to play catch up. Let me know if this time works for you.

---

### → [Join Skype Meeting](#)

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

### Join by phone

[Join the meeting and have Lync call you or dial-in](#) (Richland) English (United States)

[866-528-1882 or 509-375-4555](#) (Richland) English (United States)

[On-campus PNNL staff dial 5-4555](#) (Richland) English (United States)

[Find a local number](#)

Conference ID: (b)(6)

[Forgot your dial-in PIN?](#) | [Help](#)

.....



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

## Publish Date

1FM Last  
2FM Last

3FM Last  
4FM Last



Prepared for the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

(b)(5)

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-SA-XXXXX

# **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

FM Last  
FM Last

FM Last  
FM Last

Publish Date

Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)



(b)(5)



(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

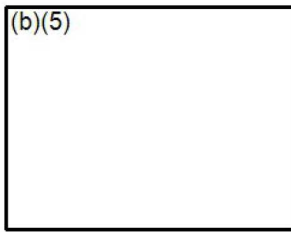
(b)(5)

(b)(5)

(b)(5)

(b)(5)

A large rectangular area of the document is redacted, indicated by a black border. The text "(b)(5)" is located in the top-left corner of this redacted area.





(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

U.S. DEPARTMENT OF  
**ENERGY**

---

**[www.pnnl.gov](http://www.pnnl.gov)**

**From:** Purtscher, Patrick  
**Sent:** Wed, 29 Aug 2018 16:42:31 +0000  
**To:** 'Ramuhalli, Pradeep'; Hiser, Matthew  
**Subject:** RE: TLR Update  
**Attachments:** harvesting\_composite\_8-28.docx

Note to requester: Attachment to this email record is immediately following. This same email record was released in full, and forwarded without its attachment, in the second interim response. This email record, and its attachment, partially address your sixth bullet point in your 5/19/2020 letter.

Hi,

Matt and I took turns changing the report with our recommendations, the attached is a composite of our comments. The biggest changes were to drop the abstract, combine sections 1 and 2, make the examples in section 3.3.2 into a separate section, and drop the specific harvesting examples in Section 4. We don't need that level of details for historical perspective. The general lessons learned are the points to be emphasized.

These are suggestions and would like to discuss with you after you have some time to review. Let me know when you have time. We hope to meet with NRR near the end of Sept. to go over the report and how their comments were considered.

Pat

**From:** Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]

**Sent:** Friday, August 17, 2018 2:45 PM

**To:** Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

**Subject:** [External\_Sender] TLR Update

The update so far is attached. This still needs some cleanup and citations included; I am working on a tech editor on these.

With best regards,

Note to requester: After searching further, the 8/17/2018 Email from PNNL to NRC staff with the subject line "[External\_Sender] TLR Update" could not be located.

Pradeep

---

Pradeep Ramuhalli, PhD  
Senior Research Scientist,  
Applied Physics Group  
Pacific Northwest National Laboratory  
902 Battelle Blvd.  
P.O.Box 999, MSIN K5-26  
Richland, WA 99352  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)  
<http://www.pnnl.gov>

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response.

**From:** [Purtscher, Patrick](#)  
**To:** [Hiser, Matthew](#); [Audrain, Margaret](#); [Tregoning, Robert](#)  
**Subject:** Harvesting-TLR-final DRAFT-12\_04\_2017.docx  
**Date:** Tuesday, December 05, 2017 8:20:45 AM  
**Attachments:** [Harvesting-TLR-final DRAFT-12\\_04\\_2017.docx](#)

---

Here is the final draft of the harvesting report.

Pat



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

**December 2017**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY

*operated by*

BATTELLE

*for the*

UNITED STATES DEPARTMENT OF ENERGY

*under Contract DE-AC05-76RL01830*

Printed in the United States of America

Available to DOE and DOE contractors from the  
Office of Scientific and Technical Information,  
P.O. Box 62, Oak Ridge, TN 37831-0062;  
ph: (865) 576-8401  
fax: (865) 576-5728  
email: [reports@adonis.osti.gov](mailto:reports@adonis.osti.gov)

Available to the public from the National Technical Information Service  
5301 Shawnee Rd., Alexandria, VA 22312  
ph: (800) 553-NTIS (6847)  
email: [orders@ntis.gov](mailto:orders@ntis.gov) <<http://www.ntis.gov/about/form.aspx>>  
Online ordering: <http://www.ntis.gov>



This document was printed on recycled paper.

(8/2010)

# **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
with the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response.

**From:** [Purtscher, Patrick](#)  
**To:** [Hiser, Matthew](#); [Audrain, Margaret](#); [Hull, Amy](#); [Tregoning, Robert](#)  
**Subject:** harvesting report  
**Date:** Tuesday, October 31, 2017 1:51:55 PM  
**Attachments:** [Harvesting-TLR-final DRAFT Oct 2017.docx](#)

---

Draft from Pradeep on harvesting.

