

Note to requester: The attachment (an email record) is immediately following this email. Portions of this record are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Hull, Amy
Sent: Thu, 23 Jul 2015 17:09:10 -0400
To: Frankl, Istvan
Cc: Hiser, Matthew; Stout, Kathleen
Subject: OK, understand .. good news from PNNL, attached

(b)(5)

(b)(5)

Attachments: RE: RFP

Steve Unwin has assigned Pradeep to work with Katie on this project, as technical lead. See attached. Pradeep is well-aware of work on SLR and LTO and harvesting of ex-plant materials and developing infotools. I have worked with Pradeep before on a project on AET for HTGRs. It is great ! and I am delighted !

From: Frankl, Istvan
Sent: Thursday, July 23, 2015 4:39 PM
To: Hull, Amy
Cc: Hiser, Matthew; Stout, Kathleen
Subject: RE: very important,

(b)(5)

(b)(5)

Amy,

(b)(5)

Thanks,

Steve

From: Hull, Amy
Sent: Thursday, July 23, 2015 4:02 PM
To: Frankl, Istvan
Cc: Hiser, Matthew; Stout, Kathleen
Subject: very important,

(b)(5)

(b)(5)

Hi Steve,

Work is progressing quickly now and we should have the Lab cost proposal in 10 days. See attached.

(b)(5)

From: Frankl, Istvan

Sent: Thursday, July 23, 2015 1:26 PM

To: Stout, Kathleen

Cc: Thomas, Brian; Brock, Kathryn; Rao, Appajosula; Iyengar, Raj; Baquera, Mica; Martinez, Erick; Hull, Amy

Subject:

(b)(5)

Kathleen,

(b)(5)

Thanks,

Istvan (Steve) Frankl

Branch Chief
RES/DE/CMB
U.S. Nuclear Regulatory Commission

Phone: (301) 251-7901
E-mail: Istvan.Frankl@nrc.gov

Note to requester: This email is the attachment to the previous email record.

From: Hull, Amy
Sent: Thu, 23 Jul 2015 20:34:40 +0000
To: Unwin, Stephen
Subject: RE: RFP

Thanks for the response. I will see Pradeep next week at the QNDE meeting.

Amy

From: Unwin, Stephen [mailto:Stephen.Unwin@pnnl.gov]
Sent: Thursday, July 23, 2015 4:33 PM
To: Hull, Amy
Subject: [External_Sender] RFP

Hi Amy:

Thanks for the RFP and phone call. I've spoken to Katie and I believe we have it in hand. Subject to confirmation, Pradeep Ramuhalli will be our technical lead.

Steve

Stephen D. Unwin, Ph.D.

Manager
Nuclear Sector

Energy & Environment Directorate
Pacific Northwest National Laboratory
P.O. Box 999, MSIN K9-69
Richland, WA 99352, USA
Tel: 509-375-2448

From: Hiser, Matthew
Sent: Wed, 1 Jul 2015 20:40:51 +0000
To: Hull, Amy
Subject: PNNL Harvesting Checklist.docm
Attachments: PNNL Harvesting Checklist.docm

Note to requester: Portions of the attachment, which is immediately following this email, are redacted under FOIA Exemption B5, Deliberative Process Privilege.

[Click Here to Hide Purpose](#)

The purpose of the Requisition Checklist is to assist Contracting Officer's Representatives (CORs) in developing a complete requisition package. This checklist must be completed and uploaded to the supporting documents library in STAQS before the requisition is routed for approval.

The Requisition Checklist is required for new interagency agreements (including DOE Laboratory Agreements), new task/delivery orders under existing Enterprise Wide Agreements, and modifications to interagency agreements and task orders involving scope changes or ceiling increases.

Using the Template: For each item, choose YES, NO or N/A in the right column. Additionally, you can click "Show Additional Guidance" for more guidance information and links to resources. To view the navigation pane, HOLD ALT and PRES V then D to open, use this to navigate through the template.

For assistance, please contact the Business Advisory Center (BAC) at BAC.Resource@nrc.gov.

I. REQUISITION INFORMATION TO BE PROVIDED IN STAQS

Completion of this section is optional; however this information will be required for completion of your STAQS requisition.

COR Name:	Amy Hull
Purpose & Description of Requisition:	Strategic Approach for Obtaining Material and Component Aging Information
APP# (if applicable):	APP-15-RES-0011
Amount To Be Funded:	<input type="text"/> (b)(5)
Product/Service Code: Look up PSC Code Here	R425 - ENGINEERING AND TECHNICAL SERVICES <i>Click here to enter Other PSC</i>
NAICS Code : Search FPDS.gov or Search Census.gov	541990 - All Other Professional, Scientific, and Technical Services <i>Click here to enter Other NAICS</i>
SA Commodity Code:	Research
Type of Action :	Task Order
Business Advisory Center (BAC):	No Enter BAC Contact Here
Notes to Buyer (if applicable):	Click here to enter Notes.

II. REQUISITION PACKAGE REQUIREMENTS: IAA/ DOE LABS

1. STRATEGIC SOURCING GROUP (SSG) (EXCLUDING EWA ORDERS)

<p>Has this been approved by the Strategic Sourcing Group (SSG)? Hide Additional Guidance</p> <p>Is this requirement valued at \$1M or more? If yes, please upload the SSG approval to the supporting documents library in STAQS.</p> <p>[Please contact the Business Advisory Center for access to the SSG Template.]</p>	No
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2. STATEMENT OF WORK/ PERFORMANCE WORK STATEMENT

<p>A Have you provided a Statement of Work (SOW)? Hide Additional Guidance</p> <ul style="list-style-type: none"> - DOE Laboratory Agreement - Interagency Agreement 	Yes
<p>B Are any aspects of the SOW Inherently Governmental Functions?</p>	No
<p>C Does the SOW require contractor performance of work that is closely associated to inherently governmental functions?</p>	No

3. INDEPENDENT GOVERNMENT COST ESTIMATE (IGCE)

<p>Have you completed an IGCE? Hide Additional Guidance</p> <p>IGCE Templates:</p> <ul style="list-style-type: none"> Official Use Only - IGCE for Argonne National Laboratory (ANL) Official Use Only - IGCE for Brookhaven National Laboratory (BNL) Official Use Only - IGCE for DOE Labs other than ANL, BNL, INL, ORNL, PNNL and SNL Official Use Only - IGCE for Idaho National Laboratory (INL) Official Use Only - IGCE for Oak Ridge National Laboratory (ORNL) Official Use Only - IGCE for Pacific Northwest National Laboratory (PNNL) Official Use Only - IGCE for Sandia National Laboratory (SNL) Official Use Only - IGCE for Interagency Agreements (Other than DOE Labs) 	Yes
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4. URGENT REQUIREMENTS

<p>Is this requirement urgent? If so, upload the urgency determination to the supporting documents library in STAQS.</p> <p>DOE Lab Urgency Statement</p>	No
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REQUISITION CHECKLIST: IAA/ DOE LABS

VERSION CONTROL DATE: JANUARY 26, 2015

5. JUSTIFICATIONS (FOR DOE LAB AGREEMENTS ONLY)

<p>A A DOE Source Selection Justification (SSJ) NRC Form 367 is required to be completed and uploaded to the supporting documents library in STAQS for the following actions:</p> <ul style="list-style-type: none"> • New DOE Lab agreement • Modification to a DOE Lab agreement or task order that involves a change to the scope of work. 	No
<p>B EWA Source Selection Justification template (applies to EWA's only and is required for all EWA Task Orders).</p>	Yes

6. DETERMINATIONS AND FINDINGS (D&F) (FOR NON-DOE LAB IAA ONLY)

<p>A Is a D&F required? FAR 17.502-2 – The Economy Act</p>	N/A
<p>B If so, upload the D&F to the supporting documents library in STAQS. D&F Template</p>	N/A

7. ADDITIONAL APPROVALS

<p>A Personnel Security/Facility Access Hide Additional Guidance</p> <p>If any of the following situations apply, have you uploaded the NRC Form 187, Security/Classification Requirements, to the supporting documents library in STAQS?</p> <ul style="list-style-type: none"> - Access to Classified Information - Facility Clearance - Unescorted Access to Nuclear Power Plants - Access to Unclassified Safeguards Information - Access to Sensitive IT Systems And Data - Unescorted Access to NRC HQ Buildings - Require Operation of Government Vehicles or Transport Passengers for the NRC - Will Operate Hazardous Equipment at NRC Facilities - Required to Carry Firearms - Found to Use or Admit to Use of Illegal Drugs 	No
<p>B Personally Identifiable Information (PII) Hide Additional Guidance</p> <p>Do the agreement requirements require access to PII to receive, process, and/or possess information?</p>	No
<p>C Access to a NRC System of Records Hide Additional Guidance</p>	No

REQUISITION CHECKLIST: IAA/ DOE LABS

VERSION CONTROL DATE: JANUARY 26, 2015

	Do the agreement requirements involve contractor access to (design, develop, or operate) a NRC System of Records to accomplish an agency function subject to the Privacy Act of 1974?	
D	<p>Training Hide Additional Guidance</p> <p>Is training required as part of the requisition? Office of Chief Human Capital Officer (OCHCO) approval is required if the agreement is for training services and/or materials. Please upload the approval (email) from the Chief Learning Officer or designee to the supporting documents library in STAQS.</p> <p>Branch Chief of Learning Operations Branch: Leslie Donaldson Leslie.Donaldson@nrc.gov</p>	No
E	Do the requirements include hosting a conference or large meeting ?	No
F	<p>Space Approval Hide Additional Guidance</p> <p>Approval is required if NRC Headquarters space is to be used in performance of the agreement (i.e., contractor needs office space). Please upload approval from Office space coordinator.</p>	No

8. INFORMATION TECHNOLOGY (IT) APPROVALS

A	<p>Does this requisition include the requirement for the contractor to provide ELECTRONIC AND INFORMATION TECHNOLOGY (EIT) as a deliverable?</p> <p>Hide Additional Guidance</p> <p>Examples of EIT include the following items, or upgrades to the following items:</p> <ul style="list-style-type: none"> - Software application or operating system (e.g., word processing application, accounting software, authoring and document presentation tools) - Web-based Internet information and applications (e.g., Websites) - Desktop or portable computer (e.g., laptops, PCs, PDAs) - Electronic office product (e.g., photocopiers, calculators, fax machines, printers) - Telecommunication product (e.g., telephones, cell phones, pagers) - Video and multimedia product (e.g., televisions, VCRs, DVD players) <p>If YES, proceed to 9B. If NO, enter NO in the column to the right and proceed to Requirement 10. If unsure, please email CRM.Resource@nrc.gov to determine whether or not IT approvals apply.</p>	No
B	<p>If YES, are the exact items that are required listed on the NRC's Technical Reference Model (TRM)? Hide Additional Guidance</p> <p>If the exact items are in the TRM, include a screen shot of the relevant TRM section as a supporting document in STAQS and proceed to 8D. However, if your item has "Pending"</p>	N/A

REQUISITION CHECKLIST: IAA/ DOE LABS

VERSION CONTROL DATE: JANUARY 26, 2015

	or "Pending Final Review" on the TRM list, this has not been approved by the ITB. You will need to have ITB approval; therefore, please proceed to 8C.	
C	<p>If NO to 8B: Complete the Environment Change Request (ECR) form located on the IT/IM Board (ITB) SharePoint site and send the completed form to CRM.Resource@nrc.gov. Hide Additional Guidance</p> <p>Once you obtain the required IT/IM approval(s) from CRM.Resource@nrc.gov, proceed to requirement 8D.</p> <p>Contact CRM.Resource@nrc.gov with any questions or for assistance with this step.</p>	N/A
D	<p>Go to www.buyaccessible.gov, take the following steps: click on "Buyers," click on "Enter Wizard," click on "New Wizard Session", answer the questions it asks you (click "More Information..." to obtain clarification or more details), and click "Next" after answering each question. Hide Additional Guidance</p> <p>This will help you to determine whether Section 508 of the Rehabilitation Act of 1973, as amended, applies to your EIT requirement, and if so, which criteria apply. Once you are done answering the questions, generate the report and upload it to the supporting documents library in STAQS as a supporting document, along with IT/IM approval(s). If you need additional guidance please contact John Beatty (John.Beatty@nrc.gov).</p>	N/A

9. FUNDING

A	Is this requisition subject to availability of funds?	No
B	<p>Is this work FEE-RECOVERABLE? If yes, identify the required TAC codes in the requisition.</p> <p>If you have any questions, please contact OCFO.</p>	No

From: Frankl, Istvan
Sent: Wed, 22 Nov 2017 17:48:17 +0000
To: Audrain, Margaret;Hiser, Matthew;Purtscher, Patrick
Cc: Hull, Amy
Subject: RE: ACTION: New Emergent Domestic Trip for CMB
Importance: High

Meg,

Thanks for your inputs.

Please work with Matt and go forward with the scheduling of the DE management briefing on ex-plant harvesting in early December. The briefing should cover the overall objectives and plans for the harvesting project going forward, including the full plan for how the inventory will be determined and how this aspect fits into the holistic harvesting framework and strategy. Our tentative plans to reach out to all the labs should also be part of the briefing. (Expect pushback on this from DE management.)

Pat,

Your related trip in December is basically a rescheduling of an already approved trip, so please submit the trip request with eTravel ASAP.

Thanks,

Steve

From: Audrain, Margaret
Sent: Wednesday, November 22, 2017 12:04 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: ACTION: New Emergent Domestic Trip for CMB

Steve,

In response to Brian's question: yes, we have contacted ANL and they have a very good understanding of what we're looking for. We have some input in the area of irradiated materials and they will work before our trip to compile materials in other areas.

In response to Chris's question: We had tentative plans to reach out to all the labs this FY but didn't really get going with this effort until after the travel call. Instead of waiting until next year, we thought it would be best to tag an extra half day or so on to existing trips to the labs (Pat's ANL trip, my PNNL and Knoxville trips).

We can set up a briefing for early Dec if needed. Please let me know.

Happy Thanksgiving,

Meg

From: Frankl, Istvan
Sent: Wednesday, November 22, 2017 10:34 AM
To: Audrain, Margaret <Margaret.Audrain@nrc.gov>
Cc: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>
Subject: ACTION: New Emergent Domestic Trip for CMB
Importance: High

Meg,

Brian and Chris have good questions on the upcoming harvesting trip to ANL.

In your reply to me, please address the highlighted items below. Please reach out to Matt and Amy if you need assistance. If possible, please reply today.

My sense is that management would benefit from a briefing on harvesting and on our plans going forward. We need to be more proactive in this area.

Thanks,

Steve

From: Thomas, Brian
Sent: Wednesday, November 22, 2017 10:06 AM
To: Regan, Christopher <Christopher.Regan@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: New Emergent Domestic Trip for CMB

Steve,

Please refresh my memory – is the explant harvesting contract with ANL? And do you have any input from ANL on the proposed framework for harvesting and identifying explant materials?

From: Regan, Christopher
Sent: Wednesday, November 22, 2017 9:49 AM
To: Oberson, Greg <Greg.Oberson@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Thomas, Brian <Brian.Thomas@nrc.gov>
Subject: RE: New Emergent Domestic Trip for CMB

Greg, Steve,
I approve.

BUT

Steve,

I'd like to be informed of the full plan for how the inventory will be determined and how this aspect fits into the holistic harvesting framework and strategy. In theory, had we a fully defined strategy this trip should have been identified and not be considered an "emergent" travel need.

Thanks,
Chris

From: Oberson, Greg
Sent: Wednesday, November 22, 2017 9:44 AM
To: Regan, Christopher <Christopher.Regan@nrc.gov>
Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: New Emergent Domestic Trip for CMB

Chris,
Steve requested the emergent travel below. I have added to the running list on sharepoint:
<http://fusion.nrc.gov/res/team/de/Divison%20Meeting%20Docs/Travel/FY18%20Travel/FY18%20travel%20workbook%20-%20emergent.xlsx>

Funds are available if you approve.

Greg

From: Frankl, Istvan
Sent: Tuesday, November 21, 2017 6:59 PM
To: Oberson, Greg <Greg.Oberson@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: New Emergent Domestic Trip for CMB

Greg,

We have another emergent domestic trip next month. Here are the details:

Audrain	Meg	CMB	Domestic	ANL Ex-plant Harvesting Review	Mission	Priority 2 - License and Regulation Related	Argonne, IL	12/13/2017	12/13/2017	\$400	Begin to assemble an inventory of available ex-pant materials from ANL to consider for the harvesting program in coordination with that in the INL NSUF Nuclear Fuels and Materials Library (NFML).
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												This activity directly supports SLR UNR NRR-2017-006.
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Please note that Pat has changed the date of his approved travel to ANL from April 2018 to next month. The cost of his approved travel is lower by \$400 which covers the cost of the above emergent trip.

Thanks,

Steve

From: Hiser, Matthew
Sent: Fri, 3 Apr 2015 11:44:58 +0000
To: Frankl, Istvan
Subject: RE: ACTION: Request of FY15 Reprommed Funds

Hi Steve,

My understanding is Amy will be the COR and I will be her backup / assist with some of the tasks, but with all her and my other responsibilities (including Srimi's party), we haven't had time to move this forward very much. Hopefully once I return from travel the week after next we can regain some momentum on this...

Thanks!
Matt

From: Frankl, Istvan
Sent: Thursday, April 02, 2015 4:34 PM
To: Hiser, Matthew
Subject: RE: ACTION: Request of FY15 Reprommed Funds

Thanks, Matt.

My understanding was that you were going to assist Amy with the requisition for the strategic harvesting project as COR (or backup COR?). In any case, please reach out to her on this topic. This project has been "languishing" and we will need to proceed with the requisition during this quarter.

Steve

From: Hiser, Matthew
Sent: Thursday, April 02, 2015 3:51 PM
To: Frankl, Istvan
Cc: Hull, Amy
Subject: RE: ACTION: Request of FY15 Reprommed Funds

Hi Steve,

I have updated the justifications as necessary. Since Amy is the lead for the strategic harvesting project, I'll leave that to her.

Thanks!
Matt

Matthew Hiser
*Materials Engineer
Corrosion and Metallurgy Branch
Division of Engineering
Office of Nuclear Regulatory Research*

301-251-7601

From: Frankl, Istvan
Sent: Thursday, April 02, 2015 2:38 PM
To: Hiser, Matthew
Subject: RE: ACTION: Request of FY15 Reprommed Funds

Please provide justification for all of your projects where you are the COR or the backup. Please talk to Sri and Amy on this.

Thanks,

Steve

From: Hiser, Matthew
Sent: Thursday, April 02, 2015 10:32 AM
To: Frankl, Istvan
Subject: RE: ACTION: Request of FY15 Reprommed Funds

Hi Steve,

This looks good to me!

Thanks!
Matt

From: Frankl, Istvan
Sent: Tuesday, March 31, 2015 6:02 PM
To: Baquera, Mica; Focht, Eric; Hiser, Matthew; Hull, Amy; Oberson, Greg; Rao, Appajosula
Subject: ACTION: Request of FY15 Reprommed Funds
Importance: High

All,



(b)(5)

This is a quick turnaround item, Since you already provided preliminary info on this, I do not expect that this request will take significant effort.

Please provide your inputs by noon Thursday.

Thanks,

Steve

From: Frankl, Istvan

Sent: Monday, March 16, 2015 5:18 PM

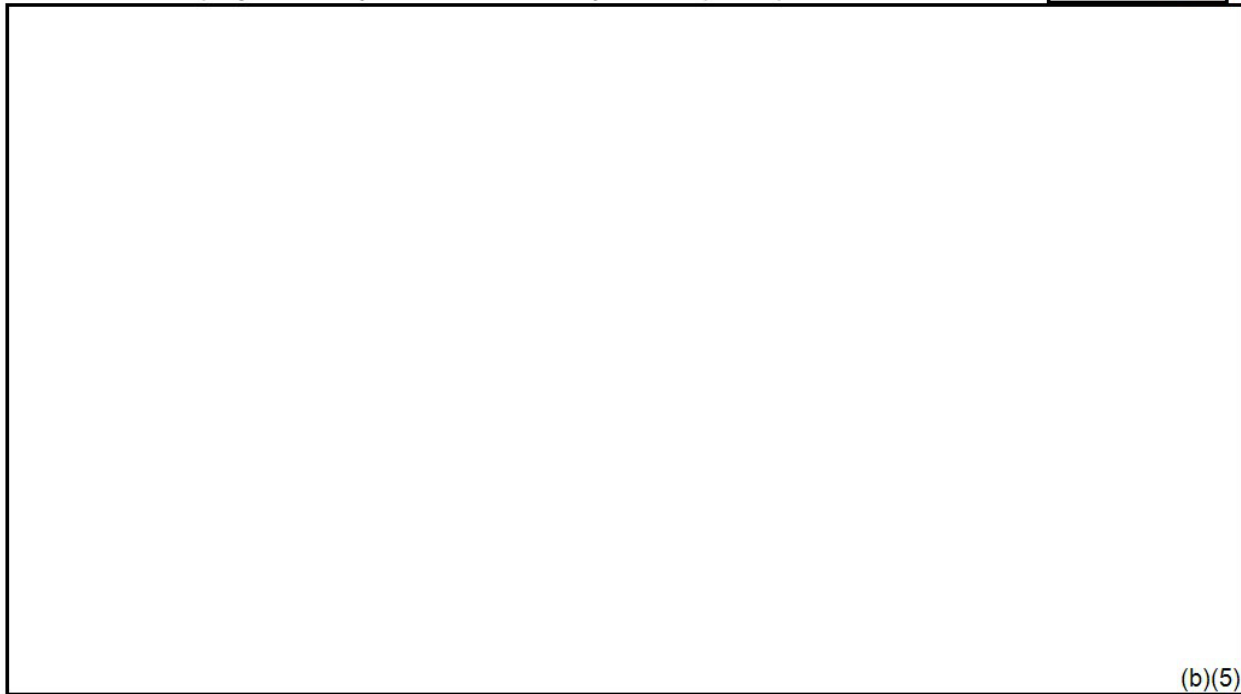
To: Baquera, Mica; Focht, Eric; Hiser, Matthew; Hull, Amy; Oberson, Greg; Rao, Appajosula; Srinivasan, Makuteswara

Subject: UPDATE: on the CMB Restack

Importance: High

All,

As some of you know we had to provide detailed inputs and clarifications to DE management for some of our projects today. Thanks for all of you who participated in this exercise. (b)(5)



(b)(5) Please continue to update the spreadsheet with the best-estimate spending plans for your projects. (b)(5)

Thanks,

Steve

From: Frankl, Istvan

Sent: Monday, March 16, 2015 10:04 AM

To: Baquera, Mica; Focht, Eric; Hiser, Matthew; Hull, Amy; Oberson, Greg; Rao, Appajosula; Srinivasan, Makuteswara

Subject: UPDATE: ACTION: Update on the CMB Restack

All,

In order to assure consistent input I created a spreadsheet for this action.

Please input the information requested below in sheet

(b)(5)

(b)(5)

Thanks,

Steve

From: Frankl, Istvan

Sent: Thursday, March 12, 2015 4:02 PM

To: Baquera, Mica; Focht, Eric; Hiser, Matthew; Hull, Amy; Oberson, Greg; Rao, Appajosula; Srinivasan, Makuteswara

Subject: ACTION: Update on the CMB Restack

Importance: High

All,

(b)(5)

Management requested quick turnaround on this request. So, if your spending plans in BFS are up-to-date and accurate, providing this additional information should not be a significant effort. Therefore, please provide your inputs to me **by COB Monday**.

Thanks,

Steve

Note to requester: The attachments are immediately following this email. Portions of the attachments are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Thu, 19 Oct 2017 18:33:04 +0000
To: Frankl, Istvan
Cc: Hull, Amy
Subject: RE: ACTION: Revised Draft Response to SLR UNR
Attachments: memo SLR UNR response 09-22-2017 (002)BT comments ABH (IF) cem.docx, Response to User Need Request NRR-2017-006 (002).response BT comments abh (IF) EMF cem.docx
Importance: High

Steve,

I believe the User Need Request Response on SLR is finally ready to re-enter concurrence. Please see the attached mark-up copies of the Memo and Enclosure, and provide any additional comments.

These files are in the folder: G:\DE\CMB\2017-006 UNR NRR 2017-006\1 current version of response

Thank you,
Carol

From: Frankl, Istvan
Sent: Monday, October 16, 2017 8:49 AM
To: Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: ACTION: Revised Draft Response to SLR UNR

Thanks, Amy.

From: Hull, Amy
Sent: Monday, October 16, 2017 8:43 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: ACTION: Revised Draft Response to SLR UNR

This is indeed the version that Brian saw. I put the UNR package and Brian's comments on Carol's desk. The RAR response was approved by Brian Thomas with a few changes he wanted to be made.

From: Frankl, Istvan
Sent: Saturday, October 14, 2017 12:07 AM
To: Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: ACTION: Revised Draft Response to SLR UNR
Importance: High

Thanks, Amy.

I have attached my revisions with comments. Did you resolve the issue with the different document versions? I am assuming you used the version that Brian reviewed. Please confirm.

Carol,

Since Amy is out next week on training, please try to resolve my comments and have the final draft ready for my review **by COB Tuesday**, so that the package can be returned to management for concurrence and approval on Wednesday. (Please note that we may get additional comments from Brian and the RES FO, and I don't want to request another extension.)

Thanks,

Steve

From: Hull, Amy
Sent: Friday, October 06, 2017 2:35 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: my suggested changes: question -- package in ADAMS for SLR UNR

This gives you an idea of what I am thinking.

From: Frankl, Istvan
Sent: Friday, October 06, 2017 1:34 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Great!

At least you will be able to document your ideas/thoughts on this now.

Steve

From: Hull, Amy
Sent: Friday, October 06, 2017 1:32 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

OK. I will do that and send to you. Then we can incorporate it into the correct file next Weds.

From: Frankl, Istvan
Sent: Friday, October 06, 2017 1:29 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Thanks for the update, Amy.

My recommendation would be for you to draft the text that addresses Brian's generic comments now and then insert it in the final version once you get it from the AAs.

Steve

From: Hull, Amy
Sent: Friday, October 06, 2017 12:43 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Cassandra sent me a version – 9/22 - that predates the version that Brian gave me, and I think predates the version you signed off on (your signature is 9/25). I guess I will wait until Weds when

(b)(6)

From: Frankl, Istvan
Sent: Friday, October 06, 2017 12:16 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Interesting....

This can mean that the final version was not uploaded or has a different ML#. You may need to wait for the AAs to sort this out.

Thanks,

Steve

From: Hull, Amy
Sent: Friday, October 06, 2017 12:12 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

You did explain to me earlier and I understand all that. The problem is that I tried to get it out of ADAMS using, ADAMS # per 9/25/2017 concurrence page, and it is still today the old version from Aug. See attached.

From: Frankl, Istvan
Sent: Friday, October 06, 2017 12:08 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Amy,

The version that needs to be updated is the one that Brian reviewed. That version should be in ADAMS (and not the G: drive) and should be considered the "last" version. (You may or may not have owner rights.)

As explained earlier, the AAs control the revision of files in ADAMS once the concurrence package is submitted to management for review/approval. Once you get and update the final version (with track changes enabled), please send it to me for review and then to the AAs, so that they can do the final formatting, the uploading to ADAMS and re-submitting the concurrence package to DE management.

Thanks,

Steve

From: Hull, Amy
Sent: Friday, October 06, 2017 11:54 AM
To: Savoy (RES), Steven <Steven.Savoy2@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: FW: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

Steven,

(b)(6) I am implementing changes in the version that Brian gave back to me last Friday but I have been working on an old document – not a smart thing to do.

Please will you help me find the most recent version? I tried to find it in ADAMS and Gdrive but had no luck.

Thanks,
Amy

From: Hull, Amy
Sent: Friday, October 06, 2017 11:33 AM
To: Vera, Graciela <Graciela.Vera@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: can you send me the most recent version please?: question -- package in ADAMS for SLR UNR

From: Vera, Graciela
Sent: Friday, September 29, 2017 5:57 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: question -- package in ADAMS for SLR UNR

Hi,

I got it. What was the last new version that you sent to Cassandra?

WE have fours versions in ADAMS; 2 versions from August and 2 versions this month.

I will be here to help before I get off at 1:40pm today.

Thanks

Graciela Vera

Administrative Assistant
Division of Engineering
Office of Nuclear Regulatory Research
Washington, D.C. 20555
TWFN10-A00

From: Moyer, Carol
Sent: Thursday, September 28, 2017 5:04 PM
To: Cole, Cassandra <Cassandra.Cole@nrc.gov>; Vera, Graciela <Graciela.Vera@nrc.gov>; Savoy (RES), Steven <Steven.Savoy2@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: FW: question -- package in ADAMS for SLR UNR
Importance: High

Hi Cassandra,

On Monday morning (9/25), CMB submitted a User Need Response memo & enclosure for Brian's signature. You logged it for his concurrence (confirmation attached). The UNR package was an update to a prior version (addressing some NRR comments on our draft response), so we asked that the same ML number be assigned.

What is in ADAMS now at that ML# is the August version of the documents, NOT the Sept. 25 version. Can you please check this, and find out what happened? We want to make sure Brian is reviewing the latest version, and that the 9/25 version was not lost. If the newer version was assigned a different number, please let us know what that number is, so we can share it with our NRR customers.

Thank you,
Carol Moyer & Amy Hull

From: Hull, Amy
Sent: Thursday, September 28, 2017 4:22 PM
To: Moyer, Carol <Carol.Moyer@nrc.gov>

Subject: question -- package in ADAMS for SLR UNR still old - - this should have new documents??? - do we have duplicate packages?

RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT PERIOD
OF EXTENDED OPERATION: NRR-2017-006

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	Response to User Need Request NRR-2017-006.docx	ML17227A485	No	Non-Publicly Available		Aug 15, 2017 3:00 PM

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: Brian E. Holian, Acting Director
Office of Nuclear Reactor Regulation

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH
ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF
EXTENDED OPERATION: NRR-2017-006

By memorandum dated May 4, 2017, the Office of Nuclear Reactor Regulation (NRR) requested assistance from the Office of Nuclear Regulatory Research (RES) to provide "specific research products to facilitate the evaluation of future applications for a license to operate during the subsequent license renewal (SLR) period (i.e., 60 to 80 years). These products should build upon analysis methods, tools, and expertise developed as part of ongoing and new research activities, focused specifically on aging effects during the SLR period." This user need request (UNR) supersedes and incorporates work from Tasks A and D of the previous UNR NRR-2010-006 "provide support in developing technical information to support evaluating the feasibility of license renewal beyond 60 years." This UNR also supersedes NRR-2014-001 "provide expert assistance with reviewing the guidance documents for subsequent license renewal." and This UNR NRR-2017-006 serves an integrative function, providing as an "umbrella" under which other associated SLR-focused technical UNRs are coordinated put in context. These technical UNRs supported include NRR-2017-001 (reactor vessel internals); NRR-2014-007 (reactor pressure vessel), NRR-2016-012 (electrical cables), NRR-2012-004 and NRR-2015-007 (concrete degradation). More details on these UNRs are provided in See Table 1 of in Task 4 the Enclosure. For tracking purposes, RES has designated this UNR as NRR-2017-006 (ML16358A427).

The purpose of this memorandum is to respond to UNR NRR-2017-006 with RES's plans to accomplish the following tasks:

- **Task 1:** Hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate aging degradation issues identified in in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191).
- **Task 2:** Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants.
- **Task 3:** Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research.
- **Task 4:** Develop documentation evaluating significant technical issues germane to the review of SLR applications.
- **Task 5:** Provide expert assistance with reviewing SLR applications (optional task)

Commented [HA1]: confirm the correct ADAMS #.
Different from that on the concurrence page.

IF: The ML# on the concurrence should be different and
should be the ML# for the concurrence package.

Commented [CM2R2]: Confirmed: This is the ML# for
the UNR package.

CONTACT: Amy Hull, RES/DE
301-415-2435

RES staff is conducting ongoing coordinating activities to address Tasks 1, 2, and 3, including both independent and collaborative efforts with industry and other partners. RES staff will continue these activities and integrate the results in deliverables under Task 4. The response has been closely coordinated with NRR technical staff and management. As a result of this effort, RES added optional Task 5. If needed, under this task, RES staff would provide expert assistance with the review and evaluation of SLR applications. The enclosure addresses in greater detail the scope of ongoing and planned activities associated with each task, as well as the estimated resources and the anticipated schedule for the deliverables.

RES staff appreciates the coordination with NRR technical staff and management in this area. We will continue to coordinate with NRR staff and management to ensure that regulatory needs and priorities are satisfied. Changes in the availability of resources or NRR needs could impact the activities, deliverables and schedules of this UNR. In such cases, changes will be implemented jointly by RES and NRR and, if warranted, the UNR will be amended.

Enclosure:

1. Response to User Need Request for
Research Assistance on Potential Significant
Technical Issues during the Subsequent Period
of Extended Operation

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT
PERIOD OF EXTENDED OPERATION: NRR-2017-006

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ADAMS Package Accession No.:ML17227A483

OFFICE	RES/DE/CMB	RES/DE/CMB	RES/DE/CMB
NAME	C. Moyer	A. Hull	I. Frankl
DATE	/ /2017	/ /2017	/ /2017

OFFICE	D:RES:DE	RES Mail	D:RES
NAME	B. Thomas	K. Johnson	M. Weber
DATE	/ /2017	/ /2017	/ /2017

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Response to User Need Request NRR-2017-006
Research Assistance on Potential Significant Technical Issues during
the Subsequent Period of Extended Operation

Task 1

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two domestic and international activities (such as, a workshop, conference, symposium, or meeting), one tentatively planned for spring 2019 on mechanical components and one tentatively planned for summer 2020 on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR report, and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before each workshop. RES will document the information from each of these activities in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components – As part of the requested workshop/ conference/ symposium/ meeting on materials issues for mechanical components, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated US industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cable Issues – RES will also hold an NRC/industry workshop with international participation (tentatively planned for summer 2020) on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific technical topics and items of interest. RES will

Enclosure

document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late summer 2020.

Task 2

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D of the UNR.

Under a long-term research project preceding the current request from NRR, RES pursued a strategic approach to ex-plant harvesting through two coordinated activities: technical issue prioritization and a workshop on ex-plant material harvesting.

In the first activity, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), developed an approach to prioritize technical issues best addressed by harvesting. The criteria for prioritizing harvesting data needs will be described in the anticipated TLR, expected by the end of 2017 "*Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal.*" The deliverable will provide criteria to assess the need for harvesting to address a particular technical issue. The report will then apply these criteria to assess four representative technical issues: electrical cable degradation, embrittlement of cast austenitic stainless steel (CASS), cracking of dissimilar metal welds, and irradiation-assisted degradation (IAD) of stainless steel. This report will also cover the background on the need for harvesting, and past harvesting efforts and experience. The purpose of this report is to serve as a foundation for NRC staff to prioritize technical issues best addressed by harvesting. The initial technical letter report (TLR) for this research is expected to be published in September, 2017, as a PNNL document. This TLR will be reviewed by NRR and RES staff to determine any follow-on work by RES and the final publication type.

In the second activity preceding UNR NRR-2017-006, RES closely collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) to host a workshop on ex-plant materials harvesting on March 7-8, 2017. The purpose of this workshop was to engage with various stakeholders involved in the harvesting process to discuss all aspects of harvesting, including motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting, lessons learned from past harvesting efforts, and future harvesting program planning. The workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which sources to focus on. The workshop was well-attended by representatives from DOE, EPRI, the U.S. industry, and international research organizations. Key insights from the workshop included the need for a clearly defined objective to justify the level of effort, and the benefit of early planning and engagement with the plant from which materials will be harvested. The workshop summary report will be distributed among meeting participants and is expected to be finalized by September, 2017. RES will be pursuing further engagement with interested workshop participants on two outstanding workshop action items: identifying data needs for harvesting and initially creating a 'sources of materials' information tool/database. This is discussed further under Subtask 2.B.

Subtask 2.A.

Moving forward, RES will work internally to evaluate how the four significant issues identified for SLR in the SRM on SECY-14-0016 may be best addressed by harvesting. RES will initially develop an Excel spreadsheet (precursor to the information tool/database) that identifies and prioritizes the materials, components, and operating conditions needed to best address the significant issues. The work in this task includes collecting and inputting information on materials needed and the sources of materials expected to be available.

RES will apply the criteria developed with PNNL described above to the issues for SLR, and will document the outcome of the analysis in an 'information tool/database' (based on Microsoft products such as Access or Excel), as described above, which will identify and prioritize the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool/database to be a living document that can evolve and be updated to reflect the latest operating experience and research, so that users may understand which data needs can be best addressed by harvesting. The purpose of the database is to have a systematic approach to harvesting materials and prioritize limited resources on the best values for harvesting. The database is not an end unto itself, but the means to do the highest priority harvesting for the best technical value.

As a specific example, RES will develop a process to evaluate harvested concrete samples, and will follow through with implementing the process as concrete materials become available from additional plants. The scope of the harvesting strategy includes: structures exposed to high radiation (typically bio-shield structures of certain PWR designs); alkali silica reaction (ASR)-affected structures; post-tensioned structures with emphasis on pre-stressed concrete containment vessels (PCCVs); corrosion of pre-stressing tendons, liners, reinforcing steel, and embedments; and concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects).

Based on information gleaned from discussions with international counterparts on the potential for harvesting and testing of concrete, RES will provide in the information tool the possibilities for this activity and document testing priorities as applicable. As an example, RES has engaged in discussions with the Canadian Nuclear Safety Commission (CNSC) about possibilities for harvesting concrete from a decommissioned plant in Canada extensively affected by ASR. RES also will document the process to evaluate concrete samples from nuclear power plants and their suitability for harvesting. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

In addition to irradiation effects on concrete materials, RES will continue research on IAD of stainless steel. RES will seek potential sources of reactor pressure vessel internals that may become available for harvesting, to evaluate their utility for regulatory research being conducted under UNR NRR-2017-001.

RES will continue to evaluate the SLR-significant issue of cable aging using harvested cables. The goal will be to expand on the selection of cable types harvested as part of the existing similar effort under UNRs NRR-2011-014 and NRR-2016-012 to include more cable types (insulation types and medium voltage level cables) and to evaluate the aging effects on power cables at different voltage levels.

Subtask 2.B.

In parallel with the information tool/database activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting. Based on past experience and

insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from NPPs to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in plant records. RES will work internally and with other interested organizations to identify the best approach to gather the relevant information and use it to inform which harvesting opportunities should be pursued. A TLR documenting the information tool/database with prioritized technical issues and a process to identify suitable sources of materials will be targeted for completion by July, 2018.

Subtasks 2.C. and 2.D.

Implementation of the evaluation process developed in Subtask 2.B. will be pursued in Subtasks 2.C. and 2.D., as requested in the UNR. RES will evaluate potentially-available components from plants performing component replacements or entering decommissioning (Subtask 2.C). If other nuclear facilities present opportunities for material harvesting, RES will assist in evaluating the value of such components (Subtask 2.D). RES will remain in close contact with NRR on the latest developments as this process is implemented.

The evaluation process will identify confirmatory needs that harvested samples can effectively address, will consider decommissioned plants in the U.S. and abroad, and will leverage resources to the greatest extent possible for domestic and international cooperative research opportunities, as stipulated in Subtask 2.E, which is closely integrated with Task 3. Through their national and international contacts, RES staff will maintain alertness for harvesting opportunities relating to various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the information tool/database.

Task 3

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

The DOE Light Water Reactor Sustainability (LWRS) and the EPRI LTO programs support most of the domestic research on aging management in NPPs. RES maintains separate collaborative research agreements with each of these organizations to exchange technical information. These exchanges are essential for the review and assessment of the technical bases for the viability of LTOs. RES staff have frequent technical exchange meetings with DOE and EPRI staff. These meetings have focused on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

RES is a participant in several multi-national cooperative research programs, including the International Forum on Reactor Aging Management (IFRAM), and many others. The RES Office Director signed a multilateral 4-year memorandum of understanding (MOU) for IFRAM in 2015. IFRAM is envisioned to be a network of research organizations, industry groups, regulatory

bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned NPPs worldwide to study irradiation effects under in-service conditions (in coordination with Subtask 2.E). RES and Oak Ridge National Laboratory (ORNL) submitted white papers to the OECD Halden Reactor Project (HRP) proposing research on irradiation effects on the steel-concrete bond, and on creep effects on irradiation damage. RES is also collaborating with HRP on IAD under the auspices of UNR NRR-2017-001 Task 2. These results will inform Task 4 of UNR NRR-2017-006.

RES is working to finalize a bilateral agreement with IRSN, France for exchange of technical information on the effects of ASR on the performance of nuclear concrete. IRSN is conducting a 10-15 year research project focused on studying the long-term performance of concrete affected by ASR, Delayed Ettringite Formation, corrosion and carbonation of nuclear concrete. RES will build upon its ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete, and will continue to participate in OECD/NEA/CSNI activities that develop and assess expertise in the modeling of ASR affected concrete structures.

Through their national and international contacts, and through codes and standards development activities, the RES staff will maintain alertness for partnerships to share expertise, capabilities, and resources in all areas of concern, perhaps especially reactor vessel embrittlement. Information on these opportunities will be communicated to NRR in a timely manner as outlined in the deliverables.

RES will evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues. RES will provide to cognizant NRR staff and management trip reports, summaries, papers, presentations, reports and other information from interactions with *domestic and international organizations as a result of this activity. These products will be provided in a timely manner and this effort will continue until the closure of this UNR. Relevant findings from recent interactions, status and future plans will be discussed as a standing agenda item during appropriate interface meetings between RES/DE, NRR/DMLR and NRR/DE. A report (or slides) for presentation at appropriate Director/Deputy Director interface meetings will be provided 5 days before the meeting.*

Task 4

This UNR (NRR-2017-006) serves as an "umbrella" under which other associated SLR-focused technical UNRs are coordinated, providing an umbrella under which SLR-focused technical UNRs are put in context. These technical UNRs supported are shown in Table 1 below.

Table 1. SLR-Related Technical UNRs Associated with UNR NRR-2017-006

UNR #	UNR Title	Comments	
NRR-2017-001 ML16300A303 ✓ RES Response to NRR-2017-001 ML17110A202 ✓	Request for Assistance to Evaluate Irradiation- Assisted Degradation of Rx Vessel Internals (b)(5) (b)(5) (b)(5) (b)(5)	This UNR is based on a previous UNR NRR-2012-008 and updates the regulatory research project on void swelling and clarifies current what projects RES is currently involved with and what future projects that are being considered. A third task was added to this UNR for RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves. Funding Contract: (b)(5) FY17: (b)(5) FY18: (b)(5) and FY19: (b)(5) FTEs: FY17: (b)(5) FY18: (b)(5) and FY19: (b)(5)	Commented [IF1]: Why are some UNRs highlighted on this page? Commented [CM2R2]: fixed Commented [IF3]: Please double-check by FY. Commented [CM4R4]: Confirmed with UNR response.
NRR-2014-007 ML14126A818 ✓ RES Response to NRR-2014-007 ML14212A127 (package) ✓	Reactor Pressure Vessel Integrity Issues (b)(5) (b)(5)	This UNR superseded UNR NRR-2007-001 and includes 6 tasks: (1) Appendix H in process by NRR, NRO, and RES staff; rulemaking funded in FY17 and team in place to finalize rulemaking effort, (2) updating the tech bases for Appendix G, (3) examination and analysis of irradiated reactor vessel material, (4) providing emergent technical assistance, (5) maintaining database and documentation, and (6) performing/ documenting a tech evaluation on irradiation damage mechanisms and potential revisions to 10 CFR, part 50 App. G of RG 1.99 "Radiation Embrittlement of Reactor Vessel Materials" Rev 2. (b)(5) (b)(5) (b)(5) (b)(5) Funding Contract: (b)(5) FY15: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FTEs: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5)	Commented [IF5]: Same as above Commented [CM6R6]: Confirmed with UNR response. Commented [IF7]: Same as above Commented [IF8]: Same as above
NRR-2011-014 ML11307A205 ✓ RES Response to NRR-2011-014 ML11335A169 ✓ Amendment to NRR-2011-014 (NRR-2016-012) ML16096A221 ✓	Assessment of Cable Condition Monitoring Amendment to UNR for Assessment of Electrical Cable Condition Monitoring	The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR). (b)(5) (b)(5) (b)(5) Funding: (b)(5) Prior FY total: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5) FTEs: Prior FY total: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5)	Commented [CM9]: Input from T. Koshy
NRR-2012-004 ML12109A324 ✓ RES Response to NRR-2012-004 ML12152A107 ✓	Alkali-Silica Reaction (ASR) Research (b)(5) (b)(5) (b)(5) (b)(5)	The objective of this UNR is to develop technical bases for regulatory guidance for evaluating ASR-affected concrete structures, primarily focusing on impact on the structural capacity under design basis loads through its service life, including PEO, and its aging management. The research at NIST includes obtaining data on highly instrumented concrete block specimens to monitor the progression of ASR and assess its impact on in-situ mechanical properties, conducting destructive testing to assess structural impact including seismic response, evaluating numerical modeling methods, and material aspects for determining the state and rate of ASR. Funding: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5) FTEs: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5)	(b)(5) (b)(5) (b)(5) Commented [IF10]: Same as above. Commented [CM11R11]: Input from J. Philip & D. Seber
NRR-2015-007 ML15076A217 ✓ RES Response to NRR-2015-007 ML15229A100 ✓	Effects of Irradiation on Concrete Structures (b)(5)	The purpose of this UNR is to develop technical bases for regulatory guidance to evaluate radiation effects on concrete structures close to reactors. The focus of related regulatory research is to evaluate the impact on structural capacity under design basis loads for service life up to 80 years and develop aging management strategy. The project includes reviewing EPRI and DOE reports by ANL (contract awarded in Jan 2016), harvesting the materials from the decommissioned Jose Cabrera NPP in Zorita, Spain (b)(5) Funding: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FTEs: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5)	Commented [IF12]: Same as above. Commented [CM13R13]: Input from D. Seber

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff.