Pat

-----Original Message-----

From: Purtscher, Patrick  
Sent: Tuesday, October 31, 2017 1:49 PM  
To: 'Ramuhalli, Pradeep' <Pradeep.Ramuhalli@pnnl.gov>  
Subject: RE: You have files ready for pickup

Thanks, I got the file.

My idea to finish everything now is for us (Amy, Matt, Rob, Meg, and myself) to read through it one more time and then send it to my branch chief for his information. Then you can get a PNNL lab report # and complete phase 1 of the project.

Pat

-----Original Message-----

From: Ramuhalli, Pradeep [<mailto:collaboration@pnnl.gov>]  
Sent: Tuesday, October 31, 2017 10:41 AM  
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>  
Subject: [External\_Sender] You have files ready for pickup

Hello,

Ramuhalli, Pradeep (Pradeep.Ramuhalli@pnnl.gov) has sent you the following 1 file(s)

Subject: TLR - resending draft

Comments: Patrick,

The TLR update should be available via the link below. Just saw your email from last week (b)(6) and then playing catchup). Resending this via FTP instead of email attachment.

Pradeep

The following files have been uploaded to the MassTransit Web File Transfer Services. You can download them by going to:

(b)(4)

and selecting the file(s) and clicking Download (All/Selected).

NOTE: This link and contained passkey are only good for 14 days.

Harvesting-TLR-DRAFT.docx (5.07M bytes)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

**November 2017**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs



Prepared for the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY

*operated by*

BATTELLE

*for the*

UNITED STATES DEPARTMENT OF ENERGY

*under Contract DE-AC05-76RL01830*



This document was printed on recycled paper.

(9/2003)

---

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-XXXXX

# **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs

November 2017

Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)





(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

U.S. DEPARTMENT OF  
**ENERGY**

---

**[www.pnnl.gov](http://www.pnnl.gov)**

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response.

**From:** [Hiser, Matthew](#)  
**To:** [Sircar, Madhumita](#)  
**Cc:** [Purtscher, Patrick](#)  
**Subject:** FW: Harvesting document update  
**Date:** Friday, March 17, 2017 10:12:20 AM  
**Attachments:** [Draft Outline Harvesting PNNL rev3-013117.docx](#)

---

Hi Mita,

Here is the latest version of the PNNL report. Please feel free to take a look and provide comments.

I'll be reviewing and sending comments to Pat in the next few days.

Thanks!

Matt

---

**From:** Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]

**Sent:** Wednesday, February 01, 2017 1:10 AM

**To:** Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

**Cc:** Hiser, Matthew <Matthew.Hiser@nrc.gov>

**Subject:** [External\_Sender] Harvesting document update

Patrick,

Note to requester: After searching further, the 2/1/2017 Email from PNNL to NRC staff with the subject line "[External\_Sender] Harvesting document update" could not be located.

Attached is an updated draft of the harvesting document. Please note – this is a draft. As always, feedback/suggested edits are welcome. I am finishing up the draft slides and will have them out later tomorrow.

With best regards,

Pradeep

---

Pradeep Ramuhalli, PhD  
Senior Research Scientist,  
Applied Physics Group  
Pacific Northwest National Laboratory  
902 Battelle Blvd.  
P.O.Box 999, MSIN K5-26  
Richland, WA 99352  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)  
<http://www.pnnl.gov>





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

**January 2017**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs



Prepared for the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

(b)(5)

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-XXXXX

# **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs

January 2017

Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

U.S. DEPARTMENT OF  
**ENERGY**

---

**[www.pnnl.gov](http://www.pnnl.gov)**

**From:** [Purtscher, Patrick](#)  
**To:** [Hiser, Matthew](#)  
**Subject:** FW: TLR  
**Date:** Tuesday, September 25, 2018 6:54:43 AM  
**Attachments:** [DMLR Specific Comments on PNNL-27120-pr nrc 9-7-18 w-PTP add-ons-pr.docx](#)

---

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response.

**From:** Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]

**Sent:** Monday, September 24, 2018 3:02 PM

**To:** Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

**Subject:** [External\_Sender] TLR

Note to requester: After searching further, the 9/24/2018 Email from PNNL to NRC staff with the subject line "[External\_Sender] TLR" could not be located.

Pat,

Attached is an updated (changes accepted) version of TLR. Reading through your comments, seemed like most of them were OK. I accepted them. About the only ones I have left in there are some formatting changes, comments on adding references (I agree – just haven't added them yet), and a suggested deletion of the concrete section. I also have a suggestion on drastically cutting down the past harvesting discussions. We can talk about this on the call today.

With best regards,

Pradeep

---

Pradeep Ramuhalli, PhD  
Senior Research Scientist,  
Applied Physics Group  
Pacific Northwest National Laboratory  
902 Battelle Blvd.  
P.O.Box 999, MSIN K5-26  
Richland, WA 99352  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)  
<http://www.pnnl.gov>

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli      SW Glass  
R Devanathan      K Knobbs  
RM Meyer

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

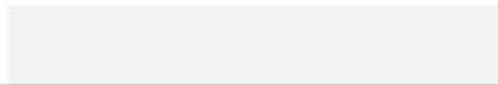
(b)(5)



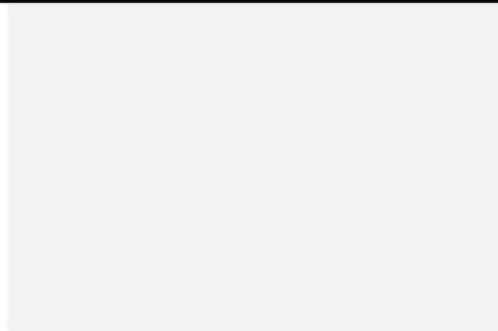
(b)(5)

(b)(5)





(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)





**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

**From:** [Hiser, Matthew](#)  
**To:** [Miller, Kenneth A](#); [Sircar, Madhumita](#)  
**Subject:** FW: TLR Update  
**Date:** Tuesday, August 21, 2018 10:36:00 AM  
**Attachments:** [DMLR Specific Comments on PNNL-27120-pr.docx](#)

---

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response.

Hi Mita and Kenn,  
FYI for your awareness – PNNL report on prioritizing harvesting needs (has somewhat informed our criteria). We are addressing NRR comments, which were mostly concerned with implications of wording in report on SLR guidance and reviews...

Thanks!

Matt

**Matthew Hiser**

Materials Engineer

US Nuclear Regulatory Commission | Office of Nuclear Regulatory Research

Division of Engineering | Corrosion and Metallurgy Branch

Phone: 301-415-2454 | Office: TWFN 10D62

[Matthew.Hiser@nrc.gov](mailto:Matthew.Hiser@nrc.gov)

---

**From:** Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]

**Sent:** Friday, August 17, 2018 2:45 PM

**To:** Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

**Subject:** [External\_Sender] TLR Update

The update so far is attached. This still needs some cleanup and citations included; I am working on a tech editor on these.

With best regards,

Pradeep

Note to requester: After searching further, the 8/17/2018 Email from PNNL to NRC staff with the subject line "[External\_Sender] TLR Update" could not be located.

---

Pradeep Ramuhalli, PhD

Senior Research Scientist,

Applied Physics Group

Pacific Northwest National Laboratory

902 Battelle Blvd.

P.O.Box 999, MSIN K5-26

Richland, WA 99352

Tel: 509-375-2763

Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)

<http://www.pnnl.gov>



Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli	SW Glass
R Devanathan	K Knobbs
RM Meyer	

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

[REDACTED]

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response, and was also included as an attachment in a previous record in the 5th interim response.

**From:** [Hiser, Matthew](#)  
**To:** [Audrain, Margaret](#)  
**Subject:** FW: TLR Update  
**Date:** Friday, August 17, 2018 2:45:59 PM  
**Attachments:** [DMLR Specific Comments on PNNL-27120-pr.docx](#)

---

**From:** Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]

**Sent:** Friday, August 17, 2018 2:45 PM

**To:** Hiser, Matthew ; Purtscher, Patrick

**Subject:** [External\_Sender] TLR Update

The update so far is attached. This still needs some cleanup and citations included; I am working on a tech editor on these.

With best regards,

Pradeep

---

Pradeep Ramuhalli, PhD  
Senior Research Scientist,  
Applied Physics Group  
Pacific Northwest National Laboratory  
902 Battelle Blvd.  
P.O.Box 999, MSIN K5-26  
Richland, WA 99352  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)  
<http://www.pnnl.gov>

Note to requester: After searching further, the 8/17/2018 Email from PNNL to NRC staff with the subject line "[External\_Sender] TLR Update" could not be located.

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli	SW Glass
R Devanathan	K Knobbs
RM Meyer	

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

[REDACTED]

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

**From:** [Purtscher, Patrick](#)  
**To:** ["Ramuhalli, Pradeep"](#)  
**Cc:** [Hiser, Matthew](#)  
**Subject:** First Draft Outline Harvesting PNNL rev2 PTP comments  
**Date:** Friday, December 09, 2016 10:45:25 AM  
**Attachments:** [First Draft Outline Harvesting PNNL rev2 PTP comments.docx](#)  
[Harvesting Workshop Announcement.docx](#)

---

Note to requester: Both attachments to this email record are immediately following. Second attachment was also included in the 4th interim response.

Hi,

I have added a few more comments, but mainly editorial. Can you give me an estimated delivery date for final draft?

We are moving ahead with planning the workshop. It will be a closed meeting on March 7-8, 2017. We expect to limit the attendance to 25 to 30 people.

We still need to talk about a contract mod to allow for your travel and workshop summary. Let me know what your availability will be for next week. I could be available most any day around noon.