RES will prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [REDACTED] year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional)

Under this optional task, NRR may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, which would need further evaluation to assess their continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule

based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) []/year	[] for FY 18 and FY 21 [] (b)(5)
Total (Task 1)			(b)(5) []	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components			(b)(5)
2.A.	Develop an information tool/database	FY 18	(b)(5) []	[]
2.B.	Develop a process to evaluate plant components	FY 18	(b)(5) []	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5) []	
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	[]/year (Total [] (b)(5))	
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	(b)(5)
Total (Task 2)			(b)(5) []	[]
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21 (b)(5)	[]/year (Total [] (b)(5))	[] (b)(5) (total for 4 years IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) []/year (Total [] (b)(5))	
5 (optional)	Provide technical assistance to NRR for reviewing SLR applications.	FY 18-21	To be funded if needed	To be funded if needed
Total (Tasks 1-4, over 4 years)			(b)(5) []	(b)(5) []

Note to requester: Portions of this record are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Iyengar, Raj
Sent: Tue, 12 Apr 2016 13:09:39 -0400
To: Hiser, Matthew;Frankl, Istvan
Subject: RE: ACTON: Major Unfunded List Modifications

Steve,

I used some of Matt's information and added the below benefit to line 2 of the worksheet.

I have not added any information on Cables and Concrete. I will check with Ilka on that. Depending upon what she has, I can provide some input (or not) to her.

(b)(5)

Raj

From: Hiser, Matthew
Sent: Tuesday, April 12, 2016 12:49 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>
Subject: RE: ACTON: Major Unfunded List Modifications

Hi Steve,

(b)(5)

Thanks!
Matt

From: Frankl, Istvan
Sent: Tuesday, April 12, 2016 12:13 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>

Subject: FW: ACTON: Major Unfunded List Modifications
Importance: High

Raj, Matt,

(b)(5)

Please provide your inputs ASAP.

Thanks,

Steve

From: Frankl, Istvan
Sent: Monday, April 11, 2016 4:50 PM
To: Rossi, Matthew <Matthew.Rossi@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>
Subject: FW: ACTON: Major Unfunded List Modifications
Importance: High

Matt, Greg,

(b)(5)

I need your input by 11 AM tomorrow.

Thanks,

Steve

From: Berrios, Ilka
Sent: Monday, April 11, 2016 4:16 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Rudland, David <David.Rudland@nrc.gov>; Burke, John <John.Burke@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>
Cc: Thomas, Brian <Brian.Thomas@nrc.gov>; Brock, Kathryn <Kathryn.Brock@nrc.gov>
Subject: FW: ACTON: Major Unfunded List Modifications
Importance: High

All,

Please see email below from Veronica Portillo. Please update the benefit column. Please provide your input by tomorrow at noon from Brian and Kathryn's review.

[Redacted] (b)(5)

Thanks,

Ilka

415-2404

From: Dennis, Suzanne
Sent: Monday, April 11, 2016 4:09 PM
To: Armstrong, Kenneth <Kenneth.Armstrong@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>
Cc: Correia, Richard <Richard.Correia@nrc.gov>; Lund, Louise <Louise.Lund@nrc.gov>; Webber, Kimberly <Kimberly.Webber@nrc.gov>; Johnson, Joanne <Joanne.Johnson@nrc.gov>; Ki, DaBin <DaBin.Ki@nrc.gov>
Subject: FW: ACTON: Major Unfunded List Modifications
Importance: High

Ilka, These updates are for your items. (b)(5)

Kenneth, [Redacted]

[Redacted] (b)(5)

Sound good?
Suzanne

From: Portillo, Veronica
Sent: Monday, April 11, 2016 3:07 PM
To: Johnson, Joanne <Joanne.Johnson@nrc.gov>
Cc: Dennis, Suzanne <Suzanne.Dennis@nrc.gov>; Ojeda, Jennifer <Jennifer.Ojeda@nrc.gov>; Lund, Louise <Louise.Lund@nrc.gov>
Subject: ACTON: Major Unfunded List Modifications
Importance: High

Hi Joanne,

Jenny and I met with Bill Dean this morning on the Lower Priority and Major Unfunded Lists and he requested the following revisions to the RES items.

(b)(5)

(b)(5)

Please provide your revised input by **COB, tomorrow, April 12th**.

Thank you!
Veronica

From: Dean, Bill

Sent: Monday, April 11, 2016 11:55 AM

To: Weber, Michael <Michael.Weber@nrc.gov>; Hackett, Edwin <Edwin.Hackett@nrc.gov>

Cc: Ojeda, Jennifer <Jennifer.Ojeda@nrc.gov>; Portillo, Veronica <Veronica.Portillo@nrc.gov>; Ross-Lee, MaryJane <MaryJane.Ross-Lee@nrc.gov>; Gavrilas, Mirela <Mirela.Gavrilas@nrc.gov>; Evans, Michele <Michele.Evans@nrc.gov>; McDermott, Brian <Brian.McDermott@nrc.gov>

Subject: Major unfunded list modifications

(b)(5)

I just met with my budget team on the major unfunded list and wanted you to be aware of two things:

[REDACTED]

(b)(5)

Bill Dean
Director
Office of Nuclear Reactor Regulation

Note to requester: Portions of this record are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Frankl, Istvan
Sent: Tue, 12 Apr 2016 13:27:12 -0400
To: Hiser, Matthew
Cc: Iyengar, Raj
Subject: RE: ACTON: Major Unfunded List Modifications

Thanks a lot Matt.

Sorry, line item 2 is for row 6 in the spreadsheet. I have added your inputs to the spreadsheet.

Steve

From: Hiser, Matthew
Sent: Tuesday, April 12, 2016 12:49 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>
Subject: RE: ACTON: Major Unfunded List Modifications

Hi Steve,

(b)(5)

Thanks!
Matt

From: Frankl, Istvan
Sent: Tuesday, April 12, 2016 12:13 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>
Subject: FW: ACTON: Major Unfunded List Modifications
Importance: High

Raj, Matt,

(b)(5)

Please provide your inputs ASAP.

Thanks,

Steve

From: Frankl, Istvan

Sent: Monday, April 11, 2016 4:50 PM

To: Rossi, Matthew <Matthew.Rossi@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>

Subject: FW: ACTON: Major Unfunded List Modifications

Importance: High

Matt, Greg,

(b)(5)

I need your input by 11 AM tomorrow.

Thanks,

Steve

From: Berrios, Ilka

Sent: Monday, April 11, 2016 4:16 PM

To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Rudland, David <David.Rudland@nrc.gov>; Burke, John <John.Burke@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>

Cc: Thomas, Brian <Brian.Thomas@nrc.gov>; Brock, Kathryn <Kathryn.Brock@nrc.gov>

Subject: FW: ACTON: Major Unfunded List Modifications

Importance: High

All,

Please see email below from Veronica Portillo. Please update the benefit column. Please provide your input by tomorrow at noon from Brian and Kathryn's review.

(b)(5)

Thanks,

Ilka

415-2404

From: Dennis, Suzanne

Sent: Monday, April 11, 2016 4:09 PM

To: Armstrong, Kenneth <Kenneth.Armstrong@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>

Cc: Correia, Richard <Richard.Correia@nrc.gov>; Lund, Louise <Louise.Lund@nrc.gov>; Webber, Kimberly <Kimberly.Webber@nrc.gov>; Johnson, Joanne <Joanne.Johnson@nrc.gov>; Ki, DaBin <DaBin.Ki@nrc.gov>

Subject: FW: ACTON: Major Unfunded List Modifications

Importance: High

Ilka, These updates are for your items. (b)(5)

Kenneth

(b)(5)

Sound good?
Suzanne

From: Portillo, Veronica

Sent: Monday, April 11, 2016 3:07 PM

To: Johnson, Joanne <Joanne.Johnson@nrc.gov>

Cc: Dennis, Suzanne <Suzanne.Dennis@nrc.gov>; Ojeda, Jennifer <Jennifer.Ojeda@nrc.gov>; Lund, Louise <Louise.Lund@nrc.gov>

Subject: ACTON: Major Unfunded List Modifications

Importance: High

Hi Joanne,

Jenny and I met with Bill Dean this morning on the Lower Priority and Major Unfunded Lists and he requested the following revisions to the RES items.

(b)(5)

Please provide your revised input by **COB, tomorrow, April 12th**.

Thank you!
Veronica

From: Dean, Bill

Sent: Monday, April 11, 2016 11:55 AM

To: Weber, Michael <Michael.Weber@nrc.gov>; Hackett, Edwin <Edwin.Hackett@nrc.gov>

Cc: Ojeda, Jennifer <Jennifer.Ojeda@nrc.gov>; Portillo, Veronica <Veronica.Portillo@nrc.gov>; Ross-Lee, MaryJane <MaryJane.Ross-Lee@nrc.gov>; Gavrilas, Mirela <Mirela.Gavrilas@nrc.gov>; Evans, Michele <Michele.Evans@nrc.gov>; McDermott, Brian <Brian.McDermott@nrc.gov>

Subject: Major unfunded list modifications

(b)(5)

I just met with my budget team on the major unfunded list and wanted you to be aware of two things: [REDACTED]

[REDACTED] (b)(5)

Bill Dean
Director
Office of Nuclear Reactor Regulation

From: Purtscher, Patrick
Sent: Tue, 12 Sep 2017 07:56:39 -0400
To: Hull, Amy; Hiser, Matthew
Subject: RE: can we talk about parking for adv mfg \$ per Frankl: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

(b)(5)

[Redacted]
[Redacted] If you want to talk to me more about it, I am working from home today until 10:30 am.

(b)(5)

Pat

From: Hull, Amy
Sent: Monday, September 11, 2017 3:46 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: can we talk about parking for adv mfg \$ per Frankl: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

Pls See below comments from Steve.

From: Frankl, Istvan
Sent: Monday, September 11, 2017 8:37 AM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: 2 questions: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

(b)(5)

Thanks,
Steve

From: Hull, Amy
Sent: Monday, September 11, 2017 7:21 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: 2 questions: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

(b)(5)

(b)(5)

From: Frankl, Istvan

Sent: Sunday, September 10, 2017 11:04 PM

To: RES_DE_CMB <RESDECMB@nrc.gov>

Subject: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

Importance: High

CORs,

(b)(5)

If you have questions, please come by my office to discuss.

Thanks,

Steve

From: Hiser, Matthew
Sent: Mon, 6 Jun 2016 19:29:46 +0000
To: Frankl, Istvan
Subject: RE: COR Actions

Will do!

From: Frankl, Istvan
Sent: Monday, June 06, 2016 3:03 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: RE: COR Actions

Great idea. Please wait until I get response from Amy.

From: Hiser, Matthew
Sent: Monday, June 06, 2016 3:02 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: COR Actions

(b)(5)

I will add the COR change to the funding REQ for the on that contract.

From: Hiser, Matthew
Sent: Monday, June 06, 2016 3:00 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: COR Actions

Oh no, I have no objection - just wanted to confirm 😊

From: Frankl, Istvan
Sent: Monday, June 06, 2016 2:55 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: RE: COR Actions

I think it makes sense for him to assume COR duties for this project, I believe Amy was retained as COR only because of loss of Aloysius. Amy will still be involved in the technical monitoring of this contract. I will send separate email to Amy on this soon.

Any reason why we should not make this COR change?

Thanks,

Steve

From: Hiser, Matthew
Sent: Monday, June 06, 2016 2:40 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: COR Actions

Hi Steve,

OK, so replace Amy with Pat as the COR for PNNL work?

Thanks!
Matt

From: Frankl, Istvan
Sent: Monday, June 06, 2016 2:34 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: COR Actions

Matt,

My understanding is that Pat is now a certified COR Level I, so please submit ZEROREQ to add him as COR to the Strategic Harvesting contract with PNNL. (You will still be the backup COR.) Also, please submit ZEROREQ to extend the POP for the contract with INL.

Thanks,

Steve.

From: Frankl, Istvan
Sent: Thu, 6 Oct 2016 13:34:06 -0400
To: Hiser, Matthew
Cc: Purtscher, Patrick
Subject: RE: Harvesting FY17 Funds

Thanks for your timely inputs.

Steve

From: Hiser, Matthew
Sent: Thursday, October 06, 2016 1:31 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: Harvesting FY17 Funds

Hi Steve,

(b)(5) Pat and I discussed the FY17 budget for the harvesting contract at PNNL and agree that we could get by with [REDACTED] in FY17 to do what we need to do with PNNL.

Thanks and let us know if you need any more information!
Matt

From: Hiser, Matthew
Sent: Tue, 19 Jan 2016 20:39:04 +0000
To: Ramuhalli, Pradeep
Subject: RE: Harvesting Information Tool (Reactor Reliability and Integrity Management) Project

Hi Pradeep,

FYI – links to public meetings on SLR guidance documents this week:

<http://adamswebsearch2.nrc.gov/webSearch2/view?AccessionNumber=ML16013A054>

<http://adamswebsearch2.nrc.gov/webSearch2/view?AccessionNumber=ML16015A055>

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

From: Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]
Sent: Tuesday, January 19, 2016 11:58 AM
To: Hull, Amy <Amy.Hull@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Cc: Knobbs, Katie <katie.knobbs@pnnl.gov>
Subject: [External_Sender] Harvesting Information Tool (Reactor Reliability and Integrity Management) Project

Amy, Matt:

Happy new year!

We have made some progress on this work in the last few weeks (especially around Task 1.1 and the information tool example development). We'd like to go over the status with you (hopefully next week, if that works with your schedule), and begin to populate and update questionnaires as needed. If I recall, the plan was to present some of the example info tool screens and potential questionnaires with your advisory group prior to RIC (which is in March), and roll out the questionnaire at RIC to potential stakeholders.

(b)(5)

On a related note, we have about [REDACTED] This will likely take us through the middle of next month. What should I be doing to request the next increment of funding for continuing work on this project?

Thanks!

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
<http://www.pnnl.gov>

From: Frankl, Istvan
Sent: Tue, 21 Jun 2016 08:54:17 -0400
To: Hull, Amy
Cc: Purtscher, Patrick;Hiser, Matthew
Subject: RE: harvesting project? ACTION: Use of Excess FY16 Funds in CMB

Amy,

[Redacted]

(b)(5)

Thanks,

Steve

From: Hull, Amy
Sent: Tuesday, June 21, 2016 8:10 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: harvesting project? ACTION: Use of Excess FY16 Funds in CMB

[Redacted]

From: Frankl, Istvan
Sent: Monday, June 20, 2016 2:55 PM
To: RES_DE_CMB <RESDECMB@nrc.gov>
Subject: ACTION: Use of Excess FY16 Funds in CMB
Importance: High

CORs,

[Redacted]

(b)(5)

Thanks,

Steve

From: Moyer, Carol
Sent: Fri, 16 Feb 2018 16:37:23 +0000
To: Frankl, Istvan
Cc: Hull, Amy
Subject: RE: line item after discussions?....: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx
Attachments: Copy of FY20 DE OR major unfunded items 2-9-18 rlt.abh-cib-cmb-cem.xlsx

Note to requester: The attachment is immediately following this email record.

Steve,

Non Responsive Record

Thanks,
Carol

From: Frankl, Istvan
Sent: Friday, February 16, 2018 9:55 AM
To: Hull, Amy <Amy.Hull@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: line item after discussions?....: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Amy,

Non Responsive Record

Thanks,

Steve

From: Hull, Amy
Sent: Friday, February 16, 2018 8:27 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: line item after discussions?...: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Steve,

Non Responsive Record

Thanks,
Amy

From: Frankl, Istvan
Sent: Monday, February 12, 2018 9:48 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: 2nd of 2 initial responses...: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Amy, Carol,

Non Responsive Record

Steve

From: Moyer, Carol
Sent: Monday, February 12, 2018 8:52 AM
To: Hull, Amy <Amy.Hull@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: 2nd of 2 initial responses...: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Steve,

Non Responsive Record

Carol

From: Hull, Amy
Sent: Monday, February 12, 2018 8:31 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>

Cc: Moyer, Carol <Carol.Moyer@nrc.gov>

Subject: 2nd of 2 initial responses...: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Hi Steve,

Non Responsive Record

From: Frankl, Istvan

Sent: Friday, February 09, 2018 9:59 PM

To: Hull, Amy <Amy.Hull@nrc.gov>

Cc: Moyer, Carol <Carol.Moyer@nrc.gov>

Subject: FW: FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Importance: High

Amy,

Non Responsive Record

Thanks,

Steve,

From: Tregoning, Robert

Sent: Friday, February 09, 2018 4:30 PM

To: Iyengar, Raj <Raj.Iyengar@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>

Subject: RE: Copy of FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Raj:

Non Responsive Record

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
Two White Flint North, M/S T-10 A36
11545 Rockville Pike
Rockville, MD 20852-2738
ph: 301-415-2324
fax: 301-415-6671

From: Iyengar, Raj
Sent: Friday, February 09, 2018 4:26 PM
To: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: Copy of FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Rob,

Non Responsive Record

Raj

From: Tregoning, Robert
Sent: Friday, February 09, 2018 4:08 PM
To: Iyengar, Raj <Raj.Iyengar@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: Copy of FY20 DE OR major unfunded items 2-9-18 rlt.xlsx

Steve/Raj:

Non Responsive Record

Cheers,

Rob

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
Two White Flint North, M/S T-10 A36
11545 Rockville Pike
Rockville, MD 20852-2738
ph: 301-415-2324
fax: 301-415-6671

Non Responsive Record

Official Use Only
Attachment 3

Items presented in the FY 2020 Major Unfunded List are prioritized highest to lowest within each business line.

FY 2020 Budget - Operating Reactors Major Unfunded Items													
							Projected FY20 Budget CS&T (\$K)	Major Unfunded Request CS&T (\$K)	FTE <i>Must adhere to full integer guidance</i>	Total (\$K)			
Item No.	Business Line/Product Line Priority (H, M, L)	Business Line	Product Line	Product	Project/Activity Title	Office	(b)(5)				Description of Project/Activity	Benefit of Funding for This Item <i>Describe what will be accomplished by funding this item. <u>Do not</u> describe the impact of not funding this item.</i>	Risk of not funding this item
1	OR-H	Operating Reactors	Research	Aging and Materials Research	Research activities on materials degradation and irradiation assisted degradation (IAD) research	RES					Research projects on irradiation-assisted damage of vessel internals, enhancement of component integrity tools for confirmatory analyses, strategic initiatives to harvesting reactor materials to obtain useful information on materials aging and degradation from decommissioned plants. These projects will support long-term operations (LTO) of nuclear power plants and subsequent license renewal (SLR).		Lack of additional funds will delay the development of technical bases for evaluation of irradiation-assisted degradation at high fluences. This may delay revision of applicable aging management programs and the review of SLR applications received beyond the 2020 period.
Non Responsive Record													

FY 2020 Budget - Operating Reactors Major Unfunded Items

							Projected FY20 Budget CS&T (\$K)	Major Unfunded Request CS&T (\$K)	FTE <i>Must adhere to full integer guidance</i>	Total (\$K)			
Item No.	Business Line/Product Line Priority (H, M, L)	Business Line	Product Line	Product	Project/Activity Title	Office	(b)(5)				Description of Project/Activity	Benefit of Funding for This Item <i>Describe what will be accomplished by funding this item. Do not describe the impact of not funding this item.</i>	Risk of not funding this item

Non Responsive Record

Note to requester: All the attachments are immediately following this email.

From: Moyer, Carol
Sent: Tue, 30 Jan 2018 17:45:28 +0000
To: Frankl, Istvan
Cc: Hull, Amy;Hiser, Matthew
Subject: Revised Descriptions for RIC posters
Attachments: NRC 1102 - AM 20180130.pdf, NRC 1102 - Harvesting 20180130.pdf, Consolidated ePoster Titles and Descriptions from QTE (in alpha order) as of 120417_compare.docx

Steve,

Can you please review and approve the attached revised Description paragraphs for the RIC posters on Additive Manufacturing (#6) and Harvesting (#8)? These have been revised as follows:

#6 AM

Revised title (shortened to fit poster template)

Revised text to match what is now on the significantly-revised poster

[Note, the text on the RIC website now is incorrect. The text shown for poster #6 should be with poster #8. RIC staff have been asked by email to change it, but the text remains. Perhaps a replacement Form 1102 will precipitate the needed corrections.]

#8 Harvesting

Revised title (shortened to fit poster template)

Revised text to reflect QTE recommended edits.

I was advised by Brennet Warren on the RIC Team that posters #6 & #8 were not selected for OGC review.

The revised posters were submitted to QTE, with a copy to the RIC Team, this morning. The revised Description forms must also go to QTE for editing before the revised titles and text can be uploaded for the conference program. Bren stressed that this was time-sensitive.

Please let me know if you have any questions. Thanks,
Carol

Carol E. Moyer
Sr. Materials Engineer
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
MS: T-10A36
Washington, DC 20555-0001
carol.moyer@nrc.gov
301-415-2153

RIC PROPOSED DIGITAL PRESENTATION
SUBMISSION FORM☐ Original Submission
☒ Updated Submission

Description: A graphical presentation of research results, the status of standards development, the status of safety or security issues, or other topics of major interest to the agency, interested parties and/or the public.

Standard Setup: Standard setup consists of one 46" monitor (screen size 40" width x 22.5" height) mounted on a floor stand; one USB media player; one remote control; one small table and one chair.

- **Digital Presentation (Single-slide):** Format is a one-slide PowerPoint. Word limit is 400-500. Limit of 5-6 large photos, images, or diagrams.
- **Digital Presentation (Multi-slide):** Format is a multi-slide PowerPoint. Word limit is 400-500 per slide. Limit of 5-6 large photos, images, or diagrams per slide.

Submitting Office(s): Enter office acronym, if a joint session, enter lead office followed by supporting office.

RES

Title: Title should be relatively short, yet creative and appealing to the audience.

Harvesting of Aged Materials from Nuclear Power Plants

Description: Description should be innovative, succinct, and include key elements such as purpose, learning objectives, focus areas, and/or take-away messages.

Recent plans to shut down a number of nuclear power plants provide opportunities for harvesting components that were exposed to light-water reactor environments. Harvesting can provide highly representative aged materials for research and, in some cases, may be the only practical source of representative aged materials to address high-priority issues. Harvesting can be expensive and time consuming, which makes it essential to focus on technical needs with the highest importance and to cooperate with multiple organizations whenever possible to optimally leverage resources. The NRC is interested in engaging with other organizations to prioritize data needs for harvesting, identify areas of common interest, and develop a database for sources of materials for harvesting.

Presenter(s): If known, for each presenter, enter first and last name, position, division title and organization. If possible, list names in the order they will be presenting.

No.	First and Last Name	Position Title	Division Title	Office/Organization (NRC) (Acronyms)	Organization/Agency (Non-NRC)	Add (+) Remove (-)
1	Matthew Hiser	Materials Engineer	Division of Engineering	RES		<input type="button" value="+"/> <input type="button" value="-"/>

Topic Submitted By: If the names of the Presenter(s) are not known, enter a point of contact, Name and contact information, for the topic submission.

Carol Moyer (carol.moyer@nrc.gov, 301-415-2153) - Revised form submitted 1/30/2018

Please submit the completed form, via e-mail, by the following date:

Due Date:**11/27/2017**



RIC PROPOSED DIGITAL PRESENTATION SUBMISSION FORM

☐ Original Submission
☒ Updated Submission

Description: A graphical presentation of research results, the status of standards development, the status of safety or security issues, or other topics of major interest to the agency, interested parties and/or the public.

Standard Setup: Standard setup consists of one 46" monitor (screen size 40" width x 22.5" height) mounted on a floor stand; one USB media player; one remote control; one small table and one chair.

- **Digital Presentation (Single-slide):** Format is a one-slide PowerPoint. Word limit is 400-500. Limit of 5-6 large photos, images, or diagrams.
- **Digital Presentation (Multi-slide):** Format is a multi-slide PowerPoint. Word limit is 400-500 per slide. Limit of 5-6 large photos, images, or diagrams per slide.

Submitting Office(s): Enter office acronym, if a joint session, enter lead office followed by supporting office.

RES

Title: Title should be relatively short, yet creative and appealing to the audience.

Review of Additive Manufacturing by Direct Metal Laser Melting

Description: Description should be innovative, succinct, and include key elements such as purpose, learning objectives, focus areas, and/or take-away messages.

The NRC has been informed that Additively Manufactured (AM) parts are being considered for applications in the operating fleet as early as CY2018. In 2017, industry prototyping efforts involved use of the direct metal laser melting (DMLM) method to manufacture parts for reactor components. RES is beginning to evaluate the technology to gain insight into any technical issues that must be addressed to assure safety and reliability of specific DMLM-produced components that may be accepted by NRC, including design, precursor materials, finished material properties, structural integrity, nondestructive evaluation, and quality assurance. This poster also discusses the emergence and harmonization of relevant codes & standards activities. This poster will give an overview of NRC findings and preliminary recommendations related to additive manufacturing via DMLM.

Presenter(s): If known, for each presenter, enter first and last name, position, division title and organization. If possible, list names in the order they will be presenting.

No.	First and Last Name	Position Title	Division Title	Office/Organization (NRC) (Acronyms)	Organization/Agency (Non-NRC)	Add (+) Remove (-)
1	Amy Hull	Senior Materials Engineer	Division of Engineering	RES		<input type="checkbox"/> + <input type="checkbox"/> -
2	Thomas Herrity	Reactor Operations Engineer	Division of Construction Inspection & Operational Programs	NRO		<input type="checkbox"/> + <input type="checkbox"/> -
3	Carol Moyer	Senior Materials Engineer	Division of Engineering	RES		<input type="checkbox"/> + <input type="checkbox"/> -

Topic Submitted By: If the names of the Presenter(s) are not known, enter a point of contact, Name and contact information, for the topic submission.

Carol Moyer (301-415-2153) - Revised form submitted 1/30/2018

Please submit the completed form, via e-mail, by the following date:

Due Date:

11/27/2017



Digital Presentations (ePosters) —grouped(Grouped in alpha-orderAlphabetical Order)

Non Responsive Record



Non Responsive Record



Non Responsive Record

6 RES—Evaluation of Additive Manufacturing of Metallic Parts via Direct Metal Laser Melting

Recent plans to shut down a number of nuclear power plants (NPPs) provide opportunities for harvesting components that were exposed to light-water reactor (LWR) environments. Harvesting can provide highly representative aged materials for research and, in some cases, may be the only practical source of representative aged materials to address high-priority issues. Harvesting can be expensive and time-consuming, which makes it essential to focus on technical needs with the highest importance and to cooperate with multiple organizations whenever possible to optimally leverage resources. The NRC is interested in engaging with other organizations to prioritize data needs for harvesting, identify areas of common interest, and develop a database for sources of materials for harvesting.

>>>>>>

8 RES—Harvesting of Aged Materials from Operating and Decommissioning Nuclear Power Plants

In the U.S. nuclear industry today, there are some nuclear power plants (NPPs) that are prematurely ceasing operation, while other plant operators are making plans to extend operating lifespans through subsequent license renewal (SLR) from 60 to 80 years. Extending plant operation raises technical issues that may require further research on aging mechanisms to reduce uncertainties associated with material performance. Decommissioning plants provide opportunities for harvesting components that have been aged in representative light-water reactor (LWR) environments.

The NRC has recently undertaken an effort, with the assistance of Pacific Northwest National Laboratory (PNNL), to develop a strategic approach to harvesting aged materials from NPPs. The work will identify criteria to consider when prioritizing the data needs for harvesting. The NRC is interested in engaging with other organizations to prioritize data needs for harvesting, to share information about harvested materials and those that may become available, and to identify areas of common interest. The poster will give an overview of NRC findings and recommendations related to harvesting of components and material specimens from operating nuclear power plants NPPs and those undergoing decommissioning.

>>>>>>



Non Responsive Record



Non Responsive Record



Non Responsive Record



Non Responsive Record

From: Frankl, Istvan
Sent: Tue, 12 Sep 2017 17:14:12 -0400
To: Hiser, Matthew
Cc: Purtscher, Patrick
Subject: RE: REMINDER - URGENT ACTION: FY18 Budget Allocation for CMB Contracts

Thanks, Matt.

Steve

From: Hiser, Matthew
Sent: Tuesday, September 12, 2017 4:06 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: REMINDER - URGENT ACTION: FY18 Budget Allocation for CMB Contracts

Hi Steve,

(b)(6)

I wasn't able to touch base with Pat today, (b)(6) If it's alright with Pat
(on cc), (b)(5)

(b)(5)

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

From: Frankl, Istvan
Sent: Monday, September 11, 2017 3:38 PM
To: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Focht, Eric <Eric.Focht@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: REMINDER - URGENT ACTION: FY18 Budget Allocation for CMB Contracts
Importance: High

All,

So far, only one COR responded to the enclosed request.

Please make sure to provide inputs by COB tomorrow.

Thanks,

Steve

From: Frankl, Istvan

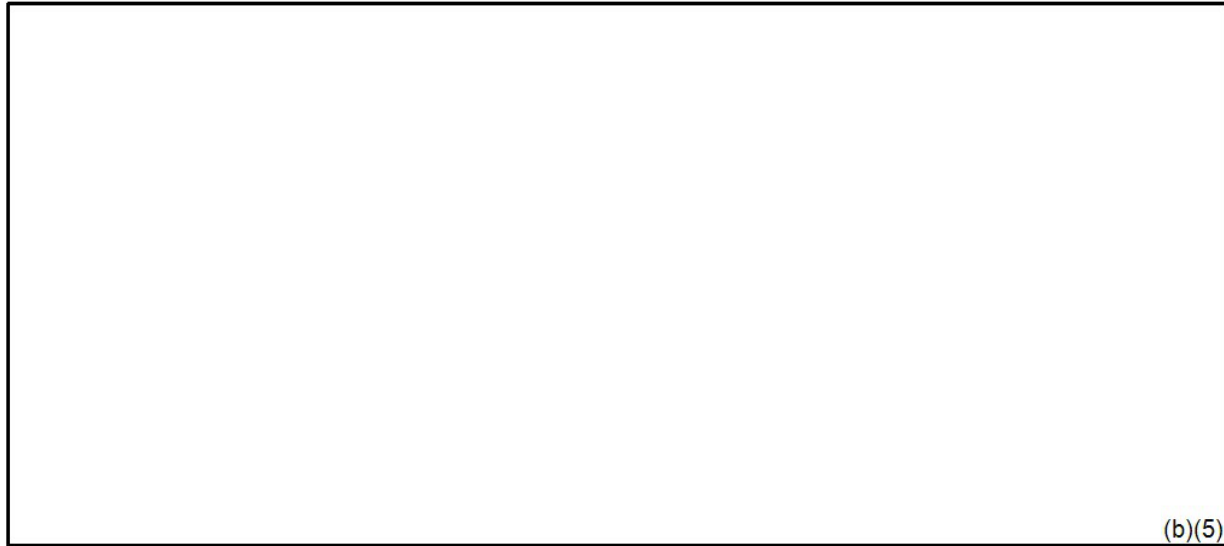
Sent: Sunday, September 10, 2017 11:04 PM

To: RES_DE_CMB <RESDECMB@nrc.gov>

Subject: URGENT ACTION: FY18 Budget Allocation for CMB Contracts

Importance: High

CORs,



(b)(5)

If you have questions, please come by my office to discuss.

Thanks,

Steve

Note to requester: The box with the X inside it is the Word attachment. Portions of the attachment, which is immediately following this email, are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Wed, 9 May 2018 12:33:47 +0000
To: Hull, Amy; Hiser, Matthew
Subject: RE: REMINDER ACTION: Prep for the Upcoming NRR/DMLR - RES/DE Quarterly UNR Status Meeting
Attachments: EPID status sheet - MDA_cem 20180509.docx

Amy & Matt,

I have a couple of minor questions on Page 4 of the attached. Can you take a look, please?

Thanks,
Carol



From: Hull, Amy
Sent: Wednesday, May 09, 2018 7:33 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: REMINDER ACTION: Prep for the Upcoming NRR/DMLR - RES/DE Quarterly UNR Status Meeting

Looking at it quickly, the SLR part looks OK to me. Carol do you seen anything else that needs to be done?

From: Frankl, Istvan
Sent: Tuesday, May 08, 2018 5:00 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: REMINDER ACTION: Prep for the Upcoming NRR/DMLR - RES/DE Quarterly UNR Status Meeting
Importance: High

All,

This is friendly reminder for you to complete this action by COB tomorrow.

Thanks,

Steve

From: Frankl, Istvan

Sent: Tuesday, May 01, 2018 2:44 PM

To: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Focht, Eric <Eric.Focht@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>

Subject: ACTION: Prep for the Upcoming NRR/DMLR - RES/DE Quarterly UNR Status Meeting

Importance: High

All,

The next quarterly meeting with DMLR management is scheduled for May 16. The format will be the same as last time, i.e. the BCs will summarize the status of UNRs/RARs using the EPID based format that was used during the last meeting.

This action is for the UNR POCs to update the EPID status tables for their UNRs. Please use the following links for your updates and make sure to save and close the file immediately after you complete your update:

<G:\DE\CMB\User Needs\EPID Summary\EPID status sheet - MDA.docx>

<G:\DE\CMB\User Needs\EPID Summary\EPID status sheet - SGI.docx>

If someone else is using the file, please notify the user to exit the file. Please note that it is important to keep track changes on, so that I will be able to review the revisions.

Also, we are planning to revise some of our UNRs and expect new RARs/UNRs in FY18, FY19 and FY20, so please capture the related FTEs and funds in the Resource Summary table of the specific EPID file. Even if we don't have UNR/RAR in place, please make sure to capture follow-on work in this table. (Please add a new row to the Resource Summary table for each new UNR, RAR or follow-on work.).

Please complete this action **by COB Wednesday, May 9.**

Thanks,

Steve

Materials Degradation, Analysis and Mitigation Techniques (R-2016-MDA-0001)

UNRs and Research Plans Assigned to Materials Degradation, Analysis and Mitigation Techniques			
NAME	Accession Number	Response Accession Number	UNR Date
UNR NRR-2013-005: User-Need Request to Develop the Technical Bases for the Evaluation of Neutron Absorbing Materials in Spent Fuel Pools	ML13053A171	ML13151A073	March 2013
UNR NRR-2014-001: User Need Request for the Office of Nuclear Regulatory Research to Provide Expert Assistance with Revising the Guidance Documents for Subsequent License Renewal	ML13312A267	ML14058A673	February 2014
UNR NRR-2014-010: User Need Request on Chemical Effects Research to Support GSI-191 Resolution	ML14198A156	ML14272A392	August 2014
UNR NRR-2017-001: Request for Research Assistance to Evaluate Irradiation-Assisted Degradation of Reactor Vessel Internals	ML16300A303	ML17110A202	January 2017
UNR NRR-2017-006: Research Assistance on Potential Significant Technical Issues During the Subsequent Period of Extended Operation	ML16358A427	ML17227A483	May 2017
UNR NRR-2017-010: User Need Request: Flaw Evaluation, Repair and Mitigation Techniques for Primary Water Stress Corrosion Cracking	ML17166A526	ML17227A004	July 2017

Materials Degradation, Analysis and Mitigation Techniques Resource Summary				
	FY18 Executed to Date (FTE/\$K*)	FY18 Plan (FTE/\$K**)	FY19 Plan (FTE/\$K)	FY20 Plan (FTE/\$K)
UNR NRR-2013-005 (NAM)	(b)(5)			
UNR NRR-2014-001 (SLR Assist.)				
UNR NRR-2014-010 (GSI-191)				
UNR NRR-2017-001 (IAD)				
UNR NRR-2017-006 (SLR)				
UNR NRR-2017-010 (PWSCC Task 1)				
EPID Total				
Product Total				
*Total includes FY17 carryover contract funds executed in FY18				
**Total includes FY18 contract funds only				
***Some resources for irradiated materials testing are executed for FY18 in the EPID: Vessel Integrity (RPV and Internals), and are reported on that status sheet. The resources will be formulated in the EPID: Materials Degradation, Analysis and Mitigation Techniques beginning in FY19. This is the cause of the resource increase for this EPID in FY19.				

UNR NRR-2013-005 (NAM) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1	1.1	TLR on qualification and an assessment of surveillance program for aluminum-based NAMs.	RES: E. Focht NRR: M. Yoder	Start Date: 1/18 Proj. End Date: <u>9/12/18</u>	NRR will use the RES findings and recommendations to inform the development of generic and plant specific regulatory decisions regarding SFP neutron absorbing materials degradation.
		Status Update: In progress			
	1.2	TLR on degradation mechanisms for aluminum-based NAMs	RES: E. Focht NRR: M. Yoder	Start Date: 11/15 Proj. End Date: <u>4/18/18</u>	
		Status Update: SRNL is conducting confirmatory research on the performance of Boral under normal and off-normal SFP service conditions and will prepare a TLR based on the research.			
2	2.1	TLR on degradation mechanisms for aluminum-based NAMs during and after the following design-basis events: loss of pool chemistry control, loss of pool cooling, and seismic event. This TLR is combined with Deliverable 1.2.	RES: E. Focht NRR: M. Yoder	Start Date: 11/15 Proj. End Date: <u>4/18/18</u>	NRR will use the RES findings and recommendations to inform the development of generic and plant specific regulatory decisions regarding SFP neutron absorbing materials degradation.
		Status Update: SRNL is conducting confirmatory research on the performance of Boral under normal and off-normal SFP service conditions and will prepare a TLR based on the research.			
3	3.1	Internal memo on CNWRA reports	RES: E. Focht NRR/DSS: K. Wood	Start Date: completed Proj. End Date: 4/17	NRR will use the RES findings to disposition technical issues evaluated in CNWRA reports on NAM performance during SFP accidents
		Status Update: Completed			
4	4.1	Maintain NAM databases	RES: E. Focht NRR: M. Yoder	Start Date: as needed Proj. End Date: as needed	NRR will use the databases to support regulatory decisions regarding SFP neutron absorbing materials (e.g. license amendments, FSAR updates).
		Status Update: Performed on as needed basis. The databases are currently being updated based on the information submitted by licensees in response to the NAM Generic Letter			

UNR NRR-2014-010 (Sump Clogging Chemical Reactions – GSI 191 Closures) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1	1.1	Deterministic GSI-191 Resolution	RES: M. Hiser NRR: P. Klein	Start Date: 7/14 Proj. End Date 12/16	Support provided through this user need will assist NRR's review of generic and plant specific chemical effects evaluations for both PWRs and BWRs. This support will also assist NRR in developing guidance documents for performing risk-informed chemical effects evaluations
		Status Update: Completed			
2	2.1	Risk Informed GSI-191 Resolution	RES: M. Hiser NRR: P. Klein	Start Date: 7/14 Proj. End Date 12/16	
		Status Update: Completed			
3	3.1	Generic PWROG Test Program Evaluations	RES: M. Hiser NRR: P. Klein	Start Date: 7/14 Proj. End Date 12/16	
		Status Update: Completed			
4	4.1	BWROG Chemical Effects Evaluation	RES: M. Hiser NRR: P. Klein	Start Date: 7/14 Proj. End Date 12/18	
		Status Update: Holding the contract with EMS open in case some unanticipated work comes in before the contract expires			

UNR NRR-2017-010 (PWSCC) Task 1 Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1.1	1.1.1	NUREG/CRs for Crack Growth Rate Curve Validation	RES: M. Audrain NRR: J. Collins	Start Date: 9/14 Proj. End Date: 8/19	Supports the review and validation of CGR curves developed by the industry
		Status Update: In progress. Several NUREGs have been completed. Scheduled to have 2 additional from PNNL and 1 additional from ANL.			
1.2	1.2.1	TLR on Alloy 600/182 (15% cold worked)	RES: E. Focht NRR: J. Collins	Start Date: 9/14 Proj. End Date: 5/18	Support xLPR use, mitigation evaluation, and probabilistic flaw evaluation.
		Status Update: Phase 1 of A600 testing is completed and will be reported in the TLR. A182 testing on 15% cold work continues with 6 of the 36 total specimens still under test.			
	1.2.2	TLR on Alloy 182 (applied stress effects, 15% cold work)	RES: E. Focht NRR: J. Collins	Start Date: 9/14 Proj. End Date: 6/20	
		Status Update: Testing on A182 to investigate applied stress effects began in 11/17 and will continue.			
	1.2.3	TLR on Alloy 690/52/152	RES: E. Focht NRR: J. Collins	Start Date: 9/14 Proj. End Date: 8/21	
		Status Update: Testing on Alloy 690/52/152 began in 1/16 and continue with no PWSCC crack initiations.			
	1.2.4	TLR on Alloy 690/52/152 HAZ/dilution zones and defects	RES: E. Focht NRR: J. Collins	Start Date: TBD Proj. End Date: 12/21	
		Status Update: This work has not begun, yet, due to materials and testing facility availability.			

UNR NRR-2017-006 (SLR) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1	1.1	Hold focused NRC/industry workshop on specified degradation issue(s) and prepare NUREG/CP Status Update: in planning stages	RES: Carol Moyer NRR: Bennett Brady	Start Date: --FY19 Proj. End Date -- FY20	Pave the path forward for resolution of challenges and issues related to materials degradation during the SLR period by holding NRC/industry workshop(s) to address and evaluate aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191)
	1.2	Hold focused NRC/industry workshop on specified degradation issue(s) and prepare NUREG/CP Status Update: in long-term planning stages	RES: Carol Moyer NRR: Bennett Brady	Start Date: -- FY20 Proj. End Date -- FY21	
2	2.A.	Develop an information tool/database Status Update: underway – prioritization criteria have been developed and exercised for metals components. Next step is to expand to electrical and concrete.	RES: Matt Hiser NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY18	By developing and implementing a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants, this task will provide fundamental insights on reactor materials degradation and information addressing potential technical issues or identified gaps to support anticipated future NRC needs. It will also inform the value of existing databases based on simulated aging conditions by assessing their applicability to in-service conditions.
	2.B	Develop a process to evaluate plant components Status Update: underway	RES: Matt Hiser NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY18	
	2C	Evaluate the suitability of plant components Status Update: in planning stages, based on results from 2B	RES: Matt Hiser NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY19	
	2.D.	Continue to evaluate plant components Status Update: underway, based on results from 2B	RES: Matt Hiser NRR: Bennett Brady	Start Date: – FY20 Proj. End Date – FY21	
	2.E	Pursue partnerships for cost-sharing Status Update: underway	RES: Matt Hiser NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY21	
3	3.1	Participate as POC in relevant outreach (EPRI, DOE, IAEA) Status Update: underway	RES: Carol Moyer NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY21	Develop agreements with domestic and international partners to collaborate on aging management research that results in information to help inform agency decisions regarding SLR applications. RES should evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues. Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research
	3.2	Participate as POC in relevant outreach (IFRAM, IAEA) Status Update: underway	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY18 Proj. End Date– FY21	
4	4.1	TLR: "CY17: Status of Research for the Significant Technical Issues for SLR" Status Update: underway	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY18 Proj. End Date – FY18	Develop documentation evaluating significant technical issues germane to the review of SLR applications. Support NRR in keeping the Commission informed on the progress in resolving the four significant technical issues related to SLR. The SRM also directed the staff to keep the Commission informed regarding the staff's readiness for accepting an application and any further need for regulatory process changes, rulemaking, or research.
	4.2	TLR: "CY18: Status of Research for the Significant Technical Issues for SLR" Status Update: in long-term planning stages	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY19 Proj. End Date – FY19	

Commented [MC1]: Matt: Is this still a good date? Will we have a deliverable by Sept.?

Commented [MC2]: Amy: While this term is clear, do you think this would be the time to switch to "materials degradation research" or "long-term materials degradation research"?

UNR NRR-2017-006 (SLR) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
	4.3	TLR: "CY19: Status of Research for the Significant Technical Issues for SLR"	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY20 Proj. End Date – FY20	
		Status Update: in long-term planning stages			
	4.4	TLR: "CY20: Status of Research for the Significant Technical Issues for SLR"	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY21 Proj. End Date – FY21	
		Status Update: in long-term planning stages			
	4.5	TLR: "CY21: Status of Research for the Significant Technical Issues for SLR"	RES: Amy Hull NRR: Bennett Brady	Start Date: – FY22 Proj. End Date – FY22	
		Status Update: in long-term planning stages			
5	5.1	Provide technical assistance for reviewing SLR applications	RES: Amy Hull NRR: Bennett Brady	Start Date: as needed Proj. End Date: as needed	Provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses
		Status Update: Performed on as needed basis.			

UNR NRR-2014-001 (SLR Expert Assistance) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1	1.1 - 1.3	Identification of key significant technical issues	RES: Amy Hull NRR: Bennett Brady	Start Date: -- FY14 Proj. End Date FY18	Contribute to SLR guidance documents to ensure NRC's readiness to review possible license renewal applications (LRAs) for NPPs to operate beyond the first renewal period, beyond 60 years.
		Status Update: Completed.			
	The SLR guidance documents NUREGs 2191 and 2192 were published 4 th Q, FY17. The supporting documents NUREGs 2221 and 2222 were published 2 nd Q, FY18.				
	1.4	Revision of RG 1.188	RES: Amy Hull NRR: Bennett Brady	Start Date: -- FY18 Proj. End Date -- FY19	Last revised in 2005, RG 1.188 provides guidance on information to be submitted in LRAs.
Status Update: ongoing					
2	2.1 - 2.2	Provide ongoing subject matter experts (SMEs)	RES: Amy Hull NRR: Bennett Brady	Start Date:--FY14 Proj. End Date—FY19	Until the publication of NUREGs 2191, 2192, 2221, and 2222, RES provided NRR access to SMEs for the development of SLRGD content.
		Status Update: ongoing until the revision of RG 1.188 is completed.			