Pat

PNNL-SA-XXXXX



*Proudly Operated by Battelle Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

**January 2017**

P Ramuhalli  
R Devanathan  
R Meyer

SW Glass  
K Knobbs



Prepared for the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

(b)(5)





Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-SA-XXXXXX

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

FM Last  
FM Last

FM Last  
FM Last

January 2017

Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

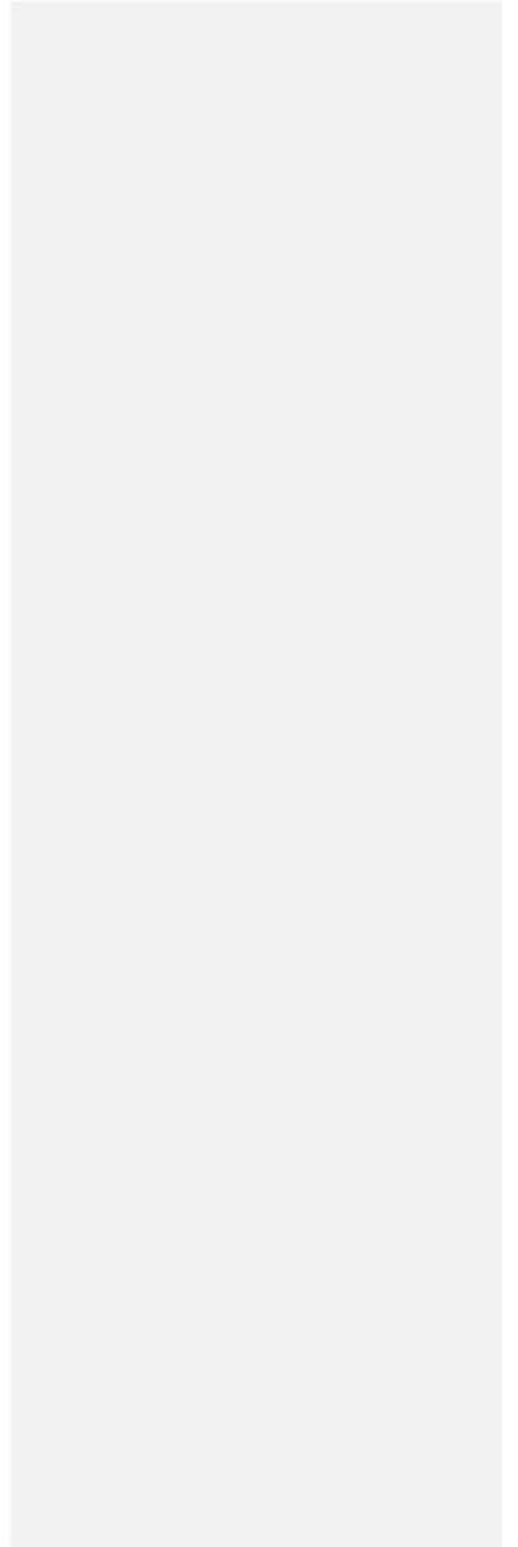
(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

A.1

(b)(5)



Distr.1







**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

U.S. DEPARTMENT OF  
**ENERGY**

---

**[www.pnnl.gov](http://www.pnnl.gov)**

## Ex-Plant Materials Harvesting Workshop

**Location:** NRC Headquarters in Rockville, MD, USA

**Dates:** March 7-8, 2017

### Motivation:

- There are increasing opportunities to harvest the safety-critical components from decommissioning plants, both domestic and international.
- The harvested materials are valuable because they have been exposed to actual in-service plant operating conditions (temperature, irradiation, coolant, etc.), unlike virgin materials tested under simulated conditions in the lab.
- Data from ex-plant materials should help address technical gaps identified for extended operation of nuclear power plants due to highly relevant aging conditions.

### Purpose and Objective:

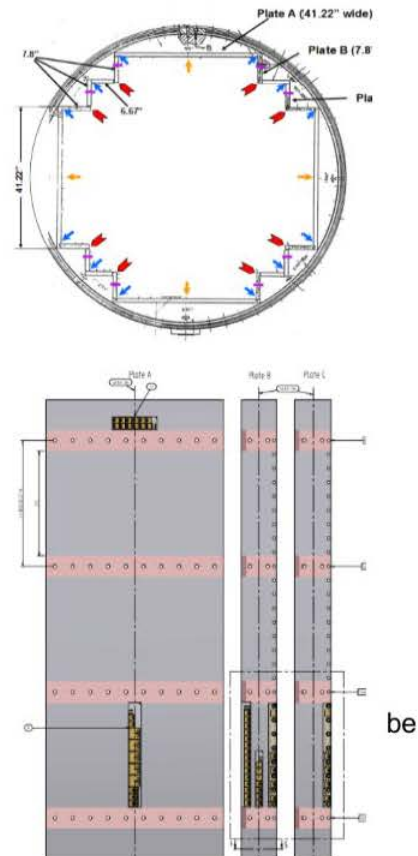
- For NRC staff and interested stakeholders to have greater awareness and knowledge of the benefits and challenges associated with ex-plant harvesting.
- Facilitate contacts and communication to enable specific cooperative ex-plant harvesting programs to be initiated.

### Workshop Topics:

- Harvesting decision-making and prioritization
  - Technical data needs best addressed by harvesting
  - Technical information needed in advance of harvesting
- Sources of materials:
  - Decommissioning reactors
  - Operating reactors – replaced components
  - Previous harvesting programs – “boneyards”
  - Tracking available materials
- Harvesting process
  - Lessons learned from harvesting experience
  - Perspective of utility-owner and decommissioning contractor on harvesting
  - Communication and coordination between decommissioning and researchers
- International collaborative programs on specific components at specific plants

Workshop will consist of solicited presentations followed by discussion periods. If interested in attending or learning more about the workshop, please reach out to the contacts below.

**Contacts:** Robert Tregoning, [Robert.Tregoning@nrc.gov](mailto:Robert.Tregoning@nrc.gov)  
 Matthew Hiser, [Matthew.Hiser@nrc.gov](mailto:Matthew.Hiser@nrc.gov)  
 Patrick Purtscher, [Patrick.Purtscher@nrc.gov](mailto:Patrick.Purtscher@nrc.gov)



Note to requester: Attachment to this email record is immediately following. Attachment was also included in the 4th interim response. This record addresses the second bullet in your 5/19/2020 letter.

**From:** Ramuhalli, Pradeep  
**Sent:** Mon, 4 Dec 2017 21:21:48 +0000  
**To:** Purtscher, Patrick  
**Subject:** [External\_Sender] RE: draft report from PNNL on Harvesting project  
**Attachments:** Harvesting-TLR-final DRAFT-120417.docx

Patrick,

I don't recall if I got this back to you or not. If not, attached is the updated version. In addition to the editorial changes you suggested, an internal peer review caught a few more editorial changes (format checks, grammatical issues). These are in the attached.

---

With best regards,

Pradeep Ramuhalli, PhD  
Tel: 509-375-2763  
Email: [pradeep.ramuhalli@pnnl.gov](mailto:pradeep.ramuhalli@pnnl.gov)

---

**From:** Purtscher, Patrick [mailto:Patrick.Purtscher@nrc.gov]  
**Sent:** Friday, November 24, 2017 10:05 AM  
**To:** Ramuhalli, Pradeep <Pradeep.Ramuhalli@pnnl.gov>  
**Subject:** FW: draft report from PNNL on Harvesting project

Note to requester: After searching further, the 11/24/2017 Email from NRC staff to PNNL with the subject line "FW: draft report from PNNL on Harvesting project" could not be located. Therefore, we could not locate its attachment, and we also could also not locate any emails forwarding this information. This addresses the third bullet in your 5/19/2020 letter.

Good afternoon,

Here is the report with some little editorial changes that we would like you to make before we send it through for management approval.

Pat



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

**December 2017**

P Ramuhalli  
R Devanathan  
RM Meyer

SW Glass  
K Knobbs



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY

*operated by*

BATTELLE

*for the*

UNITED STATES DEPARTMENT OF ENERGY

*under Contract DE-AC05-76RL01830*

Printed in the United States of America

Available to DOE and DOE contractors from the  
Office of Scientific and Technical Information,  
P.O. Box 62, Oak Ridge, TN 37831-0062;  
ph: (865) 576-8401  
fax: (865) 576-5728  
email: [reports@adonis.osti.gov](mailto:reports@adonis.osti.gov)

Available to the public from the National Technical Information Service  
5301 Shawnee Rd., Alexandria, VA 22312  
ph: (800) 553-NTIS (6847)  
email: [orders@ntis.gov](mailto:orders@ntis.gov) <<http://www.ntis.gov/about/form.aspx>>  
Online ordering: <http://www.ntis.gov>



This document was printed on recycled paper.

(8/2010)



Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-XXXXX

# **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli	SW Glass
R Devanathan	K Knobbs
RM Meyer	

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
with the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)



(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)







**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

Note to requester: After searching further, the 3/26/2018 email from NRC staff to PNNL with the subject line "FW: MDLR comments on PNNL's Guidelines for Harvesting Materials for SLR" could not be located. This 3/26/2018 email forwarded the 3/20/2018 email on this page. However, we located another email, dated 3/21/2018, that had the same subject line with its attachments, that was also forwarding the same 3/20/2018 email message. Both of the attachments to this email are following. This record addresses the fourth bullet in your 5/19/2020 letter.

**From:** Purtscher, Patrick  
**Sent:** Wed, 21 Mar 2018 17:54:22 +0000  
**To:** Tregoning, Robert; Audrain, Margaret; Hiser, Matthew  
**Subject:** FW: MDLR comments on PNNL's Guidelines for Harvesting Materials for SLR  
**Attachments:** DMLR Specific Comments on PNNL-27120.docx, DMLR General Comments on PNNL -27120.docx

Here are DMLR comments. Eight people provided comments, do you think that is some kind of record? I don't remember any RES document that got that kind of review while I was in NRR.