UNR NRR-2017-001 (IAD) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
1	1.1	NUREG report on void swelling	RES: Appajosula S. Rao NRR: Mark Yoo	Start Date: Proj. End Date: 9/2018	NRR will use the RES assessment to inform the development of generic and plant-specific regulatory decisions regarding the adequacy of aging management of void swelling.
		Status Update: ZIRP IASCC crack growth rate (CGR) testing is complete. IASCC CGR testing of additional materials at ANL is underway. RES investigates the causes and mechanisms for void swelling of austenitic stainless steel PWR internals. The RES assessment will address the causes, mechanisms, and possible extent for plant conditions that cover an operating period of 80 years.			
2	2.1	Periodic Update Meetings	RES: Matt Hiser Appajosula S. Rao NRR: Mark Yoo	Start Date: Quarterly Proj. End Date	NRR will use these periodic update meetings to be informed of new information gained from RES's continuing interactions with the industry
		Status Update: Ongoing. RES actively monitors and collaborates with the industry on research projects that are being pursued by the industry and are associated with the aging effects and mechanisms that come from long-term operation.			
	2.2	Draft report on industry IAD activities	RES: Matt Hiser Appajosula S. Rao NRR: Mark Yoo	Start Date: Proj. End Date 12/2018	NRR will use this assessment to better understand and inform the generic and plant-specific regulatory decisions regarding the aging effects and mechanisms that come from long-term operation.
		Status Update: Beginning development with information gathering from recent technical conferences, industry research publications, and dialogue to industry research counterparts. Draft report in planning stage.			
3	3.1	Formal report on industry IAD activities (e.g., NUREG, NUREG/CR)	RES: Appajosula S. Rao NRR: Mark Yoo	Start Date: Proj. End Date 6/2019	NRR will use the RES assessment to inform the generic and plant-specific regulatory decisions regarding EPRI's new IASCC crack growth rate curves and to support the NRC participation in the ASME Code group that will consider this code case.
		Status Update: Will start after Task 2.2 is completed. The formal report will include a comprehensive assessment of the results from research projects that have been completed by the industry. Status Update: Ongoing technical support being provided by RES to review the basis of the new irradiation-assisted stress corrosion cracking crack (IASCC) growth rates curves developed by EPRI. Draft TLR documenting technical basis for staff position can be developed if desired by NRR is in planning stage. To date, RES support has focused on interactions with industry through ASME Code. NRC will voted negative on ASME IASCC Case (025/2018). This decision was approved by the NRC Standards Steering Committee. RES to review the basis of the new irradiation-assisted stress corrosion cracking crack (IASCC) growth rates curves developed by EPRI. EPRI intends to incorporate these new disposition curves into the ASME Code; however, the NRC has not approved these curves.			

UNR NRR-2017-001 (IAD) Deliverables Status					
Task	Deliverable Number	Deliverable	POC	Schedule	Regulatory Use
	3.2	Technical Support	RES: Appajosula S. Rao NRR: Mark Yoo	Start Date: As needed Proj. End Date	NRR will use RES technical support to inform the generic and plant-specific regulatory decisions regarding aging management of baffle bolts in PWRs.
		Status Update: Ongoing activity – limited support provided to date, available as needed by NRR staff.			
		RES to provide technical support to NRR's review of industry actions that are in response to recent operating experience involving significant degradation of baffle bolts at PWRs.			

From: Shaffer, Sarah
Sent: Tue, 11 Oct 2016 08:27:03 -0400
To: Frankl, Istvan
Cc: Purtscher, Patrick; Rossi, Matthew; Hiser, Matthew; Berrios, Ilka; Brezovec, Michael
Subject: RE: Request #1 for Transfer of CMB Funds in FY17 Q1

Steve:

The first three have been completed. I only see one APP for CMB, There is no APP for Amy Hull. Did you mean the one below?

APP-17-RES-0006	Testing of Irradiated Ex-Plant Materials in LWR Environment (including Void Swelling Investigations of Austenitic SS)	Appajosula Rao
-----------------	---	----------------

From: Frankl, Istvan
Sent: Thursday, October 06, 2016 2:24 PM
To: Shaffer, Sarah <Sarah.Shaffer@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rossi, Matthew <Matthew.Rossi@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>; Brezovec, Michael <Michael.Brezovec@nrc.gov>
Subject: RE: Request #1 for Transfer of CMB Funds in FY17 Q1
Importance: High

Thanks, Sarah.

(b)(5)

Steve

From: Shaffer, Sarah
Sent: Thursday, October 06, 2016 2:05 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rossi, Matthew <Matthew.Rossi@nrc.gov>; Hiser,

Matthew <Matthew.Hiser@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>; Brezovec, Michael <Michael.Brezovec@nrc.gov>

Subject: RE: Request #1 for Transfer of CMB Funds in FY17 Q1

Steve:

(b)(5)

Thanks,
Sarah

From: Frankl, Istvan

Sent: Thursday, October 06, 2016 1:58 PM

To: Shaffer, Sarah <Sarah.Shaffer@nrc.gov>

Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rossi, Matthew <Matthew.Rossi@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>; Brezovec, Michael <Michael.Brezovec@nrc.gov>

Subject: RE: Request #1 for Transfer of CMB Funds in FY17 Q1

Importance: High

Sarah,

(b)(5)

Thanks,

Steve

From: Shaffer, Sarah

Sent: Wednesday, October 05, 2016 1:00 PM

To: Frankl, Istvan <Istvan.Frankl@nrc.gov>

Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rossi, Matthew <Matthew.Rossi@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>; Brezovec, Michael <Michael.Brezovec@nrc.gov>

Subject: RE: Request #1 for Transfer of CMB Funds in FY17 Q1

Steve:

(b)(5)

Sarah

From: Frankl, Istvan

Sent: Wednesday, October 05, 2016 10:24 AM

To: Shaffer, Sarah <Sarah.Shaffer@nrc.gov>

Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Rossi, Matthew <Matthew.Rossi@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>

Subject: Request #1 for Transfer of CMB Funds in FY17 Q1

Importance: High

Sarah,

As discussed please execute the following Q1 transfers

(b)(5)

Matt H. and Pat/Matt R. will review/update respective spending plans in BFS ASAP to support the associated Q1 funding actions.

Thanks,

Steve

From: Hiser, Matthew
Sent: Thu, 14 Apr 2016 11:47:31 +0000
To: Frankl, Istvan
Subject: RE: RES-16-0295

Hi Steve,

OK, let's discuss next week.

(b)(5)

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

From: Frankl, Istvan
Sent: Wednesday, April 13, 2016 10:12 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: RE: RES-16-0295

Matt,

(b)(5)

Thanks,

Steve

From: Hiser, Matthew
Sent: Wednesday, April 13, 2016 8:14 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RES-16-0295

Hi Steve,

(b)(5)

I had discussed with you on Friday about RES-16-0295, which is for a \$20K incremental funding of the harvesting project at PNNL. However, there is only [REDACTED] remaining to the ceiling on this contract, so Sarah recommended just going ahead and funding this the ceiling ([REDACTED]) instead of (b)(5) \$20K). That makes sense to me and now that we have our full budget, we should have the necessary funds.

If that's OK with you, I will resubmit the REQ for [REDACTED]

(b)(5)

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

Note to requester: Both attachments are immediately following this email. A portion of the first attachment is redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Hiser, Matthew
Sent: Tue, 20 Sep 2016 21:10:49 +0000
To: Iyengar, Raj
Cc: Purtscher, Patrick;Frankl, Istvan
Subject: RE: Resources and Schedule for Task 2
Attachments: DLR-UNR-Resources.xlsx, 2016 NRR UNR - SLR Draft Enclosure-Bennett-CMBdocx - hiser - Bennett RMI....docx

Hi Raj,

My input on schedule/resources is attached. I am also cc'ing Pat and Steve for their awareness/input.

Thanks!
Matt

From: Iyengar, Raj
Sent: Monday, September 19, 2016 4:21 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: Resources and Schedule for Task 2

Matt,

Attached are the resources document and revised UNR.

Please let me know if you can give me estimates for strategic harvesting task.

Raj

Schedule and Resources for the Various Tasks

Task Number	Task Description	Completion Date	FTE	Contract \$
1	Hold NRC/industry workshop(s) and prepare TLRs on four SRM topics		(b)(5)	
1a	Hold workshops (2018, 2020)	FY20		
1b	<i>Prepare TLRs</i>			
	RPV Embrittlement	FY17		
	Vessel Internals	FY17		
	Concrete Degradation	FY18		
	Cables	mid-FY19		
2	Develop/Implement a strategy for harvesting materials/components from decommissioned plants			
2A		FY17		
2B		FY17		
2C		FY18		
2D		Ongoing		
3	Develop Domestic and International Partnerships	FY17-FY21		

User Need

Evaluate the Aging Management of Systems, Structures, and Components for Subsequent License Renewal

Background:

The NRC staff ([staff](#)) has recently completed the draft guidance documents for subsequent license renewal (SLR), ~~the draft SLR guidance documents which were issued for public comment~~ in December 2015. ~~The (draft NUREG-2191, Volumes 1 and 2, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) ReportReport;" (NUREG-2191, Volumes 1 and 2) and draft NUREG-2192, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants" (SRP-SLR) (NUREG-2492)).~~ ~~These guidance documents were developed in a multi-year and multi-step process, as described below.~~ NRC experts in the aging degradation of various structures, systems and components participated in over ninety expert panels to review over 800 comments that were collected for consideration in developing guidance for operation from 60 to 80 years. Staff from the Office of Nuclear Regulatory Research (RES) were members of most of these expert panels, as well as staff members from other NRR divisions. The expert panels dispositioned these comments and drafted the new guidance for SLR.

~~In one of the key steps, the NRC completed the Expanded Materials Degradation Assessment (EMDA) (Some of the 800 comments came from the RES Expanded Materials Degradation Assessment (EMDA) study and RES' assistance in the Aging Management Program (AMP) Effectiveness Audits at three plants in the period of extended operation.~~

In cooperation with the Department of Energy (DOE) Light Water Reactor Sustainability (LWRS) Program, ~~The resultant reports, the NRC completed~~ NUREG/CR-7153, "Expanded Materials Degradation Assessment (EMDA), Vol. 1-5" (ADAMS Accession Nos. ML14279A321, ML14279A331, ML14279A349, ML14279A430, ML14279A461), ~~describe the conclusions from an expert elicitation process to~~ identify the most significant aging degradation technical issues for nuclear power reactor operation beyond 60 years. The EMDA ranked the significance, current knowledge, and uncertainty associated with aging-related degradation phenomena that could affect systems, structures, and components (SSCs) over 80 years of operation. As outlined in the staff requirements memorandum (SRM) on SECY 14-0016, the major technical issue areas are:

- Reactor pressure vessel neutron embrittlement at high fluence;
- Irradiation-assisted stress corrosion cracking of reactor internals and primary system components;
- Concrete and containment degradation; ~~and~~
- Electrical cable qualification and condition assessment.

In another key step, staff from the Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research (RES) ~~also assisted in~~ conducted three audits to investigate the

effectiveness of aging management programs (AMPs) used in the plant operating period from 40 to 60 years. The findings from the first two audits are documented in the report titled, "Summary of Aging Management Program Effectiveness Audits to Inform Subsequent License Renewal: R.E. Ginna Nuclear Power Plant and Nine Mile Point Nuclear Station, Unit 1" (ML13122A007). The summary of the third audit can be found in the August 5, 2014, report, "H.B. Robinson Steam Electric Plant, Unit 2, Aging Management Program Effectiveness Audit" (ADAMS Accession No. ML14017A289). In addition on June 15, 2016, the staff issued the Technical Letter Report, "Review of Aging Management Programs: Compendium of Insight from License Renewal Applications and from AMP Effectiveness Audits Conducted to Inform Subsequent License Renewal Guidance Documents," (ADAMS Accession No. ML16167A076), which provides the staff's observations from reviewing license renewal applications and the AMP audits.

As part of the expert panels, RES evaluated~~In addition, an assessment of~~ domestic and international operating experience of nuclear plants, lessons learned from staff review of previous license renewal applications, and an assessment of recent research findings, were considered in the development of the SLR guidance documents.

The draft guidance documents were developed by NRC~~the staff with experience in addressing~~ aging degradation of ~~systems, structures~~structures, systems and components. The staff who participated in over ninety "expert panels," ~~These panels~~which included staff members from the NRR Division of License Renewal and other NRR divisions, as well as staff from the Office of Nuclear Regulatory Research (RES). The expert panels dispositioned more than 800 inputs, which some of the 800 comments came from the RES Expanded Materials Degradation Assessment (EMDA) study, and RES' assistance in the Aging Management Program (AMP) Effectiveness Audits at three plants in the period of extended operation, and from the review of operating experience and other information.

Since~~After~~ the draft guidance documents were issued for public comment, the staff ~~has~~ held several public meetings with stakeholders and the public to discuss the proposed revisions and bases for the revisions. In ~~The most recent meetings were held on January 21 and February 19, 2016. The purposes of these meetings~~ the staff were outreach activities to stakeholders and the public to provide information and clarifications on the proposed changes to the guidance documents, and to solicit~~solicited~~ feedback on the documents, and revise the documents, as appropriate, to reflect stakeholder and public feedback. The final guidance documents are expected to be issued in mid-2017.

The NRC staff is currently evaluating the public comments and developing final versions of the guidance documents. These documents will be issued in final form in mid-2017.

To support their ~~support the review of an~~ SLR application, an applicant~~s~~ will need to

demonstrate ~~that how~~ the effects of aging will be adequately managed for an operating period from 60 to 80 years, including aging effects ~~these~~ associated with the technical issues listed above. Although the industry is conducting research to address these major technical issues for SLR, not all of the research will be completed before the first application is submitted. For those issues that the industry has not yet developed a generic technical basis to support its resolution and the staff has not provided generic guidance for aging management, the NRC will request applicants will need to address the technical issues with plant-specific programs in their SLR applications. The staff will review these plant-specific programs that address the SLR technical issues, but anticipates a longer application review process in these cases.

Commented [HA1]: Not true in all cases, since GALL-SLR has identified generic approaches to address some of the issues.

The requested research ~~described below would~~ provides information to support the staff in effectively evaluating AMPs and developing staff positions on the technical issues identified in EMDA reports and in the subsequent license renewal guidance. ~~This effort will also augment the staff's preparedness for the evaluation of future applications for an SLR period. These requested products should build upon analysis methods, tools, and expertise developed as part of ongoing research activities and new research activities focused specifically on aging effects during an SLR period.~~

Description of Scope and Tasks

1A. – Hold NRC/industry workshop(s) on status of domestic and international research activities and operating experience to address and evaluate the status of materials degradation issues identified in the EMDA reports, with particular focus on the issues identified in the GALL-SLR and in the SRM on SECY 14-0016 for SLR.

Technical Need: In February 2008, the NRC and DOE first co-sponsored a "Workshop on U.S. Nuclear Power Plant Life Extension Research and Development" (ADAMS Accession Number ML080570419), which requested stakeholder input into aging management research areas for "Life Beyond 60." Since then, there have been multiple domestic and international workshops/meetings on the research activities and operating experience that may impact aging management of SSCs for an SLR period, with the next such meeting to be sponsored by the International Atomic Energy Agency (IAEA) in France in the October 2017.

Commented [BB2]: To be of use to NRR, the workshops should focus on the issues identified in the GALL-SLR and in SRM on SECY 14-0016

The EMDA would have been more useful for subsequent license renewal had it been more in line with GALL components and issues.

CMB: Revised. Please change as you see fit.

These meetings have been helpful in facilitating technical discussions, disseminating knowledge and information, enabling the understanding of technical challenges, and paving the path forward for resolution of the challenges and issues related to materials degradation during the SLR period. As the NRC staff prepares for the review of subsequent license renewal applications (SLRAs), there is a need for continued engagement with the domestic industry, DOE, and other federal organizations, academia, international partners, and interested public stakeholders through workshops focused on the status and resolution of major technical issues outlined in the GALL-SLR, the SRM, and in EMDA.

Commented [BB3]: I thought RES was a sponsor for three large international meetings. I attended the third one that was held by IAEA in Salt Lake City. But I thought RES was a sponsor.

Request: RES is requested to facilitate a minimum of two international activities (either a workshop, conference, symposium, or meeting) in the early fall 2018 and in late spring 2020 to address:

CMB: I do not have the details. Hence not captured. We can add this information, if needed.

- operating experience from the initial license renewal period (or the long term operation period for international plants)
- the state of knowledge on the relevant technical issues
- on-going research on materials degradation issues and aging management of these issues, in particular as related to the SLR period

These activities should be specifically targeted toward the resolution of technical issues for effective aging management of SSCs during the SLR period.

Deliverable: RES staff should facilitate several workshops/meetings on operating experience from the initial license renewal period, research results on materials degradation issues, and aging management of SSCs during the SLR period.

These meetings should be specifically targeted toward the resolution of technical issues for effective aging management of SSCs during the SLR period. The deliverables include the international activities (either a workshop, conference, symposium, or meeting) and technical letter reports that summarize the state-of-knowledge and resolution of the four major issues identified in the SRM on SECY 14-0016 for SLR.

Prior to the meetings, RES should provide a draft agenda and proposed presenters. The information from these activities should be documented in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (e.g., presentations or papers) available for subsequent use. RES staff should provide an annual technical letter report summarizing the understanding gained through the workshops/meetings. The summary should include the status of domestic and international research activities in addressing materials degradation issues and aging management practices during the SLR period. The report should also discuss (1) areas of progress and issues resolution, (2) areas of insufficient progress that may warrant additional NRC-driven interactions, and (3) any newly identified technical issues that should be considered.

Schedule: The effort should continue until the completion of the deliverables from the second activity, tentatively scheduled for late spring 2020, last no more than 36 months from the period of inception of this user need request.

2B. Provide RES staff assessments of the current knowledge and disposition of materials degradation issues identified in the EMDA reports, with particular focus on the issues identified in the GALL-SLR and in SRM on SECY 14-0016 for SLR.

Technical Need: As mentioned earlier, the EMDA reports identified significant technical issues for nuclear power reactor operations beyond 60 years related to materials degradation. These issues fall under the following four topical areas, as outlined in the SRM on SECY 14-0016:

- Reactor pressure vessel neutron embrittlement at high fluence;

Commented [HA4]: I am skeptical of this task. We need to identify more specific deliverables

Commented [BB5]: I think this is an activity we should support but I am not sure how this would be received in the current NRC climate of frugality.

CMB: This was specifically requested by Allen Hiser and agreed upon (in a broad sense) in our meetings with DLR during the course of development of this UNR.

Commented [HA6]: I am skeptical of this task. We need to identify more specific deliverables

Commented [BB7]: I think this is an activity we should support but I am not sure how this would be received in the current NRC climate of frugality.

CMB: This was specifically requested by Allen Hiser and agreed upon (in a broad sense) in our meetings with DLR during the course of development of this UNR.

Commented [BB8]: We need very explicit deliverables such as an agenda coordinated with NRR, proposed speakers, presentation slides, and a report that addresses aging management programs that may lead to revision of our guidance documents

CMB: Totally agree. During the process of developing the workshops, we will work closely with DLR to ensure agenda, schedule, speakers are agreed upon by all of us. We will mention the close collaboration and alignment with DLR in our response to the UNR. The draft internal report will be sent to NRR for review and comment. If NRR wants to make the final report public, that will be fine. As mentioned before, all milestones will be tracked.

Commented [BB9]: The previous UNR for SLR also had a task to hold public workshops on aging management research with a deliverable after each meeting to provide a technical letter report after each meeting. To my knowledge, all we got was a two-page memo from Gene Carpenter.

CMB: We will make sure these deliverables, with due dates, are specifically stated in our response. As soon as the UNR (and the RES response) is put in place, CMB will add milestones in our Op Plan to track the deliverables. DLR will have access and can view the updates on the RES OpPlan.

Commented [HA10]: I suggest deleting this.

Commented [BB11]: Again, it would be more useful to NRR if the assessment of issues focused on the issues in the GALL-SLR and in the SRM to SECY 14-0016

CMB: Added the emphasis on SRM.

- Irradiation-assisted stress-corrosion cracking of reactor internals and primary system components;
- Concrete and containment degradation; and
- Electrical cable qualification and condition assessment.

The NRC, DOE, and industry are addressing the key technical issues related to materials degradation at nuclear power plants (NPPs). In order to gain better understanding of the materials aging and degradation mechanisms and their implications of structural and component integrity, DOE and the industry have initiated numerous research activities on the four major technical areas. The NRC staff conducts confirmatory research, through several user need requests on specific technical issues, to independently verify licensee data, determine safety margins, and explore uncertainties. In addition, the NRC research will support and increase the efficiency of staff review of SLR applications. To fully support the staff's review of the SLR applications, RES should develop staff assessments of the current knowledge and disposition of materials degradation issues related to the four major technical areas. The assessments should also include recommendations on the need for:

- new regulatory guidance and/or revision of existing regulatory guides (RGs) to address uncertainties in knowledge and/or potential non-conservatism.

Deliverable: Deliver a technical letter report that summarizes the current knowledge and disposition of materials degradation issues identified in EMDA, with particular focus on the issues identified in the GALL-SLR and in SRM on SECY 14-0016 for SLR. The report should also include recommendations on the need for any new or revised guidance to address component integrity of aging structures.

Schedule: The effort should last no more than 36 months from the period of inception of this user need request. The initial draft report should be completed by the end of FY 2018.

C. Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants.

Technical Need: The NRC performs confirmatory research to inform and develop the technical basis for regulatory decisions related to aging management programs for

SLR. Historically, this research has included testing virgin materials under simulated aging conditions, as well as testing and characterization of ex-plant materials harvested from nuclear power plants. Ex-plant 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. Testing ex-plant materials also reduces the uncertainty associated with the applicability of the aging conditions. Therefore, this effort is expected to provide fundamental insights on reactor materials degradation and information addressing potential

technical issues or identified gaps to support anticipated future NRC needs. It will also

Commented [BB12]: the assessment of issues focused on the issues in the GALL-SLR and in the SRM to SECY 14-0016

CMB: Added the emphasis on SRM.

I think DLR is very good at identifying ISGs and revisions to our regulatory guidance. Furthermore, ISGs may discontinued.

CMB: Reference to ISG deleted.

Commented [BB13]: Need more specifics on what NRR is getting. Is this an annual report?

CMB: This will be a final report (after incorporating NRR comments on the draft report). During the process of developing the report, RES will work with NRR closely, with frequent updates and meetings.

Commented [BB14]: Or in the GALL-SLR and SRM?

CMB: See change.

Commented [BB15]: Why so long?

CMB: The final report will capture the insights and information gathered from the current research activities (conducted by DOE, EPRI, industry, and NRC) on the SRM technical issues. Many of the activities (cables, internals, selected concrete activities, RPV) are expected to produce results over the course of the next two years. We understand that some of the activities may not be completed (some concrete activities, high-fluence testing of vessel internals etc.) in two years. For these, we will provide a status update and recommendations, if necessary, for any additional research that industry or DOE (or NRC) may want to consider.

inform the value of existing databases based on simulated aging conditions by assessing their applicability to in-service conditions.

—Based on the recent experience of recovering materials from decommissioned plants, such as Zion, Crystal River, and Zorita (Spain), the efforts of planning, coordination, and eventual harvesting of these materials could be resource-intensive and time-challenging. Future efforts to retrieve materials from decommissioned plants should be focused on the highest value SSCs by proactively developing a strategic database for obtaining unique and significant materials aging degradation information from ex-plant components. Such a database will enable the NRC to focus its harvesting efforts and expeditiously obtain materials and components from plants to be decommissioned in the near future and develop information and knowledge to assess the efficacy of the AMPs.

Request: RES is requested to:

- A. Develop a database which identifies and prioritizes the materials, components, and operating conditions that are needed to address the four topical areas outlined in the SRM on SECY 14-0016, and that, due to challenges in simulating actual service conditions, may be best addressed by harvesting either from plants that are entering decommissioning or ex-plant components from operating plants.
- B. Develop a process to evaluate the components from plants that are entering decommissioning or ex-plant components from operating plants that would be appropriate candidates for harvesting, and to ensure that timely contact is made with the plant owner to facilitate any harvesting targets that may be identified.
- C. Use the process developed in item B to evaluate the suitability of components from plants that are currently either under decommissioning or replacing components that may be of interest.
- D. Continue to implement the process developed in item B as components become available from additional plants.

Deliverable: RES should provide the database for NRR review, and summarize the priority listing in a letter report. Likewise, Items B and C should be documented in a letter report. Item D is a continuing item that should be summarized in a letter report or e-mail as appropriate. develop a database covering the four topical areas outlined in the SRM on SECY 14-0016 and containing information on:

- research gaps for SLR that may be best addressed by harvesting due to challenges in simulating actual service conditions, and
- materials that can be harvested from to-be-decommissioned NPPs and ex-plant components from operating plants to better inform the NRC's aging management programs (AMPs) and aging-related regulatory oversight and to better plan research activities.

Commented [BB16]: I think this would be a useful product and might reduce research costs by focusing only on the material for which research is needed. Also, as we learned from the concrete samples from Zorita there is a timing issue in that you have to be ready to be specific what is needed and in a relatively specified by the provider.

CMB: This is our position, as well.

Commented [HA17]: Suggest that we add confirming current approaches

Schedule: Item A and B should be completed within 18 months of issuance of this user need request. Item C should be completed within 24 months of issuance of this user need request. Item D is an activity that should continue. The effort should last no more than 36 months from the period of inception/issuance of this user need request.

D3.-Continue to Develop Domestic and International Partnerships to Share Expertise, Capabilities and Resources Related to Aging Management Research for Long-Term Operations (LTO)

Technical Need: Various domestic and foreign research organizations, government agencies, utilities and research organizations are presently engaged in aging management research, the results of which may be of value to the NRC regarding plant operations during the SLR period. Additionally, the Electric Power Research Institute (EPRI) is engaged with various international research organizations to develop data on aging mechanisms/effects. As such, it benefits the NRC to be engaged in domestic and international research partnerships in order to evaluate all available operating experience and relevant research, leverage resources, and minimize unnecessary duplication of efforts. It would be advantageous to the NRC to develop partnerships with these entities such that the various research programs could be better coordinated and focused on high-priority needs.

Request: RES is requested to continue to develop agreements with domestic and international partners to collaborate on aging management research that results in information to help inform agency decisions regarding SLR operating periods.

Deliverable: Continue to develop agreements with domestic and international partners to collaborate on aging management research that results in information to help inform agency decisions regarding SLR and long-term operations. Integrate as appropriate the results of these collaborative research and information exchanges from international partnerships into Tasks A and B. RES should provide to interested NRR branch chiefs (from DE and DLR) and senior staff relevant products (e.g., trip reports, meeting summaries, papers, presentations, reports and other information) from interactions with domestic and international organizations. In addition, relevant findings from recent interactions and future plans should be discussed as a standing agenda item during quarterly meetings between RES/DE, NRR/DLR and NRR/DE. an annual summary of international collaborative research results and status of interactions (e.g., references to meeting minutes, presentations, technical reports, etc.), highlighting international activities and results that may affect SLR.

Schedule: These products should be provided to NRR in a timely manner effort should continue until the closure of this user need request.

E.

Commented [BB18]: We had a similar task in the previous UNR and a deliverable of an annual summary of international collaborative research but I don't recall getting any reports.

CMB: Again, we will make sure all the deliverables and schedules are specified in our response to the UNR. And we will track the milestones.

Commented [HA19]: We need to be more specific on task and deliverables

Portions of the attachment, which is immediately following this email, is redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Iyengar, Raj
Sent: Fri, 30 Sep 2016 11:44:16 -0400
To: Frankl, Istvan
Cc: Hull, Amy;Hiser, Matthew
Subject: RE: Revised estimates and UNR
Attachments: DLR-UNR-Resources-Sept26.xlsx

Steve,
Yes, Matt provided those estimates. I made a slight revision and ran that by Matt.

Matt, Agree?

Raj

From: Frankl, Istvan
Sent: Friday, September 30, 2016 11:35 AM
To: Iyengar, Raj <Raj.Iyengar@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: Revised estimates and UNR

Thanks, Raj.

Did you align with Matt H. on the harvesting scope as well as related FTEs and contract funds?

I have no additional technical comments on the draft UNR (It will need to go to QTE but that will be done at NRR.)

If Matt H. is OK with the FTEs and \$s for the ex-plant harvesting task, I am OK with the rest.

Thanks,

Steve

From: Iyengar, Raj
Sent: Thursday, September 29, 2016 2:05 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: FW: Revised estimates and UNR

Steve,

You may review the resource estimates. Amy mentioned that DLR did not want to see the TID task in the new UNR.

I have also made a minor change in the deliverables for Task 1.

Raj

From: Hull, Amy
Sent: Thursday, September 29, 2016 1:47 PM
To: Iyengar, Raj <Raj.Iyengar@nrc.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: Revised estimates and UNR

Yes, as far as I am concerned.

From: Iyengar, Raj
Sent: Thursday, September 29, 2016 1:20 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: Revised estimates and UNR

Thanks, Amy. Then, can I send a note to Steve Frankl that he can review the latest estimate (and the minor revision of the UNR Task 1 deliverable) I sent you all on Monday?

From: Hull, Amy
Sent: Wednesday, September 28, 2016 3:56 PM
To: Iyengar, Raj <Raj.Iyengar@nrc.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: Revised estimates and UNR

As mentioned, I hit wall yesterday.

From: Iyengar, Raj
Sent: Wednesday, September 28, 2016 2:48 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: Revised estimates and UNR

Amy/Rob,

Steve was inquiring about this. Please let me know if you have changes to the estimates/deliverables/tasks.

Thanks so much.

Raj

From: Iyengar, Raj
Sent: Monday, September 26, 2016 12:07 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: Revised estimates and UNR

Amy/Rob,

I have added the development of the summary reports to the deliverable for Task 1 (brief addition). I have also revised the resource estimates by rolling the FTE for summary documents with the resources needs for Task 1.

If you folks decide to add the new task on TID, please do so in the attached revised UNR.

After you make any changes, we can send to those who attended this AM meeting for comment or awareness. I will leave that to Steve.

Raj

Schedule and Resources for the Various Tasks
Period of Performance (FY17-20)

Task Number	Task Description	Completion Date	FTE	Contract \$
1	Hold NRC/industry workshops (2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY20	(b)(5) [] year	[] for FY18 and FY20
				[]
		Total (Task 1)	[] (b)(5)	[] (b)(5)
2	Develop/Implement a strategy for harvesting materials/components from decommissioned plants			
2A	Develop a database	FY17	(b)(5)	
2B	Develop a process to evaluate the components from plants	FY17		[] (b)(5)
2C	Use the process developed in item B to evaluate the suitability of components from plants	FY18		
2D	Continue to implement the process developed in item B as components become available from additional plants	Ongoing (FY19-FY20)	(b)(5) [] year	
		Total (Task 2)	[] (b)(5)	[] (b)(5)
3	Develop Domestic and International Partnerships	FY17-FY20	[]/year (total [])	

(b)(5)

(b)(5)

From: Moyer, Carol
Sent: Thu, 22 Jun 2017 00:47:55 +0000
To: Hull, Amy;Rao, Appajosula;Hiser, Matthew;Purtscher, Patrick;Kirk, Mark;Sircar, Madhumita;Philip, Jacob;Murdock, Darrell
Cc: Frankl, Istvan;Iyengar, Raj;Seber, Dogan;Miller, Kenneth A;Koshy, Thomas;Tregoning, Robert;Pires, Jose
Bcc: Moyer, Carol
Subject: RE: SLR User Need Request Kickoff
Attachments: SLR UNR Response Timeline 20170621.docx, Copy of DLR-UNR-Resources-Sept26.xlsx

Dear SLR Research Team,

As I am sure you have heard by now, Steve Frankl was successful in securing an extension on the RES response to the NRR User Need Request on subsequent license renewal (SLR). While it seems that the new due date of the end of August is a long way off, there really is not much extra time in the schedule, given the complexity of the content and of the concurrence process. A draft timeline for writing the UNR response is in the attached Word file, for your information.

Now is the time for the Team members to start entering your proposed response text into the [skeleton response memo](#) that Amy has placed in the G-drive folder (G:\DE\CMB\UNR NRR 2017-006). Please try to have your entries completed by June 27th.

Also, part of your response to the UNR will need to take into account whether the estimated resources (FTE and \$) from NRR are appropriate for the work. Please review the attached table and consider these estimates in your response.

Thank you,
Carol

Carol Moyer
Sr. Materials Engineer
RES/DE/CMB
carol.moyer@nrc.gov
301-415-2153

From: Moyer, Carol
Sent: Thursday, May 18, 2017 12:13 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Kirk, Mark <Mark.Kirk@nrc.gov>; Philip, Jacob <Jacob.Philip@nrc.gov>
Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>
Subject: RE: SLR User Need Request Kickoff

Dear SLR Research Team,

I just coined this name, and I hope it is all right with all of you. I am not trying to create any new structure or obligations – only to acknowledge that your ongoing research contributes to our collective understanding that supports NRR's subsequent license renewal safety reviews.

Second, I neglected to include Mark Kirk and Jake Philip on my previous communications related to NRR-2017-006, the new User Need Request on SLR research. My apologies!! Both RPV integrity and ASR are still included in the confirmatory research for SLR, and they need to be considered in our planning.

As you know, Amy Hull is the POC for this User Need with NRR. She and I are working together to develop the RES response. We plan to use, as a starting point, the recently-approved UNR and RES response on irradiation assisted damage (IAD), NRR-2017-001. The response memo can be found here:

<G:\DE\CMB\UNR NRR 2017-006\1 DLR-related UNRs, responses\IAD response 2017-05-04-123737.docx>. This provides a good example with respect to length and level of detail.

Amy has started a template document for the NRR-2017-006 response, and we are requesting each of the contributing team members to propose edits to this document. The draft response is **here**: <G:\DE\CMB\UNR NRR 2017-006\draft collective SLR UNR response 05-20-2017.abh.docx>. Please use **track changes**, so I can keep the various contributions and changes straight. Also, if you are proposing to add technical scope to the response – work that is not clearly in NRR's request – please flag that to me right away, so that it can be discussed with our NRR counterparts.

The UNR and other related documents may be found in this folder: <G:\DE\CMB\UNR NRR 2017-006>

Also, Amy has been updating the SharePoint page on Long Term Operations research, here: <http://fusion.nrc.gov/res/team/de/cmb/LTO/default.aspx>

Thank you, again,
Carol

From: Moyer, Carol

Sent: Tuesday, May 16, 2017 5:40 PM

To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>

Cc: Pires, Jose <Jose.Pires@nrc.gov>

Subject: SLR User Need Request Kickoff

All,

Thank you, again, for participating in today's kickoff meeting for NRR-2017-006 (attached), the recent user need request on research related to subsequent license renewal. RES/DE has been

supporting this work for many years, and this latest request provides a framework for additional related research and documentation of lessons learned.

Each of you is doing work related to this request. Again, this UNR is not intended to duplicate ongoing work, and it is hoped that it will not cause confusion in tracking these items, either. As you review the UNR, please consider how you can contribute to any or all of the tasks. I will need input from each of you to compile the response to the UNR. We have been given a due date for the response (to RES/PMDA) of **June 12th**. If you cannot provide your input in time to support that target date (due to travel, workload, etc.) – that is, by about **June 2nd**, please let me know when you will be able to reply. Steve Frankl is willing to request an extension, if needed, but would prefer to do so only once.

For each of the four main Tasks in the UNR to which you will contribute, please reply with:

- A. Description of proposed Subtask
- B. Recommendation for use of NRC or Contractor staff
- C. Level of effort (hrs.), cost (\$), and rough schedule
- D. Cross-reference to existing UNRs

For example, please note if the proposed work complements or extends work that is tracked under another UNR.

If you have any questions on this, please feel free to contact me.

Thanks in advance,
Carol

Carol Moyer
Sr. Materials Engineer
RES/DE/CMB
carol.moyer@nrc.gov
301-415-2153

SLR UNR Response Timeline

6/21/2017

	Action	Start Date	Target Completion Date (COB)	Completion Date	Work days allowed	Lead	Comments
	Input from SLR Team members to draft response	6/21	6/27		5	All	
	Review suggested changes and send draft response to BC: CMB	6/28	6/29		2	Moyer / Hull	
	Review & send comments on draft response back to Moyer	6/30	7/5		3	Frankl	
	Review draft response with NRR PM	6/30	7/7		5	Moyer / Hull / Brady	
	Make any requested changes in UNR response and return revised draft to BC:CMB for approval to send to DE BCs for concurrence	7/6	7/10		3	Moyer / Hull	
	Second review & concurrence by BC: CMB	7/11	7/13		3	Frankl	
	Email draft response with explanatory cover letter to DE BCs for review & concurrence	7/14	7/14		1	Moyer	CIB, CMB, SGSEB, ICEEB
	BCs review & concur or return comments to Moyer	7/17	7/21		5	DE BCs	
	Make any changes in UNR response and email back to DE BCs for concurrence	7/21	7/21		1	Moyer / Hull	
	Second review & concurrence by BCs	7/24	7/26		3	DE BCs	
	Send draft response to DE mgt. for concurrence	7/27	7/27		1	Moyer	
	DE mgt. review & concur or return comments to Moyer	8/01	8/10		8	Thomas/Regan	Both Moyer & Hull on travel Aug 7-9
	Brief DE mgt., if needed	8/02 or TBD	8/02 or TBD		1	Moyer/Hull	
	Make any changes in UNR response and	8/10	8/11		2	Hull/Moyer	

resubmit to DE mgt. for concurrence						
Second review and concurrence by DE mgt.	8/14	8/17		4	Thomas/ Regan	Moyer on travel Aug 14-17
Send draft response to RES mgt. for concurrence	8/18	8/18		1	Moyer	
RES mgt. review & concur or return comments to Moyer	8/21	8/25		5	Weber / Boland	
Brief RES mgt., if needed	8/22 or TBD	8/22 or TBD		1	Moyer/Hull	
Make any changes in UNR response and resubmit to RES mgt. for concurrence	8/28	8/28		1	Moyer/Hull	
Second review and concurrence by RES mgt.	8/28	8/30		3	Weber / Boland	
Transmit response to NRR	8/31	8/31		1	Moyer	

Schedule and Resources for the Various Tasks
Period of Performance (FY17-20)

Task Number	Task Description	Completion Date	FTE	(b)(5)Contract \$
1	Hold NRC/industry workshops (2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY20	(b)(5) [redacted]/year	[redacted] for FY18 and FY20 [redacted] (b)(5)
		Total (Task 1)	(b)(5)	(b)(5)
2	Develop/Implement a strategy for harvesting materials/components from decommissioned plants			
2A	Develop a database	FY17	[redacted]	
2B	Develop a process to evaluate the components from plants	FY17	(b)(5)	[redacted] (b)(5)
2C	Use the process developed in item B to evaluate the suitability of components from plants	FY18		
2D	Continue to implement the process developed in item B as components become available from additional plants	Ongoing (FY19-FY20)	(b)(5) [redacted] year	
		Total (Task 2)	[redacted] (b)(5)	[redacted] (b)(5)
3	Develop Domestic and International Partnerships	FY17-FY20	[redacted] year (total [redacted]) (b)(5) (b)(5)	

From: Hiser, Matthew
Sent: Thu, 5 Jan 2017 16:23:08 +0000
To: Rao, Appajosula
Cc: Frankl, Istvan
Subject: RE: STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)

Hi Sri,

(b)(5)

Here is the current status in STAQS. The REQ is for (see left column of screenshot) and with Kathy for approval.

Summary

Version: 000001 Pending
View: Current Version

This Amendment: 000001

Status: Pending
Stage: Amended Requisition
Total Items: 1

Commitment Amount

(b)(5)

Net View of Amendment: 000001

Status: Pending
Stage: Amended Requisition
Total Items: 1

Commitment Amount

(b)(5)

Amendment 000001 is currently on route pending approval.

The amendment is currently with KATHRYN M. BROCK. Click "View route history" below for details.

What would you like to do?

- View route history
- View snapshot
- Validate amendment data
- View change text
- Change route
- Cancel route

Switch to a different version of this requisition
000001 Pending

Create a new document from this requisition
Select

[Return to Home](#)

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

Matt:

(b)(5)

I thought that we are requesting for with this STAQS requisition. I addressed Steve's comments and changes on the evaluation. Please submit the form and let me know how much you have added in the requisition.

Thank you

Sri

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

From: Hiser, Matthew

Sent: Wednesday, January 04, 2017 12:48 PM

To: Rao, Appajosula <Appajosula.Rao@nrc.gov>

Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>

Subject: FW: STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)

Importance: High

Hi Sri,

Here are Steve's comments/tracked changes on the evaluation. Once you address them, I'll resubmit in STAQS.

Thanks!

Matt

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

From: Frankl, Istvan

Sent: Wednesday, January 04, 2017 12:24 PM

To: Hiser, Matthew <Matthew.Hiser@nrc.gov>

Subject: RE: STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)

Importance: High

Thanks, Matt.

I have several comments/corrections for the evaluation. Please see the attachment for details and address them ASAP.

Steve

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

From: Hiser, Matthew

Sent: Wednesday, January 04, 2017 10:11 AM

To: Frankl, Istvan <Istvan.Frankl@nrc.gov>

Subject: RE: STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)

Hi Steve,

Just resubmitted with proposal and evaluation. Wow, didn't realize Kathy was departing so quickly!

Thanks!

Matt

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

From: Frankl, Istvan
Sent: Tuesday, January 03, 2017 3:58 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: RE: STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)
Importance: High

Matt,

Did you assist Sri with this submittal? If not, please reach out to him.

(b)(5) As per the Notes section, this action is accepting the ANL proposal and it obligates available FY17 Q2 funds [REDACTED]. If this is correct, the forms documenting the evaluation and negotiation (if any) need to be uploaded before I can review/accept this requisition. If possible, please do this ASAP so that Kathryn can also approve it by Friday, her last day with DE.

Thanks,

Steve

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

From: STAQS_Notifications_NoReply@esc.gov
[mailto:STAQS_Notifications_NoReply@esc.gov]
Sent: Tuesday, January 03, 2017 1:18 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: [External_Sender] STAQS Document Notification: For your approval--Requisition: Testing of Irradiated Ex-plant Materials in Environment (RES-17-0005)

Requisition: RES-17-0005 is ready for your approval in STAQS.
Project Title: Testing of Irradiated Ex-plant Materials in Environment
Amendment: 000001
Description: "Testing of irradiated ex-plant materials in environment". To conduct crack growth rate and fracture toughness tests in PWR environment and also examine the microstructure of the fractured surface of Zorita reactor internals that were irradiated to high neutron doses.
Owner: MATTHEW A. HISER
Requisitioner: APPAJOSULA S. RAO
Technical Point of Contact: APPAJOSULA S. RAO
Buyer: APRIL M. BUCHER
Site: RES

Note to requester: Portions of the attachment, which is immediately following this email, is redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Kanney, Joseph
Sent: Fri, 8 May 2015 13:14:40 -0400
To: Hiser, Matthew
Subject: RE: Strategic Harvesting for Active Components
Attachments: LTRP-FY2016-Submittal-JFK-2013-10-09.docx

Here is the long-term research idea that I submitted on this topic. The idea was selected by the SL committee, approved by Brian and slated for an early start. That's how we got to this point.

--- Joe



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

From: Hiser, Matthew
Sent: Thursday, May 07, 2015 1:22 PM
To: Hiser, Matthew; Kanney, Joseph
Subject: Strategic Harvesting for Active Components
When: Friday, May 08, 2015 1:30 PM-2:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Matt will call 301-251-7600

Sounds good!

LTRP Submittal FY16

(updated 2013-10-09)

Contact Information

Name: Kanney, Joseph

Organization: RES/DRA/ETB

Project Information

Project Title: Strategic Approach for Obtaining Material and Component Aging Information from Decommissioning Nuclear Power Plants

Category: Other

Cost Estimate: (b)(5)

FTE: (b)(5)

Fiscal Year: FY2016

Work Description

Structures, systems and components (SSCs) serving in a nuclear power plant (NPP) must withstand a very harsh environment including extended time at temperature, neutron irradiation, stress, and/or corrosive environments. The many modes of degradation are complex and vary depending on location and material. However, understanding and managing material and component degradation is a key for the continued safe and reliable operation of NPPs.

The NRC and Industry will soon have an unprecedented opportunity to obtain very valuable but often difficult to obtain information on material and component degradation from the cohort of NPPs that will be decommissioned in the coming decade(s). In the last year four plants have ceased operation or announced that will cease operation in the next year (Crystal River Unit 3, Kewaunee, SONGS Units 2 & 3, and Vermont Yankee). These plants comprise a range of reactor types, containments, as well as structures, systems, and components (SSCs) important to safety. Other NPPs may be added to this list in the near future.

The objective of this project is to develop a long-range strategy or roadmap for obtaining information from these plants as they go through decommissioning. The focus will be on timely acquisition of information that can significantly improve the agency's risk-informed and performance-based regulatory approach, but has been very difficult or impossible to obtain from the operating reactor fleet. A very broad range of materials, components or structures could be eventually investigated if the appropriate roadmap is made in advance. Potential items of interest include: 1) corrosion of core internals plus

primary and secondary piping; 2) reactor pressure vessel embrittlement; 3) corrosion of Ni-based metals; 4) concrete degradation; 5) corrosion of buried piping; and 6) degradation of Electrical power and I&C cabling and insulation; 7) effectiveness of previous mitigation or repairs; and 8) performance of replacement materials. Potential activities to consider could range from the relatively simple and inexpensive (e.g. enhanced inspections of previously inaccessible features) to complex and resource intensive (e.g., acquisition of sample materials or components followed by laboratory investigation or destructive testing).

The roadmapping process will identify a range of options and score them with regard to importance, complexity and resource requirements. The roadmap will, to the extent possible, take into account the type and schedule of decommissioning for NPPs in the cohort. The roadmap will identify options that represent “low-hanging fruit” as well as options that are high-risk, but high-reward.

The roadmap will be developed in three stages. The first stage will consist of a questionnaire and interviews with focus groups from various technical disciplines within NRC. The second stage will comprise one or two public workshops. The results of the first two phases will be combined into a final roadmap in the third stage. The roadmap will be developed in cooperation with Industry and other federal agencies such as DOE. International counterparts may also be interested in participation.

Leveraging Resources (weight 10%)

The project leverages resources while maintaining the NRC's independence and supporting the need schedule for issue resolution.

This project will leverage resources both within and external to NRC. The most important internal resource to be leveraged is the collective knowledge and experience of NRC staff and selected contractors who have been engaged in license extension reviews, inspections, analysis of operating experience data, research on material and component aging issues, and probabilistic risk assessment. Previous efforts such as those that produced the Generic Aging Lessons Learned (GALL) Report and the Expert Panel Report on Proactive Materials Degradation Assessment, as well as insights developed by the “Life Beyond 60” Program will be leveraged in this project. Results of previous research projects on material aging and degradation issues will also be leveraged.

One major external resource this project will leverage is DOE's Light Water Reactor Sustainability Program (LWRS) Program, specifically results from two LWRSP R&D Pathways: 1) Materials Aging & Degradation; and 2) Risk-Informed Safety Margin Characterization. R&D efforts under the LWRS Program are managed by DOE-NE's Office of Light Water Reactor Technologies, NE-72, and the program Technical Integration Office, located at the Idaho National Laboratory (INL).

Another significant external resource to be leveraged is EPRI's EPRI's Long-Term Operation (LTO) Program; particularly R&D efforts in: 1) Primary System Metals Aging; 2) Concrete Structures, including Containment Degradation; 3) Advanced Safety and Risk Analysis Tools; 5) Cable Aging; and 6) Aging Management Program Scope for Operation Beyond 60 Years. R&D efforts in the Long-Term Operations (LTO) Program are managed as a separate technical program operating in the Plant Technology

Department of the EPRI Nuclear Power Sector, with the guidance of an industry advisory Integration Committee.