Pat

---

**From:** Brady, Bennett  
**Sent:** Tuesday, March 20, 2018 5:19 PM  
**To:** Purtscher, Patrick <[Patrick.Purtscher@nrc.gov](mailto:Patrick.Purtscher@nrc.gov)>  
**Cc:** Oesterle, Eric <[Eric.Oesterle@nrc.gov](mailto:Eric.Oesterle@nrc.gov)>  
**Subject:** MDLR comments on PNNL's Guidelines for Harvesting Materials for SLR

Pat

Following your request, I asked eight of our technical review staff to review and provide comments on PNNL's technical letter report on harvesting materials. Attached are general comments on the report and specific comments that I have compiled in redline/strikeout version of the report itself. Some of the comments are repetitious of comments made by other reviews. I have tried to group similar comments together. When you have had a chance to review them, please see me if you have any questions. I will try to answer your questions or get you to the right reviewer.

In spite of the rather negative comments on this report, we continue to believe that the Materials Harvesting Project will be valuable in the future as the NRC deals with aging plants and needs an organized approach for selecting materials for harvesting with the increased availability of sources.

Bennett

*Bennett M. Brady*  
Senior Project Manager  
Division of License Renewal  
Office of Nuclear Reactor Regulation  
O 11 – D8  
301-415-2981

Note to requester: The document provided to the FOIA staff also included skipped numbers before page 1. There are no missing pages.

PNNL-27120

## **Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal**

P Ramuhalli      SW Glass  
R Devanathan      K Knobbs  
RM Meyer

December 2017

Prepared for  
the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement  
~~with~~With the U.S. Department of Energy  
Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory  
Richland, Washington 99352

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

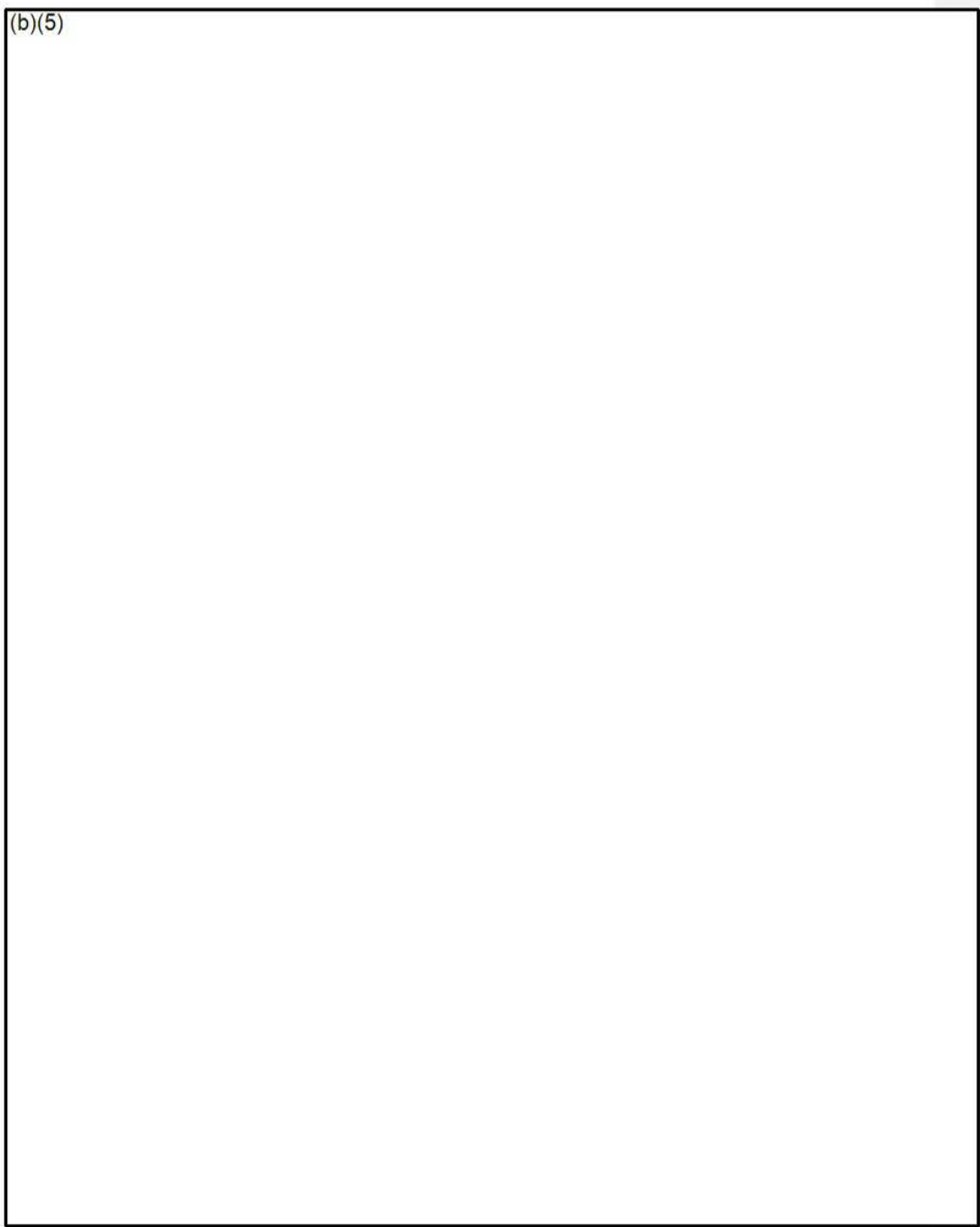
(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)