An initial list of targets for inspection or testing will be developed mainly through leveraging the internal resources listed above. The roadmap will be modified and refined through interactions with the external resources. But the final roadmap will represent the NRC's priorities and strategies for moving forward. It can serve as the basis for new MOUs, modifications to existing MOUs, or other formal arrangements with Industry.

Advancing State Of The Art (weight 30%)

The project advances the state of the art in a subject area with significant uncertainties and significant risk or safety implications.

Understanding and managing material and component degradation is unquestionably a key need for the continued safe and reliable operation of NPPs. It is also an area with very significant uncertainties. In many cases, the scientific basis for understanding and predicting long-term environmental degradation behavior of materials in NPPs is incomplete. A strategic approach to examination and testing of materials and components from a relatively large cohort of decommissioning reactors can dramatically increase our knowledge-acquisition rate in this very important area.

Independent Decision Making Tool (weight 10%)

The project provides an independent tool or information that is needed for future regulatory decision making.

This project is aimed at constructing a roadmap for obtaining unique and significant information that will inform the NRC's age-related regulatory oversight decisions over the next two decades, and perhaps beyond. Implementation of the roadmap, in cooperation with Industry and DOE partners can be accomplished over time, through individual research projects as the identified plants progress through their decommissioning phase.

Multi-program Improvement (Weight: 20%)

The project improves more than one program area or the integration between multiple program areas.

The strategic approach to be adopted in this project is aimed at providing benefits to a number of NRC programs. Obviously, acquisition of key material and component aging and degradation information will improve the technical basis for NRC's review of license renewal applications; specifically review of licensee aging management programs. In addition, oversight of operating NPPs would be enhanced by acquisition of data and information useful reducing uncertainties or improving sensitivity analysis in

probabilistic risk assessments (PRA). Another strategic target could be data and information useful in updating qualification standards for equipment used NPPs.

Addressing Gaps (Weight 30%)

The project addresses gaps created by technology advancements that may be employed by licensees or applicants.

There are a number of technical gaps that this project addresses. Most importantly, the current piecemeal approach that obtains isolated and fragmented degradation information as targets of opportunity arise at a few plants can be replaced with a strategic plan that is more comprehensive, wider in scope, and more risk-informed. The roadmap for inspections and/or testing developed in this project will be useful guidance for obtaining key measurements of degradation in a variety of areas. These measurements will be valuable on their own. They will also be useful in basic research on the underlying mechanisms and modes of degradation, and for validation of modeling and simulation tools. Data and information developed from implementation of the roadmap will also be useful in evaluating aging monitoring and mitigation strategies proposed by Industry.

Additional Information

Please provide additional support information for adding the LTRP in prioritizing your project.

From: Hiser, Matthew
Sent: Wed, 3 Feb 2016 20:23:09 +0000
To: Frankl, Istvan
Cc: Obodoako, Aloysius;Tregoning, Robert;Rao, Appajosula;Hull, Amy
Subject: RE: URGENT ACTION: FY16 Shortfall Funds

Hi Steve,

(b)(5)

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

From: Frankl, Istvan
Sent: Wednesday, February 03, 2016 8:59 AM
To: RES_DE_CMB <RESDECMB@nrc.gov>
Subject: URGENT ACTION: FY16 Shortfall Funds
Importance: High

CORs,

(b)(5)

If possible, I would like to get your input today.

Thanks,

Steve

Note to requester: Portions of the attachment, which is immediately following this email, are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Wed, 18 Oct 2017 12:09:09 +0000
To: Seber, Dogan
Subject: Response to User Need Request NRR-2017-006 (002).response BT comments
abh (IF).docx
Attachments: Response to User Need Request NRR-2017-006 (002).response BT comments
abh (IF).docx

Dogan,

Here is the latest working draft of the response to the SLR UNR. I appreciate your help to complete the table that has been inserted, showing related UNRs we are already working on.

Thank you,
Carol

Response to User Need Request NRR-2017-006
Research Assistance on Potential Significant Technical Issues during
the Subsequent Period of Extended Operation

Task 1

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two domestic and international activities (such as, a workshop, conference, symposium, or meeting), one tentatively planned for spring 2019 on mechanical components and one tentatively planned for summer 2020 on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR report, and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before each workshop. RES will document the information from each of these activities in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components – As part of the requested workshop/conference/ symposium/ meeting on materials issues for mechanical components, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated US industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cable Issues – RES will also hold an NRC/industry workshop with international participation (tentatively planned for summer 2020) on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific technical topics and items of interest. RES will

Enclosure

document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late summer 2020.

Task 2

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D of the UNR.

Under a long-term research project preceding the current request from NRR, RES pursued a strategic approach to ex-plant harvesting through two coordinated activities: technical issue prioritization and a workshop on ex-plant material harvesting.

In the first activity, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), developed an approach to prioritize technical issues best addressed by harvesting. The criteria for prioritizing harvesting data needs will be described in the anticipated TLR, expected by the end of 2017 "*Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal*." The deliverable will provided criteria to assess the need for harvesting to address a particular technical issue. The report will then applied these criteria to assess four representative technical issues: electrical cable degradation, embrittlement of cast austenitic stainless steel (CASS), cracking of dissimilar metal welds, and irradiation-assisted degradation (IAD) of stainless steel. This report will also cover the background on the need for harvesting, and past harvesting efforts and experience. The purpose of this report is to serve as a foundation for NRC staff to prioritize technical issues best addressed by harvesting. The initial technical letter report (TLR) for this research is expected to be published in September, 2017, as a PNNL document. This TLR will be reviewed by NRR and RES staff to determine any follow-on work by RES and the final publication type.

In the second activity preceding UNR NRR-2017-006, RES closely collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) to host a workshop on ex-plant materials harvesting on March 7-8, 2017. The purpose of this workshop was to engage with various stakeholders involved in the harvesting process to discuss all aspects of harvesting, including motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting, lessons learned from past harvesting efforts, and future harvesting program planning. The workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which sources to focus on. The workshop was well-attended by representatives from DOE, EPRI, the U.S. industry, and international research organizations. Key insights from the workshop included the need for a clearly defined objective to justify the level of effort, and the benefit of early planning and engagement with the plant from which materials will be harvested. The workshop summary report will be distributed among meeting participants and is expected to be finalized by September, 2017. RES will be pursuing further engagement with interested workshop participants on two outstanding workshop action items: identifying data needs for harvesting and initially creating a 'sources of materials' information tool/database. This is discussed further under Subtask 2.B.

Subtask 2.A.

Moving forward, RES will work internally to evaluate how the four significant issues identified for SLR in the SRM on SECY-14-0016 may be best addressed by harvesting. RES will initially develop an Excel spreadsheet (precursor to the information tool/database) that identifies and prioritizes the materials, components, and operating conditions needed to best address the significant issues. The work in this task includes collecting and inputting information on materials needed and the sources of materials expected to be available.

RES will apply the criteria developed with PNNL described above to the issues for SLR, and will document the outcome of the analysis in an 'information tool/database' (based on Microsoft products such as Access or Excel), as described above, which will identify and prioritize the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool/database to be a living document that can evolve and be updated to reflect the latest operating experience and research, so that users may understand which data needs can be best addressed by harvesting. The purpose of the database is to have a systematic approach to harvesting materials and prioritize limited resources on the best values for harvesting. The database is not an end unto itself, but the means to do the highest priority harvesting for the best technical value.

As a specific example, RES will develop a process to evaluate harvested concrete samples, and will follow through with implementing the process as concrete materials become available from additional plants. The scope of the harvesting strategy includes: structures exposed to high radiation (typically bio-shield structures of certain PWR designs); alkali silica reaction (ASR)-affected structures; post-tensioned structures with emphasis on pre-stressed concrete containment vessels (PCCVs); corrosion of pre-stressing tendons, liners, reinforcing steel, and embedments; and concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects).

Based on information gleaned from discussions with international counterparts on the potential for harvesting and testing of concrete, RES will provide in the information tool the possibilities for this activity and document testing priorities as applicable. As an example, RES has engaged in discussions with the Canadian Nuclear Safety Commission (CNSC) about possibilities for harvesting concrete from a decommissioned plant in Canada extensively affected by ASR. RES also will document the process to evaluate concrete samples from nuclear power plants and their suitability for harvesting. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

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Subtask 2.B.

In parallel with the information tool/database activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting. Based on past experience and

insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from NPPs to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in plant records. RES will work internally and with other interested organizations to identify the best approach to gather the relevant information and use it to inform which harvesting opportunities should be pursued. A TLR documenting the information tool/database with prioritized technical issues and a process to identify suitable sources of materials will be targeted for completion by July, 2018.

Subtasks 2.C. and 2.D.

Implementation of the evaluation process developed in Subtask 2.B. will be pursued in Subtasks 2.C. and 2.D., as requested in the UNR. RES will evaluate potentially-available components from plants performing component replacements or entering decommissioning (Subtask 2.C). If other nuclear facilities present opportunities for material harvesting, RES will assist in evaluating the value of such components (Subtask 2.D). RES will remain in close contact with NRR on the latest developments as this process is implemented.

The evaluation process will identify confirmatory needs that harvested samples can effectively address, will consider decommissioned plants in the U.S. and abroad, and will leverage resources to the greatest extent possible for domestic and international cooperative research opportunities, as stipulated in Subtask 2.E, which is closely integrated with Task 3. Through their national and international contacts, RES staff will maintain alertness for harvesting opportunities relating to various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the information tool/database.

Task 3

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

The DOE Light Water Reactor Sustainability (LWRS) and the EPRI LTO programs support most of the domestic research on aging management in NPPs. RES maintains separate collaborative research agreements with each of these organizations to exchange technical information. These exchanges are essential for the review and assessment of the technical bases for the viability of LTOs. RES staff have frequent technical exchange meetings with DOE and EPRI staff. These meetings have focused on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

RES is a participant in several multi-national cooperative research programs, including the International Forum on Reactor Aging Management (IFRAM), and many others. The RES Office Director signed a multilateral 4-year memorandum of understanding (MOU) for IFRAM in 2015. IFRAM is envisioned to be a network of research organizations, industry groups, regulatory

bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned NPPs worldwide to study irradiation effects under in-service conditions (in coordination with Subtask 2.E). RES and Oak Ridge National Laboratory (ORNL) submitted white papers to the OECD Halden Reactor Project (HRP) proposing research on irradiation effects on the steel-concrete bond, and on creep effects on irradiation damage. RES is also collaborating with HRP on IAD under the auspices of UNR NRR-2017-001 Task 2. These results will inform Task 4 of UNR NRR-2017-006.

RES is working to finalize a bilateral agreement with IRSN, France for exchange of technical information on the effects of ASR on the performance of nuclear concrete. IRSN is conducting a 10-15 year research project focused on studying the long-term performance of concrete affected by ASR, Delayed Ettringite Formation, corrosion and carbonation of nuclear concrete. RES will build upon its ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete, and will continue to participate in OECD/NEA/CSNI activities that develop and assess expertise in the modeling of ASR affected concrete structures.

Through their national and international contacts, and through codes and standards development activities, the RES staff will maintain alertness for partnerships to share expertise, capabilities, and resources in all areas of concern, perhaps especially reactor vessel embrittlement. Information on these opportunities will be communicated to NRR in a timely manner as outlined in the deliverables.

RES will evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues. RES will provide to cognizant NRR staff and management trip reports, summaries, papers, presentations, reports and other information from interactions with *domestic and international organizations as a result of this activity. These products will be provided in a timely manner and this effort will continue until the closure of this UNR. Relevant findings from recent interactions, status and future plans will be discussed as a standing agenda item during appropriate interface meetings between RES/DE, NRR/DMLR and NRR/DE. A report (or slides) for presentation at appropriate Director/Deputy Director interface meetings will be provided 5 days before the meeting.*

Task 4

This UNR (NRR-2017-006) serves as an "umbrella" under which other SLR-focused technical UNRs are coordinated, providing an umbrella under which SLR-focused technical UNRs are put in context. These technical UNRs supported are shown in Table 1 below.

Table 1. SLR-Related Technical UNRs Coordinated/Integrated by UNR NRR-2017-006

UNR #	UNR Title	Comments
NRR-2017-001 ML16300A303 ✓ RES Response to NRR-2017-001 ML17110A202 ✓	Request for Assistance to Evaluate Irradiation-Assisted Degradation of Rx Vessel Internals (b)(5) (b)(5) (b)(5) (b)(5)	<p>This UNR is based on a previous UNR NRR-2012-008 and updates the regulatory research project on void swelling and clarifies current what projects RES is currently involved with and what future projects that are being considered.</p> <p>A third task was added to this UNR for have RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves.</p> <p>Funding Contract: (b)(5) FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5) FTEs: FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5)</p>
NRR-2014-007 ML14126A818 ✓ RES Response to NRR-2014-007 ML14212A127 (package) ✓	Reactor Pressure Vessel Integrity Issues (b)(5) (b)(5)	<p>This UNR superseded UNR NRR-2007-001 and includes 6 tasks: (1) Appendix H in process by NRR, NRO, and RES staff; rulemaking funded in FY17 and team in place to finalize rulemaking effort, (2) updating the tech bases for Appendix G, (3) examination and analysis of irradiated reactor vessel material, (4) providing emergent technical assistance, (5) maintaining database and documentation, and (6) performing/ documenting a tech evaluation on irradiation damage mechanisms and potential revisions to 10 CFR, part 50 App. G of RG 1.99 "Radiation Embrittlement of Reactor Vessel Materials" Rev 2.</p> <p>(b)(5) (b)(5) (b)(5) (b)(5) Funding Contract: \$ [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5)</p>
NRR-2011-014 ML11307A205 ✓ RES Response to NRR-2011-014 ML11335A169 ✓ Amendment to NRR-2011-014 (NRR-2016-012) ML16096A221 ✓	Assessment of Cable Condition Monitoring Amendment to UNR for Assessment of Electrical Cable Condition Monitoring	<p>NRR/DMLR's focus on this UNR is to assess and evaluate condition monitoring methods on electrical cables subjected to accelerated aging under normal and accident conditions.</p> <p>Accelerated aging of the cable samples is expected to commence toward the end of FY2017.</p> <p>The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR).</p> <p>Funding: [redacted] FTEs: [redacted]</p>
NRR-2012-004 ML12109A324 ✓ RES Response to NRR-2012-004 ML12152A107 ✓	Alkali-Silica Reaction (ASR) Research	<p>The objective of this UNR is to develop technical bases for regulatory guidance for evaluating ASR-affected concrete structures, primarily focusing on impact on the structural capacity under design basis loads through its service life, including PEO, and its aging management. The research at NIST includes obtaining data on highly instrumented concrete block specimens to monitor the progression of ASR and assess its impact on in-situ mechanical properties, conducting destructive testing to assess structural impact including seismic response, evaluating numerical modeling methods, and material aspects for determining the state and rate of ASR.</p> <p>Funding: [redacted] FTEs: [redacted]</p>
NRR-2015-007 ML15076A217 ✓ RES Response to NRR-2015-007 ML15229A100 ✓	Effects of Irradiation on Concrete Structures	<p>The purpose of this UNR is to develop technical bases for regulatory guidance to evaluate radiation effects on concrete structures close to reactors. The focus of related regulatory research is to evaluate the impact on structural capacity under design basis loads for service life up to 80 years and develop aging management strategy.</p> <p>The project includes reviewing EPRI and DOE reports by ANL (contract awarded in Jan 2016), harvesting the materials from the decommissioned Jose Cabrera NPP in Zorita, Spain</p> <p>Funding: [redacted] FTEs: [redacted]</p>

Commented [IF1]: Why are some UNRs highlighted on this page?

Commented [IF2]: Please double-check by FY.

Commented [IF3]: Same as above

Commented [IF4]: Same as above

Commented [IF5]: Same as above

Commented [IF6]: Please add \$s and FTEs by fiscal year.

Commented [IF7]: Same as above.

Commented [IF8]: Same as above.

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff.

RES will prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [REDACTED] /year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional)

Under this optional task, NRR may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, which would need further evaluation to assess their continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule

based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) [] year	[] for FY-18 and FY 21 [] (b)(5)
Total (Task 1)			(b)(5) []	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components			
2.A.	Develop an information tool/database	FY 18	(b)(5) []	[] (b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	(b)(5) []	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5) []	
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	(b)(5) [] year (Total [] (b)(5))	
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	(b)(5)
Total (Task 2)			(b)(5) []	[]
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	(b)(5) [] year (Total [] (b)(5))	[] (b)(5) (total for 4 years IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) [] year (Total [] (b)(5))	
5 (optional)	Provide technical assistance to NRR for reviewing SLR applications.	FY 18-21	To be funded if needed	To be funded if needed
Total (Tasks 1-4, over 4 years)			(b)(5) []	(b)(5) []

Note to requester: Portions of the attachments, which are immediately following this email, are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Wed, 17 Jan 2018 15:40:10 +0000
To: Purtscher, Patrick
Subject: Response to User Need Request NRR-2017-006 response 20171019.docx
Attachments: Response to User Need Request NRR-2017-006 response 20171019.docx, memo
SLR UNR response NRR-2017-006 20171019.docx

Pat,

If you need to ensure you are looking at the final Enclosure, check the package ML# at the end of the memo (also attached).

Carol

Response to User Need Request NRR-2017-006
Research Assistance on Potential Significant Technical Issues during
the Subsequent Period of Extended Operation

Task 1

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two domestic and international activities (such as, a workshop, conference, symposium, or meeting), one tentatively planned for spring 2019 on mechanical components and one tentatively planned for summer 2020 on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR report, and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before each workshop. RES will document the information from each of these activities in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components – As part of the requested workshop/conference/ symposium/ meeting on materials issues for mechanical components, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated US industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cable Issues – RES will also hold an NRC/industry workshop with international participation (tentatively planned for summer 2020) on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific technical topics and items of interest. RES will

Enclosure

document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late summer 2020.

Task 2

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D of the UNR.

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Task 3

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

The DOE Light Water Reactor Sustainability (LWRS) and the EPRI LTO programs support most of the domestic research on aging management in NPPs. RES maintains separate collaborative research agreements with each of these organizations to exchange technical information. These exchanges are essential for the review and assessment of the technical bases for the viability of LTOs. RES staff have frequent technical exchange meetings with DOE and EPRI staff. These meetings have focused on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

RES is a participant in several multi-national cooperative research programs, including the International Forum on Reactor Aging Management (IFRAM), and many others. The RES Office Director signed a multilateral 4-year memorandum of understanding (MOU) for IFRAM in 2015. IFRAM is envisioned to be a network of research organizations, industry groups, regulatory

bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned NPPs worldwide to study irradiation effects under in-service conditions (in coordination with Subtask 2.E). RES and Oak Ridge National Laboratory (ORNL) submitted white papers to the OECD Halden Reactor Project (HRP) proposing research on irradiation effects on the steel-concrete bond, and on creep effects on irradiation damage. RES is also collaborating with HRP on IAD under the auspices of UNR NRR-2017-001 Task 2. These results will inform Task 4 of UNR NRR-2017-006.

RES is working to finalize a bilateral agreement with IRSN, France for exchange of technical information on the effects of ASR on the performance of nuclear concrete. IRSN is conducting a 10-15 year research project focused on studying the long-term performance of concrete affected by ASR, Delayed Ettringite Formation, corrosion and carbonation of nuclear concrete. RES will build upon its ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete, and will continue to participate in OECD/NEA/CSNI activities that develop and assess expertise in the modeling of ASR affected concrete structures.

Through their national and international contacts, and through codes and standards development activities, the RES staff will maintain alertness for partnerships to share expertise, capabilities, and resources in all areas of concern, perhaps especially reactor vessel embrittlement. Information on these opportunities will be communicated to NRR in a timely manner as outlined in the deliverables.

RES will evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues. RES will provide to cognizant NRR staff and management trip reports, summaries, papers, presentations, reports and other information from interactions with *domestic and international organizations as a result of this activity. These products will be provided in a timely manner and this effort will continue until the closure of this UNR. Relevant findings from recent interactions, status and future plans will be discussed as a standing agenda item during appropriate interface meetings between RES/DE, NRR/DMLR and NRR/DE. A report (or slides) for presentation at appropriate Director/Deputy Director interface meetings will be provided 5 days before the meeting.*

Task 4

This UNR (NRR-2017-006) serves as an “umbrella” under which associated SLR-focused technical UNRs are coordinated. These technical UNRs are shown in Table 1 below.

Table 1. SLR-Related Technical UNRs Associated with UNR NRR-2017-006

UNR #	UNR Title	Comments
<p>NRR-2017-001 ML16300A303 ✓</p> <p>RES Response to NRR-2017-001 ML17110A202 ✓</p>	<p>Request for Assistance to Evaluate Irradiation-Assisted Degradation of Rx Vessel Internals</p> <p>(b)(5)</p> <p>(b)(5)</p> <p>(b)(5)</p> <p>(b)(5)</p>	<p>This UNR is based on previous UNR NRR-2012-008 and updates regulatory research on void swelling and clarifies current projects and future projects that are being considered.</p> <p>A third task was added to this UNR for RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves.</p> <p>Funding:</p> <p>FY17: [redacted]</p> <p>FY18: [redacted] and FY19: [redacted]</p> <p>(b)(5)</p> <p>FTEs: FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5) (b)(5)</p>
<p>NRR-2014-007 ML14126A818 ✓</p> <p>RES Response to NRR-2014-007 ML14212A127 (package) ✓</p>	<p>Reactor Pressure Vessel Integrity Issues</p> <p>(b)(5)</p>	<p>This UNR superseded UNR NRR-2007-001 and includes 6 tasks: (1) Appendix H in process by NRR, NRO, and RES staff; rulemaking funded in FY17 and team in place to finalize rulemaking effort, (2) updating the tech bases for Appendix G, (3) examination and analysis of irradiated reactor vessel material, (4) providing emergent technical assistance, (5) maintaining database and documentation, and (6) performing/ documenting a tech evaluation on irradiation damage mechanisms and potential revisions to 10 CFR, part 50 App. G of RG 1.99 "Radiation Embrittlement of Reactor Vessel Materials" Rev 2.</p> <p>Funding: (b)(5) (b)(5) (b)(5)</p> <p>FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FY18 - [redacted]</p> <p>FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5)</p>
<p>NRR-2011-014 ML11307A205 ✓</p> <p>RES Response to NRR-2011-014 ML11335A169 ✓</p> <p>Amendment to NRR-2011-014 (NRR-2016-012) ML16096A221 ✓</p>	<p>Assessment of Cable Condition Monitoring</p> <p>Amendment to UNR for Assessment of Electrical Cable Condition Monitoring</p> <p>(b)(5)</p> <p>(b)(5)</p> <p>(b)(5)</p>	<p>NRR/DMLR's focus on this UNR is to assess and evaluate condition monitoring methods on electrical cables subjected to accelerated aging under normal and accident conditions.</p> <p>Accelerated aging of the cable samples is expected to commence toward the end of FY2017.</p> <p>The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR).</p> <p>Funding: (b)(5) (b)(5) (b)(5)</p> <p>Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] (b)(5)</p> <p>FTEs: Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] (b)(5)</p>
<p>NRR-2012-004 ML12109A324 ✓</p> <p>RES Response to NRR-2012-004 ML12152A107 ✓</p>	<p>Alkali-Silica Reaction (ASR) Research</p> <p>(b)(5)</p> <p>(b)(5)</p> <p>(b)(5)</p>	<p>The objective of this UNR is to develop technical bases for regulatory guidance for evaluating ASR-affected concrete structures, primarily focusing on impact on the structural capacity under design basis loads through its service life, including PEO, and its aging management. The research at NIST includes obtaining data on highly instrumented concrete block specimens to monitor the progression of ASR and assess its impact on in-situ mechanical properties, conducting destructive testing to assess structural impact including seismic response, evaluating numerical modeling methods, and material aspects for determining the state and rate of ASR. (b)(5)</p> <p>Funding: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted]</p> <p>FTEs: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] (b)(5) (b)(5) (b)(5)</p>
<p>NRR-2015-007 ML15076A217 ✓</p> <p>RES Response to NRR-2015-007 ML15229A100 ✓</p>	<p>Effects of Irradiation on Concrete Structures</p> <p>(b)(5)</p> <p>(b)(5)</p>	<p>The purpose of this UNR is to develop technical bases for regulatory guidance to evaluate radiation effects on concrete structures close to reactors. The focus of related regulatory research is to evaluate the impact on structural capacity under design basis loads for service life up to 80 years and develop aging management strategy.</p> <p>The project includes reviewing EPRI and DOE reports by ANL (contract awarded in Jan 2016), harvesting the materials from the decommissioned José Cabrera NPP in Zorita, Spain (b)(5)</p> <p>Funding: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted]</p> <p>FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5)</p>

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff.

RES will prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [] year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional)

Under this optional task, NRR may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, which would need further evaluation to assess their continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule

based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) /year	for FY 18 and FY 21 (b)(5)
Total (Task 1)			(b)(5)	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components			
2.A.	Develop an information tool/database	FY 18	(b)(5)	(b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	(b)(5)	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5)	
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	(b)(5) year (Total (b)(5))	
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	
Total (Task 2)			(b)(5)	(b)(5)
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	(b)(5) year (Total 1.0)	(b)(5) (total for 4 years IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) year (Total (b)(5))	
5 (optional)	Provide technical assistance to NRR for reviewing SLR applications.	FY 18-21	To be funded if needed	To be funded if needed
Total (Tasks 1-4, over 4 years)			(b)(5)	(b)(5)



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: Brian E. Holian, Acting Director
Office of Nuclear Reactor Regulation

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH
ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF
EXTENDED OPERATION: NRR-2017-006

By memorandum dated May 4, 2017, the Office of Nuclear Reactor Regulation (NRR) requested assistance from the Office of Nuclear Regulatory Research (RES) to provide "specific research products to facilitate the evaluation of future applications for a license to operate during the subsequent license renewal (SLR) period (i.e., 60 to 80 years). These products should build upon analysis methods, tools, and expertise developed as part of ongoing and new research activities, focused specifically on aging effects during the SLR period." This user need request (UNR) supersedes and incorporates work from Tasks A and D of the previous UNR NRR-2010-006 "provide support in developing technical information to support evaluating the feasibility of license renewal beyond 60 years." This UNR also supersedes NRR-2014-001 "provide expert assistance with reviewing the guidance documents for subsequent license renewal" and serves as an "umbrella" under which associated SLR-focused technical UNRs are coordinated. These technical UNRs include NRR-2017-001 (reactor vessel internals); NRR-2014-007 (reactor pressure vessel), NRR-2016-012 (electrical cables), NRR-2012-004 and NRR-2015-007 (concrete degradation). More details on these UNRs are provided in Table 1 of the Enclosure. For tracking purposes, RES has designated this UNR as NRR-2017-006 (ML16358A427).

The purpose of this memorandum is to respond to UNR NRR-2017-006 with RES's plans to accomplish the following tasks:

- **Task 1:** Hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate aging degradation issues identified in in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191).
- **Task 2:** Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants.
- **Task 3:** Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research.
- **Task 4:** Develop documentation evaluating significant technical issues germane to the review of SLR applications.
- **Task 5:** Provide expert assistance with reviewing SLR applications (optional task)

CONTACT: Amy Hull, RES/DE
301-415-2435

RES staff is conducting ongoing coordinating activities to address Tasks 1, 2, and 3, including both independent and collaborative efforts with industry and other partners. RES staff will continue these activities and integrate the results in deliverables under Task 4. The response has been closely coordinated with NRR technical staff and management. As a result of this effort, RES added optional Task 5. If needed, under this task, RES staff would provide expert assistance with the review and evaluation of SLR applications. The enclosure addresses in greater detail the scope of ongoing and planned activities associated with each task, as well as the estimated resources and the anticipated schedule for the deliverables.

RES staff appreciates the coordination with NRR technical staff and management in this area. We will continue to coordinate with NRR staff and management to ensure that regulatory needs and priorities are satisfied. Changes in the availability of resources or NRR needs could impact the activities, deliverables and schedules of this UNR. In such cases, changes will be implemented jointly by RES and NRR and, if warranted, the UNR will be amended.

Enclosure:

1. Response to User Need Request for
Research Assistance on Potential Significant
Technical Issues during the Subsequent Period
of Extended Operation

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT
PERIOD OF EXTENDED OPERATION: NRR-2017-006

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ADAMS Package Accession No.:ML17227A483

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DATE	10/ /2017	10/ /2017	10/19/2017

OFFICE	D:RES:DE	RES Mail	D:RES
NAME	B. Thomas	K. Johnson	M. Weber
DATE	/ /2017	/ /2017	/ /2017

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From: Moyer, Carol
Sent: Wed, 20 Sep 2017 04:05:13 +0000
To: Frankl, Istvan
Cc: Hull, Amy;Moyer, Carol
Subject: Revised SLR UNR Response
Attachments: SLR UNR response 09-19-2017_cem.docx

Note to requester: A portion of the attachment, which is immediately following this email, is redacted under FOIA Exemption B5, Deliberative Process Privilege.

Steve,

The attached draft response to the SLR User Need Request incorporates the latest changes from Rob T., Amy, and myself, including changes to address NRR/DLR staff comments and questions on our first draft response.

Please review and add your comments.

Thank you,
Carol



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September xx, 2017

MEMORANDUM TO: Brian E. Holian, Acting Director
Office of Nuclear Reactor Regulation

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH
ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL ISSUES
DURING THE SUBSEQUENT PERIOD OF EXTENDED OPERATION:
NRR-2017-006

By memorandum dated May 4, 2017, the Office of Nuclear Reactor Regulation (NRR) requested assistance from the Office of Nuclear Regulatory Research (RES) to provide "specific research products to facilitate the evaluation of future applications for a license to operate during the subsequent license renewal (SLR) period (i.e., 60 to 80 years). These products should build upon analysis methods, tools, and expertise developed as part of ongoing and new research activities, focused specifically on aging effects during the SLR period." This user need request (UNR) supersedes and incorporates work from the previous UNR NRR-2010-006 "provide support in developing technical information to support evaluating the feasibility of license renewal beyond 60 years." This UNR also supersedes NRR-2014-001 "provide expert assistance with reviewing the guidance documents for subsequent license renewal" and complements NRR 2017-001 "research assistance to evaluate irradiation-assisted degradation of reactor vessel internals." For tracking purposes, RES has designated this UNR as NRR-2017-006 (ML16358A427).

The purpose of this memorandum is to respond to UNR NRR-2017-006 with RES's plans to accomplish the following tasks:

- **Task 1:** Hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191).
- **Task 2:** Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants.
- **Task 3:** Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research.
- **Task 4:** Develop documentation evaluating significant technical issues germane to the review of SLR applications.
- **Task 5:** Provide expert assistance with reviewing SLR applications (optional task)

CONTACT: Amy Hull, RES/DE
301-415-2435

RES staff is conducting ongoing coordinating activities to address Tasks 1, 2, and 3, including both independent and collaborative efforts with industry and other partners. RES staff will continue these activities and integrate the results in deliverables under Task 4. RES also proposes an additional, optional task, Task 5. If needed by NRR, under this task, RES staff would provide expert assistance to review and evaluate applications for subsequent license renewals. The enclosure addresses in greater detail the scope of ongoing and planned activities associated with each task, as well as the estimated resources and the anticipated schedule for the deliverables.

RES staff appreciates the coordination with NRR technical staff and management in this area. We will continue to coordinate with NRR staff and management to ensure that regulatory needs and priorities are satisfied. Changes in the availability of resources or NRR needs could impact the activities, deliverables and schedules of this UNR. In such cases, changes will be implemented jointly by RES and NRR and, if warranted, the UNR will be amended.

Enclosure:

Response to User Need Request for Research Assistance on Potential Significant Technical Issues during the Subsequent Period of Extended Operation

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING
THE SUBSEQUENT PERIOD OF EXTENDED OPERATION: NRR-2017-006

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DATE	/ /2017	/ /2017	/ /2017	/ /2017

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DATE	/ /2017	/ /2017	/ /2017	/ /2017

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Response to User Need Request NRR-2017-006

Research Assistance on Potential Significant Technical Issues during the Subsequent Period of Extended Operation

Task 1

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two domestic and international activities (~~either such as, a~~ workshop, conference, symposium, or meeting), one ~~in early autumn 2018 tentatively planned for spring 2019~~ on mechanical ~~issues components~~ and one ~~in late spring tentatively planned for summer 2020~~ on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR [report](#), and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before the each workshop. Prior to the meetings, RES will provide a draft agenda with specific topics for the meeting and the proposed presenters. RES will document the information from each of these activities in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components Issues – As part of the requested ~~autumn 2018~~spring 2019 workshop/ conference/ symposium/ meeting on materials issues for mechanical components issues, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning ~~issues associated with~~ reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated US industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cables Issues – RES will also hold an NRC/industry workshop with international participation ~~in the third fourth quarter of FY20 (spring tentatively planned for summer of 2020)~~ on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific ~~issues technical topics~~ and items of interest. ~~RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before the workshop.~~ RES will document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late ~~spring-summer~~ 2020.

Task 2

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D as stipulated on page 4 of the UNR.

Under a long-term research project preceding the current request from NRR, RES pursued a strategic approach to ex-plant harvesting through two coordinated activities: technical issue prioritization and a workshop on ex-plant material harvesting.

- In the first activity, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), developed an approach to prioritize technical issues best addressed by harvesting. The criteria for prioritizing harvesting data needs are described in the September 2017 TLR “Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal.” The deliverable provided criteria to assess the need for harvesting to address a particular technical issue. The report then applied these criteria to assess four representative technical issues: electrical cable degradation, embrittlement of cast austenitic stainless steel (CASS), cracking of dissimilar metal welds, and irradiation-assisted degradation (IAD) of stainless steel. This report also covered the background on the need for harvesting, and past harvesting efforts and experience. The purpose of this report was to serve as a foundation for NRC staff to prioritize technical issues best addressed by harvesting. The initial technical letter report (TLR) for this research is expected to be published in September, 2017, as a PNNL document. This TLR will be reviewed by NRR and RES staff to determine any follow-on work by RES and the final publication type.
- In the second activity preceding UNR NRR-2017-006, RES closely collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) to host a workshop on ex-plant materials harvesting on March 7-8, 2017. The purpose of this workshop was to engage with various stakeholders involved in the harvesting process to discuss all aspects of harvesting, including motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting, lessons learned from past harvesting efforts, and future harvesting program planning. The

workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which sources to focus on. The workshop was well-attended by representatives from DOE, EPRI, the U.S. industry, and international research organizations. Key insights from the workshop included the need for a clearly defined objective to justify the level of effort, and the benefit of early planning and engagement with the plant from which materials will be harvested. The workshop summary report will be distributed among meeting participants and is expected to be finalized by September, 2017. RES will be pursuing further engagement with interested workshop participants on two outstanding workshop action items: identifying data needs for harvesting and initially creating a 'sources of materials' information tool/database. This is discussed further under Subtask 2.B.

Subtask 2.A.

Moving forward, RES will work internally to evaluate how the four significant issues identified for SLR in the SRM on SECY-14-0016 may be best addressed by harvesting. RES will initially develop an Excel spreadsheet (precursor to the information tool/database) that identifies and prioritizes the materials, components, and operating conditions needed to best address the significant issues. The work in this task includes collecting and inputting information on materials needed and the sources of materials expected to be available.

RES will apply the criteria developed with PNNL described above to the issues for SLR, and will document the outcome of the analysis in an 'information tool/database' (based on Microsoft products such as Access or Excel), as described above, which will identify and prioritize the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool/database to be a living document that can evolve and be updated to reflect the latest operating experience and research, so that users may understand which data needs can be best addressed by harvesting. The purpose of the database is to have a systematic approach to harvesting materials and prioritize limited resources on the best values for harvesting. The database is not an end unto itself, but the means to do the highest priority harvesting for the best technical value.

As a specific example, RES will develop a process to evaluate harvested concrete samples-~~harvested from decommissioned plants~~, and will follow through with implementing the process as concrete materials become available from additional plants. The scope of the harvesting strategy includes: structures exposed to high radiation (typically bio-shield structures of certain PWR designs); alkali silica reaction (ASR)-affected structures; post-tensioned structures with emphasis on pre-stressed concrete containment vessels (PCCVs); corrosion of pre-stressing tendons, liners, reinforcing steel, and embedments; and concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects).

Based on information gleaned from discussions with international counterparts on the potential for harvesting and testing of concrete ~~from decommissioned reactors~~, RES will provide in the information tool the possibilities for this activity and document testing priorities as applicable. As an example, RES has engaged in discussions with the Canadian Nuclear Safety Commission (CNSC) about possibilities for harvesting concrete from a decommissioned plant in Canada extensively affected by ASR. RES also will document the process to evaluate concrete samples

from nuclear power plants and their suitability for harvesting. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

In addition to irradiation effects on concrete materials, RES will continue research on IAD of stainless steel. RES will seek potential sources of reactor pressure vessel internals that may become available for harvesting, to evaluate their utility for regulatory research being conducted under UNR NRR-2017-001.

RES will continue to evaluate the SLR-significant issue of cable aging ~~utilizing~~ using harvested cables. The goal will be to expand on the selection of cable types harvested as part of the existing similar effort under UNRs NRR-2011-014 and NRR-2016-012 to include more cable types (insulation types and medium voltage level cables) and to evaluate the aging effects on power cables at different voltage levels.

Subtask 2.B.

In parallel with the information tool/database activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting. Based on past experience and insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from NPPs to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in plant records. RES will work internally and with other interested organizations to identify the best approach to gather the relevant information and use it to inform which harvesting opportunities should be pursued. A TLR documenting the information tool/database with prioritized technical issues and a process to identify suitable sources of materials will be targeted for completion by July, 2018.

Subtasks 2.C. and 2.D.

Implementation of the evaluation process developed in Subtask 2.B. will be pursued in Subtasks 2.C. and 2.D., as requested in the UNR. RES will evaluate potentially-available components from plants performing component replacements or entering decommissioning (Subtask 2.C). If other nuclear facilities present opportunities for material harvesting, RES will assist in evaluating the value of such components (Subtask 2.D). RES will remain in close contact with NRR on the latest developments as this process is implemented.

The evaluation process will identify confirmatory needs that harvested samples can effectively address, will consider decommissioned plants in the U.S. and abroad, and will leverage resources to the greatest extent possible for domestic and international cooperative research opportunities, as stipulated in Subtask 2.E, which is closely integrated with Task 3. Through their national and international contacts, RES staff will maintain alertness for harvesting opportunities relating to various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the information tool/database.

Task 3

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to

develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

The DOE Light Water Reactor Sustainability (LWRS) and the EPRI LTO programs support most of the domestic research on aging management in NPPs. RES maintains separate collaborative research agreements with each of these organizations to exchange technical information. These exchanges are essential for the review and assessment of the technical bases for the viability of LTOs. RES staff have frequent technical exchange meetings with DOE and EPRI staff. These meetings have focused on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

RES is a participant in several multi-national cooperative research programs, including the ~~OECD Halden Reactor Project (HRP)~~, the International Forum on Reactor Aging Management (IFRAM), and many others. ~~For example, t~~The RES Office Director signed a multilateral 4-year memorandum of understanding (MOU) for IFRAM in 2015. IFRAM is envisioned to be a network of research organizations, industry groups, regulatory bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned NPPs worldwide to study irradiation effects under in-service conditions (in coordination with Subtask 2.E). RES and Oak Ridge National Laboratory (ORNL) submitted white papers to the OECD Halden Reactor Project (HRP) proposing research on irradiation effects on the steel-concrete bond, and on creep effects on irradiation damage. RES is also collaborating with HRP on IAD under the auspices of UNR NRR-2017-001 Task 2. These results will inform Task 4 of UNR NRR-2017-006.

RES is working to finalize a bilateral agreement with IRSN, France for exchange of technical information on the effects of ASR on the performance of nuclear concrete. IRSN is conducting a 10-15 year research project focused on studying the long-term performance of concrete affected by ASR, Delayed Ettringite Formation, corrosion and carbonation of nuclear concrete. RES will build upon its ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete, and will continue to participate in OECD/NEA/CSNI activities that develop and assess expertise in the modeling of ASR affected concrete structures.

Through their national and international contacts, and through codes and standards development activities, the RES staff will maintain alertness for partnerships to share expertise, capabilities, and resources in all areas of concern, perhaps especially reactor vessel embrittlement. Information on these opportunities will be communicated to NRR in a timely manner as outlined in the deliverables.

RES will evaluate products and reports from these organizations that may be provided to NRC

in support of generic or plant-specific issues. RES will provide to cognizant NRR staff and management trip reports, summaries, papers, presentations, reports and other information from interactions with domestic and international organizations as a result of this activity. These products will be provided in a timely manner and this effort will continue until the closure of this UNR. Relevant findings from recent interactions, status and future plans will be discussed as a standing agenda item during appropriate interface meetings between RES/DE, NRR/DMLR and NRR/DE. A report (or slides) for presentation at appropriate Director/Deputy Director interface meetings will be provided 5 days before the meeting.

Task 4

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff. ~~Task 4 also allows for NRR to call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant specific gap analyses.~~

RES will ~~also~~ prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

~~Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.~~

~~As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components such as breakers and relays which would need further evaluation to assess its continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated.~~

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional)

Task 4 also allows forShould it choose to implement optional Task 5, NRR to may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, whichwhich would need further evaluation to assess itsstheir continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) [] year	[] for FY 18 and FY 21 [] (b)(5)
Total (Task 1)			[] (b)(5)	[] (b)(5)
2	Develop a strategy for harvesting <u>Ex-Plant</u> materials/components <u>from decommissioned plants</u>			[] (b)(5)
2.A.	Develop an information tool/database	FY 18	[] (b)(5)	[] (b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	[]	(b)(5)
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	[]	(b)(5)
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	[]/year (Total [])	(b)(5) (b)(5)
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	
Total (Task 2)			[] (b)(5)	[] (b)(5)
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	(b)(5) [] year (Total []) (b)(5)	[] (b)(5) (total for 4 years IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) [] year (Total []) (b)(5)	
5 (proposed)	<u>Provide technical assistance to NRR for reviewing SLR applications.</u>	<u>FY 18-21</u>	<u>To be funded if needed</u>	<u>To be funded if needed</u>
Total (Tasks 1-4, over 4 years)			[] (b)(5)	[] (b)(5)

Note to requester: A portion of the attachment, which is immediately following this email, is redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Tue, 24 Oct 2017 16:50:17 +0000
To: Cole, Cassandra
Cc: Frankl, Istvan;Hull, Amy
Subject: SLR UNR Response - Revised file for the enclosure
Attachments: Response to User Need Request NRR-2017-006 response 20171024.docx

Cassandra,

The attached file is the electronic version of the paper copy that I gave you this morning, along with the concurrence package.

The package is at ML17227A483. The attached file is the enclosure for the memo, at ML17227A485.

Please let me know if you have questions.

Thank you,
Carol

Carol Moyer
Sr. Materials Engineer
RES/DE/CMB
carol.moyer@nrc.gov
301-415-2153

Response to User Need Request NRR-2017-006
Research Assistance on Potential Significant Technical Issues during
the Subsequent Period of Extended Operation

Task 1: Hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate aging degradation issues

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two activities (such as, a workshop, conference, symposium, or meeting) with domestic and international participation, one tentatively planned for spring 2019 on mechanical components and one tentatively planned for summer 2020 on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR report, and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before each workshop. RES will document the information from each of these activities in a NUREG report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components – As part of the requested workshop/conference/ symposium/ meeting on materials issues for mechanical components, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated domestic industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cable Issues – RES will also hold an NRC/industry workshop with domestic and international participation (tentatively planned for summer 2020) on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and

that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific technical topics and items of interest. RES will document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late summer 2020.

Task 2: Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D of the UNR.

Under a long-term research project preceding the current request from NRR, RES pursued a strategic approach to ex-plant harvesting through two coordinated activities: technical issue prioritization and a workshop on ex-plant material harvesting.

In the first activity, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), developed an approach to prioritize technical issues best addressed by harvesting. The criteria for prioritizing harvesting data needs will be described in the anticipated TLR, expected by the end of 2017 *“Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal.”* The TLR will provide criteria to assess the need for harvesting to address a particular technical issue and then will apply these criteria to assess four representative technical issues: electrical cable degradation, embrittlement of cast austenitic stainless steel (CASS), cracking of dissimilar metal welds, and irradiation-assisted degradation (IAD) of stainless steel. This report will also cover the background on the need for harvesting, and past harvesting efforts and experience.

In the second activity preceding UNR NRR-2017-006, RES closely collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) to host a workshop on ex-plant materials harvesting on March 7-8, 2017. The purpose of this workshop was to engage with various stakeholders involved in the harvesting process to discuss all aspects of harvesting, including motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting, lessons learned from past harvesting efforts, and future harvesting program planning. The workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which sources to focus on. The workshop was well-attended by representatives from DOE, EPRI, the U.S. industry, and international research organizations. Key insights from the workshop included the need for a clearly defined objective to justify the level of effort, and the benefit of early planning and engagement with the plant from which materials will be harvested. The workshop summary report will be distributed among meeting participants when finalized. RES will be pursuing further engagement with interested workshop participants on two outstanding workshop action items: identifying data needs for harvesting and initially creating a ‘sources of materials’ information tool/database. This is discussed further under Subtask 2.B.

Subtask 2.A.

Moving forward, RES will work internally to evaluate how the four significant issues identified for SLR in the SRM on SECY-14-0016 may be best addressed by harvesting. RES will initially develop an Excel spreadsheet (precursor to the information tool/database) that identifies and prioritizes the materials, components, and operating conditions needed to best address the significant issues. The work in this task includes collecting and inputting information on materials needed and the sources of materials expected to be available.

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Task 3: Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

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IFRAM is envisioned to be a network of research organizations, industry groups, regulatory bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

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Task 4: Develop documentation evaluating significant technical issues germane to the review of SLR applications

This UNR (NRR-2017-006) serves as an “umbrella” under which associated SLR-focused technical UNRs are coordinated. Table 1 below provides additional detail on these UNRs, along with a summary of the level of effort and funding.