(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)

(b)(5)



(b)(5)

(b)(5)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard  
P.O. Box 999  
Richland, WA 99352  
1-888-375-PNNL (7665)

**[www.pnnl.gov](http://www.pnnl.gov)**



Prepared for the U.S. Nuclear Regulatory Commission  
under a Related Services Agreement with the U.S. Department of Energy  
CONTRACT DE-AC05-76RL01830

U.S. DEPARTMENT OF  
**ENERGY**

## **GENERAL COMMENTS ON PNNL-27120**

- In a meeting with the Director of DMLR, George Wilson, he recommended that the information or criteria for harvesting to be captured on the sample to be harvested include an estimate of the cost of the material, including the cost of shipping it from the source to the research facility and the cost of storing the sample for later use.
- He also suggested that priority be given in the following order to:
  - Domestic sources
  - International sources where the research would be done in collaboration with other research organizations (such as the Haldon Reactor projects) with the results and cost to be shared
  - Other international sources

- This report is very misleading about the need for and impact of data from harvesting efforts. In particular, this report cites the following:

[REDACTED] (b)(5)

This statement is flat wrong. The issuance of the GALL-SLR and the SRP-SLR reports provides (b)(5) without any additional information from harvesting. And, SLR could proceed without any information from harvesting in the future.

- The roles/benefits of data from harvested materials are:
  - Confirmation of the current GALL-SLR approaches for aging management.
  - The potential to reduce margins if the data from harvested materials indicate such a possibility.
- The form, function, and characteristics of the “information tools” in section 5 should be reconsidered by NRC staff, both RES and NRR. The description provided is very ambitious and may not have clear benefits to either harvesting activities or plant regulation.
- From the UNR, NRR was expecting the project to provide a database of potential components with specific materials and potential sources of components and guidance on determining the selection of materials to be harvested. Section 5 appears to go beyond that which may be difficult in times of reduced budgets and staff.
- The report (or follow-on work) could provide a substantial benefit by identifying harvesting efforts over the last 30 plus years, not just those since 2010. Such a review will greatly aid in the technical “lessons learned” from past harvesting

efforts and help to identify those areas with true holes in harvested data in a comprehensive manner.

- The word “gap” is overused in the report – 63 times.
- Consider a different word choice instead of “technical gap” which has a pejorative connotation of no knowledge or no basis for regulatory decisions.
- Many statements of “fact” are presented without attribution – these should have references to support them. As an example, there should be a reference cited in Section 3.4.4, item 6, which states [REDACTED]

(b)(5)

(b)(5)

(b)(5)

[REDACTED] should be supported by a reference.

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

- Page 3, 2<sup>nd</sup> full paragraph – Text states that [REDACTED]

(b)(5)

(b)(5)

[REDACTED] This is incorrect as the GALL/GALL-SLR reports are predominantly based on lessons learned from plant operating experience and review of license renewal applications. Note that the first GALL report (Rev. 0) was issued in 2000 and PMDA was not issued until 2007. It would be correct to state that [REDACTED]

(b)(5)

(b)(5)

[REDACTED] This context should be added to other places in the report as well.

- The NRR technical staff did a review of the five volumes of EMDA and noted any new issues or component types of materials that were not in GALL 2. These items were all viewed by the expert panels and dispositioned as to whether they should be included in GALL-SLR. They did no review the PMDA as the EMDA authors had reviewed the PMDA tables and updated them in the EMDA.
- Harvesting components is GREAT and getting more data/information is a nice to have. But there are places in the report that seem to indicate/imply that without this information from harvesting that going into SLR is a concern. I am not sure this is the correct messaging, considering the NRC just issued the GALL-SLR and SRP-SLR.
- Throughout the report, the tone seems to be that harvesting activities NEED to be performed otherwise failure of components will lead to unsafe operation of plants. I disagree with this notion – the whole premise of aging management is to inspect/manage so that issues are detected before they happen or early



enough before there is a loss of intended function of a component. The inspection/aging management is normally commensurate with how much we know about the material and degradation. For example - If we know less – there should be more inspections. If we know more –inspections may not need to be as frequent.