Table 1. SLR-Related UNRs Associated with UNR NRR-2017-006

UNR #	UNR Title	Comments
<p>NRR-2017-001 ML16300A303 ✓</p> <p>RES Response to NRR-2017-001 ML17110A202 ✓</p>	<p>Request for Assistance to Evaluate Irradiation-Assisted Degradation of Rx Vessel Internals</p>	<p>This UNR is based on previous UNR NRR-2012-008 and updates regulatory research on void swelling and clarifies current projects and future projects that are being considered.</p> <p>A third task was added to this UNR for RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves.</p> <p>Funding: (b)(5)</p> <p>FY17: [redacted] FY18: [redacted] and FY19: [redacted] FTEs: FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5)</p>
<p>NRR-2014-007 ML14126A818 ✓</p> <p>RES Response to NRR-2014-007 ML14212A127 (package) ✓</p>	<p>Reactor Pressure Vessel Integrity Issues</p>	<p>This UNR superseded UNR NRR-2007-001 and includes 6 tasks: (1) Appendix H in process by NRR, NRO, and RES staff; rulemaking funded in FY17 and team in place to finalize rulemaking effort, (2) updating the tech bases for Appendix G, (3) examination and analysis of irradiated reactor vessel material, (4) providing emergent technical assistance, (5) maintaining database and documentation, and (6) performing/ documenting a tech evaluation on irradiation damage mechanisms and potential revisions to 10 CFR, part 50 App. G of RG 1.99 "Radiation Embrittlement of Reactor Vessel Materials" Rev 2.</p> <p>Funding: (b)(5) (b)(5) (b)(5) (b)(5) FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5)</p>
<p>NRR-2011-014 ML11307A205 ✓</p> <p>RES Response to NRR-2011-014 ML11335A169 ✓</p> <p>Amendment to NRR-2011-014 (NRR-2016-012) ML16096A221 ✓</p>	<p>Assessment of Cable Condition Monitoring</p> <p>Amendment to UNR for Assessment of Electrical Cable Condition Monitoring</p>	<p>NRR/DMLR's focus on this UNR is to assess and evaluate condition monitoring methods on electrical cables subjected to accelerated aging under normal and accident conditions.</p> <p>Accelerated aging of the cable samples is expected to commence toward the end of FY2017.</p> <p>The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR).</p> <p>Funding: (b)(5) (b)(5) (b)(5) (b)(5) Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] FTEs: Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] (b)(5)</p>
<p>NRR-2012-004 ML12109A324 ✓</p> <p>RES Response to NRR-2012-004 ML12152A107 ✓</p>	<p>Alkali-Silica Reaction (ASR) Research</p>	<p>The objective of this UNR is to develop technical bases for regulatory guidance for evaluating ASR-affected concrete structures, primarily focusing on impact on the structural capacity under design basis loads through its service life, including PEO, and its aging management. The research at NIST includes obtaining data on highly instrumented concrete block specimens to monitor the progression of ASR and assess its impact on in-situ mechanical properties, conducting destructive testing to assess structural impact including seismic response, evaluating numerical modeling methods, and material aspects for determining the state and rate of ASR. (b)(5)</p> <p>Funding: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FTEs: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] (b)(5) (b)(5)</p>
<p>NRR-2015-007 ML15076A217 ✓</p> <p>RES Response to NRR-2015-007 ML15229A100 ✓</p>	<p>Effects of Irradiation on Concrete Structures</p>	<p>The purpose of this UNR is to develop technical bases for regulatory guidance to evaluate radiation effects on concrete structures close to reactors. The focus of related regulatory research is to evaluate the impact on structural capacity under design basis loads for service life up to 80 years and develop aging management strategy.</p> <p>The project includes reviewing EPRI and DOE reports by ANL (contract awarded in Jan 2016), harvesting the materials from the decommissioned Jose Cabrera NPP in Zorita, Spain (b)(5)</p> <p>Funding: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5) FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5)</p>

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff.

RES will prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional): Provide expert assistance with reviewing SLR applications

Under this optional task, NRR may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, which would need further evaluation to assess their continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule

based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in Table 2.

Table 2: Schedule and Resources¹ for the Various Tasks				
Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) year	for FY 18 and FY 21 (b)(5)
Total (Task 1)			(b)(5)	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components			
2.A.	Develop an information tool/database	FY 18	(b)(5)	(b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	(b)(5)	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5)	
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	(b)(5) year (Total (b)(5))	
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	
Total (Task 2)			(b)(5)	(b)(5)
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	(b)(5) year (Total (b)(5))	(total for 4 years (b)(5) IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) year (Total (b)(5))	
5 (optional)	Provide technical assistance to NRR for reviewing SLR applications.	FY 18-21	To be funded if needed	To be funded if needed
Total (Tasks 1-4, over 4 years)			(b)(5)	(b)(5)

¹ Note that the resources associated with this UNR include RES/DE/SGSEB (b)(5) yr over 4 years and (b)(5) and RES/DE/CMB (balance). All other SLR-related work is covered by the UNRs shown in Table 1.

Note to requester: The attachments are immediately following this email. Portions of the two Excel files (.xlsx attachments) are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Frankl, Istvan
Sent: Tue, 7 Jul 2015 21:25:10 -0400
To: West, Steven
Cc: Brock, Kathryn;Bamford, Lisa;Stout, Kathleen;Hull, Amy;Hiser, Matthew;Focht, Eric
Subject: STAQS action for "Strategic Approach for Obtaining Material and Component Aging Information" w/ PNNL
Attachments: StratHarv SOW 7-6-15.docx, PNNL TASK 1 IGCE.xlsx, PNNL ALL TASKS IGCE.xlsx

Steve,

PMDA has notified me today that subject request for proposal and funding action to initiate new work with PNNL had not been routed to you for approval.

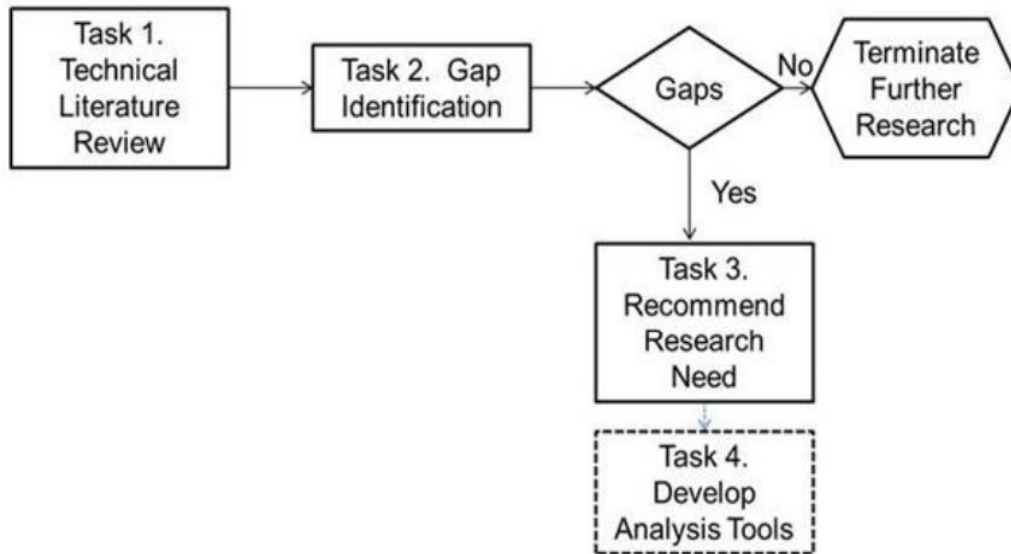
This work has three inter-related objectives:

- (1) Develop a long-range strategy for obtaining information from decommissioned NPPs as well as providing the flexibility to get ex-plant components from operating plants. The focus will be on timely acquisition of experiential real-world aging-degradation information that can significantly improve the agency's risk-informed and performance-based regulatory approach, but has been very difficult or impossible to obtain from the operating reactor fleet.
- (2) Construct a strategic plan and specifications for obtaining unique and significant materials aging degradation information from diverse sources (operating experience, nuclear facilities, long-lived industrial plants, materials organizations) that will inform the NRC's age-related regulatory oversight in the future. This exploratory research is expected to provide fundamental insights on reactor materials degradation to support anticipated future NRC needs.
- (3) Update the Proactive Management of Materials Degradation (PMMD) information tool developed at PNNL for RES to incorporate LTO/SLR-relevant information so that it can be better used to inform prioritization in the ex-plant material strategic plan.

The tasks associated with this work and their duration are described in the table below:

Task	Task Title/Description	Duration (Months)
Task 1	Scoping Study and technical literature review	18
Optional Task 2	Decision Making on Specific Confirmatory Research Needed to Address Gaps	6
Optional Task 3	Confirmatory Research Addressing Technical Gaps	33
Optional Task 4	Development of Independent Decision Making Tools	33

The optional tasks above will be conducted, as shown in the figure below:



A decision on further optional research outlined in Tasks 2, 3, and 4 above will be made after completion of Task 1.

For your information I have attached the Statement of Work as well as the Independent Government Cost Estimates that include the cost of the base scope (Task 1) as well as the total cost with options (Tasks 1 through 4).

Please let us know if you want this action recalled and resubmitted for your review in STAQS.

Thanks,

Istvan (Steve) Frankl

Branch Chief
RES/DE/CMB
U.S. Nuclear Regulatory Commission

Phone: (301) 415-2227 (after 6/22/2015)
E-mail: Istvan.Frankl@nrc.gov

STATEMENT OF WORK

NRC Agreement Number	NRC Agreement Modification Number	NRC Task Order Number (If Applicable)	NRC Task Order Modification Number (If Applicable)
NRC-HQ-25-14-D-0001	N/A	NEW	N/A
Project Title			
Strategic Approach for Obtaining Material and Component Aging Information			
Job Code Number	B&R Number	DOE Laboratory	
		Pacific Northwest National Laboratory (PNNL)	
NRC Requisitioning Office			
Nuclear Regulatory Research (RES)			
NRC Form 187, Contract Security and Classification Requirements			
<input type="checkbox"/> Applicable		<input type="checkbox"/> Involves Proprietary Information	
<input checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Sensitive Unclassified	
<input checked="" type="checkbox"/> Non Fee-Recoverable		<input type="checkbox"/> Fee-Recoverable (If checked, complete all applicable sections below)	
Docket Number (If Fee-Recoverable/Applicable)		Inspection Report Number (If Fee Recoverable/Applicable)	
Technical Assignment Control Number (If Fee-Recoverable/Applicable)		Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)	

1.0 BACKGROUND**Regulatory Context:**

The NRC has established a license renewal process that will allow nuclear power plants (NPP) to renew their licenses for an additional 20 years, via 10 CFR 54.31(d) stating that “a renewed license may be subsequently renewed.” The biggest challenges for the NRC and the industry will be addressing the major technical issues for this second “subsequent” license renewal (SLR) beyond 60 years. As summarized in SECY-14-0016, the NRC staff believe that the most significant technical issues challenging power reactor operation beyond 60 years are related to:

- Reactor pressure vessel (RPV) neutron embrittlement at high fluence
- Irradiation assisted degradation (IAD) of reactor internals and primary system components
- Concrete and containment degradation

- Electrical cable qualification and condition assessment.

Understanding the causes and control of degradation mechanisms forms the basis for developing aging management programs (AMPs) to ensure the functionality and safety margins of NPP systems, structures, and components (SSC). The resolution to these issues should provide reasonable assurance of safe operation of the components in the scope of license renewal during the subsequent period of extended operation.

Because of the cost and inefficiency of piecemeal sampling, there is a need for a strategic and systematic approach to sampling materials from SSC in decommissioning plants. The envisioned work addresses both passive and active components. In that sense, it addresses aging management of passive components under the license renewal rule, 10 CFR 54, as well as the maintenance of active components covered by the maintenance rule, 10CFR50.65, as seen in Figure 1 below.

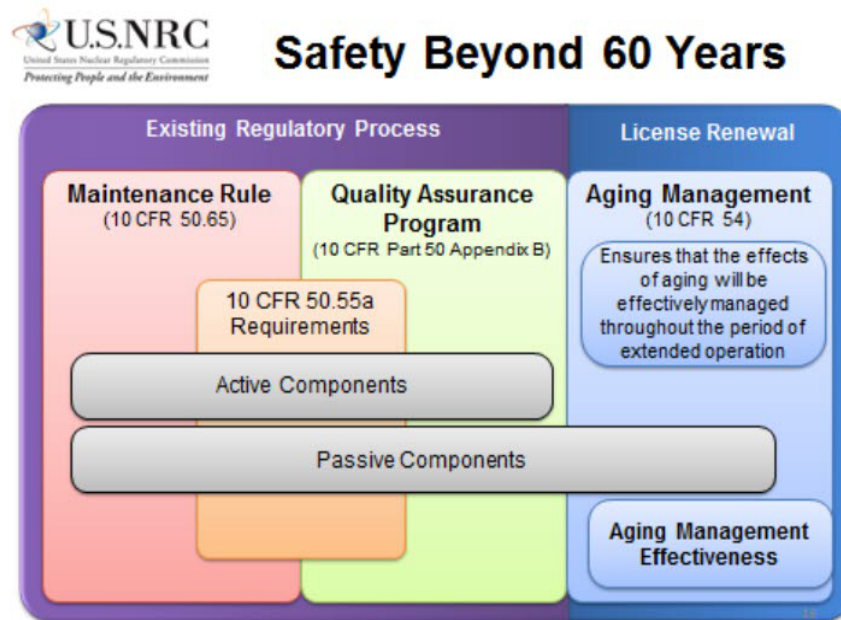


Figure 1: Relationship between aging management of active and passive components (from NRR/RES presentation to ACRS, 2014)

In the past few years, four plants have ceased operation or announced that they will cease operation: Crystal River Unit 3 (PWR), Kewaunee (PWR), San Onofre Units 2 & 3 (PWR), and Vermont Yankee (BWR). These plants comprise a range of reactor types, containments, and SSCs important to safety. The primary objective of this project is to develop a long-range strategy for obtaining information from these plants as they go through decommissioning. The focus will be on timely acquisition of experiential real-world aging-degradation information that

can significantly improve the agency's risk-informed and performance-based regulatory approach, but has been very difficult or impossible to obtain from the operating reactor fleet.

Technical Context:

Creating a roadmap for obtaining information from designated NPPs as they go through decommissioning is complementary to ongoing NRC research in developing technical information to support evaluating SLR as well as data collection and testing of ex-plant materials.

Material degradation has traditionally been managed reactively in response to events and operating experience, rather than proactively to prevent failures. For the NPPs currently entering their first license renewal period from 40-60 years, and submitting SLR applications, it is necessary to evaluate potential degradation mechanisms out to 80 years of operation. Evaluation of material properties in SSCs from actual decommissioned NPPs will provide a basis for comparison with results of laboratory tests and calculations to resolve the four issues listed above.

The proactive management of materials degradation (PMMD) information tool was originally created at PNNL for RES (POC: Amy Hull) to give an expert opinion of the possible future degradation mechanisms on a subcomponent/material specific basis (PNNL-17779)ⁱ. Combined with the LER database, the PMMD information tool allows one to not only react to past events, but to anticipate future issues. The original PMMD information tool was based on NUREG/CR-6923, "Proactive Materials Degradation Assessment (PMDA)," for the first license renewal period, so it is now appropriate to integrate information from the excel databases from the recently-published five volumes of NUREG/CR-7153, "Expanded Materials Degradation Assessment (EMDA)" for SLR. At this juncture, there is demonstrated industry interest in NPP long-term operation (LTO) and regulatory interest in SLR.

2.0 OBJECTIVES

Understanding and managing material and component degradation is a key need for the continued safe and reliable operation of NPPs, but has significant uncertainties. In many cases, the scientific basis for understanding and predicting long-term environmental degradation behavior of materials in NPPs is incomplete. A strategic approach to examination and testing of materials and components from decommissioned reactors can dramatically increase our knowledge-acquisition rate in this very important area.

There are three inter-related objectives to this work:

- (1) Develop a long-range strategy for obtaining information from decommissioned NPPs as well as providing the flexibility to get ex-plant components from operating plants as well. The focus will be on timely acquisition of experiential real-world aging-degradation information that can significantly improve the agency's risk-informed and performance-based regulatory approach, but has been very difficult or impossible to obtain from the operating reactor fleet.

- (2) Construct a strategic plan and specifications for obtaining unique and significant materials aging degradation information from diverse sources (operating experience, other nuclear facilities, other long-lived industrial plants, other materials organizations such as ASM and NACE) that will inform the NRC's age-related regulatory oversight in the future. Implementation of this plan and specifications, in cooperation with industry and DOE partners can be accomplished over time, through individual research projects as the identified plants progress through their decommissioning process. This exploratory research is expected to provide fundamental insights on reactor materials degradation and information addressing potential technical issues or identified gaps to support anticipated future NRC needs.
- (3) Update the PMMD information tool to incorporate LTO/SLR-relevant information so that it can be better used to inform prioritization in the ex-plant material strategic plan.

3.0 SCOPE OF WORK

There are a number of technical gaps that this project seeks to address. Most importantly, the current piecemeal approach can be replaced with a strategic plan that is more comprehensive, broader in scope, and more risk-informed. The strategic plan for inspections and/or testing developed in this project will be useful guidance for obtaining key measurements of degradation in a variety of areas. These measurements will be valuable on their own and will also be useful in basic research on the underlying mechanisms and modes of degradation, and for validation of modeling and simulation tools. Data and information developed from implementation of the strategic plan will also be useful in evaluating aging management and mitigation strategies proposed by the industry.

Many sources of materials degradation information will be queried, including human repositories of knowledge both within NRC and within the industry. Both the PMDA and EMDA present information in terms of component or material degradation susceptibility and currently available knowledge for degradation mitigation or prevention. A component with high degradation susceptibility/low knowledge would be the strongest candidate for proactive actions. It is necessary to be able to understand this before prioritizing ex-plant materials sampling available from a given retired NPP. Previously, under the auspices of NRC contracts (i.e., JCN N6029, N6907), PNNL used the large amount of information presented in the PMDA report to develop a web-based platform to facilitate analysis through interactive visualizations that offer intuitive ways to explore the information. PNNL shall explore the viability of adding materials degradation susceptibility data presented in the EMDA Report.

Such an information tool (Figure 2 below) is expected to save considerable staff efforts to understand and apply the PMDA and EMDA insights to regulatory review of licensee information. PNNL shall develop a web-based modified scalable reasoning system (SRS) for tracking, disposition, and resolution of critical issues, such as determining the appropriate SSC

from which to acquire cast austenitic stainless steel (CASS) material of specific composition and radiation dose.

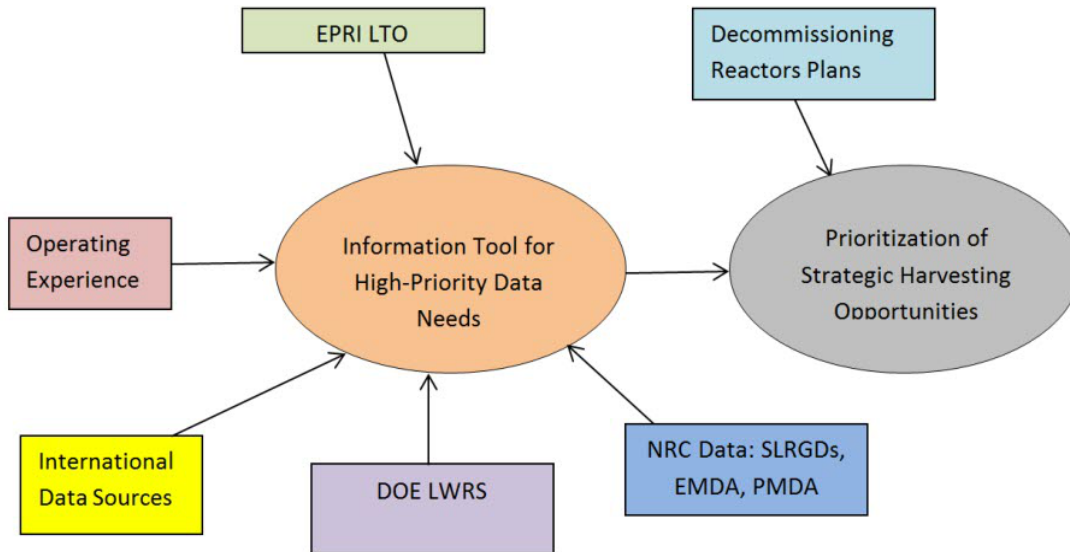


Figure 2: Pre-conceptual Architecture of prognostic tool to track and resolve critical technical issues for SLR

As shown in Figure 2 above, the information tool was originally envisioned as integrating domestic and international operating experience and experimental information as well as information from the EPRI LTO, DOE Light Water Reactor Sustainability (LWRS) program, and NRC sources such as EMDA, PMDA, and SLR guidance documents (SLRGDs) and precursors. The international data sources that might provide effective data feed include the cable aging data and knowledge (CADAK, <http://cadak.hrp.no/cadak>.) project and the Component Operational Experience, Degradation and Ageing Programme (CODAP, <http://www.oecd-neo.org/jointproj/codap.html>), both sponsored by OECD/NEA. The Atlas constructed by PNNL from the Program to Assess the Reliability of Emerging Non-destructive Technology (PARENT) and the Program to Inspect Nickel Alloy Components (PINIC) Atlas is an international database containing a vast array of SCC crack morphology and NDE information. PNNL shall investigate whether this is an appropriate framework to track issue resolution associated with SLR. This is a much broader objective than just developing a strategic roadmap for harvesting SSCs.

The general tasks and their duration are described in Table 1.

Table 1: Task Description and Duration

Task	Task Title/Description	Duration (Months)
Task 1	Scoping Study and technical literature review	18
Task 2	Decision Making on Specific Confirmatory Research Needed to Address Gaps (optional)	6
Task 3	Confirmatory Research Addressing Technical Gaps (optional)	33
Task 4	Development of Independent Decision Making Tools (optional)	33

The conditional tasks shall be conducted, as detailed in Figure 3 below. A decision on further optional research outlined in Tasks 2, 3, and 4 will be made after completion of Task 1 depending on the outcome and recommendation from the conclusion of specific tasks. The overall nexus between the scoping study and other potential tasks is shown in Figure 3.

The PNNL staff shall not restrict their activities solely to these descriptions and shall be flexible in using their technical knowledge and experience in proposing additions, deletions, or deviations from the prescribed requirements as research progresses.

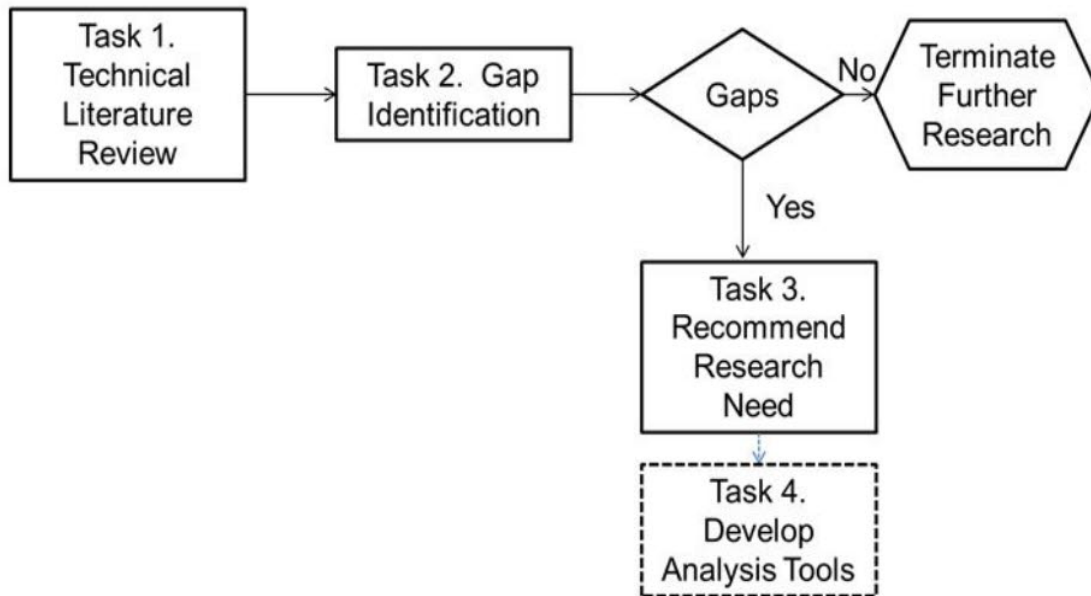


Figure 3: Schematic of the Overall Research

4.0 SPECIFIC TASKS

Task 1 is the scoping study. Tasks 2-4 are optional. NRC plans to revise the SOW for these tasks based on the outcome of Task 1. The time at which the tasks begin and end will be dependent on available information and NRC's ongoing evaluation of testing priorities. NRC staff does not require that PNNL necessarily perform the tasks be performed sequentially following the order in which they are listed. For the test matrix described in this section, nearly all subtasks will have to be tested in tandem with another subtask in order to complete the program within the requested period of performance. PNNL and the NRC CORs will continually review the testing plan during monthly status update teleconferences.

PNNL shall, in the first stage of Task 1, develop a questionnaire and help the NRC staff conduct interviews with focus groups from various technical disciplines within NRC. PNNL shall, in the second stage of Task 1, assist the NRC staff conduct one or two public workshops. PNNL shall analyze and combine the results of the first two phases into a final strategic plan in the third stage. This strategic plan will provide a prioritization of strategic harvesting opportunities. PNNL shall help the NRC staff develop the ex-plant harvesting strategic plan in cooperation with industry and other federal agencies such as DOE as well as any international counterparts that may be interested in participation.

In Tasks 2-4, PNNL may be assigned optional tasks to identify requirements to further elucidate the risk assessment of component degradation. Such research should also provide technical data and information, as necessary, to request the national codes and standards bodies (such as ASME, ASTM, or NACE) to re-examine requirements for structural materials for passive components in light water reactors (LWRs) and in assessing material degradation during service and its effect on design safety margin of components. The PNNL principal investigator (PI) for this project shall attend ASME, ASTM, or NACE Code Committee meetings, as appropriate and as approved by the COR during the course of this research. The PI shall provide adequate information to support an IAEA international cooperative research program (ICRP) on this subject to bring worldwide resources to address this research need.

The specific tasks are as follows:

Task 1 – Literature Review and Assessment of Greatest Needs in Sampling of Ex-plant Materials

NRC recently completed a research program to investigate material degradation after extended operation. To investigate aging degradation mechanisms, aging degradation effects, and the relative susceptibility to degradation, PNNL shall perform a comparison of available information.

PNNL shall conduct the Task 1 scoping study and provide all resources necessary to accomplish the subtasks and deliverables. Task 1 shall be performed in stages as shown in the Task-specific subsections below.

The activities required for this task are:

Task 1.1 – Conduct Materials Aging Degradation Literature Review

PNNL shall selectively review both domestic and international sources of technical information of generic nature with respect to anticipated material degradation in NPPs during LTO, extrapolating to 80 years of operation. The objective is to identify other issues not in PMDA/EMDA, such as related to active components or spent fuel storage systems, and to determine what is being done to address LTO issues. NRC will provide guidance on appropriate information to review.

Task 1.2 – Evaluate Availability of Ex-Plant Material and Information

PNNL shall evaluate what relevant ex-plant material is projected to be available for potential harvesting. PNNL shall work with the NRC COR to develop a questionnaire and interview the cognizant individuals at the plants who possess critical knowledge.

Task 1.3 – Develop Questionnaire and Conduct Interviews with Prospective NRC Stakeholders

PNNL shall develop a questionnaire and work with NRC staff to conduct interviews with focus groups from various technical disciplines within NRC. This would include the SLR Expert Panels for a sample of different aging management programs (AMPs) as well as other NRC technical advisory groups. PNNL shall have a comprehensive approach to all the possible stakeholders interested in harvesting materials from decommissioned plants. The objective of this initial scoping study is to assess interest in issues concerning both passive and active component degradation. The questionnaire will address, as a minimum, (1) the perceived needs for ex-plant materials, (2) the perceived utility of the existing information tool and how and where this prognostic tool should be maintained (NRC, contractor, cloud). During the early brainstorming and scoping study, PNNL shall also consider degradation of SSC materials associated with extended long-term storage of used fuel.

Task 1.4 – Develop Questionnaire and Conduct Interviews with Prospective External Stakeholders

Based on interactions with NRC staff in Task 1.3 above, PNNL shall propose a preliminary strategic approach to sampling representative ex-plant materials during one or two presentations at public workshops to further refine the concept of what would be needed in a useful interrogatory tool linking aging-degradation research objectives with available resources

for ex-plant materials. The searchable information tool shall be available via an interactive web page.

Task 1.5 –Conduct Scoping Analysis on Viability of Searchable Information Tool

Task 1.5.1 PNNL shall briefly consider available approaches to creating a preliminary database that will link the highest susceptibility/lowest knowledge anticipated degradation scenarios with potential availability of ex-plant materials. As part of this subtask, PNNL shall review the status and viability of the PMMD information tool created as part of the PMMD project (conducted at PNNL under previous NRC contracts (i.e., JCN N6029, N6907). The goals of the PMMD project were to identify reactor components that could reasonably be expected to experience future degradation, estimate the susceptibility of components to various degradation mechanisms, and assess the degree of knowledge available to develop mitigative strategies. It was anticipated that this information could be used to guide regulatory actions related to license renewal and subsequent license renewal. The PMMD panel evaluated 3863 components (2203 for PWRs, 1603 for BWRs) for their susceptibility to 16 degradation mechanisms (Figure 4 below). Because of the unwieldiness of the source material, a searchable information tool (pmmd.pnl.gov) was developed to make this information usable to NRC staff and others.

Task 1.5.2 PNNL shall work with the NRC to create a proposal to develop a platform for the searchable database methodology (selected in Task 1.5.1) that can be supported within NRC.

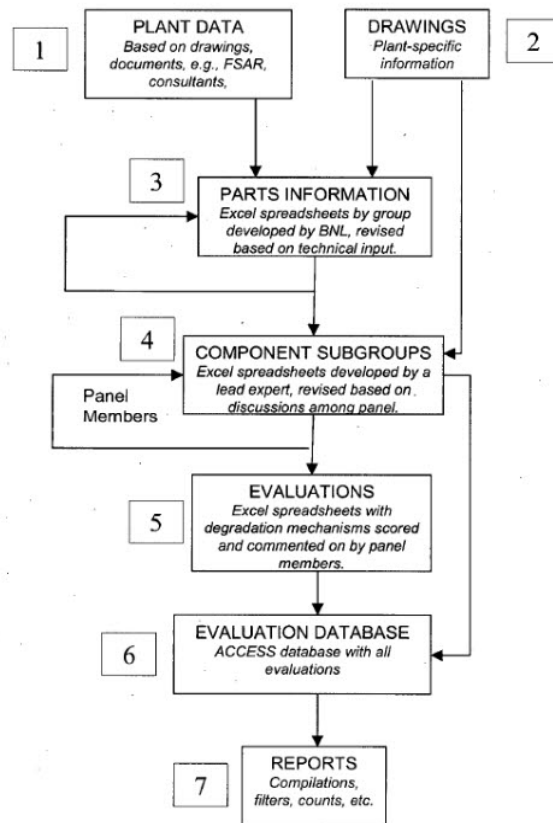


Figure 4. Flowchart for files created and used in PMMD infotool

Task 1.6 – Provide Archival Summary Document of Findings from Task 1

PNNL shall analyze and review the reports generated from the work conducted under Tasks 1.1 through 1.5 and provide a stand-alone NUREG/CR documenting the major findings.

Optional Task 2 – Decision Making on Specific Research Need to Address Gaps

If the Task 1 scoping study succeeds in determining previously unidentified significant knowledge gaps that need further attention, more work will be done in the context of Task 2, pending the approval from the NRC Contract Officer (CO). Thus, Task 2 is optional pending the outcome of Task 1 and requires NRC activation. The activities required for this task are:

Task 2.1 – Gap Identification

PNNL shall identify specific information and technical data gaps from the execution of Task 1 and document these gaps. In identifying the gaps, PNNL shall include an examination of the current ASME B&PV Code or other industry practices that the NRC has endorsed with respect

to addressing the specific degradation mechanism in the design and the assurance of the retention of the design margin during the period of licensed reactor operation time.

Task 2.2 – Determine Significance and Disposition of Technical Gaps

PNNL shall determine whether or not there are any technical gaps from the execution of Task 2.1. If there are no gaps and if it is determined that the current ASME Code or other industry practices ensure that the design margin for components are adequate, recommend termination of further research in this topic by NRC. If specific information and technical gaps are identified then proceed to Task 3 after getting approval from the NRC Contract Officer (CO).

Optional Task 3 – Research Addressing Technical Gaps Related to Material Degradation

If critically important information and technical gaps are identified in Task 2, Task 3 is activated after getting approval from the NRC CO. Thus, Task 3 is optional pending the outcome of Task 2. The activities required for this task are:

Task 3.1 – Recommend Specific Laboratory Experimentation and Analytical Model Development

PNNL shall work with NRC subject matter experts (SMEs) to recommend specific laboratory experimentation and analytical model development, which may address the information gap identified in Task 2.1. If novel nondestructive evaluation methods (such as the next-generation acoustic emission technology which reportedly can ‘hear’ crack initiation) become available to identify progressing reactor material degradation by the time Task 3 is initiated, PNNL shall recommend inservice inspection (ISI) technology enablers which will be suitable for detecting the material changes resulting from different stressors. PNNL shall work with NRC SMEs to recommend the need for developing tools for detection and assessment of potential degradation of the design safety margin to independently confirm the licensee’s technical basis for LTO.

Task 3.2 – Review Adequacy of Existing Codes and Standards

PNNL shall conduct a review of existing applicable ASME B&PV Codes that may need to be revised as a result of Task 2.1 and PNNL shall work with NRC SMEs to engage relevant ASME Code Committees for assessing future path. PNNL shall propose other Codes and Standards that should be reviewed (such as but not limited to, ANS, ASTM, and NACE codes and standards).

Optional Task 4 – Investigate Development of Independent Decision Making Tools

Task 4 is optional pending the outcome of Tasks 1 – 3. If gaps are identified under Task 2 and appropriate research needed to inform the gaps are also identified under Task 3, NRC expects that the industry will perform the needed research and provide NRC the data for regulatory decisions.

Depending on the outcome of Tasks 2 and 3 and ensuing industry research, the decision-making tool development may be complex and truly involve multi-year, multi-disciplinary long

term research. It is expected, however, that the decision making tool may include: (a) Material and component condition after different stressors; (b) Better knowledge of specific degradation and its potential for reducing the design safety margin for the components; (c) Incorporation of plant data into the various material, inspection, and structural integrity evaluation models; and (f) An integration of all these aspects into the regulatory decision making process to consider the risk contribution due to material degradation.

Specific subtasks for this task will be established later in this research. PNNL shall investigate the feasibility of developing a modern visualization confirmatory analysis research tool for aging management of safety-significant SSC degradation in NPPs. As currently envisioned, this could provide a knowledge management and strategic planning tool for conducting gap assessments and prioritizing R&D resources related to NPP LTO. This research will leverage the work previously performed by PNNL on the PMMD Information Tool, sponsored by RES.

RES/DE would benefit from a R&D gap assessment, strategic planning and knowledge management tool to enhance the tracking, disposition, resolution of technical issues that surface as industry moves towards SLR. Such a database would save staff time in addressing the degradation challenges for NPP passive components, spent fuel pools, and independent spent fuel storage installations (ISFIs). The proposed LTO issues visualization tool can incorporate, up-to-date information on critical issues associated with cable, concrete and RPV aging. Work is actively progressing on developing SLR guidance documents with unresolved technical issues arising almost on a daily basis. These could be captured by the proposed service-oriented analytic framework. The existing PMMD database containing detailed information about susceptibility, knowledge, and confidence associated with hundreds of degradation scenarios can be augmented with aging risk indices, when developed by the DOE LWRS research. This will enable a better understanding of service life projections of NPP SSC.

5.0 DELIVERABLES AND/OR MILESTONES SCHEDULE

Except for Task 1.6 where a draft summary NUREG/CR is stipulated, all deliverables shall be in the form of technical letter reports or alternatives previously discussed and determined acceptable by the COR. Based on the detailed tasks provided in Section 4.0 of this Statement of Work, PNNL shall estimate the number of Figures/Tables or other copyrighted information from technical journals, etc. and shall incorporate this estimation in the cost proposal in addressing the SOW. PNNL shall also estimate reasonable effort by their technical editing staff in order to provide the NRC tech-edited draft final and final reports.

Task Number	Deliverable/Milestone Description (include NRC acceptance criteria if applicable)	Due Date (if any)
All	Monthly Letter Status Report (MLSR)	20 th day of each month
1.1	PNNL to provide Report 1.1. Draft TLR to NRC on Subtask (1.1) reviewing anticipated NPP LTO materials degradation and prognostics	NLT 6 months after contract award
1.1	NRC to provide comments to contractor on Report 1.1 on NPP LTO materials degradation and prognostics	NLT 1 month after receiving draft Report 1.1 from PNNL
1.1	PNNL to publish TLR Report 1.1 on materials degradation and prognostics. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments
1.2	PNNL to provide Report 1.2. Draft TLR to NRC on Subtask (1.2) concerning availability of ex-plant material and information	NLT 8 months after contract award
1.2	NRC to provide comments to contractor on Report 1.2 concerning availability of ex-plant material and information	NLT 1 month after receiving draft Report 1.2 from PNNL
1.2	PNNL to publish TLR Report 1.2 concerning availability of ex-plant material and information. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments
1.3	PNNL to provide Report 1.3 (consisting of questionnaire and interview results) to NRC on Subtask (1.3) concerning interest of prospective NRC stakeholders in a systematic approach to harvesting ex-plant materials	NLT 10 months after contract award
1.3	NRC to provide comments to contractor on Report 1.3 concerning interest of prospective NRC stakeholders in a systematic approach to harvesting ex-plant materials	NLT 1 month after receiving Report 1.3 from PNNL
1.4	PNNL to provide Report 1.4 (consisting of questionnaire and interview results) to NRC on Subtask (1.4) concerning interest of prospective external stakeholders in a systematic approach to harvesting ex-plant materials	NLT 14 months after contract award
1.4	NRC to provide comments to contractor on Report 1.4 concerning interest of prospective external stakeholders in a systematic approach to harvesting ex-plant materials	NLT 1 month after receiving Report 1.4 from PNNL
1.5.1	PNNL to provide Report 1.5.1 to NRC on Subtask (1.5.1) with suggested alternatives for creating a prognostic tool to track and resolve critical technical issues for SLR	NLT 16 months after contract award
1.5.1	NRC to provide comments to contractor on Report 1.5.1 concerning alternatives for creating a prognostic tool to track and resolve critical technical issues for SLR	NLT 1 month after receiving Report 1.5.1 from PNNL

1.6	Summary Report 1.6. Draft NUREG/CR to NRC including information from Reports 1.1 through 1.5.2. <i>(Note: At the discretion of COR, a decision may also be made to publish Summary Report 1 as a TLR rather than as an NUREG/CR, depending on the significance of the literature review and research assessment results).</i>	NLT 20 months after contract award
1.6	The Contractor will make a technical presentation to the NRC staff on Summary Report 1.6 at NRC Headquarters in Rockville, MD.	When the draft Summary Report 1.6 is delivered to NRC.
1.6	NRC to provide comments to contractor on Summary Report 1.6.	NLT 2 months after receiving draft Summary Report 1.6 from PNNL
1.6	DOE Contractor to publish Summary Report 1.6 as NUREG/CR. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 2 months after receiving NRC comments
Task 2 is optional pending outcome of Task 1.		
2	PNNL to provide Report 2 Draft TLR to NRC based on results from Subtask (2.1) concerning technical gap identification and subtask (2.2) determination of significance and disposition of gaps	NLT 24 months after original contract award
2	NRC to provide comments to contractor on Report 2 concerning technical gap identification, significance, and disposition	NLT 1 month after receiving draft Report 2 from PNNL
2	PNNL to publish TLR Report 2 technical gap identification, significance, and disposition. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments
Task 3 is optional pending outcome of Task 2		
3.1	PNNL to provide Report 3.1 Draft TLR to NRC based on results from Subtask (3.1) concerning specific laboratory experimentation and analytical model development	NLT 46 months after contract award
3.1	NRC to provide comments to contractor on Report 3.1 concerning specific laboratory experimentation and analytical model development	NLT 1 month after receiving draft Report 3.1 from PNNL
3.1	PNNL to publish TLR Report 3.1 concerning specific laboratory experimentation and analytical model development. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments
3.2	PNNL to provide Report 3.2 Draft TLR to NRC reviewing adequacy of existing codes and standards for SLR	NLT 46 months after contract award
3.2	NRC to provide comments to contractor on Report 3.2 reviewing adequacy of existing codes and standards for SLR	NLT 1 month after receiving draft Report 3.2 from PNNL
3.2	PNNL to publish TLR Report 3.2 reviewing adequacy of existing codes and standards for SLR. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments
Task 4 is optional pending outcome of Task 1 and partially pending on Task 2 and 3.		

4	PNNL to provide Report 4 Draft TLR to NRC documenting development of prognostic tool to track and resolve critical SLR technical issues	NLT 46 months after contract award
4	NRC to provide comments to contractor on Report 4 reviewing development of prognostic tool to track and resolve critical SLR technical issues	NLT 1 month after receiving draft Report 3.2 from PNNL
4	PNNL to publish TLR Report 4 reviewing development of prognostic tool to track and resolve critical SLR technical issues R. Deliver 12 hard copies to the NRC COR, in addition to an electronic file.	NLT 1 month after receiving NRC comments

6.0 TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

Specific qualifications for this effort include senior materials engineers and metallurgists who have in-depth knowledge of reactor pressure vessel and core internal materials subjected to irradiation and stress at elevated temperature, and effects of water chemistry on structural reactor materials. The personnel involved should have in-depth experience, knowledge, and demonstrated contributions in the areas of mechanical deformation, material degradation phenomena, such as corrosion, stress corrosion cracking and irradiation effects. The contract personnel should be well-versed in the use of nuclear power plant ASME B&PV Codes and Standards, Industry Guidance Documents, such as those of NEI, EPRI, NRC's Regulatory Guides and NRC's License Renewal Guidance Documents (such as NUREGs 1800, 1801, and 1950) Information Notice (IN), Regulatory Issue Summary (RIS), Generic Letter (GL), Generic Issue (GI) for licensing review by the NRC staff.

The contract personnel should also be aware of the safety evaluation reports (SER) written by the NRC staff on industry guidance documents, as applicable. The contract personnel should have previous experience developing appropriate software architecture for proposed R&D planning tool.

7.0 ESTIMATED LABOR CATEGORIES AND LEVELS OF EFFORT

Task	Labor Category	FY15 (hours)	FY16 (hours)	FY17 (hours)	FY18 (hours)	FY19 (hours)	Total
1	Project Manager	30	15	15			60
1	Senior Key Staff	30	15	15			60
1	Key Staff	75	30	30			135
1	Support Staff	35	30	30			95
2	Project Manager		50	50			100
2	Senior Key Staff		50	50			100
2	Key Staff		100	100			200
2	Support Staff		40	40			80
3	Project Manager		100	100	90	40	330
3	Senior Key Staff		100	100	90	40	330
3	Key Staff		260	260	180	80	780
3	Support Staff		40	40	50	20	150
4	Project Manager				75	60	135
4	Senior Key Staff				75	60	135
4	Key Staff				210	170	380
4	Support Staff				60	55	115
	TOTAL	170	830	830	830	525	3185

Task Order Labor Breakdown						
Labor Category	FY15 (hours)	FY16 (hours)	FY17 (hours)	FY18 (hours)	FY19 (hours)	Total
Project Manager	30	165	165	165	100	625
Senior Key Staff	30	165	165	165	100	625
Key Staff	75	390	390	390	250	1495
Support Staff	35	110	110	110	75	440
Total	170	830	830	830	525	3185

8.0 MEETINGS AND TRAVEL

The PNNL Principal Investigator and one other engineer shall visit the NRC Headquarters in Rockville, MD and present the overall research outcome to the staff and share in technical discussions. Any suggestions from the staff, as appropriate, may be considered for the final report by the PI. No other domestic or foreign travel is permitted under the initial scoping study.

9.0 REPORTING REQUIREMENTS

PNNL is responsible for structuring the deliverable to follow agency standards. The current agency standard is Microsoft Office Suite 2010. The current agency Portable Document Format (PDF) standard is Adobe Acrobat 9 Professional. Deliverables shall be submitted free of spelling and grammatical errors and conform to requirements stated in this section.

Monthly Letter Status Reports

In accordance with Management Directive 11.7, NRC Procedures for Placement and Monitoring of Work with the U.S. Department of Energy, PNNL shall electronically submit a Monthly Letter Status Report (MLSR) by the 20th day of each month to Amy Hull, the Contracting Officer Representative (COR), to Matthew Hiser and Joseph Kanney, the technical monitors, with copies to the Contracting Officer (CO) and the Office Administration/Division of Contracts to ContractsPOT.Resource@nrc.gov. If a project is a task ordering agreement, a separate MLSR shall be submitted for each task order with a summary project MLSR, even if no work has been performed during a reporting period. Once NRC has determined that all work on a task order is completed and that final costs are acceptable, a task order may be omitted from the MLSR.

MLSR should be distributed additionally to the Chief, Corrosion and Metallurgy Branch, RES, the Director, Division of Engineering, RES. Other required distribution will be communicated at the start of this research program.

The MLSR shall include the following: agreement number; task order number, if applicable; job code number; title of the project; project period of performance; task order period of performance, if applicable; COR's name, telephone number, and e-mail address; full name and address of the performing organization; principal investigator's name, telephone number, and e-mail address; and reporting period. At a minimum, the MLSR shall include the information discussed in Attachment 1. The preferred MLSR format can also be found in Attachment 1.

10.0 PERIOD OF PERFORMANCE

The estimated period of performance for this work is 48 months from date of agreement award. The expected contract beginning date is September 1, 2015.

11.0 CONTRACTING OFFICER'S REPRESENTATIVE

The COR monitors all technical aspects of the agreement/task order and assists in its administration. The COR is authorized to perform the following functions: assure that the DOE Laboratory performs the technical requirements of the agreement/task order; perform inspections necessary in connection with agreement/task order performance; maintain written and oral communications with the DOE Laboratory concerning technical aspects of the agreement/task order; issue written interpretations of technical requirements, including

Government drawings, designs, specifications; monitor the DOE Laboratory's performance and notify the DOE Laboratory of any deficiencies; coordinate availability of NRC-furnished material and/or GFP; and provide site entry of DOE Laboratory personnel.

Contracting Officer's Representative

Name: Dr. Amy B. Hull
Agency: U.S. Nuclear Regulatory Commission
Office: Office of Nuclear Regulatory Research
Mail Stop: CS-05-C07M
Washington, DC 20555-0001
E-Mail: amy.hull@nrc.gov
Phone: 301-251-7656

Alternate Contracting Officer's Representative

Name: Matthew Hiser
Agency: U.S. Nuclear Regulatory Commission
Office: Office of Nuclear Regulatory Research
Mail Stop: CS-05-C07M
Washington, DC 20555-0001
E-Mail: Matthew.Hiser@nrc.gov
Phone: 301-251-7601

12.0 MATERIALS REQUIRED (TYPE N/A IF NOT APPLICABLE)

N/A

13.0 NRC-FURNISHED PROPERTY/MATERIALS

PNNL will transfer NRC furnished property and materials acquired under previous contracts (i.e., JCN N6029, N6907) to this task order. NRC will provide additional information from EMDA and SLR databases.

14.0 RESEARCH QUALITY (TYPE N/A IF NOT APPLICABLE)

The quality of NRC research programs are assessed each year by the Advisory Committee on Reactor Safeguards. Within the context of their reviews of RES programs, the definition of quality research is based upon several major characteristics:

Results meet the objectives (75% of overall score)

Justification of major assumptions (12%)

Soundness of technical approach and results (52%)

Uncertainties and sensitivities addressed (11%)

Documentation of research results and methods is adequate (25% of overall score)

Clarity of presentation (16%)

Identification of major assumptions (9%)

It is the responsibility of the DOE Laboratory to ensure that these quality criteria are adequately addressed throughout the course of the research that is performed. The NRC COR shall review all research products with these criteria in mind.

15.0 STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS (TYPE N/A IF NOT APPLICABLE)

The U.S. Nuclear Regulatory Commission (NRC) began to capture most of its official records electronically on January 1, 2000. The NRC will capture each final NUREG-series publication in its native application. Therefore, please submit your final manuscript that has been approved by your NRC Project Manager in both electronic and camera-ready copy.

The final manuscript shall be of archival quality and comply with the requirements of NRC Management Directive 3.7 "NUREG-Series Publications." The document shall be technically edited consistent with NUREG-1379, Rev. 2 (May 2009) "NRC Editorial Style Guide." The goals of the "NRC Editorial Style Guide" are readability and consistency for all agency documents.

All format guidance, as specified in NUREG-0650, "Preparing NUREG-Series Publications," Rev. 2 (January 1999), will remain the same with one exception. You will no longer be required to include the NUREG-series designator on the bottom of each page of the manuscript. The NRC will assign this designator when we send the camera-ready copy to the printer and will place the designator on the cover, title page, and spine. The designator for each report will no longer be assigned when the decision to prepare a publication is made. The NRC's Publishing Services Branch will inform the NRC Project Manager for the publication of the assigned designator when the final manuscript is sent to the printer.

For the electronic manuscript, the Contractor shall prepare the text in Microsoft Word, and use any of the following file types for charts, spreadsheets, and the like.

File Types to be Used for NUREG-Series Publications	
File Type	File Extension
Microsoft®Word®	.doc
Microsoft® PowerPoint®	.ppt
Microsoft®Excel	.xls
Microsoft®Access	.mdb
Portable Document Format	.pdf

This list is subject to change if new software packages come into common use at NRC or by our licensees or other stakeholders that participate in the electronic submission process. If a portion of your manuscript is from another source and you cannot obtain an acceptable electronic file type for this portion (e.g., an appendix from an old publication), the NRC can, if necessary, create a tagged image file format (file extension.tif) for that portion of your report.

Note that you should continue to submit original photographs, which will be scanned, since digitized photographs do not print well.

If you choose to publish a compact disk (CD) of your publication, place on the CD copies of the manuscript in both (1) a portable document format (PDF); (2) a Microsoft Word file format, and (3) an Adobe Acrobat Reader, or, alternatively, print instructions for obtaining a free copy of Adobe Acrobat Reader on the back cover insert of the jewel box.

16.0 OTHER CONSIDERATIONS (TYPE N/A IF NOT APPLICABLE)

References

1. Bond LJ, SR Doctor, and TT Taylor. 2008. *Proactive Management of Materials Degradation - A Review of Principles and Programs*. PNNL-17779, Pacific Northwest National Laboratory, Richland, WA.
2. Bond, LJ, TT Taylor, SR Doctor, AB Hull, and SH Malik, (2008) *Proactive Management of Materials Degradation for nuclear power plant systems*. Proc. Int. Conf. Prognostics and Health Management 2008, Denver, CO, October 6-9. IEEE Reliability Society, # OP-20-01 120
3. Chopra, OK, et al, *Managing Aging Effects on Dry Cask Storage Systems for Extended Long-Term Storage and Transportation of Used Fuel*, Rev. 0, FCRD-USED-2012-000119, 2012.
4. EPRI 3002000576, *Long-Term Operations: Assessment of R&D Supporting AMPs for LTO*, Aug. 2013 (80pp).
5. NEI, *Roadmap for Subsequent License Renewal*, Dec. 2013. (45pp)
6. NEI, *Second License Renewal Roadmap*, May 2015. (22pp).
7. NUREG/CR-6923, *Expert Panel Report on Proactive Materials Degradation Assessment*, 2007 (3895pp, ML063520517)
8. NUREG/CR-7153, *Expanded Materials Degradation Assessment*, 5 volumes, October 2014 (861pp)
9. SECY-14-0016, *Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal*, January 31, 2014 (25pp)
10. Taylor, WB, CE Carpenter, KJ Knobbs, S Malik, *Using Technology to Support Proactive Management of Materials Degradation for the U.S. Nuclear Regulatory Commission*, Proceedings of the ASME Pressure Vessels & Piping Division/K-PVP Conference, PVP 2010, July 18-22, 2010. Bellevue, WA, USA. Paper PVP2010-26063.
11. *The Scalable Reasoning System: Lightweight Visualization for Distributed Analytics*, IEEE Symposium on Visual Analytics Science & Technology, 978-1-4244-2935-6/08

Access to Non-NRC Facilities/Equipment (Type N/A if not applicable)

N/A

Applicable Publications (Type N/A if not applicable)

N/A

Controls over document handling and non-disclosure of materials (Type N/A if not applicable)
N/A

**Independent Government Cost Estimate
Fiscal Year Summary**

Project Title: **TASK 1 - Strategic Approach for Obtainin**

Estimated Period of Performance: 1-Sep-2015 thru 30-Sep-2019

DOE Laboratory: **Pacific Northwest National Laboratory (PNNL)**

Fiscal Year	Labor (Fully Burdened)	Materials & Services	Travel	Subcontractors & Consultants	Other Direct Costs	Total	G&A Rate	DOE Added Factor: 3%	Grand Total (Total + G&A Rate + DOE Added Factor)
FY 2015	(b)(5)								
FY 2016									
FY 2017									
FY 2018									
FY 2019									
FY 2020									
Total									

Project Title: **TASK 1 - Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015** thru **30-Sep-2019**

Labor Cost

	FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		TOTAL	
Labor Category	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total

(b)(5)														
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COMMENTS:

Project Title: **TASK 1 - Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015**

thru

30-Sep-2019

Materials & Services Costs

Total Materials/Services Costs											
FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost
Total	(b)(5)										

COMMENTS:

Project Title: **TASK 1 - Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance:

1-Sep-2015

thru

30-Sep-2019

Travel Costs

(b)(5)

FY 2015				FY 2016				FY 2017			
Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost
(b)(5)											
FY 2018				FY 2019				FY 2020			
Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost
(b)(5)											

COMMENTS:

Project Title: **TASK 1 - Strategic Approach for Obtaining Material and**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015** thru

30-Sep-2019

Subcontract & Consultant Costs

Total Subcontractor/Consultant Costs								(b)(5)	
FY 2015			FY 2016			FY 2017			
Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		
(b)(5)									
FY 2018			FY 2019			FY 2020			
Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		
(b)(5)									

COMMENTS:

Project Title: **TASK 1 - Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015** thru

30-Sep-2019

Other Direct Cost

(b)(5)

FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost
(b)(5)											

COMMENTS:

Other Direct costs

~~OFFICIAL USE ONLY~~

Instructions for use:

To update the rates for Travel, DOE Added Factor, and G&A, enter the new rate in the "Rate" column (red cells).

To update the Labor Categories, make the updates to the updates to the columns G thru X (green/white cells).

↓ DESCRIPTIONS AND VALUES ↓

(b)(5)

Instructions to add additional Labor Rates

If the labor rates captured in the IGCE are not an accurate portrayal of the labor rates necessary, additional rates

1. Go to the Maintenance tab and start with cell G11
2. Enter the new labor category name in G11
3. Follow Row 11 over and enter in the labor rates for that labor category under the correct fiscal years
4. Continue to add additional labor categories and labor rates in the cells provided until all are captured
5. These labor rates will then populate the respective fields in the other tabs of the IGCE template

**Independent Government Cost Estimate
Fiscal Year Summary**

Project Title: **Strategic Approach for Obtaining Materia**

Estimated Period of Performance: 1-Sep-2015 thru 30-Sep-2019

DOE Laboratory: **Pacific Northwest National Laboratory (PNNL)**

Fiscal Year	Labor (Fully Burdened)	Materials & Services	Travel	Subcontractors & Consultants	Other Direct Costs	Total	G&A Rate	DOE Added Factor: 3%	Grand Total (Total + G&A Rate + DOE Added Factor)
FY 2015	(b)(5)								
FY 2016									
FY 2017									
FY 2018									
FY 2019									
FY 2020									
Total									

Project Title: Strategic Approach for Obtaining Material and Component Aging Information
Site: Pacific Northwest National Laboratory (PNNL)
Estimated Period of Performance: 1-Sep-2015 thru 30-Sep-2019

Labor Cost

	FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		TOTAL	
Labor Category	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total	Hour Total	Cost Total
(b)(5)														

COMMENTS:

Project Title: **Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015**

thru

30-Sep-2019

Materials & Services Costs

Total Materials/Services Costs											
FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost	Material/Service Description	Cost
(b)(5)											

COMMENTS:

Project Title: **Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance:

1-Sep-2015

thru

30-Sep-2019

Travel Costs

(b)(5)

FY 2015				FY 2016				FY 2017			
Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost
(b)(5)											
FY 2018				FY 2019				FY 2020			
Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost	Purpose	# Staff	Duration (Days)	Cost
(b)(5)											

COMMENTS:

Project Title: **Strategic Approach for Obtaining Material and Components**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015** thru

30-Sep-2019

Subcontract & Consultant Costs

Total Subcontractor/Consultant Costs							
FY 2015			FY 2016			FY 2017	
Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost
(b)(5)							
FY 2018			FY 2019			FY 2020	
Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost		Subcontractor/Consultant Name	Estimated Cost
(b)(5)							

COMMENTS:

Project Title: **Strategic Approach for Obtaining Material and Component Aging Information**

Site: **Pacific Northwest National Laboratory (PNNL)**

Estimated Period of Performance: **1-Sep-2015** thru

30-Sep-2019

Other Direct Cost

Total Other Direct Costs (b)(5)

FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost
(b)(5)											

COMMENTS:

Other Direct costs

~~OFFICIAL USE ONLY~~

Instructions for use:

To update the rates for Travel, DOE Added Factor, and G&A, enter the new rate in the "Rate" column (red cells).

To update the Labor Categories, make the updates to the updates to the columns G thru X (green/white cells).

↓ DESCRIPTIONS AND VALUES ↓

(b)(5)

Instructions to add additional Labor Rates

If the labor rates captured in the IGCE are not an accurate portrayal of the labor rates necessary, additional rates

1. Go to the Maintenance tab and start with cell G11
2. Enter the new labor category name in G11
3. Follow Row 11 over and enter in the labor rates for that labor category under the correct fiscal years
4. Continue to add additional labor categories and labor rates in the cells provided until all are captured
5. These labor rates will then populate the respective fields in the other tabs of the IGCE template

Note to requester: The attachments are immediately following this email. Portions of the second attachment are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Thu, 19 Oct 2017 19:46:10 +0000
To: Cole, Cassandra; Vera, Graciela
Cc: Frankl, Istvan; Hull, Amy
Subject: UNR Response - Updated files
Attachments: memo SLR UNR response NRR-2017-006 20171019.docx, Response to User Need Request NRR-2017-006 response 20171019.docx

Ladies,

Please update the ADAMS package at ML17227A483 with the two files attached.

ML17227A484 - memo SLR UNR response NRR-2017-006 20171019.docx

ML17227A483 - Response to User Need Request NRR-2017-006 response 20171019.docx

I will bring the concurrence package back to you. Please contact me if you have any questions.
Thanks again for your help.

Carol

Carol Moyer
Sr. Materials Engineer
RES/DE/CMB
carol.moyer@nrc.gov
301-415-2153



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: Brian E. Holian, Acting Director
Office of Nuclear Reactor Regulation

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH
ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF
EXTENDED OPERATION: NRR-2017-006

By memorandum dated May 4, 2017, the Office of Nuclear Reactor Regulation (NRR) requested assistance from the Office of Nuclear Regulatory Research (RES) to provide "specific research products to facilitate the evaluation of future applications for a license to operate during the subsequent license renewal (SLR) period (i.e., 60 to 80 years). These products should build upon analysis methods, tools, and expertise developed as part of ongoing and new research activities, focused specifically on aging effects during the SLR period." This user need request (UNR) supersedes and incorporates work from Tasks A and D of the previous UNR NRR-2010-006 "provide support in developing technical information to support evaluating the feasibility of license renewal beyond 60 years." This UNR also supersedes NRR-2014-001 "provide expert assistance with reviewing the guidance documents for subsequent license renewal" and serves as an "umbrella" under which associated SLR-focused technical UNRs are coordinated. These technical UNRs include NRR-2017-001 (reactor vessel internals); NRR-2014-007 (reactor pressure vessel), NRR-2016-012 (electrical cables), NRR-2012-004 and NRR-2015-007 (concrete degradation). More details on these UNRs are provided in Table 1 of the Enclosure. For tracking purposes, RES has designated this UNR as NRR-2017-006 (ML16358A427).

The purpose of this memorandum is to respond to UNR NRR-2017-006 with RES's plans to accomplish the following tasks:

- **Task 1:** Hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate aging degradation issues identified in in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191).
- **Task 2:** Develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants (NPPs), as well as from ex-plant components harvested from operating plants.
- **Task 3:** Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research.
- **Task 4:** Develop documentation evaluating significant technical issues germane to the review of SLR applications.
- **Task 5:** Provide expert assistance with reviewing SLR applications (optional task)

CONTACT: Amy Hull, RES/DE
301-415-2435

RES staff is conducting ongoing coordinating activities to address Tasks 1, 2, and 3, including both independent and collaborative efforts with industry and other partners. RES staff will continue these activities and integrate the results in deliverables under Task 4. The response has been closely coordinated with NRR technical staff and management. As a result of this effort, RES added optional Task 5. If needed, under this task, RES staff would provide expert assistance with the review and evaluation of SLR applications. The enclosure addresses in greater detail the scope of ongoing and planned activities associated with each task, as well as the estimated resources and the anticipated schedule for the deliverables.

RES staff appreciates the coordination with NRR technical staff and management in this area. We will continue to coordinate with NRR staff and management to ensure that regulatory needs and priorities are satisfied. Changes in the availability of resources or NRR needs could impact the activities, deliverables and schedules of this UNR. In such cases, changes will be implemented jointly by RES and NRR and, if warranted, the UNR will be amended.

Enclosure:

1. Response to User Need Request for
Research Assistance on Potential Significant
Technical Issues during the Subsequent Period
of Extended Operation

SUBJECT: RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT
PERIOD OF EXTENDED OPERATION: NRR-2017-006

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ADAMS Package Accession No.:ML17227A483

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DATE	10/ /2017	10/ /2017	10/19 /2017

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NAME	B. Thomas	K. Johnson	M. Weber
DATE	/ /2017	/ /2017	/ /2017

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Response to User Need Request NRR-2017-006
Research Assistance on Potential Significant Technical Issues during
the Subsequent Period of Extended Operation

Task 1

RES staff will continue to hold and participate in NRC/industry workshops on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in the SRM on SECY 14-0016 and in the GALL-SLR report (NUREG-2191). The critical degradation issues are addressed further in the Note to Commissioners Assistants "Status Report on Progress of Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" ([ML15160A592](#)).

RES will facilitate a minimum of two domestic and international activities (such as, a workshop, conference, symposium, or meeting), one tentatively planned for spring 2019 on mechanical components and one tentatively planned for summer 2020 on concrete and cables-related issues. In establishing the exact date for these meetings, consideration will be given to the availability of new information on the relevant technical topics. These meetings will address:

- the state of knowledge on the technical issues requested in the SRM on SECY 14-0016,
- ongoing research on materials degradation issues and related aging management as discussed in the GALL-SLR report, and
- any new operating experience from the initial license renewal period (or the long-term operation (LTO) period for international plants).

RES will specifically target these activities toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables will include the two international activities (a workshop, conference, symposium or meeting) and summary reports on the research insights and knowledge gained on the four major issues identified in the SRM on SECY 14-0016 for SLR. RES will prepare and will provide to NRR drafts of the agenda, list of invited presenters, and workshop announcement. RES will plan for a workshop announcement and agenda scope to be made public six months before each workshop. RES will document the information from each of these activities in a NUREG/CP report, if appropriate, or by other sufficient means, including, at a minimum, a summary of the activity with all relevant contributions (presentations or technical articles, for example) and research insights and knowledge, to be provided within 6 months after each meeting.

Materials Issues for Mechanical Components – As part of the requested workshop/conference/ symposium/ meeting on materials issues for mechanical components, tentatively planned for spring 2019, the NRC staff will coordinate a session, or sessions, concerning reactor vessel embrittlement and the degradation of reactor internals due to irradiation during the SLR period. The staff will seek participation from the NRC staff, the regulated US industry, and representatives from the international industry and regulators. RES will document the product of these sessions (presentations and/or papers) as described above.

Concrete, Containment and Electrical Cable Issues – RES will also hold an NRC/industry workshop with international participation (tentatively planned for summer 2020) on the state of knowledge for the technical issues in concrete, containment, and cable degradation identified in the SRM on SECY 14-0016 and in the GALL-SLR report. The workshop will help RES secure information on research insights and knowledge from the industry, other domestic institutions working on nuclear safety, and from relevant international experts and institutions. Given that cables and concrete issues involve different technical disciplines and expertise, and that research to address some of these issues is still active, RES will plan for a three-day workshop that may include breakout sessions for specific technical topics and items of interest. RES will

Enclosure

document the results of the workshop as described above. Task 1 will continue until the completion of the deliverables from this activity, tentatively scheduled for late summer 2020.

Task 2

RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants. RES will execute the work through a 4-step process, described in paragraphs 2.A -2.D of the UNR.

Under a long-term research project preceding the current request from NRR, RES pursued a strategic approach to ex-plant harvesting through two coordinated activities: technical issue prioritization and a workshop on ex-plant material harvesting.

In the first activity, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), developed an approach to prioritize technical issues best addressed by harvesting. The criteria for prioritizing harvesting data needs will be described in the anticipated TLR, expected by the end of 2017 *“Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal.”* The deliverable will provide criteria to assess the need for harvesting to address a particular technical issue. The report will then apply these criteria to assess four representative technical issues: electrical cable degradation, embrittlement of cast austenitic stainless steel (CASS), cracking of dissimilar metal welds, and irradiation-assisted degradation (IAD) of stainless steel. This report will also cover the background on the need for harvesting, and past harvesting efforts and experience. The purpose of this report is to serve as a foundation for NRC staff to prioritize technical issues best addressed by harvesting. The initial technical letter report (TLR) for this research is expected to be published in September, 2017, as a PNNL document. This TLR will be reviewed by NRR and RES staff to determine any follow-on work by RES and the final publication type.

In the second activity preceding UNR NRR-2017-006, RES closely collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) to host a workshop on ex-plant materials harvesting on March 7-8, 2017. The purpose of this workshop was to engage with various stakeholders involved in the harvesting process to discuss all aspects of harvesting, including motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting, lessons learned from past harvesting efforts, and future harvesting program planning. The workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which sources to focus on. The workshop was well-attended by representatives from DOE, EPRI, the U.S. industry, and international research organizations. Key insights from the workshop included the need for a clearly defined objective to justify the level of effort, and the benefit of early planning and engagement with the plant from which materials will be harvested. The workshop summary report will be distributed among meeting participants and is expected to be finalized by September, 2017. RES will be pursuing further engagement with interested workshop participants on two outstanding workshop action items: identifying data needs for harvesting and initially creating a ‘sources of materials’ information tool/database. This is discussed further under Subtask 2.B.

Subtask 2.A.

Moving forward, RES will work internally to evaluate how the four significant issues identified for SLR in the SRM on SECY-14-0016 may be best addressed by harvesting. RES will initially develop an Excel spreadsheet (precursor to the information tool/database) that identifies and prioritizes the materials, components, and operating conditions needed to best address the significant issues. The work in this task includes collecting and inputting information on materials needed and the sources of materials expected to be available.

RES will apply the criteria developed with PNNL described above to the issues for SLR, and will document the outcome of the analysis in an 'information tool/database' (based on Microsoft products such as Access or Excel), as described above, which will identify and prioritize the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool/database to be a living document that can evolve and be updated to reflect the latest operating experience and research, so that users may understand which data needs can be best addressed by harvesting. The purpose of the database is to have a systematic approach to harvesting materials and prioritize limited resources on the best values for harvesting. The database is not an end unto itself, but the means to do the highest priority harvesting for the best technical value.

As a specific example, RES will develop a process to evaluate harvested concrete samples, and will follow through with implementing the process as concrete materials become available from additional plants. The scope of the harvesting strategy includes: structures exposed to high radiation (typically bio-shield structures of certain PWR designs); alkali silica reaction (ASR)-affected structures; post-tensioned structures with emphasis on pre-stressed concrete containment vessels (PCCVs); corrosion of pre-stressing tendons, liners, reinforcing steel, and embeddings; and concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects).

Based on information gleaned from discussions with international counterparts on the potential for harvesting and testing of concrete, RES will provide in the information tool the possibilities for this activity and document testing priorities as applicable. As an example, RES has engaged in discussions with the Canadian Nuclear Safety Commission (CNSC) about possibilities for harvesting concrete from a decommissioned plant in Canada extensively affected by ASR. RES also will document the process to evaluate concrete samples from nuclear power plants and their suitability for harvesting. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

In addition to irradiation effects on concrete materials, RES will continue research on IAD of stainless steel. RES will seek potential sources of reactor pressure vessel internals that may become available for harvesting, to evaluate their utility for regulatory research being conducted under UNR NRR-2017-001.

RES will continue to evaluate the SLR-significant issue of cable aging using harvested cables. The goal will be to expand on the selection of cable types harvested as part of the existing similar effort under UNRs NRR-2011-014 and NRR-2016-012 to include more cable types (insulation types and medium voltage level cables) and to evaluate the aging effects on power cables at different voltage levels.

Subtask 2.B.

In parallel with the information tool/database activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting. Based on past experience and

insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from NPPs to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in plant records. RES will work internally and with other interested organizations to identify the best approach to gather the relevant information and use it to inform which harvesting opportunities should be pursued. A TLR documenting the information tool/database with prioritized technical issues and a process to identify suitable sources of materials will be targeted for completion by July, 2018.

Subtasks 2.C. and 2.D.

Implementation of the evaluation process developed in Subtask 2.B. will be pursued in Subtasks 2.C. and 2.D., as requested in the UNR. RES will evaluate potentially-available components from plants performing component replacements or entering decommissioning (Subtask 2.C). If other nuclear facilities present opportunities for material harvesting, RES will assist in evaluating the value of such components (Subtask 2.D). RES will remain in close contact with NRR on the latest developments as this process is implemented.

The evaluation process will identify confirmatory needs that harvested samples can effectively address, will consider decommissioned plants in the U.S. and abroad, and will leverage resources to the greatest extent possible for domestic and international cooperative research opportunities, as stipulated in Subtask 2.E, which is closely integrated with Task 3. Through their national and international contacts, RES staff will maintain alertness for harvesting opportunities relating to various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the information tool/database.

Task 3

RES staff pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These exchanges are critical for the regulatory evaluation of industry research used to justify the adequacy of their aging management programs (AMPs), as well as for independent confirmatory research. RES will continue to cultivate emerging domestic and international partnerships and will continue to develop existing partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues. A majority of these partnerships will build upon already existing partnerships with the view of supporting assessment of the status of the research and operating experience in relation to SLR needs as well as implementation of a long-term strategy for the use of harvesting of ex-plant materials and components. The following illustrates some of those key partnerships and specific planned activities.

The DOE Light Water Reactor Sustainability (LWRS) and the EPRI LTO programs support most of the domestic research on aging management in NPPs. RES maintains separate collaborative research agreements with each of these organizations to exchange technical information. These exchanges are essential for the review and assessment of the technical bases for the viability of LTOs. RES staff have frequent technical exchange meetings with DOE and EPRI staff. These meetings have focused on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

RES is a participant in several multi-national cooperative research programs, including the International Forum on Reactor Aging Management (IFRAM), and many others. The RES Office Director signed a multilateral 4-year memorandum of understanding (MOU) for IFRAM in 2015. IFRAM is envisioned to be a network of research organizations, industry groups, regulatory

bodies, and academic institutions involved in reactor aging management research, regulation, education and training, as well as nonprofit research institutes having academic and industrial links enabling appropriate exchange of information addressing issues of NPP SSC aging management. The small effort and contract funding to operate the IFRAM program will be funded by this User Need Request. Other international collaborations pursued by RES are also expected to benefit this work, although resources to support those initiatives are tracked separately.

In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned NPPs worldwide to study irradiation effects under in-service conditions (in coordination with Subtask 2.E). RES and Oak Ridge National Laboratory (ORNL) submitted white papers to the OECD Halden Reactor Project (HRP) proposing research on irradiation effects on the steel-concrete bond, and on creep effects on irradiation damage. RES is also collaborating with HRP on IAD under the auspices of UNR NRR-2017-001 Task 2. These results will inform Task 4 of UNR NRR-2017-006.

RES is working to finalize a bilateral agreement with IRSN, France for exchange of technical information on the effects of ASR on the performance of nuclear concrete. IRSN is conducting a 10-15 year research project focused on studying the long-term performance of concrete affected by ASR, Delayed Ettringite Formation, corrosion and carbonation of nuclear concrete. RES will build upon its ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete, and will continue to participate in OECD/NEA/CSNI activities that develop and assess expertise in the modeling of ASR affected concrete structures.

Through their national and international contacts, and through codes and standards development activities, the RES staff will maintain alertness for partnerships to share expertise, capabilities, and resources in all areas of concern, perhaps especially reactor vessel embrittlement. Information on these opportunities will be communicated to NRR in a timely manner as outlined in the deliverables.

RES will evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues. RES will provide to cognizant NRR staff and management trip reports, summaries, papers, presentations, reports and other information from interactions with *domestic and international organizations as a result of this activity. These products will be provided in a timely manner and this effort will continue until the closure of this UNR. Relevant findings from recent interactions, status and future plans will be discussed as a standing agenda item during appropriate interface meetings between RES/DE, NRR/DMLR and NRR/DE. A report (or slides) for presentation at appropriate Director/Deputy Director interface meetings will be provided 5 days before the meeting.*

Task 4

This UNR (NRR-2017-006) serves as an “umbrella” under which associated SLR-focused technical UNRs are coordinated. These technical UNRs are shown in Table 1 below.

Table 1. SLR-Related Technical UNRs Associated with UNR NRR-2017-006

UNR #	UNR Title	Comments
<p>NRR-2017-001 ML16300A303 ✓</p> <p>RES Response to NRR-2017-001 ML17110A202 ✓</p>	<p>Request for Assistance to Evaluate Irradiation- Assisted Degradation of Rx Vessel Internals</p> <p>(b)(5) (b)(5) (b)(5) (b)(5)</p>	<p>This UNR is based on previous UNR NRR-2012-008 and updates regulatory research on void swelling and clarifies current projects and future projects that are being considered.</p> <p>A third task was added to this UNR for RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves.</p> <p>Funding: FY17: [redacted] FY18: [redacted] and FY19: [redacted] [redacted] (b)(5) FTEs: FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5) (b)(5)</p>
<p>NRR-2014-007 ML14126A818 ✓</p> <p>RES Response to NRR-2014-007 ML14212A127 (package) ✓</p>	<p>Reactor Pressure Vessel Integrity Issues</p> <p>(b)(5) (b)(5)</p>	<p>This UNR superseded UNR NRR-2007-001 and includes 6 tasks: (1) Appendix H in process by NRR, NRO, and RES staff; rulemaking funded in FY17 and team in place to finalize rulemaking effort, (2) updating the tech bases for Appendix G, (3) examination and analysis of irradiated reactor vessel material, (4) providing emergent technical assistance, (5) maintaining database and documentation, and (6) performing/ documenting a tech evaluation on irradiation damage mechanisms and potential revisions to 10 CFR, part 50 App. G of RG 1.99 "Radiation Embrittlement of Reactor Vessel Materials" Rev 2.</p> <p>Funding: (b)(5) (b)(5) (b)(5) FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5) (b)(5)</p>
<p>NRR-2011-014 ML11307A205 ✓</p> <p>RES Response to NRR-2011-014 ML11335A169 ✓</p> <p>Amendment to NRR-2011-014 (NRR-2016-012) ML16096A221 ✓</p>	<p>Assessment of Cable Condition Monitoring</p> <p>Amendment to UNR for Assessment of Electrical Cable Condition Monitoring</p> <p>(b)(5) (b)(5) (b)(5)</p>	<p>NRR/DMLR's focus on this UNR is to assess and evaluate condition monitoring methods on electrical cables subjected to accelerated aging under normal and accident conditions.</p> <p>Accelerated aging of the cable samples is expected to commence toward the end of FY2017.</p> <p>The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR).</p> <p>Funding: (b)(5) (b)(5) (b)(5) (b)(5) Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] FTEs: Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] (b)(5) (b)(5) (b)(5) (b)(5)</p>
<p>NRR-2012-004 ML12109A324 ✓</p> <p>RES Response to NRR-2012-004 ML12152A107 ✓</p>	<p>Alkali-Silica Reaction (ASR) Research</p> <p>(b)(5) (b)(5) (b)(5) (b)(5)</p>	<p>The objective of this UNR is to develop technical bases for regulatory guidance for evaluating ASR-affected concrete structures, primarily focusing on impact on the structural capacity under design basis loads through its service life, including PEO, and its aging management. The research at NIST includes obtaining data on highly instrumented concrete block specimens to monitor the progression of ASR and assess its impact on in-situ mechanical properties, conducting destructive testing to assess structural impact including seismic response, evaluating numerical modeling methods, and material aspects for determining the state and rate of ASR.</p> <p>Funding: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] FTEs: FY14 - [redacted] FY15 - [redacted] FY16 - [redacted] FY17 - [redacted] (b)(5) (b)(5) (b)(5)</p>
<p>NRR-2015-007 ML15076A217 ✓</p> <p>RES Response to NRR-2015-007 ML15229A100 ✓</p>	<p>Effects of Irradiation on Concrete Structures</p> <p>(b)(5)</p>	<p>The purpose of this UNR is to develop technical bases for regulatory guidance to evaluate radiation effects on concrete structures close to reactors. The focus of related regulatory research is to evaluate the impact on structural capacity under design basis loads for service life up to 80 years and develop aging management strategy.</p> <p>The project includes reviewing EPRI and DOE reports by ANL (contract awarded in Jan 2016), harvesting the materials from the decommissioned Jose Cabrera NPP in Zorita, Spain (b)(5)</p> <p>Funding: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5) FTEs: FY16 - [redacted] FY17 - [redacted] FY18 - [redacted] (b)(5) (b)(5) (b)(5)</p>

RES staff will document the review of the technical issues germane to the review of SLR applications. This will include, but may not be limited to, a summary of products from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff.

RES will prepare a document annually summarizing the products from the three tasks above and discussing the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM. This annual report will be at a sufficiently high level to be used to support briefings for the Commission or Advisory Committee on Reactor Safeguards, Commission Assistants' Notes, reporting to the public and interested stakeholders, or other requests for briefings on SLR. This annual report will be provided in the first quarter of each calendar year, beginning in the first quarter of calendar year 2018, discussing the research activities supporting SLR during the previous year.

(b)(5) Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [REDACTED] year for this task be adjusted once the scope of work and the required level of RES staff involvement is better understood after the first SLR application is received in early FY18. Technical assistance products and SME support will be provided to NRR in a timely manner, and this effort shall continue until the closure of this UNR.

Task 5 (Optional)

Under this optional task, NRR may call upon RES to provide independent confirmatory analyses and expert technical assistance with the review of anticipated SLR applications with potentially significant issues, such as those needing plant-specific gap analyses. Building upon the extensive work previously done under UNR NRR 2014-001, RES staff will continue to be available to provide confirmatory analyses and expert technical assistance with the review of the technical documents to be submitted with SLR applications. RES will be available to support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. RES subject matter experts (SMEs) will be available to participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders.

As an example, the staff will continue to be available to review operational equipment failures to assess the trend in critical risk-significant electrical equipment. There are concerns with aging effects (including cyclic aging) and design life of other electrical components, such as breakers and relays, which would need further evaluation to assess their continued service life by exploring other monitoring techniques not generally covered under surveillance tests. Such analyses could complement work in Task 2, whereby critical electrical components can also be harvested and evaluated. These SLR-related studies are being pursued independently of this UNR, and the work is being tracked through existing communication between RES and NRR staff.

Deliverables and Schedules

RES staff will participate in periodic meetings with NRR staff and management to discuss the latest developments and information from industry and NRC-supported research, as well as collaborative research, particularly insights that may impact regulatory decisions or aging management guidance. Staff-level interactions are expected to be as frequent as needed.

RES agrees with the deliverables proposed by NRR, with some adjustments to the schedule

based on expected project completion dates. RES staff will closely coordinate with NRR staff and adjust the schedules for deliverables as needed to support effective regulatory decision making.

The deliverables and schedules for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks Period of Performance (FY 18-21)				
Task Number	Task Description	Completion Date	FTE	Contract \$ (b)(5)
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) year	for FY 18 and FY 21
Total (Task 1)			(b)(5)	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components			
2.A.	Develop an information tool/database	FY 18	(b)(5)	(b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	(b)(5)	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5)	
2.D.	Continue to implement the process from 2.B. as components become available from additional plants	Ongoing (FY 20-21)	(b)(5) year (Total (b)(5))	
2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials	Ongoing (FY18-FY21)	Included in Task 3, below	(b)(5)
Total (Task 2)			(b)(5)	
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	(b)(5) year (Total (b)(5))	(b)(5) (total for 4 years IFRAM dues)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	(b)(5) year (Total (b)(5))	
5 (optional)	Provide technical assistance to NRR for reviewing SLR applications.	FY 18-21	To be funded if needed	To be funded if needed
Total (Tasks 1-4, over 4 years)			(b)(5)	(b)(5)

Note to requester: This record was originally provided to the FOIA team in paper, and then scanned. This is the best quality available.

MAaD Pathway



Keith Leonard
LWRS Spring Program Review and Technical Information
Exchange Meeting
DOE Germantown, April 26-27, 2016

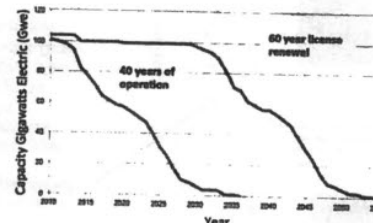
Light Water Reactor Sustainability R&D Program



Extended Operations of the Existing Reactor Fleet is in the National Interest

- Demand for electrical energy is expected to grow ~29% from 2012 to 2040.

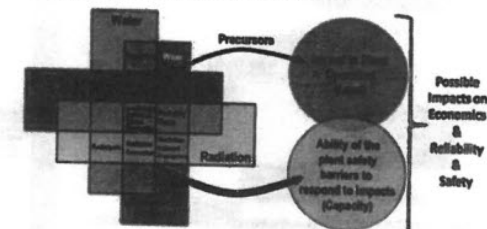
- At the same time, most of the currently operating nuclear power plants will begin reaching the end of their initial 20-year extension to their original 40-year operating license.



- If current operating nuclear power plants do not operate beyond 60 years (and new nuclear plants are not built quickly enough to replace them), the total fraction of generated electrical energy from nuclear power will rapidly decline.



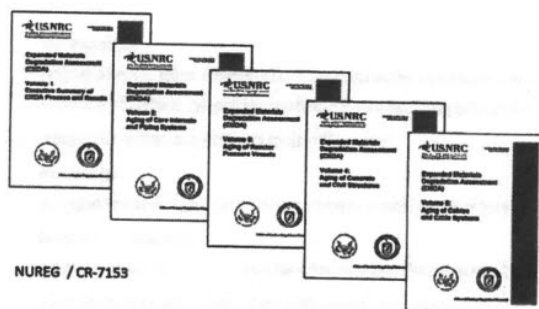
Extension of service life may cause new challenges for materials service



- Extending reactor service lifetimes to and beyond 60 years increases the operational demands on materials and components.
- The motivation of the Materials Aging and Degradation Pathway is to deliver fundamental understanding to enable and support nuclear power plant (NPP) life extension decisions in a timely manner



DOE and NRC have investigated issues of reactor aging beyond 60 years to identify possible knowledge gaps



NUREG / CR-7153



Materials Aging and Degradation

- Metals: Including Reactor Pressure Vessels, core internals, steam generators, and balance of plant
 - Irradiation-Assisted Stress Corrosion Cracking
 - High-fluence phase transformations and swelling of core internals
 - High-fluence effects on RPV steel
 - Crack initiation in Nickel based alloys
 - Thermal Aging of Cast Austenitic Stainless Steels
 - Environmentally Assisted Fatigue
- Concrete: Joint research plan with EPRI focused on radiation effects (supports and biological shield), ASR and monitoring tools
- Cables: Joint research plan with EPRI and NRC to better predict and monitor cable aging
- Mitigation, repair, and replacement technologies: Weld repair techniques; Post irradiation annealing; Advanced replacement alloys.



MAaD includes a diverse materials research effort team



The 5 M's of the MAaD/LWRS Pathway

- **Measurements of degradation:** Collect high quality data
- **Mechanisms of degradation:** Understand the underlying mechanisms for better prediction and mitigation
- **Modeling and simulation:** Use mechanistic models to explore data trends for extended life
- **Monitoring:** Monitor and validate predicted degradation
- **Mitigation strategies:** Develop technologies to reduce the rate of degradation, facilitate economic repair, and potentially replace with advanced materials that are less susceptible



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Research Highlights: Cable Aging and NDE

Cable Aging and Cable NDE

Purpose - Develop cable aging models and monitoring techniques to support long-term operation of nuclear power plant cable systems

Method /Approach

- Coordinated, accelerated aging of cable insulation and jacket materials representative of cable systems currently in use
- Electrical, chemical, and mechanical characterization to establish aging trends and key factors for cable condition monitoring



Accomplishments over Second Quarter of FY2016

- Participated in EPRI Cable Users Group with DOE/EPRI/NRC meetings, Phoenix, Jan. 12-14th.
- Initial study of FDR for NDE measurements showed comparable results to other similar NDE methods
- Accelerated thermal aging of harvested Hypalon/CSPE cables to determine RUL nearly completed
- Update of DOE/EPRI/NRC Cable Research Roadmap based on CY2015 activities and discussion

Leo Fifield, Bill Glass (PNNL)
Robert Duckworth (ORNL)



Cable Aging Degradation and Gap Analysis

Method /Approach

- Coordinated, accelerated aging of harvested cable insulation/ jacket materials that are representative of current NPP systems

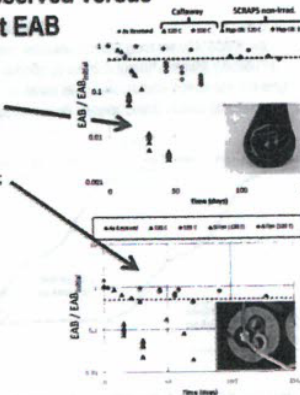
Status of work and completed tasks

- Combined thermal/gamma irradiated series of XLPE at 90C completed
- Accelerated thermal aging of harvested Hypalon/CSPE cables nearly completed
- Developed swell/gel method and correlated results with EAB for thermally aged EPR
- Began evaluation of new stock of vintage BIW Hypalon/EPR cable insulation and jacket

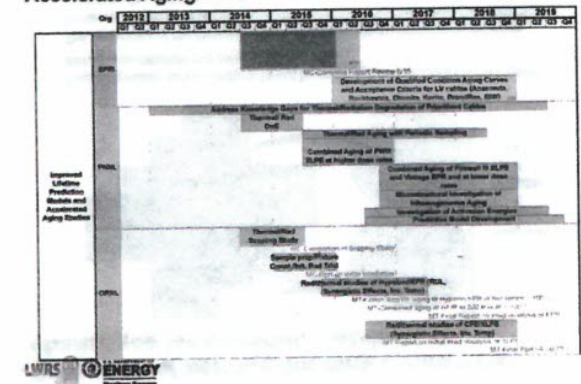


Consistent differences observed versus database values for jacket EAB

- Accelerated aging in air at 100°C & 120°C
 - Callaway control rod cable: BIW Hypalon Jacket with EPR insulated wires; in operation for approximately 30 yrs
 - San Onofre power cable: Firewall III CSPE jacket with XLPE insulated wires; in storage since 2006
- Elongation at Break measured on jacket material at aging intervals compared to SCRAPs and CPAD databases
- Data comparison database materials:
 - degree of aging / irradiation (Callaway)
 - differences in formulation (San Onofre)
- OIT and DSC characterization planned



Updated Cable Research Roadmap: Accelerated Aging



Leo Fifield (PNNL)
Robert Duckworth (ORNL)



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NDE of Cable and Cable Insulation

Purpose - Develop and validate new non-destructive evaluation technologies for nuclear power plant cable condition monitoring

Method /Approach

- Evaluate promising commercial technologies through collaboration with EPRI/vendors/industry
- Develop new technologies with high potential for tracking key cable health indicators



Accomplishments over Second Quarter of FY2016

- Concluded NDE with FAUSKE/Wire-Scan/LIRA and with AMS
- Collaborated with FAUSKE/Wirescan re: effects of substrate on frequency domain reflectometry data
- Held frequency domain reflectometry (FDR) workshop with AMS in Knoxville TN (last week of March)
- Received numerous in-plant cable images representing local damage contributors



Bill Glass (PNNL), Cable NDE
Leo Field (PNNL), Cable Aging



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Preliminary Conclusions from FDR and TDR Work

- FDR data taken among four instruments (VNA, LIRA, CHAR-FDR, CHAR-TDR) at similar frequencies was similar but not identical - Major peaks of all FDR data were at similar locations with similar amplitudes after normalization.
- FDR results for these cables show better resolution at higher frequencies of 200-500MHz rather than 100MHz.
- Responses from subtle insulation flaws (cuts and gouges) can be magnified by applying water
- For globally aged cables, the reduced signal velocity can be treated and displayed as an increase in cable length. Changes as large as 5% were noted.
- Exact value can be more precisely measured with TDR, but the phenomenon is present in both techniques.
- Subtle changes in insulation condition can frequently be observed in the CHAR TDR data. Sensitivity is aided by rapid pulse rise time and high resolution displays of the reflected response.



VNA and LIRA FDR Systems



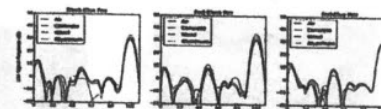
CHAR FDR and TDR Systems



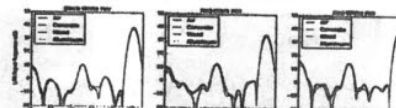
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FDR Environmental Influences

- Tight bends in cable
- Shielded vs. unshielded cable
- Presence of water
- Supporting material (air, concrete, aluminum, steel)



Unshielded cable shows differences among air, concrete, wood, and particularly aluminum at the SDR location where the damaged section and supporting material is located.



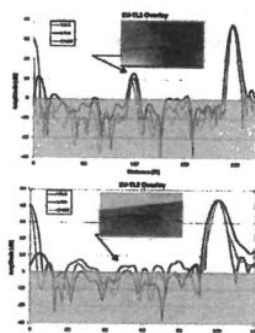
Shielded cable has virtually identical responses to air, concrete, wood, and aluminum while the damaged area at 50 ft maintains a clear peak.



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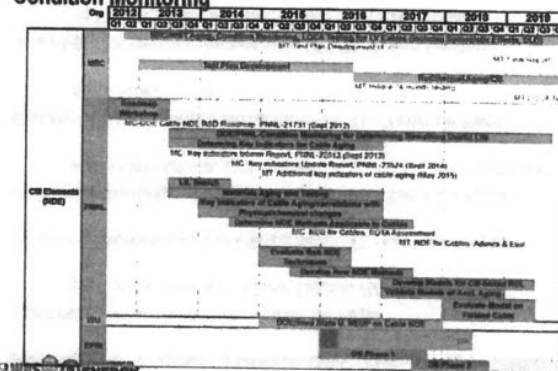
Two Different Cable FDR Comparisons Among Three Instruments

- Responses are similar but not identical - particularly at low reflection amplitudes (grey)
- Significant peaks (above grey shaded region) are at same location and similar amplitude
- Trending measurements should use the same instrument.