- The report is full of statements that could lead a reader to believe that we have an inadequate basis for the GALL-SLR Report and by extension, we should not be issuing renewed licenses for plants in the [redacted] time frame. I am confident that this is not the authors' intent. The report either needs to be significantly toned down in regard to knowledge gaps or we need to include the basis for why we are moving forward with SLR in light of knowledge gaps. (b)(5)

- I get what the authors are trying to state. However, if I was an intervener, I would use this document to shutdown SLRAs. I did not see any “robust” text in the report that tempered the words or put them into a context that we are confident in the means of managing aging effects for the four classes of SSCs of concern (e.g., concrete, cables). For example, this statement: [redacted] (b)(5)

(b)(5)

(b)(5)

[redacted] If this is our basis for why the GALL-SLR Report is adequate, it's pretty weak compared to the below underlined sentences. Further, the same paragraph goes on to state, [redacted] (b)(5)

(b)(5)

(b)(5)

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

- In the Abstract, the author states:

[redacted] (b)(5)

How did we issue the GALL-SLR Report with technical gaps and how are we going to be able to issue a renewed license if there are technical gaps to reaching a reasonable assurance conclusion?

- On page 2, the second full paragraph, the author states

(b)(5)

For the first underlined sentence, does this mean that we won't have (b)(5) (b)(5) In that case, how can we issue a renewed license for (b)(5) years before the testing is completed? Will we generate license conditions to restrict how far into the SPEO a licensee can operate before the testing is complete? This statement is too broad. For the second underlined sentence, should I infer that the (b)(5) (b)(5)

- The next paragraph says

(b)(5)

Similar comment to the above, are these knowledge gaps addressed in the applicable GALL-SLR AMPs, with compensatory measures in place?

- The first paragraph in section 3.3 page 5 states:

(b)(5)

This provides another good example of the report stating that we lack sufficient information to understand failure mechanisms.

- The GALL report is the NRC staff's generic evaluation of the acceptable aging management for the period of extended operation based on the technical basis developed in the EMDA and PMDA.

I do not believe that the EMDA and PMDA present the complete technical basis for the GALL-SLR report. We issued an entire NUREG 2221 which provides the complete technical bases for the technical bases for all the changes that were made in the GALL 2 and SRP Revision 2. Before beginning the revision of the GALL and SRP, the NRR staff reviewed the EMDA reports to see if there were any new issues that needed to be addressed for SLR. The staff did not review the PMDA as the EMDA was an update and expansion of the PMDA and the PMDA only addressed operation to 60 years.

(b)(5) • Table 1, 8<sup>th</sup> row, GALL-SLR, [REDACTED]

(b)(5) • Table 2, 8<sup>th</sup> row, GALL-SLR, [REDACTED]

(b)(5) [REDACTED]

- What data would be sought from the harvested material and how would it be used to inform aging management? An example could be cast austenitic stainless steel (CASS) from RV internals. The data sought are fracture toughness of CASS material subject to both irradiation and thermal aging at the same time. The use of this data could be to perform flaw evaluations if cracks are ever found in CASS components, or flaw tolerance evaluations to determine the appropriate interval for inspections, or to avoid inspection altogether.
- Are there any mitigating factors for the degradation mechanism? For example, for CASS in RV internals, maybe fracture toughness is not so important since CASS is known to be very resistant to stress corrosion cracking initiation. Without an active cracking mechanism, fracture toughness data are less important. So this would tend to lower the priority of harvesting CASS from RV internals.
- The report doesn't always do an adequate job of distinguishing between age-related degradation mechanisms, failure mechanisms, and intended functions. In addition, after reading some of the statements in the PNNL report, I come away with the impression the report sets the tone that, if the RES/PNNL recommended harvesting and supplemental testing activities are performed, the results of those activities would be (by themselves) sufficient to ensure reasonable assurance of component structural integrity intended functions. Instead, the results of such studies only provide additional insights into how a given age-related degradations mechanisms is occurring and progressing, and possibly how a component would fail. The harvesting activities and supplement studies (by themselves) would not constitute a sufficient basis for drawing conclusions on reasonable assurance of



component structural integrity or component intended function(s). That would need to be done by each licensee as part of its design and licensing basis.

- One thing to note is that the report refers back to the Office of Research's (RES) PMDA and EMDA studies for SLR, in which RES made recommendations on some of the areas NRR/DLR (before we turned into DMLR) would need to focus on when going through its GALL-SLR (NUREG-2191) and SRP-SLR (NUREG-2192) update efforts. When we started our efforts in late 2014 to perform the updated guidance reviews, we were instructed by our management team to review the EMDA recommended actions to see if we agreed with the actions RES was recommending. From a historical perspective, it is important to point that the staff did not always agree with the RES's PMDA / EMDA recommended actions for updating the GALL-SLR and SRP-SLR reports. For your knowledge, the Technical Basis Report for the SLR updates provides the technical bases for the changes we incorporated into NUREG-2191 and NUREG-2192, NUREG-2221 and NUREG-2222 from the prior versions of the reports (NUREG-1801, Revision 2 and NUREG-1800, Revision 2).