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Updated Cable Research Roadmap: Condition Monitoring

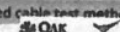


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Cable Aging and NDE Continued Work Through FY16

- Anticipated receipt of harvested and new ex-service / vintage stock cable from:
 - Zion, Crystal River Unit 3, Palo Verde, Columbia Generating Station
- Continued accelerated thermal and radiation aging at PNNL and ORNL
 - Sample exchange in order to facilitate OIT, TGA, DSC characterization of aged materials to connect mechanical performance to chemical property changes
 - Combined thermal/radiation aging to begin in ORNL HFIR Gamma Irradiation Facility and continue in PNNL High Exposure Facility (HEF)
- Normalize and reduce data from multiple FDR instruments used at AMS during last week in March to display on common plots
- Presentations of two papers at the ICONE24 in Charlotte, NC at the end of June

FY 2016 Q3 Milestones	Due Date
Complete accelerated thermal aging of Hypalon at two temperatures below 100°C (ORNL)	April 30, 2016
Evaluation of localized cable test methods (PNNL)	May 31, 2016
Evaluation of localized cable test methods (PNNL)	May 31, 2016



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Research Highlights: Concrete

Concrete Tasks Status and Accomplishments

Concrete Performance, TL: Yann Le Pape
staff: Alain Giorla & Elena Tajuelo Rodriguez

NDE of Concrete and Civil Structures, TL: Dwight Clayton

Irradiated Concrete, TL: Tom Rosseel and Yann Le Pape
staff: Alain Giorla, Igor Remec, & Elena Tajuelo Rodriguez

Grizzly Concrete Model Development, TL: Yann Le Pape
staff: Alain Giorla

Alkali-Silica Test Assembly with UT, TL: Yann Le Pape
UT Lead: Prof. Jon Ma, University of Tennessee



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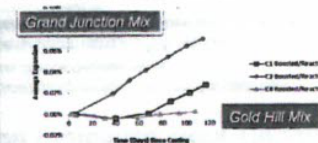


Concrete Performance WP: LW-16OR040301

Objective: Assess the safety and serviceability of Class I safety concrete nuclear structures affected by alkali-silica reaction
Accomplishments: Design of Reactive Concrete Mix for the UTK ASR Mockup

Designation	Source	Chemical / Mineralogy
C1	Gold Hill, NC	Green schist amorphous, calcite, quartz, Na-feldspar, K-feldspar, calcite, cristobalite
C2	Good Junction, CO	Basaltic feldspar, quartz, amorphous, calcite
C3	Rockville, VA	Microcrystalline crushed stone: quartz, feldspar, calcite
C4	Cockburnville, TN	Mixed calcite, amorphous calcite
C5	Adamsville, GA	Dolomitic dolomite

Grand Junction CO and Gold Hill NC aggregate show promising expansions. Ready Mix USA plant (0.5 miles away from) agreed to store, mix, deliver and dispose the remaining aggregate at no cost. On-going adjustment to the mix to limit the hydration heat (avoid Delayed Ettringite Formation) under consideration at UA.



Concrete Performance (Recently initiated) Data Accompanying Model of the UTK ASR Mockup

Explicit modeling of the steel frame and all surface/embedded structure

Objectives:

- Guidance on expected response of sensors during experiment
- Anomalies findings
- Updating modeling strategy based on monitoring data

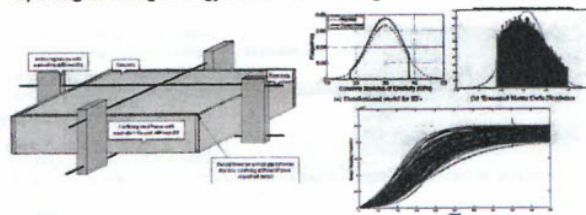


Figure 2: Uncertainty quantification of ASR

Concrete NDE WP: LW-16OR040303

> Objectives

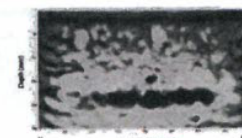
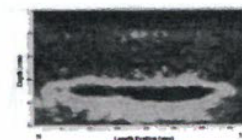
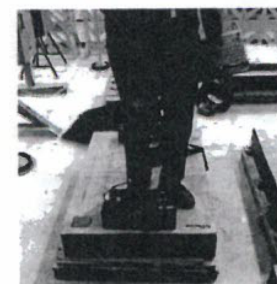
- Explore advanced signal processing techniques to improve detection and identification
- Collect linear array ultrasonic data from an alkali-silica reaction specimen
- Perform preliminary analysis of data collected from an alkali-silica reaction specimen

> Accomplishments:

- Collection of linear array ultrasonic data from four ASR specimens (thin)
- Initial analysis of ASR data using Synthetic Aperture Focusing Technique (SAFT)
- Developing of a quantitative assessment of damage



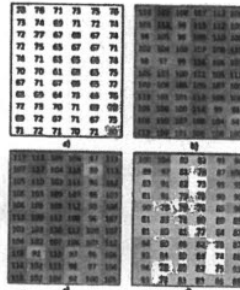
Collection of ASR Data and Initial SAFT Analysis



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Developing a Quantitative Assessment of ASR Damaged Test Blocks

- Need to reflect the difference in signal shapes that can be seen from visual inspection
- Needs to be independent of signal magnitude and the presence of time lags
- Based on the variability in signal shape and increased oscillation over time which occurs in damaged specimens
- Currently working with the Hilbert Transform



a) Control specimen, b) specimen with moderate damage, c) specimen with moderate damage, and d) specimen with minimal visible damage



Irradiated Concrete Task WP: LW-16OR040304

Objective: To understand the effects of radiation on concrete properties at extended lifetimes due to the uncertainties associated with existing experimental data.

Recent Accomplishments:

- Incorporating gamma ray dose into the development of a unified irradiation parameter to better evaluate contributions to concrete degradation.
- Characterization of irradiated first mineral analogues accelerated irradiation campaign and preparation for expanded second irradiation campaign
- Concrete damage models have incorporated temperature effects; creep / irradiation interactions.
- Initiated the development of the Irradiated Minerals, Aggregates, Concrete Database
- Through the International Committee on Irradiated Concrete (ICIC), three collaborative projects are being formed:
 - Collaboration with Japan (Nagoya University, Kajima Corporation, Mitsubishi Research Institute, and possibly CEPCCO) to characterize model concrete irradiated at IFE (Halden)
 - Collaboration with Fortum (Finland) concerning modeling and testing high granite concrete.
 - Collaboration with Czech Technical University to apply Banerjee techniques to evaluate irradiated mineral database



Irradiated Concrete Accomplishments: Publications

Peer-reviewed articles

1. Pignatelli, L.; Kumar, A.; Field, K.; Wang, B.; Yu, Y.; Le Pape, Y.; Sastry, M. & Sant, G. Direct Experimental Evidence for Differing Reactivity Alterations of Minerals following Irradiation: The Case of Calcite and Quartz. *Scientific Reports - Nature Communications*, 2016, 6(20166)
2. Le Pape, Y., Gloria, A. and Sanahujia, J. On the Effects of Temperature During Irradiation of Concrete. *Journal of Advanced Concrete Technology*, 2016, 14: 70-86.
3. Gloria, A., Le Pape, Y. and Dunant, C. Computing creep-damage interactions in irradiated concrete. *Journal of Nanomechanics and Micromechanics*, 2016 (under review)
4. Rossetti, T.M.; Le Pape, Y.; Gloria, A.; Ramee, L.; Maruyama, I.; Kontani, O.; Wall, J.J.; Streser, M.; Andrade, C. & Ordonez, M. Review of the Current State of Knowledge on the Effects of Irradiation on Concrete. *Journal of Advanced Concrete Technology*, 2016, (in final preparation)

Proceedings

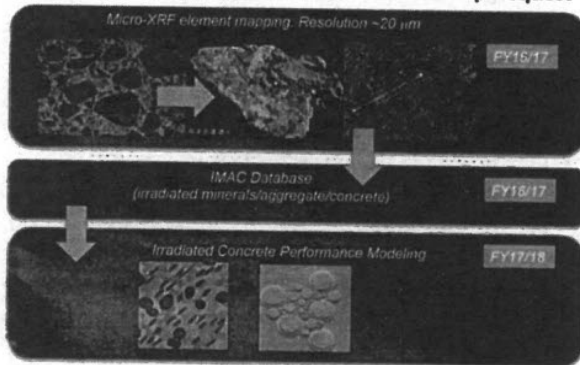
1. Gloria, A.; Le Pape, Y. & Huang, H. Mesoscale modeling of irradiation in pressurized water reactor concrete biological shield. *Proceedings of FrontCoS-8, Saoma, V.; Bolander, J. & Landis, E. (Eds.), 2016*
2. Ramee, L.; Rossetti, T.; Field, K. & Le Pape, Y. Characterization of Radiation Fields for Assessing Concrete Degradation in Biological Shields of NPPs, 6th Topical Meeting of the Radiation Protection and Shielding Division of the American Nuclear Society - (RPSD-2016), 2016

Invited Conferences

1. Guzman, M.; Le Pape, Y. and Saoma, V. On-going research on ASR at EPRI and DOE, Regulatory Information Conference (RIC), Bethesda MA, March 8-10, 2016
2. Le Pape, Y. Irradiated concrete performance, Perspectives on long-term operation of nuclear power plants, 1st International Conference on Grand Challenges in Construction Materials (GCCMAT), Los Angeles CA, March 17-18 2016



Irradiated Concrete/Concrete Performance Plus-up Request



UTK ASR Mockup, WP: LW-16OR040306

Objectives: Study the effect of structural constraints on:

- The development of ASR expansion and induced damage and
- The residual shear capacity

Expected Outcomes:

- Validation of numerical models in GRIZZLY
- Development/validation of monitoring/inspection techniques
- Develop monitoring data analysis
- Complement NRC-sponsored research at NIST and NextEra-sponsored research at the University of Texas @Austin.

Current Partners:

- University of Tennessee @ Knoxville (P.I. fabrication and instrumentation)
- ORNL (project overview and advisory role, fiber optics-based monitoring)
- University of Alabama (mix design)
- University of South Carolina (acoustic sensing)
- University of Colorado (numerical simulation and advisory role)
- Vanderbilt University (digital image correlation)



UTK ASR Mockup - Quick Facts

Specimens: 3 reinforced concrete blocks of 100 x 80 x 40 inches. 2 layers #11 (130) headed rebar @10": 1 confined ASR, 1 "free" ASR and 1 control. Total of ~31 tons of concrete

Steel Frame: 18R x 16R outer frame 144 bolt connections. Total weight: ~52 tons

Environmental Chamber: 52R x 24R x 12R (h) 100°F / 95% RH chamber

Monitoring (total for the three specimens):

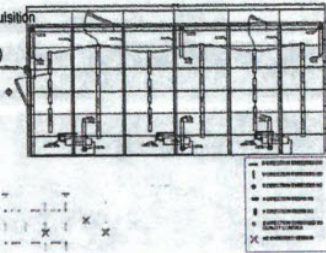
- 74 embedded (concrete) KM strain extensometers
- 24 resistivity gauges (inside rebar)
- 12 SOFO Fiber Bragg Grating 1.5 m strain sensors
- 4 Total Pressure Cells
- ~50m of distributed fiber optics (embedded and in surface)
- 16 passive acoustic sensors
- 160 DEMEC gauge studs (surface)
- 1 high-resolution camera for digital image correlation. Scan area: ~2' x 2'
- Mockups open to other periodic inspection/NDE



UTK ASR Mockup - Progress Report

- Environmental room: winning bidder, Nor-Lake Scientific
- Steel frame: winning bid Quality Machine and Welding Co
- Instrumentation: minor modifications, KM (Texas Measurements): Purchasing order released to the vendor.
- SOFO/specific coating & DAQ (RocTest): Purchasing order released to the vendor.
- National Instruments DAQ: Sole source requisition
- Fiber optic multiplexer purchased.
- Acoustic emission DAQ (loan from U. of SC)

- Pouring of blocks: Summer 2016



GRIZZLY / Raven Concrete Model Development, WP LW-16OR040305

Objectives: Develop constitutive model for Finite Element Analysis of Degrading Concrete Structures

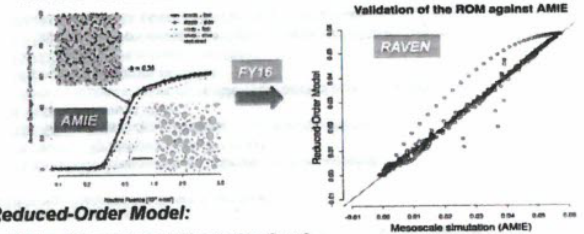
FY2016 Goals:

- Development of a Radiation-Induced Volumetric Expansion (RIVE) Reduced-Order Model (ROM) using RAVEN
- Model the UTK ASR Mockup with current ASR model available in GRIZZLY

Accomplishments:

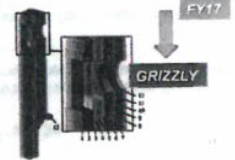
- Initiated the reduced order model with Raven

RIVE Reduced-Order Model with Raven



Reduced-Order Model:

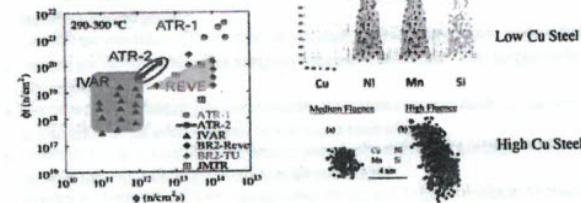
- RIVE and internal degradation as a function of material parameters and environmental conditions (fluence, temperature, etc)
- Build using RAVEN (developed at INL) from a series of mesoscale simulations with AMIE
- Polynomial approximation: easy to implement in macroscale software (Grizzly)
- Validation of the ROM in progress



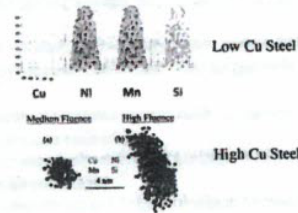
Research Highlights: Reactor Metals

High Fluence RPV Task: ATR-2 Experiment

- ATR-2 experiment was designed to bridge previous test reactor and surveillance data for insight on the effects of flux and fluence in many alloys with systematic variations in composition.



- In addition to measuring mechanical properties, a major focus is on Mn-Ni-Si phase precipitates that develop at high fluence using a variety of state-of-the-art microstructural characterization methods.

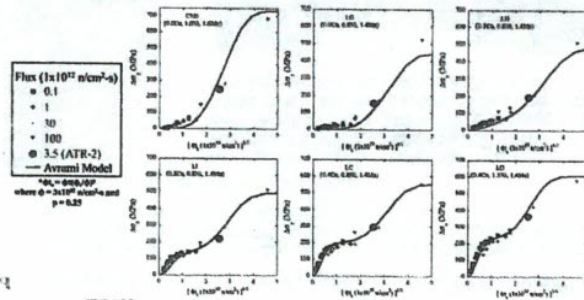


Various UCSB ATR-2 Specimens Have Been Packaged and Shipped to UCSB, LAMDA, HFIR, and BNL

- Of the 13 cups in the experiment, the three highest priority cups (6, 7, and 8) have been selected and have been opened, with specimens identified, cleaned to reduce alpha as much as possible and radioactivity measurements (y-β) have been performed. These cups contain DCT fracture specimens of key Rolls-Royce alloys, LWR surveillance materials, and key UCSB alloys. The activities are relatively low and will allow for most testing to be performed in the ORNL LAMDA facility and in the UCSB radiological facilities.
- Two containers with Rolls Royce tensile specimens were disassembled and packaged in hot cell and shipped to UCSB.
- Over 100 20-mm discs identified in hot cell, with about 30 discs packaged and shipped to UCSB.
- Specimens of the nine commercial reactor surveillance materials have also been removed from the cup, identified, and shipped to the ORNL LAMDA facility – 8-mm discs were punched from 20-mm discs and sent to HFIR for small-angle neutron scattering.
- 3-mm discs of selected materials were packed in special holders in LAMDA, packaged and shipped to Brookhaven National Laboratory for x-ray scattering experiments.
- 3-mm polished discs of 15 unirradiated surveillance materials from UCSB were microhardness tested with 0.5-kg load in LAMDA to compare with UCSB test results on the same specimens with good results.
- 8-mm unpolished discs of 15 unirradiated and irradiated surveillance materials were microhardness tested with 10-kg load in LAMDA to determine irradiation-induced hardening – preliminary results were presented at IGRDM-19 in April 2016.

Progress - ATR-2 Data Compared to Predictions

- Large red points are ATR 2 data compared to $\Delta\sigma_y$ predictions of a previous microstructurally-based effective fluence model.
- The large $\Delta\sigma_y$ in the Cu-free steels and upswing at $> 6 \times 10^{19}$ n/cm²-s are due to MnNiSi precipitates.



Summary of PIE Progress

Alloys Tested - High Fluence 290°C

Alloy Matrix	Mechanical Properties		Microstructure			
	Tensile	Hardness	FIB	APT	SAXS	SANS
UCSB	29	0	6	2	28	0
Rolls Royce	8	0	7	7	6	0
Surveillance	14	15	0	14	15	
Total	51	15	13	9	48	15

Ongoing and Near Term Schedule - High Fluence 290°C

Alloy Matrix	Mechanical Properties			Microstructure			
	Tensile	Hardness	Shear Punch	FIB	APT	SAXS	SANS
UCSB	Ongoing	Ongoing	May-16	May-16	Aug-16	May-16	
Rolls Royce	Ongoing	Ongoing	May-16	Apr-16	Aug-16	May-16	
Surveillance	Ongoing	Ongoing	May-16	Jun-16	Aug-16	May-16	

Remaining PIE: Number of Specimens (number of alloys in parenthesis)

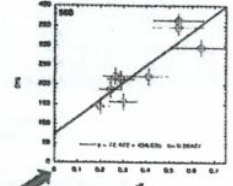
Specimen Type	250°C		270°C		290°C		310°C
	Low Fluence	Med Fluence	Low Fluence	Med Fluence	Low Fluence	Med Fluence	
Tensile	0	0	17 (9)	173 (53)	37 (2)		0
Coupons (shear punch)	99 (94)	103 (80)	307 (161)	310 (153)	323 (173)	103 (85)	
Disc, compact tension	0	0	4 (1)	14 (1)	28 (2)	0	

Multi-Purpose Discs Used to Obtain Micro-hardness Data to Estimate Irradiation-Induced Increases in Yield Strength and Transition Temperatures for Nine Reactor Surveillance Materials

- Irradiated multi-purpose discs of 20-mm and 8-mm diameter, 0.5-mm thickness, transferred from the ORNL hot cell to the ORNL Low Activated Materials Development and Analysis (LAMDA) laboratory for various evaluations - 8-mm discs punched from some of the 20-mm discs to enable small-angle neutron scattering experiments in the High-Flux Isotope Reactor.
- Vickers microhardness tests performed on unirradiated and irradiated 8-mm discs with 10-kgf, 5 indents per specimen, and with 0.8-mm spacing.

$$\Delta YS = \Delta H \sqrt{10} \approx 3.33$$

Material	Irrad. Temp. °C	Fluence	ΔHv 10	ΔYS, MPa
1	290	1.21E+20	43.2	143.8
2	290	1.21E+20	105.0	358.3
3	290	1.21E+20	56.0	186.5
4	290	1.21E+20	88.4	294.4
5	290	1.21E+20	46.6	155.2
6	290	1.21E+20	64.0	213.1
7	290	1.21E+20	68.2	228.0
8	290	1.21E+20	109.0	360.0
9	290	1.21E+20	66.4	221.4



Results indicate general correspondence with preliminary precipitate volume fractions (V_p) from small-angle neutron scattering experiments.



ATR-2: Surveillance samples

Table 3.1 Specimen Matrices Summary

	Lo Disc		Sm Disc		Temp		DCT		Any Type	
	Alloy	Spec	Alloy	Spec	Alloy	Spec	Alloy	Spec	Alloy	Spec
Total # irradiated cond										
Tensile # spec	144	1028	40	224	52	367	3	45	173	1664
DCT matrix	3	14			3	34	3	45	3	113
CM alloys	21	291			18	82			21	323
Laval alloys	10	72			8	48			10	120
UCSB Commercial alloys	13	107	1	4	9	53			13	164
EPRI alloys	20	141			6	21			20	162
ORNL alloys	5	64	5	41	8	51			9	156
RR alloys	57	358	11	80	8	48			68	484
Bettis alloys	5	25							5	25
CRJEP alloys			13	65					13	65
QV model alloy	9	15	10	34					10	49
Diffusion Matrices	1	3							1	3

Table 3.2. List of archival surveillance materials.

Plant	Material	Heat Number	Specimen Provided
Furley Unit 2	SMAW	BOLA	One (1) 1/21-CT "CW25"
Furley Unit 2	SA533B-1	C7466-1	Two (2) 1/21-CT "C129" and "C138"
V.C. Summer	Linde 124 Weld	4P4784	One (1) 1/21-CT "CW26"
Kewanee	Linde 1092 Weld	1P3571	0.5" x 3" x 1.5" slice of weldment (weld marked) Two (2) untested tensile
Maine Yankee	Linde 1092 Weld	1P3571	"4K1" and "3J2" Two (2) broken Charpy halves from specimen "372"
Furley Unit 1	Weld	33A277	
Beaver Valley Unit 2	Plate	B9004-1	Block 5x2.25x2.375 in.
Kewanee	Forging, SA 508-2	B6307-1	Block 3.19x0.875x0.55 in.
Turkey Point Unit 4	Linde 80 Weld, SA-1094	Weld wire heat #71249 and Linde 80 flux lot 8457	Block 3.375x4.25x0.625 in. (Block returned following machining of specimen)

Notes: "CT" refers to transverse orientation and "CL" refers to longitudinal orientation.

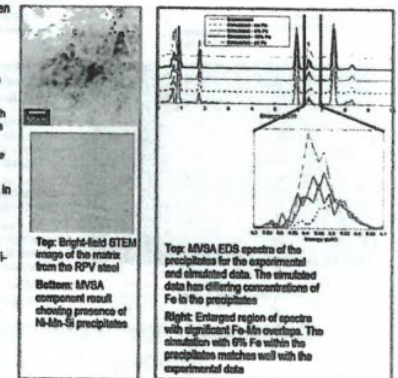
Analytical Electron Microscopy of RPV Steel

- Analytical electron microscopy has been performed on a high-Ni, low-Cu weld metal from the Ringhals reactor

- Irradiated to a high fluence
- Of interest due to large T₉₁₉ transition temperature shift (102 °C)
- Atom probe tomography reveals a high Fe content in the Fe-Mn-Si precipitates due to observations that is normally removed entirely - does this reveal the correct composition?

- No Ni-Mn-Si precipitates are observed in TEM, but can be seen in EDS. This is further enhanced using MultiVariate Spectrum Analysis (MVSA)

- Simulated EDS data reveals that the Ni-Mn-Si precipitates may contain - on average - approximately 6 at.% Fe



High Fluence Effects on RPV: Summary of ATR-2 Work

- ATR-2 is providing a basis for assessing RPV embrittlement over extended plant life.
- With 1,625 individual specimens consisting of 172 different steel alloys, ATR-2 bridges worldwide databases for a wide range of flux, fluence, temperature and composition.
- The initial results of a very aggressive PIE program are in agreement with previous physical models, showing formation of "late blooming" Mn-Ni-Si phases, that are not treated in current regulatory models.
- ATR-2 will also provide: (a) verification of the Master Curve method; (b) material for a post irradiation annealing database for embrittlement remediation; and, (c) developing of a new class of high Ni (low Mn) advanced RPV alloys (Rolls Royce materials).
- The overall ATR-2 experiment involves an international funding consortium (DOE-LWRS, KAPL, Rolls Royce, CREPI).



Recent Highlights on Stress Corrosion Crack Initiation Research at PNNL

- **Processes Controlling SCC Initiation in Alloy 600**
 - Three critical stages have been discovered to promote SCC initiation in alloy 600 exposed to PWR primary water. Precursor damage occurs by stress-assisted intergranular attack and leads to crack nucleation. Kinetics of short crack growth at low stress intensities are critical to SCC response and explain differences between highly susceptible, cold-worked alloy 600 and less susceptible as-received alloy 600.
- **Processes Controlling SCC Initiation in Cold-Worked Alloy 690**
 - Long-term constant load and blunt notch experiments in PWR primary water have revealed the formation of grain boundary cavities in heavily cold-worked alloy 690. A high density of these cavities can promote crack nucleation and SCC initiation. Cavity formation clearly depends on the degree of cold work and the applied stress.
- **Collaboration Activities**
 - PNNL is co-leading an international round-robin testing program for measurement of SCC initiation. The primary material is a PNNL/LWRS alloy 600 heat and coupons have been provided to 12 international laboratories. Materials characterization and baseline SCC initiation testing has been completed at PNNL with data being provided to all participants.
 - Joint SCC initiation research has continued with EPRI, NRC and Rolls Royce.

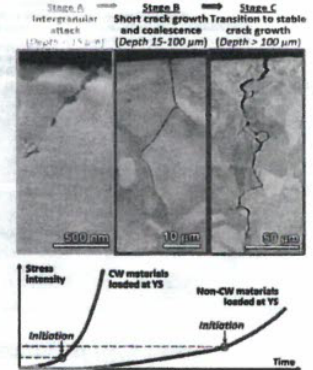


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Processes Controlling SCC Initiation in As-Received and Cold-Worked Alloy 600 Materials

- **SCC initiation response of alloy 600 in PWR primary water evolves in 3 stages:**

- **Stage A. Intergranular attack (IGA) begins immediately on high-energy grain boundaries intersecting the surface with attack depth and boundary distribution increasing with time.**
- **Stage B. Short crack growth and coalescence, development and slow growth of cracks from IGA, plus coalescence increases crack size.**
- **Stage C. Transition to stable crack growth, cracks reach critical size to produce a stress intensity (K) for practical SCC initiation and sustained growth at engineering relevant rate.**
- **The transition to short crack growth occurs at a critical IGA depth where the local K is sufficient to fail the oxidized grain boundaries.**
- **Practical SCC initiation occurs when a critical crack size and K is reached for stable SCC propagation. This K is lower for more susceptible cold-worked (CW) materials than non-CW materials.**



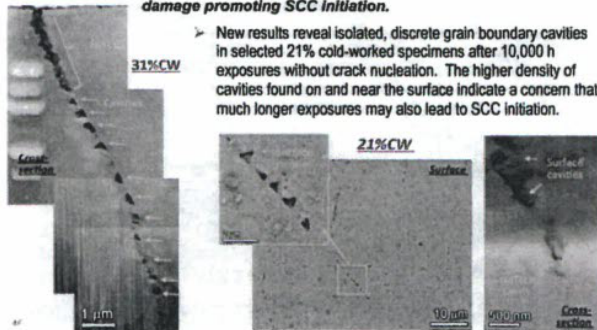
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Processes Controlling SCC Initiation in CW Alloy 690

- Crack nucleation has been observed during long-term constant load and blunt notch tests on 31% cold-worked alloy 690 in 360°C PWR primary water. Extensive grain boundary cavity formation occurs and can act as precursor to crack initiation.

damage promoting SCC initiation.

- New results reveal isolated, discrete grain boundary cavities in selected 21% cold-worked specimens after 10,000 h exposures without crack nucleation. The higher density of cavities found on and near the surface indicate a concern that much longer exposures may also lead to SCC initiation.



Ongoing SCC Initiation Research Activities at PNNL

- **Processes Controlling SCC Initiation of Alloy 600**
 - SCC initiation tests on as-received materials will be completed and new tests started on cold-worked alloy 600 investigating the effects of applied stress.
 - Presentation will be given at IGC-EAC Meeting in China and a milestone report (M3) will be completed and submitted in June 2016.
- **Processes Controlling SCC Initiation of Cold-Worked Alloy 690**
 - Detailed characterizations of grain boundary cavities and cracks will be completed on cold-worked blunt notch and constant load tensile specimens. Mechanisms controlling cavity formation, surface crack nucleation, SCC initiation and short crack growth from grain boundary cavities will be investigated.
 - Long term SCC initiation tests will continue on cold-worked alloy 690 materials.
- **Collaboration Activities**
 - Repassivation experiments are underway on alloy 690 and Ni-30Cr binary alloys investigating the influence of grain boundary Cr depletion below protective films on crack nucleation and growth. DOE Office of Basic Energy Sciences
 - Microstructural characterizations and SCC initiation tests are underway on the EPRI/GE plate and will be performed on the Rolls Royce plate as part of the SCC Initiation Round Robin. Special presentation at IGC-EAC. EPRI and Rolls Royce
 - Optimization of SCC initiation test system design including new loading arrangement and balance plates for the 36-specimen load train. EPRI and NRC



S.M. Bruemmer, Z. Zhao, M. Gholizadeh, K. Krukowski and M. B. Toloczko, PNNL

High Fluence IASCC: Goals and Recent Accomplishments

BWR materials

The efficiency of the IASCC CGR mitigation by HWC (low potential environment) appears to be fluence and stress intensity factor (K) dependent. In addition to addressing an operational issue, this change of behavior may give a important insight on the mechanism of IASCC as fluence increases.

PWR materials

Address the effect of high fluence microstructure features on IASCC (use of ex-service materials and experimental reactor materials). Specifically, to determine the role of swelling in IASCC susceptibility.



Shipping cask (in blue), and transfer cask before specimens transfer



One of the specimens machined (CT) with loads attached

- 304SS irradiated in EBRII
- 4 CT specimens, 2 tensile specimens and 4 microscopy plates machined
- Two specimens received at CAES: first reception of such specimens in this facility
- Transfer cask now available
- Shielded system for crack growth rate testing in PWR environment installed at CAES
- Testing at CAES

Further accomplishments previously discussed in "plus up" section of review.



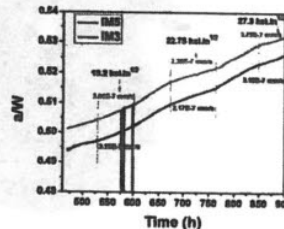
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Mechanism of IASCC

Objective: Experimental research on crack initiation and crack growth of high-fluence specimens of single-variable alloys in simulated LWR environments. Combined, these single-variable experiments will provide mechanistic understanding that can be used to identify key operational variables to mitigate or control irradiation assisted stress corrosion cracking (IASCC).

University of Michigan work:

- Two parallel experiments on CW316SS are being conducted in 288°C water to verify:
 - 1) CGR testing can be conducted remotely in a hot cell,
 - 2) Labview interface provides the same result as the ATS program now being used.
- Tests of reproducibility: crack growth rates as a function of K are in excellent agreement.

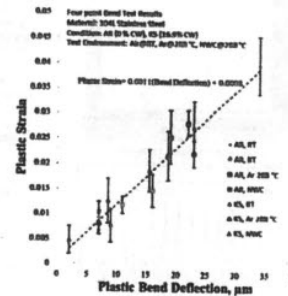


a/w during crack growth rate tests on 8 mm thick, 20% cold rolled 316 SS sample in 288 °C pure water.



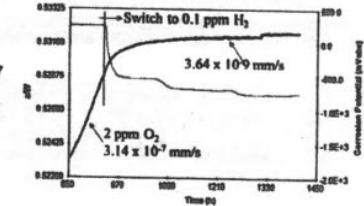
IASCC work at U. of Michigan

- The four-point bend test capability moved to the IM2 autoclave/loading system to provide a dedicated facility for the LWR program.
- In an effort to benchmark use of the IM2 system, four-point bend tests on unirradiated 304L SS were performed in air, and in argon and NWC at 288°C. Results are consistent with those from the same alloy in a more cold worked state, which improves confidence in the ability to predict sample strain by measuring bend deflection.



IASCC work at U. of Michigan

- The influence of water chemistry on crack growth rate is being investigated, using the 4-point bend test.
- CGR testing being evaluated using practice test samples of 20% cold rolled 316-grade stainless steel.
- The environment change from normal water chemistry (NWC) to hydrogen water chemistry (HWC) has been implemented and the CGR has dropped by about two orders of magnitude.
- Testing this summer on commercial and high purity 304L-grade stainless (4 to 47 dpa, BOR-60 reactor irradiated). Including several post-irradiation annealing tests.

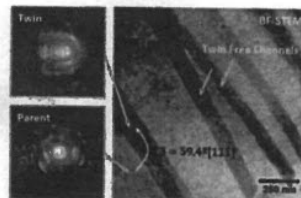


Twinning in commercial and model alloys deformed in high-temperature water - understanding mechanisms

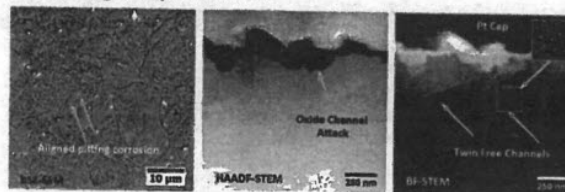


- Early deformation twinning was observed in 304L steel deformed in high-temperature water at slow strain rate. Twins inside dislocation channels may promote stress localization and cracking.
- Twinning was explored in 304L-based model alloy: 304L + 2% Mo + 1 %Hf (higher stacking fault energy compared to ordinary 304).

TEM based orientation mapping (right) showed some channels to be twins, but the majority of observed channels were twin-free in the near surface layer. Behavior as expected due to higher SFE.



Localized corrosion is a non-random process in the specimens deformed high-temperature water

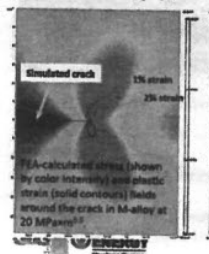


- Oxide attack at the surface and near surface was observed using SEM and TEM on deformed austenitic alloy exposed to high-temperature water

SEM and TEM show pitting to be non-random in the specimen, oxide attack was observed to be aligned on dislocation channels. Attack occurred to a depth of ~250 nm; micro-pit density varied in different grains.



Plastic strain and stress corrosion cracks

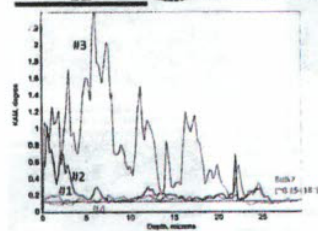
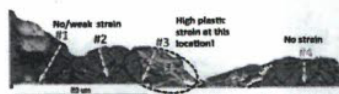


- Round compact tension specimens (RCT) are available for several 304-based model alloys. The crack growth tests were conducted under well-controlled environment parameters and stress intensity factor.
- It was important to investigate plastic strain mechanisms acting during crack propagation.
- Methods: SEM/FIB/EBSD, TEM, Finite Element Analysis (FEA).

As was expected, stress concentration near the growing crack should lead to significant plastic strains in the crack-adjacent grains. The width of the area strained at ~2% (EBSD-detectable strain level) was estimated to be ~20 μm micron on each crack side.



EBSD analysis of plastic strain around the stress corrosion crack



Kernel misorientation distribution at the crack edge. The diagrams show the detailed KAM profiles (#1-#4) taken at different locations.

- Plastic strain distribution was found to be strongly inhomogeneous.
- In the crack vicinity (<20-30 μm), many grains were practically strain-free, some grains experienced strong plastic strain.
- Plastic strain may reflect the nature of grain boundaries passed by crack; most likely, more resistant boundaries led to larger strain in the crack-adjacent grains.

Environmentally Assisted Fatigue

Objective: Develop mechanistic model for fatigue life estimation using FE models, through support of experimental test data to input materials properties as they change during fatiguing.

Industry uses stress-life (S-N) curve and elastic stress analysis results for fatigue evaluation

→ With elastic stress analysis:

- Then the stress-strain state in reactor component stays well below the yield stress and component may have a longer predicted life than actual.

Failures can occur if the overall stress state stays well below the elastic limit of the component due to localized effects or abnormal conditions:

- Residual stress (e.g. due to weld)
- Local crack or defect
- Load sequencing
- Adverse loading environment
- Some or combination of all the above

What is LWRs doing to help in this regard?

→ Development of a mechanistic model of realistic reactor component under realistic reactor load to understand how elastic-plastic stress-strain states behave under: load sequencing, presence of crack, environment, residual stress, etc.

Once fully developed ANI's generic time/cycle-dependent mechanistic modelling approach will not only help the Nuclear industry but will also help to change the fatigue evaluation procedures followed in aerospace and fossil power industry.



Few Examples on Recent Mechanistic Modeling Activities

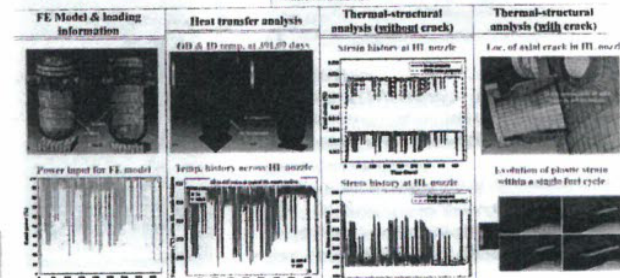
Developed FE model of RPV with/without preexisting crack

→ Performed simulation under grid load: following loads for one fuel cycle

- Heat transfer analysis
- Thermal-mechanical stress analysis

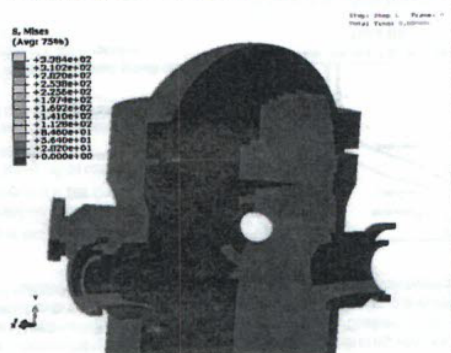
Why simulation under grid load following?

- Increasing penetration of renewable sources to interconnected power grid may overstretch the NPP components due to fluctuations in power demand.
- Power fluctuations can create load sequencing effects on reactor material which may accelerate/decelerate damage under thermal-mechanical-water environment.



The thermal-mechanical stress analysis result from FE model is used as input to a stress-controlled fatigue test (currently) undergoing at ANI, to check the FE model performance and then further improve it.

Examples movie (with magnification factor 5) showing reactor displacement and stress under load following mode



Few Examples on Recent Experimental Activities

Variable amplitude stress control fatigue tests conducted for 508 LAS base metal

- A1 300 °C, in-air condition
- A1 300 °C, PWR water

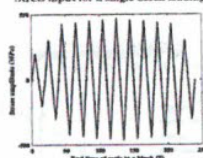
Why variable amplitude fatigue tests compared to conventional constant amplitude fatigue tests?

- Constant amplitude test based fatigue data may not adequately capture the load sequence effect under random load.
- Variable amplitude test based material model might improve the mechanistic model results particularly under realistic load-following condition.

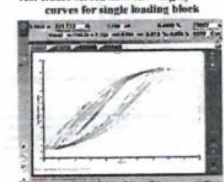
Why stress control compared to conventional strain control tests?

- Stress control test is similar as in the real reactor condition where stress as an independent variable allows the strain to decrease/increase (material hardening/softening) cyclically.
- The measured cyclically increase/decrease strain versus applied stress (or associated material models) will be fed to FE model similar as monotonic stress-strain curve. This is to further improve the time/strain dependent mechanistic fatigue models.

Stress input for a single block loading



Test frame screen shot showing hysteresis curves for single loading block



Number variable & grid load following random load tests are planned for J16 base, 508LAS-J16SS dissimilar and J16SS-J16SS dissimilar metal weld specimens to extend the modeling effort for RPV & pressurizer weld joints, H-A-L pipes and surge line pipes.

Cast Austenitic Stainless Steels Aging

Objective:

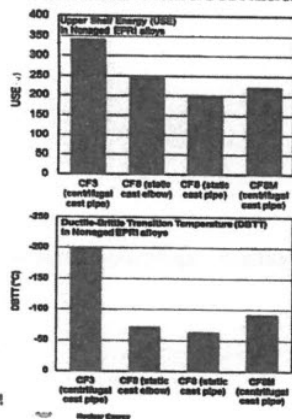
- This research aims to systematically build a scientific knowledge base for the thermal aging behavior of cast austenitic stainless steels (CASS).
- The ultimate goal of this research is to provide conclusive predictions for the integrity of CASS components in LWRs during extended service lives up to and beyond 60 years.

Accomplishments (Q2):

- Charpy impact testing and transition temperature analysis for non-aged 4 EPRI CAST alloys (CF3-centrifugal cast, CF8-static cast, CF8 (elbow)-static cast, CF8M-centrifugal cast) were completed.
- Aging treatment for 4 model CASS alloys (CF3, CF3M, CF8, and CF8M) and 2 wrought alloys (304L and 316L) reached 10,000 hour milestone on April 4, 2016.
- An invited paper for cast stainless steel thermal aging has been published: T.S. Byun, Y. Yang, N.R. Overman, J.T. Busby, "Thermal Aging Phenomena in Cast Duplex Stainless Steels," Journal of Metals, 68(2) (2016) 507-516.
- Efforts to expand scope: (a) The I-NERI project with S. Korea to study thermal aging effects in stainless steel weld metals has been granted and started. (b) The NSUF proposal to study Synergistic Effects of Thermal Aging and Neutron Irradiation was submitted (February 2016).



Baseline Characterization of EPRI CASS Alloys



□ EPRI has provided 4 CASS materials from piping and elbow components, which are being aged at 290–400°C.

- Ductile-brittle transition curve analysis for the Charpy impact data of non-aged EPRI alloys was performed.
- Among the 4 EPRI alloys the CF3 alloy from centrifugal cast pipe demonstrated the highest average USE of ~340J and the lowest DBTT of about -200°C.
- The Mo-containing alloy (CF8M) has relatively high DBTT, even being centrifugal cast.
- The static-cast CF8 alloy showed the highest DBTTs, -63 and -71 °C.

Cast Austenitic Stainless Steels Aging

On-going tasks:

- Mechanical property testing for two reference wrought alloys (304L and 316L) aged for 1500 hours is underway.
- Microscopy for aged and non-aged CASS alloys is under way using an aberration-corrected STEM to show phase and chemical distribution and morphology.
- Aging treatment for EPRI CASS alloys will reach 10,000 hour milestone in June 2016. One full set of specimens will be retrieved for characterization.
- A milestone report on the mechanical property degradation of CASS model alloys (CF3, CF8, CF3M, and CF8M) after aging at 290 to 400 °C for 1,500 hours will be submitted in April 2016 (M2LW-16OR0402152).
- Specimen machining for 4 model CASS and 2 wrought alloys after 10,000 hour aging. Mechanical and microstructural characterization will be followed.

Research Highlights: Modeling and Simulation

Thermodynamic Tools for Evaluation of Radiation-Induced Effects

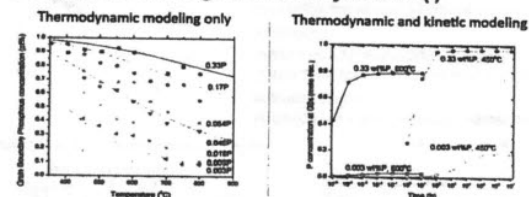
Objectives

- Development of thermal segregation models of alloying elements on the grain boundary for future integration with irradiation induced segregation modeling.
- Development of computational thermodynamic tools for predicting long term thermal stability of Cast Austenitic Stainless Steels

Accomplishments

- Thermodynamic and kinetic models for P thermal segregation in α -Fe have been developed. Two theories were used to describe equilibrium segregation thermodynamics: McLean equation and Grain Boundary Segregation Transition (GBST) theory.
- Predicted thermal stability of L12₃Ni₃Si (γ) precipitate has been experimentally validated using HRTEM on long-term thermally annealed samples (10000h at 700°C).

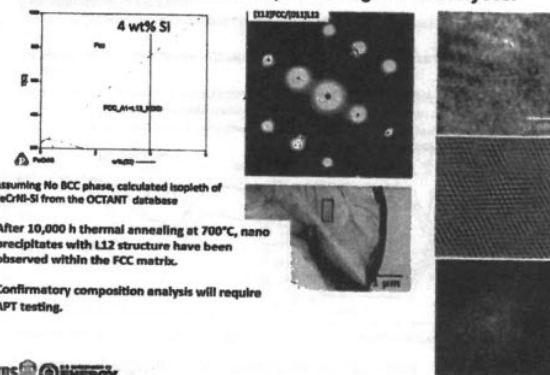
P segregation at the grain boundary of α -Fe (I)



Calculated equilibrium segregation of P at GBs based on McLean equation vs. alloy composition (wt%) and temperature, compared to the experimental data [1]

- Findings:
- The equilibrium segregation predicted from the kinetic modeling (i.e., the plateau value) is well consistent with the thermodynamic calculation, indicating the self-consistency of the two models.
 - However, the kinetic simulation suggested a long annealing period (e.g. up to 10⁶h for Fe-0.003 wt%P at 450°C) is needed for segregation to reach equilibrium for low P alloy at low temperature.
 - An important indication from this work is the real equilibrium segregation for P in α -iron may be well larger than the experimental observation.

Validation of thermal stability of L12 phase predicted by the OCTANT database - Increased Scope from High FY15 Carryover



Multi-scale Modeling of Radiation Induced Precipitation in Reactor Pressure Vessel Steels

Motivation: Precipitation is a leading cause of embrittlement of RPV steels under irradiation.

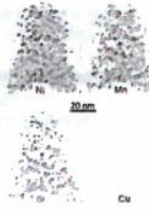
Objective: Multiscale modeling of CuMnNiSi precipitation in reactor pressure vessels (RPV) steels to predict their effects on RPV steels embrittlement under LWR extended life conditions.

Accomplishments: Development of both meso-scale Cluster Dynamics and atomic scale Kinetic Monte Carlo (KMC) models that accurately reproduce a large body of experimental data. We have then used those models to show:

MnNiSi precipitates are late-blooming and can change significantly under life-extension conditions, making their prediction an essential part of LWR life-extension.

Small changes in temperature (20°C) and local composition (0.3 at%) yield up to 10x change in precipitate number density and 1% change in precipitate volume fraction - dependencies critical to include in modeling and understanding of measurements.

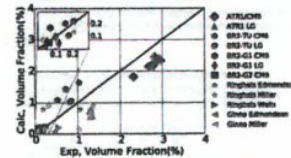
MnNiSi precipitates appear to enrich in Si during formation, perhaps due to radiation induced segregation, which is important in predicting MnNiSi precipitate evolution.



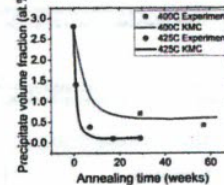
Atom maps of Ni, Mn, Si and Cu atom locations for a low (impurity level) Cu steel [1]

Validation of Cu-MnNiSi Precipitation Models

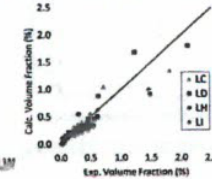
Cluster Dynamics - Irradiated MnNiSi Alloys (no Cu)



KMC - Annealed MnNiSi Alloys (no Cu)



Cluster Dynamics - Irradiated CuMnNiSi Alloys

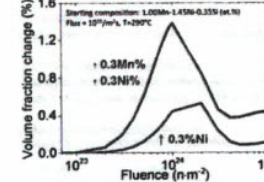


- All models show good to excellent agreement with experimental data.
- Cluster dynamics model can be used to explore embrittlement vs. temperature, flux, fluence, and composition.
- KMC model can be used to explore atomistic scale changes in precipitate composition and structure.

Experimental data predominantly from Odette group at UCSB.

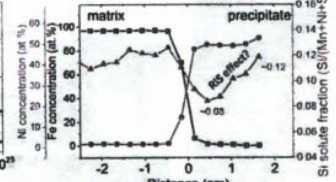
Predictions of Cu-MnNiSi Precipitation Models

Composition Effects on Volume Fraction



A small composition difference consistent with local heterogeneity can cause large difference in precipitate volume fraction.

Annealed Precipitate RIS



Annealed interface has lower Si solute fraction (~0.08) than initial precipitate (~0.12), suggesting Si RIS.

Future work

- Validate cluster dynamics model vs. UCSB+ embrittlement database through coupling with mechanical models.
- Expand KMC to include irradiation effects to determine atomic scale nucleation processes and influence of radiation induced segregation.
- Explore machine learning methods for embrittlement prediction from existing data.



[1] P. Wei, G. Odette, N. Gowing, T. Mott, T. Yin, T. Yamamoto et al. In-Situ Observed Late Blooming Phenomena in RPV Steels at High Fluence and Flux. TMS 2013, San Antonio, TX



Research Highlights: Mitigation Strategies

Mitigation Technology: Advanced Weld Repair

A Collaborative Effort: DOE under LWRs and EPRI under Long Term Operation

Objective:

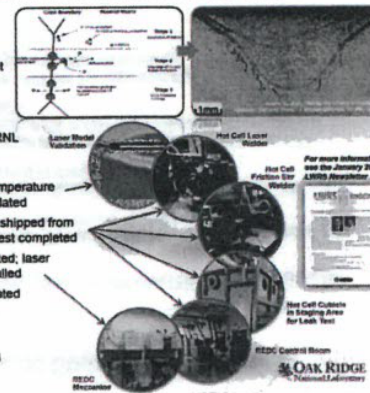
- Develop advanced welding technologies for repairing highly irradiated reactor internals without helium-induced cracking
- Demonstrate these technologies on irradiated stainless steels in a new hot cell welding facility at ORNL

Recent Accomplishments:

- Weld process model for in-situ temperature and stress/strain refined and validated
- Cubicle development completed; shipped from EPRI to ORNL; preliminary leak test completed
- Laser fiber breakage test conducted; laser power and chiller equipment installed
- Irradiated coupon shipments initiated for PIE and welding preparation

Upcoming:

- Cold FSW in cubicle - June 2016



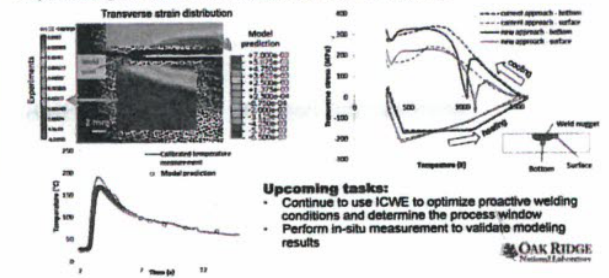
Mitigation Technology: Advanced Weld Repair

Laser Welding Highlight: Proactive in-situ welding stress control for welding irradiated materials - model development and validation

Objective/significance: Development of technology that proactively manages the stresses during laser repair welding of highly irradiated reactor internals

Approach: Integrated Computational Welding Engineering (ICWE) simulation was utilized to design and optimize innovative welding conditions that significantly reduce tensile stresses near the weld pool

Progress: (1) Numerical models were validated by in-situ measurements of strain and temperature. (2) Model predicted stresses were effectively reduced with a new proactive welding approach in the temperature range sensitive to He-induced cracking during the cooling stage



Upcoming tasks:

- Continue to use ICWE to optimize proactive welding conditions and determine the process window
- Perform in-situ measurement to validate modeling results



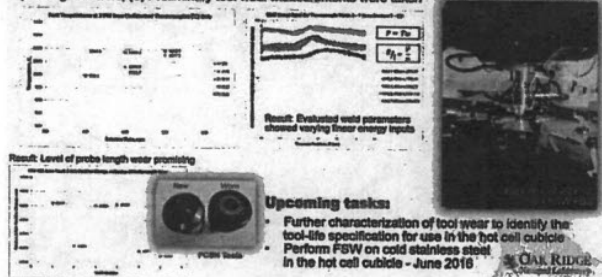
Mitigation Technology: Advanced Weld Repair

Friction Stir Welding (FSW) Highlights: Experimental weld process development in preparation of welding highly irradiated materials in the hot cell cubicle

Objective/significance: Identification of solid-state weld parameter sets for use in the cubicle and their associated maximum temperatures and weld energy inputs; initial investigation of tool wear

Approach: Various FSW processes were performed on stainless steel plates with thermocouples embedded close to the stir zone using the ORNL FSW Process Development System (PDS)

Progress: (1) Peak temperatures were identified over a parameter window that included 300 - 500 rpm and 1 - 3 kPa; (2) Weld torque was monitored and used to compute weld power and energy input per length of weld; (3) Preliminary tool wear measurements were taken



Advanced Replacement Alloys and Fabrication Techniques

Objective: Develop new advanced replacement alloys for use in LWR applications that may provide greater margins of performance.

Phase-I activities of this work involve:

- Procuring high quality heats of the downselected alloys (~80% completed)
- Conducting basic tests such as high-temperature steam testing (~10% completed), ion irradiation (~10-15% completed) and mechanical property testing (~20% completed) over conditions expected for the alloy use.

Current and near term activities:

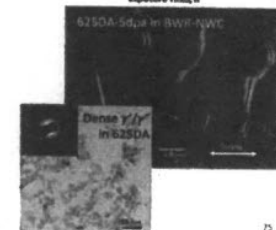
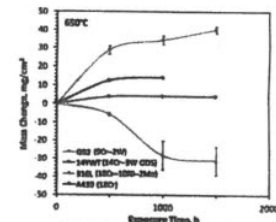
- Procurement of Alloy X-750 and discussion of desired processing and specifications of HT9 are in progress.
- High-temperature steam testing, an additional nine alloys will be begun in May.
- Fracture toughness and Charpy impact tests of ferritic alloys, with continuation of into next FY as procurement and processing of alloys continues.
- Proton-irradiation, CERT, and associated microstructural characterization of the procured alloys are in progress [Univ. of Michigan].

Highly collaborative effort with EPRI

Commercial Alloys (11 x 1 by EPRI)	Advanced Alloys (5 x 1 by ORNL)
Austenitic 316L, 316, 600	9-12Cr F8H, T91, Grade 92, HT9
Ni-base: C276, 625, 625-plus, 690, 718, 725, 8-750	High-Cr ferritic 439
Zr-base: Zr-2.5Nb	9-14Cr ODS: 14YWT
Ti-base: Grade 26 (w/ 0.1 Nb)	High-CrAl ODS: T80

ARM: Recent Progress

- High-temperature steam tests at 600 and 650°C have achieved 1,500 h on four alloys.
 - Reference steel 316L has significant scale exfoliation, resulting in weight loss.
 - The ferritic steels have improved oxidation resistance with increasing Cr-content (e.g., A439) and refined grain size (e.g., 14YWT).
- Irradiation-assisted stress corrosion cracking (IASCC) of the procured alloys is being evaluated by constant extension rate testing (CERT) of proton-irradiated specimens exposed in PWR-primary water and BWR-normal water chemistry conditions [Univ. of Michigan].
 - Favorable results for Alloy 725
 - Large variations observed for different alloy 625 conditions.



Zion Materials Harvesting Task

Objective: In support of extended service and aging management, procure materials, structures, components, and items of interest for the DOE LWRS Program, EPRI, and the U.S. NRC, from the decommissioned Zion Unit 1 & 2

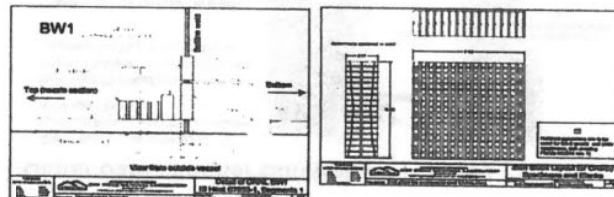
Recent Accomplishments:

- Beltline weld and base metal sections harvested from the Zion Reactor Pressure Vessel
 - Phase 1a: Harvest one segment (ORNL BW Segment 1), box, and prepare for shipment. Estimated weight: ~ 90 tons. Completed December 2015
 - Phase 1b: Ship the boxes containing paired segments to Energy Solutions Memphis Processing Facility (MPF) for cutting into 7 blocks. Completed - departed Zion on March 31, 2016
 - Phase 2a: Received and store the shipment at the MPF. Began April 12, 2016
 - Phase 2b: Contract in place to cut 7 blocks from the beltline weld and base metal
 - Phase 3: Machine four blocks into specimens. Vendor selected



Rationale and Goal of RPV Harvesting

- Most life-limiting US LWRs component: Reactor Pressure Vessel (RPV)
 - Replacement of the RPV is not an option
 - Annealing would require extensive regulatory review
- High interest in evaluating service-irradiated RPV materials to validate physically-informed transition-temperature-shift models: ECONY model
 - Models based on data from test reactor experiments and analysis of surveillance capsules
 - WF-70 (Linde-80) welds and base metal (Heat B7835-1) are well-characterized (physical and microstructural properties)
- Mechanical Property Evaluation, Microstructure Development Studies, Annealing Studies, and Through Wall Attenuation Study of Welds and Base Metal



Research Highlights: Harvesting Efforts

SUMMARY OF REVISED MACHINING PLAN :

- Summary of samples to be machined from one "C" block (base metal)
 - 239 = [(17x15)-16] Charpy specimens
 - 128 = (16 x 8) SS3 tensile specimens
 - 64 = (2 x 2 x 16) coupons (for microstructural characterization)
- Summary of samples to be machined from one "CF" blocks (weld)
 - 180 = (20 x 9) Charpy specimens
 - 144 = (9 x 2 x 8) SS3 tensile specimens
 - 72 = (2 x 2 x 18) coupons (for microstructural characterization)
 - 80 = (10 x 8) 0.4T C(T)
- Summary of samples to be machined from 2 "F" blocks (base metal):
 - 112 = 56 (4 x 14) 0.5T C(T) x 2 "F" blocks
- Summary of samples to be machined by type:
 - Charpy specimens (239 base metal + 180 weld) = 419
 - SS3 tensile specimens (128 base metal + 144 weld) = 272
 - Coupons (64 base metal + 72 weld) = 136
 - Fracture toughness (112 0.5T C(T) base metal + 80 0.4T C(T) weld) = 192



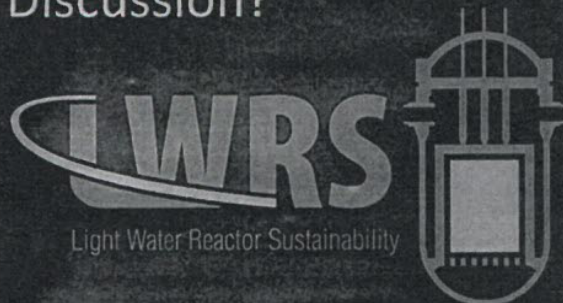
Zion Cable Harvesting

- Harvest Zion Unit 2 low and medium voltage cables in collaboration with the NRC to help understand and predict cable degradation at extended lifetimes.
 - Validate predictive models (based on accelerated aging studies) with empirical data obtained from field-aged materials and
 - Provide greater confidence in the performance of cables during an accident with measurable indicators in lieu of relying on the current methodology of calculating service life based on environmental monitoring.
- Status: Contract in place to harvest Zion Unit 2 cables (30' lengths) in collaboration with the NRC (cross-linked polyolefin, low or high density polyethylene, ethylene propylene rubber, silicone, hypalon, etc.) to be completed by May 12, 2016
 - Accumulator Discharge MOV Cabling: OMB, Lower Level of Containment
 - Instrumentation Cables: Instrument Racks, OMB, Lower Level Containment
 - Air-Operated Valve Cabling, OMB, Lower Level Containment
 - Cables in Electrical Penetrations, (OMB), Containment elevation 617'
 - Denied: Cables in Electrical Penetrations in the Aux Building Cable Spreading Room at elevation 617' and Cables from steam tunnel



(b)(4)

Discussion?



From: Hiser, Matthew
Sent: Mon, 13 Nov 2017 06:55:36 -0500
To: Audrain, Margaret; Purtscher, Patrick
Subject: FW: Table of available information
Attachments: Table of available on baffle bolts .docx

FYI – from our discussion with INL Thursday regarding baffle bolts.

From: Jackson, John Howard [mailto:john.jackson@inl.gov]
Sent: Thursday, November 09, 2017 5:06 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Cc: Simon Martin Pimblott <simon.pimblott@inl.gov>
Subject: [External_Sender] Table of available information

Matt,

Per our earlier conversation. See the attached table with the assessment of available information on the 347/316 SS baffle bolts (compiled by Frank Gift at Westinghouse).

-John

JOHN H. JACKSON, Ph.D.

GAIN Technical Interface/NSUF Industry Program Lead

Idaho National Laboratory
P.O. Box 1625
Idaho Falls, ID. 83415-3870

Voice: 208-526-0293
Fax: 208-526-4822

john.jackson@inl.gov

(b)(4)

(b)(4)

From: Hiser, Matthew
Sent: Fri, 27 Jul 2018 18:49:33 +0000
To: Purtscher, Patrick; Audrain, Margaret
Subject: RE: RE: revision of report

Hi Pat,

Did Pradeep ever send you the revised report? It'd be good to align on it next week in case I am able to meet with Pradeep the following week while I'm at PNNL...

Thanks!
Matt

From: Hiser, Matthew
Sent: Thursday, June 28, 2018 1:47 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: RE: RE: revision of report

OK, thanks Pat!

Thanks!
Matt

(b)(5)

From: Purtscher, Patrick
Sent: Thursday, June 28, 2018 1:46 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: RE: RE: revision of report

(b)(5)

(b)(5)

He expected to have the revised document to us July 9.

Regarding the inventory, for the unirradiated ex-plant materials, there is an existing inventory that they did for Care Nove. For irradiated materials, there is no inventory of ex-plant materials, but he expects that most are dissimilar welds from vessel heads.

Pat

From: Hiser, Matthew
Sent: Thursday, June 28, 2018 1:36 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: RE: RE: revision of report

(b)(5)

I understand that sentiment of doing a mod for a relatively small action,

(b)(5)

Thanks!
Matt

From: Purtscher, Patrick
Sent: Thursday, June 28, 2018 12:20 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: RE: RE: revision of report

[REDACTED] (b)(5)

Pat

From: Hiser, Matthew
Sent: Thursday, June 28, 2018 11:04 AM
To: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: RE: revision of report

Hey Pat,

(b)(5)

Did you talk to Steve yesterday [REDACTED] Should I catch up with him today?

Thanks!
Matt

From: Audrain, Margaret
Sent: Wednesday, June 27, 2018 10:27 AM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: RE: revision of report

Yeah, the hard date for all mods to be completely done is Aug. All of my mods were to the labs a couple weeks ago.

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

From: "Hiser, Matthew" <Matthew.Hiser@nrc.gov>
Date: Wed, June 27, 2018 10:24 AM -0400
To: "Purtscher, Patrick" <Patrick.Purtscher@nrc.gov>
CC: "Audrain, Margaret" <Margaret.Audrain@nrc.gov>, "Tregoning, Robert" <Robert.Tregoning@nrc.gov>
Subject: RE: RE: revision of report

Hi Pat,

OK, I'm working from home today. Do you want to talk to Steve? We really need to get something into STAQS ASAP if we're going to do it...

I can go with you to talk to him tomorrow morning as well...

Thanks!
Matt

From: Purtscher, Patrick
Sent: Wednesday, June 27, 2018 10:20 AM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: RE: revision of report

(b)(5)

[Redacted]

Pat

From: Hiser, Matthew
Sent: Wednesday, June 27, 2018 10:17 AM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: RE: revision of report

Thanks Pat! What about the funding piece?

[Redacted]

(b)(5)

Thanks!
Matt

From: Purtscher, Patrick
Sent: Wednesday, June 27, 2018 10:05 AM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: RE: RE: revision of report

All,

Pradeep expects to have the revised document to us by the Monday after the 4th of July.

He now thinks he may be at PNNL when Meg visits. An inventory of unirradiated ex-plant materials is available from previous NRC work. Some irradiated vessel head material does exist in hot cells, but is not included yet in any inventory.

Pat

From: Purtscher, Patrick
Sent: Monday, June 25, 2018 10:09 AM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: FW: RE: revision of report

This is the last I have heard from Pradeep. He never did call.

(b)(5)

[REDACTED]

Pat

From: Ramuhalli, Pradeep [<mailto:Pradeep.Ramuhalli@pnnl.gov>]
Sent: Tuesday, June 05, 2018 6:57 AM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: [External_Sender] RE: revision of report

Patrick,

The report update is about ¾ done. I am on travel this week and most of the next two weeks as well.
Can I give you a call Tuesday of next week?

With best regards,

Pradeep Ramuhalli, PhD
Tel: 509-375-2763
Email: pradeep.ramuhalli@pnnl.gov

From: Purtscher, Patrick [<mailto:Patrick.Purtscher@nrc.gov>]
Sent: Monday, June 04, 2018 6:41 AM
To: Ramuhalli, Pradeep <Pradeep.Ramuhalli@pnnl.gov>
Subject: FW: revision of report

My office phone got fixed and is now back to the original #, 301-415-3942. Let me know when you have time to talk a little.

Pat

From: Purtscher, Patrick
Sent: Wednesday, May 30, 2018 1:30 PM
To: 'Ramuhalli, Pradeep' <Pradeep.Ramuhalli@pnnl.gov>
Subject: RE: revision of report

I forgot to tell you that my office phone is not working, they have given me a temporary # 301-415-7887. You can always reach me on my cell, [REDACTED] (b)(6)

Pat

From: Purtscher, Patrick
Sent: Tuesday, May 29, 2018 7:53 AM
To: 'Ramuhalli, Pradeep' <Pradeep.Ramuhalli@pnnl.gov>
Subject: revision of report

Good morning,

I was just checking to see where you are with revision of the report. If you don't have time to talk today, just send me a reply with an update.

Pat

Materials Engineer
US Nuclear Regulatory Commission | Office of Nuclear Regulatory Research
Division of Engineering | Corrosion and Metallurgy Branch
11545 Rockville Pike | Rockville, MD 20852-2738
Phone: 301-415-3942 | Office: TWFN 10A49
ptp1@nrc.gov

From: Tregoning, Robert
Sent: Tue, 7 Feb 2017 13:39:48 +0000
To: Moyer, Carol
Subject: RE: Looking for slides
Attachments: Action Items from EPRI-NRC Dec 2016 materials meeting.docx, NRC RES Overview rev.pptx, 2016-12-14 RES-EPRI Agenda.docx

I'm not going to be much help with either of those items. Here's what I can tell you.

1. I didn't go to LWRS meeting but Raj did. I would ask him for slides. Next option would be Rich Reister
2. EPRI meeting was informal and focused on discussion. We didn't even swap slides. I'm attaching what I have which covers the NRC part as well as agenda and meeting summary/action items. If you want the EPRI slides, I can ask for them.

RT

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
Two White Flint North, M/S T-10 A36
11545 Rockville Pike
Rockville, MD 20852-2738
ph: 301-415-2324
fax: 301-415-6671

From: Moyer, Carol
Sent: Tuesday, February 07, 2017 8:13 AM
To: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: Looking for slides

Hi Rob,

I am looking for slide sets from two meetings in December. Do you by chance have a copy?

Light Water Reactor Sustainability R&D Program Technical Integration Office
LWRS Program – Fall Program Review and Technical Information Exchange Meeting
Germantown, MD, December 6-7, 2016

RES/EPRI Meeting, December 14-15, 2016

If you know where either is on a network drive, and can point me there, I would appreciate it.

Thanks,
Carol

Carol E. Moyer
Sr. Materials Engineer
U.S. Nuclear Regulatory Commission

Office of Nuclear Regulatory Research

MS: T-10A36

Washington, DC 20555-0001

carol.moyer@nrc.gov

301-415-2153

Action Items from EPRI-NRC meeting on 12/14/16 in Washington, DC

1. As NRC completes the backlog of old SG NUREG/CR reports, the NRC POCs (P. Purtscher, M. Rossi) should contact the EPRI POC (H. Cothron) just before each report is published to let her know that it's imminent.
2. NRC and EPRI should compare the IMT with NRC's research priorities after the next time that the IMT is updated. Action for EPRI (R. Dyle) to notify NRC (R. Tregoning) when update is completed. NRC evaluation will be coordinated by R. Tregoning to ensure alignment.
3. Conduct a follow-up meeting on further irradiation of high fluence materials among NRC, EPRI, and DOE. This could either be a call or a face-to-face meeting. NRC (M. Hiser) will lead in setting up meeting.
4. After the next MDM is completed, EPRI (R. Dyle) and NRC (R. Tregoning) will review the MDM priorities to determine the prognosis for future SCC research after completing all Alloy 600/690 PWR research. This could be SCC of aged SS, BWR Alloy 600 cracking, or another SCC mechanism.
5. NRC would like to know more details about the RFA prioritization process to determine if it can also be used to prioritize NRC research activities. EPRI (R. Dyle) and NRC (R. Tregoning) have an action to add this item to the next management meeting between NRC and EPRI. Also, NRC (R. Tregoning and K. Brock) will determine internally if a vehicle can be established for communicating the information to both NRR and RES Division Director-level management.
6. The xLPR application MOU should be completed with the general activities that will be conducted but not specifics (e.g., conducting a pilot-plant LBB evaluation). One approach could be to state in the MOU that a test or evaluation plan will be agreed to by both NRC and EPRI before proceeding with detailed work. NRC POC is M. Homiack and EPRI POC is C. Harrington.
7. Hold a ½ day meeting between NRC, EPRI and key contractors to determine details of the xLPR application phase, including, a decision on pursuing a pilot plant application and/or an application with a representative plant. The meeting should be jointly arranged by NRC (M. Homiack) and EPRI (C. Harrington).
8. FAVOR V&V: NRC (M. Kirk) will finalize development of a V&V plan and share it with EPRI (T. Hardin) for their review and comment. EPRI (R. Dyle & T. Hardin) will identify the scope and effort required to summarize past industry V&V activities on FAVOR as well as future participation in V&V. Both NRC (R. Tregoning) and EPRI (R. Dyle) will report on the progress of this activity during the next quarterly materials conference call. If enough progress has been made, this could be discussed during the NRC-Industry annual materials meeting in May.
9. Due to the large amount of CY-17 activity related to RPV integrity, the status of these activities will be added as standing item to quarterly materials call in 2017. EPRI (R. Dyle) has the lead for adding this to the agenda and reporting.
10. After the public meeting in February 2017 on baffle bolts, NRC (R. Tregoning) and EPRI (R. Dyle) will determine if any needed future collaboration on research activities in this area is needed between NRC and EPRI.

11. Harvesting Workshop in March 2017: NRC (R. Tregoning) will provide draft agenda and announcement to EPRI (R. Dyle) - Complete. NRC (R. Tregoning) will also cc R. Dyle on emails to S. Bernhoft requesting EPRI participation and coordination of the workshop sessions and speakers. – Ongoing.
12. HELB Acceptance Criterion work at NRC: NRC (M. Benson) will share documentation report with EPRI (R. Dyle) and any other interested industry organizations. EPRI (R. Dyle) will provide feedback on industry's needs for possibly revising this criterion before NRC starts work in this area. If NRC does start work, NRC (M. Benson) will get EPRI (R. Dyle) feedback on the proposed evaluation plan before proceeding.
13. Advanced non-Light Water Reactor discussion: If NRC's implementation action plan (IAP) becomes available for public dissemination, NRC (I. Frankl) will share the report with EPRI (R. Dyle). EPRI (R. Dyle) and NRC (R. Tregoning) will keep communicating on this topic for possible partnering with EPRI/ANT, if NRC initiates any research activities.
14. EPRI (R. Dyle, A. Demma) will provide an update on EPRI's ion irradiation research program during the Industry-NRC May materials meeting.
15. EPRI (K. Edsinger) will identify if EPRI is conducting any research on carbon fiber reinforced polymer (CFRP) materials.
16. NRC and EPRI both agreed that the current meeting format that is both informal, focuses on strategic discussions for future research planning, and discusses only a handful of research topics of mutual interest, meets the needs of both organizations. The only change is to hold these meetings annually as a 1-day meeting. Also, the desire is to identify a standing month every year for conducting the meeting. The exact date will be picked a few months out in order to determine if it can be held adjacent to another meeting. EPRI (R. Dyle) and NRC (R. Tregoning) have the lead to identify the month for the annual meeting.

NRC RES Overview

Rob Tregoning

Istvan Frankl

Carol Nove

Nuclear Regulatory Commission

EPRI-NRC Materials Meeting

Wednesday, December 14, 2016

EPRI DC Office

Washington, DC

Office of Nuclear Regulatory Research (RES) - Overview



- Mission
 - Plan, recommend, and implement nuclear regulatory research, confirmatory analyses, standards development, and resolution of potential generic safety issues for nuclear power plants and other facilities and materials regulated by the NRC
 - Provide technical advice, tools, and information to identify potential safety issues and resolve them as appropriate, support regulatory decisions, and issue regulatory requirements and guidance
- Charter
 - Established by the U.S. Congress in 1974

Office of Nuclear Regulatory Research (RES) – Overview, cont.

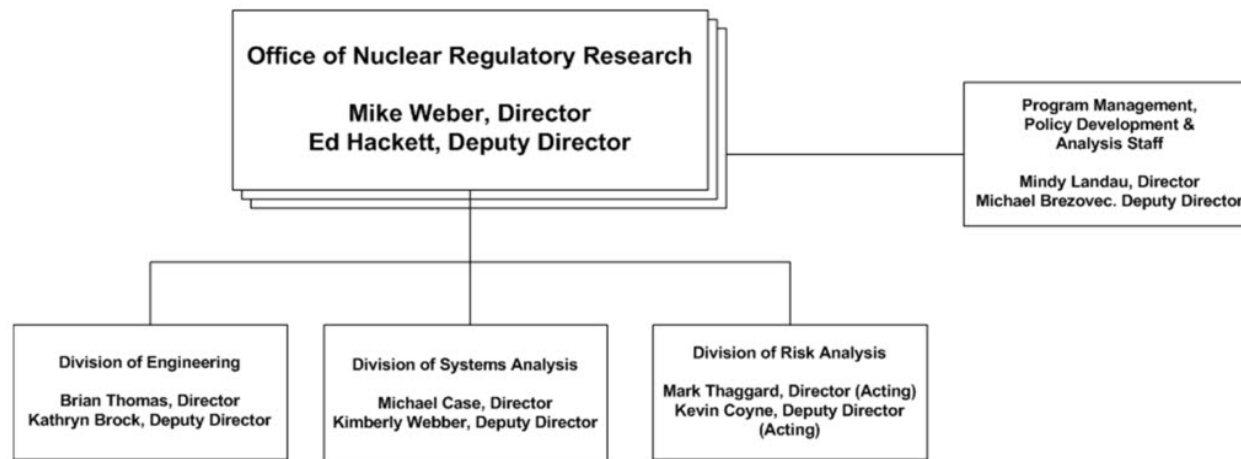


- Approach
 - Focus research primarily on near-term regulatory needs related to the oversight of operating reactors as well as to new and advanced reactor designs
 - Develop technical tools, analytical models, and experimental data to allow the agency to assess potential safety and regulatory issues
 - Use internal expertise as well as contracts with commercial entities, national laboratories, and universities, or collaborations with international organizations, to develop these tools, models, and data
- Customers and Partnerships
 - All NRC offices and the Commission
 - Other government organizations, international regulatory agencies, International nuclear agencies (e.g., NEA, IAEA)
 - Other research organizations
 - Nuclear licensees and other industry stakeholders (e.g., NEI, EPRI)
 - Public individuals and groups

RES Organization

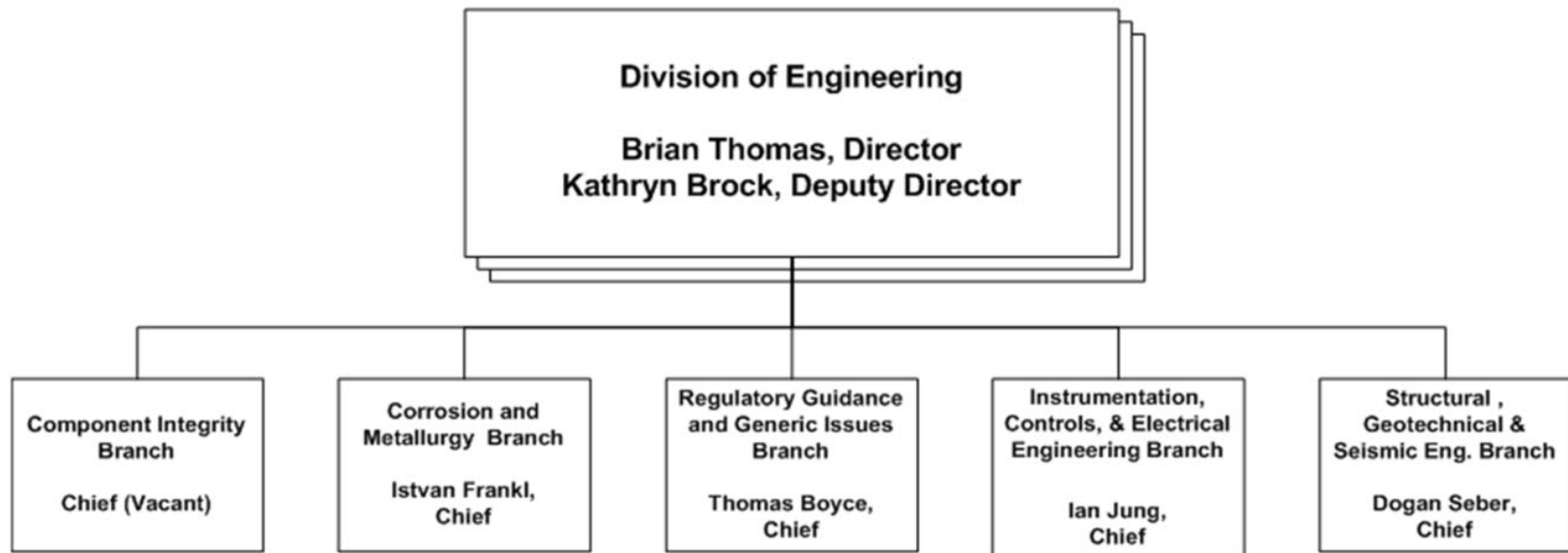


- Three technical divisions and support staff



- Division of Systems Analysis (DSA)
 - Research to develop and maintain broad technical expertise, experimental data, numerical simulation analyses tools, and knowledge bases
- Division of Risk Analysis (DRA)
 - Research relating to probabilistic risk assessments (PRA); human factors and human reliability analysis; performance and reliability analysis; movement of radionuclides through environmental systems; operating experience and generic issues; and fire safety
- Division of Engineering (DE)
 - Research and standards development to support the NRC strategic goals in the design, construction, and operation of current and advanced nuclear power plants and other regulated facilities
 - Technical areas include structural and component integrity, material characteristics, aging, natural hazards, and digital instrumental and control

DE Organization



- Component Integrity Branch (CIB)
- Corrosion and Metallurgy Branch (CMB)
- Regulatory Guidance and Generic Issues Branch (RGGIB)
- Instrumentation, Controls, and Electrical Engineering Branch (ICEEB)
- Structural, Geotechnical, and Seismic Engineering Branch (SGSEB)

DE Organization



- Component Integrity Branch (CIB)
- Corrosion and Metallurgy Branch (CMB)
- Regulatory Guidance and Generic Issues Branch (RGGIB)
 - Facilitates reviews and updates to agency regulatory guidance, particularly Regulatory Guides (RGs)
 - Coordinates agency involvement in consensus codes and standards
 - Manages the congressionally mandated Generic Issues Program
- Instrumentation, Controls, and Electrical Engineering Branch (ICEEB)
 - Develops and applies methods, data, tools, standards, and guidance to assess the adequacy of digital instrumentation and control and electrical equipment
 - I&C: digital system contributions to risk, software attributes that can affect safety or security, new reactor designs, and development of consensus standards
 - Electrical: equipment qualification, associated circuits, grid reliability; **monitoring techniques for cable degradation**; operating experience
- Structural, Geotechnical, and Seismic Engineering Branch (SGSEB)
 - Assesses structural performance of systems, structures, and components (SSCs)
 - Analyzes data related to seismic hazard and seismic performance of structures
 - Develops and applies seismic design analysis methods and guidance for geotechnical and structural design elements
 - **Evaluates aging of concrete materials and structures**

- Principal Functions

- Develops methods, data, standards, and modeling tools for identifying and evaluating degradation mechanisms that arise from irradiation on reactor pressure vessel steels
- Investigates capabilities of fracture mechanics measurement and analysis technologies
- Develops methods, data, standards, and modeling tools to assess the mechanical performance of SSCs
- Develops technical basis for revisions to ASME Section XI
- Provides and applies tools to quantitatively assess changes in structural reliability of nuclear plant systems, structures and components as a result of operating environment effects or aging of materials
- Evaluates the reliability of non-destructive examination methods for operating and new reactors

- Technical Areas and Point of Contact

- | | |
|-------------------------------------|--|
| – Piping Integrity: Patrick Raynaud | – Weld Residual Stress: Michael Benson |
| – xLPR: Matthew Homiack | – High Energy Line Break: Michael Benson |
| – HDPE: Patrick Raynaud | – ANLWR Materials & Integrity: Shah Malik |
| – CFRP: Patrick Raynaud | – NDE, Modeling and Simulation: Carol Nove |
| – RPV Integrity: Mark Kirk | – Fluence Evaluation: Jay Wallace |

CMB



- Principal Functions
 - Develops the data to characterize the causes and effects of corrosion and environmentally-assisted cracking on the structures and components of nuclear plant systems
 - Conducts materials degradation studies of irradiated-assisted stress corrosion cracking, stress-corrosion cracking, materials fatigue, and general corrosion
 - Assesses in-service inspection techniques to ensure steam generator integrity
- Technical Areas and Point of Contact
 - PWSCC CGR: Greg Oberson
 - PWSCC Initiation: Eric Focht
 - IAD: Sri Rao
 - LTO/SLR: Raj Iyengar
 - ANLWR Materials: Raj Iyengar
 - Neutron Absorber Materials: Eric Focht
 - Steam Generator Program: Pat Purtscher

Funding Projections



- FY-17 funding is contingent on actual congressional appropriation to NRC
- FY-18 funding is more uncertain
- CIB

Technical Area	FY-17 (\$K)	FY-18
RPV Integrity	(b)(5)	
Piping Integrity		
NDE		
HDPE		

- CMB

Technical Area	FY-17 (\$K)	FY-18
NAM	(b)(5)	
PWSCC CGR		
PWSCC Initiation		
IAD		
LTO/SLR		
SG		

Current Memoranda of Understanding (MOUs)



Title	Signing Date	Expiration Date	NRC Contact(s)	EPRI Contact(s)
MOU between EPRI and NRC on Collaborative Nuclear Safety Research	9/30/16	9/30/21	Nicholas DiFrancesco	Ken Canavan
Acquisition and Testing of Zion Spent Fuel Pool Neutron Absorber Materials	9/30/16	9/30/21	Eric Focht	Hatice Akkurt
Aging, Qualification and Condition Monitoring of Electrical Cables	9/30/16	9/30/21	Darrell Murdock	Andrew Mantey
Long Term Operations Beyond 60 Years	9/30/16	9/30/21	Amy Hull Raj Iyengar	Sherry Bernhoft
Primary Water Stress Corrosion Cracking - Crack Initiation Testing	9/30/16	9/30/21	Erick Focht Greg Oberson	Paul Crooker, Al Ahluwalia
Primary Water Stress Corrosion Cracking Expert Panel Activities	9/30/16	9/30/21	Greg Oberson	Paul Crooker
Extremely Low Probability of Rupture	12/16/15	12/31/16	Mathew Homiack	Craig Harrington
Nondestructive Examination	4/14/14	4/30/18	Carol Nove	Greg Selby
Steam Generator Tube Base Research Program	2/20/14	12/31/19	Matt Rossi Pat Purtscher	James Benson

Current MOUs: Neutron Absorber Materials



- Objectives
 - Coordinate harvesting and shipping of samples of in-service Boral neutron absorber materials from the spent fuel pool of the decommissioned ZNPP
 - Conduct research to establish an understanding of degradation mechanisms, the impact on retaining physical integrity and functionality by an examination and analysis of affecting properties
 - Ensure timely exchange of information on technical approaches, test plans, unprocessed data, interim results, and draft and final reports to obtain degradation data on Boral
- Status
 - November 2014: NRC witnesses BADGER testing of NAM panels in the Zion SFP
 - December 2015: NAM panels harvested and delivered to the NRC contractor
 - September 2017: Expected completion of evaluation of panels
- Deliverables
 - Witness BADGER testing at the Zion SFP
 - Boral NAM panels from Zion
 - Share test plans and data
- Planned Completion Date: September 2017
- Challenges Identified: None

Current MOUs: Long-Term Operations



- Objectives
 - Ensure the timely exchange and sharing of information, data, and knowledge on aging management programs and research activities
 - Develop LTO analysis methods, tools, and/or data to support the second, and subsequent, extended licensing periods
 - Enhance access to the nuclear power plant aging management technology, methods, and tools
- Status
 - Continuous engagement and periodic discussions (bi-weekly calls, roadmap meetings, deep-dive meetings)
- Deliverables
 - Sponsor joint NRC/industry workshop(s) on status of domestic and international research activities and operating experience to address and evaluate materials degradation issues (Spring 2018, Fall 2019)
 - Investigate aging management through information exchange and data sharing, advances in the development and application of aging management methods, and demonstration of technical tools (Ongoing)
- Planned End Date: September 2021
- Challenges Identified: None

Current MOUs: PWSCC – Crack Initiation



- Objectives
 - Develop a mutually agreeable test plan for alloy 600/182/82 and alloy 690/152/52 materials
 - Acquire data on cracking characteristics, time-to-initiation, and the quantitative effects of material variability on crack initiation
 - Share of raw data, technical reports, and monthly status reports, upon receipt.
 - Share technical reports, documents, or other products resulting from independent review of the data by the NRC and EPRI
- Status
 - November 2015: Delivered one of two PWSCC crack initiation testing systems
 - December 2015: Began testing Alloy 690/52/152 specimens
 - February 2016: Delivered second of two PWSCC crack initiation testing systems
 - March 2016: Began testing Alloy 600 specimens
- Deliverables
 - Two PWSCC crack initiation testing systems
 - PWSCC crack initiation testing data for Alloy 690/52/152 and Alloy 600/82/182.
- Planned Completion Date: December 2020
- Challenges Identified: None

Current MOUs: PWSCC – CGR Expert Panel



- Objectives
 - Allow NRC to participate in activities associated with the expert panel to generate crack growth rate disposition curves for Alloys 690/52/152
 - NRC contractors participate as members of the data evaluation group
 - NRC staff observe expert panel meetings
- Status
 - Data evaluation group:
 - Scored most of the available crack growth rate data
 - Writing the report sections to document their scoring approach
 - Data applications group:
 - Developing the disposition curve models with the scored data
- Deliverables
 - EPRI expert panel report
 - No NRC deliverable
- Planned Completion Date: mid to late 2017
- Challenges Identified: None

Current MOUs: xLPR



- Objective
 - Develop a probabilistic software tool to assess compliance with 10 CFR Part 50, Appendix A, GDC 4, to include the capability of modeling active degradation mechanisms, such as primary water stress-corrosion cracking, and associated mitigation measures
- Status
 - xLPR Version 2 code is technically complete and usable
 - Completing remaining documentation, such as the user's manual and uncertainty report
 - Negotiating a new MOU for using xLPR Version 2 in leak-before-break applications
- Deliverables
 - xLPR Version 2 Software
 - All associated documentation
- Planned End Date: December 2016
- Challenges Identified
 - Establishing a suitable legal framework for public distribution of code
 - Address legal framework under new MOU

Current MOUs: NDE, Modeling and Simulation



- Objective
 - Identify and evaluate effectiveness of NDE methods in detecting and characterizing flaws
 - Evaluate the reliability of NDE methods for selected examinations
 - Evaluate aspects of inspector qualifications
 - Specific collaboration areas: Visual testing; CASS; UT in lieu of RT for repairs, replacements, and modification; documentation of basis for ASME Section XI, Appendix VIII; RMS error; HDPE piping; and NDE modeling
- Status
 - VT round robin completed in 2016
 - EPRI's VT report published in 2016
 - NRC's NUREG/CR (PNNL) VT report is targeted for completion in 2017
 - Initiated revised MOU addendum: Addressing human performance issues for NDE
- Deliverables
 - EPRI's VT report
 - NRC's VT report
- Planned End Date: April 2018
- Challenges Identified
 - Completing legal review of the revised MOU addendum

Current MOUs: Steam Generator Program



- Objective
 - Provide the experimental data, predictive correlations, and the models needed to permit evaluation of the integrity of steam generator tubes as plants age and degradation proceeds, new forms of degradation appear, and new defect-specific aging-management schemes are implemented
- Status
 - Research outlined in agreement is proceeding as planned
- Deliverables
 - Several NUREG/CR will summarize research completed between now and 2019
 - Semi-annual meeting to share progress with partners
- Planned End Date: December 2019
- Challenges Identified: None

NRC Topics of Interest for Further Discussion



- Near-Term Research & Decision making
 - Baffle bolt research: EPRI update and discussion on possible future collaboration
 - Material harvesting workshop: NRC update and discussion
 - xLPR: Future direction and possible applications
 - RPV Integrity: Future activities and V&V

- LTO/SLR-related topics
 - High Energy Line Break criterion: Discussion of industry needs
 - High-fluence testing of stainless steels: Discussion of next steps
 - Environmentally-assisted fatigue: Discussion of next steps
 - SCC of aged stainless steel: Discussion of what's next after completing 690 research
 - Irradiation Effects on Fracture Resistance and SCC in Ni and Ni-welds (X-750): EPRI update
 - Thermal aging of CASS piping materials: Discussion of possibility to evaluate more representative plant materials (harvesting?)

- Advanced Non-Light Water Reactors
 - ANLWR materials: EPRI and NRC updates related to ASME Div. 5 support and other research activities
 - ANLWR applications: Discussion of future prognosis of materials research

Agenda
RES/EPRI meeting
December 14 and 15, 2016

December 14

0830 - 1200

- Introductions
- Finalize agenda for the meeting
- EPRI overview
 - Current EPRI Nuclear Sector / MAPC structure
 - Detail Material program roles, including new PSCR plans
 - RFA descriptions (show major topic areas)
 - Funding planned for 2017 and 2018
- NRC RES overview
 - Current structure
 - Details of RES engineering structure and roles
 - Funding planned for 2017 and 2018
- MOUs
 - Review status for current projects
 - Possible topics for future consideration

1200 – 1300 – Lunch on your own

1300-1700 - Detail project reviews (project plan, goals, schedule, etc.)

- PSCR – Demma
- MRP topics – Burgos
- BWR topic – McGehee
 - NOTE – The expectation for the EPRI folks is the most knowledgeable person presents the story. For example, Brian would speak to BFBs, ATR, RPVs, xLPR. Andy the BWR topics like X-750. Anne gets the lions share for PSCR. I'm open to your suggestions but we could break the discussions along subject matter such as – RPV, SCC EAF, irradiation effects. Open to suggestions
- NRC project discussions

December 15

0900 - 1200

- Continue project discussions
- Review of action items

From: Hull, Amy
Sent: Tue, 5 Sep 2017 15:31:11 -0400
To: Hiser, Matthew; Purtscher, Patrick
Cc: Frankl, Istvan; Moyer, Carol
Subject: Thanks Matt!!: Action: Rewrite in response to Feedback on UNR Response Task 2

From: Hiser, Matthew
Sent: Tuesday, September 05, 2017 2:23 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: Action: Rewrite in response to Feedback on UNR Response Task 2

Hi Amy,

My initial thoughts on how to respond to some of these questions are in red below. I only think maybe 1 or 2 of the bullets need changes to the text of the response (in my opinion).

Do you know who in NRR reviewed Task 2 and provided these comments? It might be just as easy to have a quick meeting with them to explain things more clearly.

I'd suggest you take the lead on editing the response as much (or little) as appropriate, since you and Carol took the lead in compiling the input initially. My feedback is in red below and Pat can certainly add anything from his perspective.

Thanks!
Matt

Matthew Hiser

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US Nuclear Regulatory Commission | Office of Nuclear Regulatory Research
Division of Engineering | Corrosion and Metallurgy Branch
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From: Hull, Amy
Sent: Tuesday, September 05, 2017 1:42 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: Action: Rewrite in response to Feedback on UNR Response Task 2

Hi Matt and Pat,

Would you like me to take a crack at the following feedback from NRR (since I put the database in the original SOW) or would you like to rewrite first? Or should we sit down and brainstorm these questions? I have attached the UNR, the response, and the NRR feedback from last Thursday.

TASK 2

- It isn't clear what these criteria/approaches/processes for the use of the database are. Where are they documented or described, how they have been validated or used? Are the criteria/approaches/processes described in the September 2017 TLR? **The criteria for prioritizing harvesting data needs are described in the September 2017 TLR.** NRR needs to have an idea of what is involved in the steps and how the database will be used.
 - It is not clear how the first two activities, the workshop on materials harvesting and prioritizing of issues to be addressed by harvested materials, contribute, or are related to the database. This must be fully explained. **The workshop was designed to discuss past harvesting experience and lessons learned and seek leveraging and cooperation with other interested research organizations. Insights from the workshop are integrated into the database and harvesting planning efforts. The database will be developed consistent with the prioritization criteria from PNNL to identify which**
 - Why just decommissioned plants? An explanation is required as to why this has been limited in scope. **This harvesting effort is not limited to only decommissioned plants as stated in draft response: "RES staff will continue to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned NPPs, as well as from ex-plant components from operating plants."**
 - It is not clear how the discussion under Subtask 2 are examples of how the database would be used. It seems to be a discussion of harvesting material. This needs to be explained, with clear outcomes defined. **The purpose of the database is to have a systematic approach to harvesting materials and prioritize limited resources on the best values for harvesting. The database is not an end unto itself, but the means to do the highest priority harvesting for the best technical value.**
- (b)(5) • seems like a lot to develop an Excel or Access database. **I don't disagree – I think at this point, it may be a 100% in-house effort.** Does this include collecting and inputting information on materials needed and the sources of materials expected to be available? **Yes** This tasking must be better defined.

Amy B. Hull, Ph.D

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