

From: Moyer, Carol
Sent: Wed, 13 Sep 2017 13:39:30 +0000
To: Rao, Appajosula;Hiser, Matthew;Purtscher, Patrick;Kirk, Mark;Sircar, Madhumita;Philip, Jacob;Murdock, Darrell;Miller, Kenneth A
Cc: Hull, Amy;Frankl, Istvan;Seber, Dogan;Koshy, Thomas;Tregoning, Robert;Pires, Jose
Subject: SLR Research User Need revisions
Attachments: UNR NRR-2017-006 reduced.pdf, Comments on draft UNR NRR 2017-006.docx, SLR UNR response 09-12-2017 cem.docx

Dear SLR Research Team,

In response to NRR's user need request 2017-006 (attached), we sent a draft response for staff-level review and comment. We received some comments and requests for clarification from the NRR staff (attached). The CMB staff members are already working on addressing these comments.

By this email, I am looking for your input on Task 1. The comment was related to the timing of workshops to exchange information on SLR research results. I believe the proposed dates for those meetings was always intended to be tentative, subject to change as the research progress warranted. I have proposed revised language for the UNR response (attached).

I am asking for your input on: (1) Are the revised target dates OK with you? Do they seem reasonable, given what we know now? And, (2) Are you aware of any planned meetings, workshops, or symposia that would accomplish similar ends? That is, does it make sense to schedule our own information-exchange meetings, or would we possibly be duplicating a meeting already planned by an international technical organization within, say, 6 months of our proposed dates?

On this piece of the revised response, I need to have your input by the end of this week. Please reply to me and to Amy Hull.

Thank you,
Carol

Carol Moyer
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RES/DE/CMB
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301-415-2153



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

May 4, 2017

MEMORANDUM TO: Michael F. Weber, Director
Office of Nuclear Regulatory Research

FROM: William M. Dean, Director
Office of Nuclear Reactor Regulation

W. M. Dean for

SUBJECT: RESEARCH ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED
OPERATION

The purpose of this memorandum is to request 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.

In a previous user need request, UNR-NRR-2010-006, "Request for Office of Nuclear Regulatory Research Support in Developing Technical Information to Support Evaluating the Feasibility of License Renewal Beyond 60 Years," Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML092470525), the Office of Nuclear Regulatory Research (RES) assisted the Office of Nuclear Reactor Regulation (NRR) in developing information for consideration in the SLR guidance documents.

This new user need request focuses on research activities on the technical issues discussed in the SLR guidance documents and in the staff requirements memorandum to SECY 14-0016 (ADAMS Accession No. ML14241A578).

Specifically, NRR is requesting RES support to:

- Hold NRC/industry workshop(s) on the status of domestic and international research activities and operating experience to address issues discussed in the SLR guidance documents;
- Develop and implement a long-term strategy and information tool for harvesting ex-plant components from decommissioning as well as from operating plants;
- Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research for SLR; and
- Use the products from the above three tasks to develop documentation of the status of research for the significant technical issues for SLR.

CONTACT: Bennett M. Brady, NRR/DLR
(301) 415-2981

Additional details are provided in the Enclosure, "Research Assistance on Potential Significant Technical Issues during the Subsequent Period of Extended Operation."

Resources

NRR requests RES to provide the specific resources (contract dollars and full-time equivalent staff) needed to complete the various tasks during the period of activity.

Intended Use of RES Products

The requested RES products will provide confirmatory research on the technical bases for industry research products related to aging degradation and identified in the staff's review of SLR applications.

Coordination and Schedules

This request has been coordinated with RES staff in the Division of Engineering (DE). Based on this, we expect that the requested work could be completed within the requested timeframe. We are prepared to work with your staff to further develop a mutually acceptable technical approach and schedule for this activity and to engage industry on this important matter. In addition, the directors of the lead divisions in each of our offices, George Wilson (NRR/Division of License Renewal (DLR)) and Brian Thomas (RES/DE), have discussed and agreed with the scope and schedules of the tasks in this request.

Priority

This request is rated as high priority based on NRR office priority ranking for reactor activities.

Points of Contact

For NRR, the contact is Bennett Brady, Subsequent Renewal, Guidance, and Operations Branch, DLR.

For RES, the contact is Amy Hull, Corrosion and Metallurgy Branch, DE.

Additional Information

None.

Enclosure:

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

RESEARCH ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED OPERATION

Background:

The U.S. Nuclear Regulatory Commission staff (NRC or staff) has recently completed the draft guidance documents for subsequent license renewal (SLR). The draft guidance documents (draft NUREG-2191, Volumes 1 and 2, Agencywide Documents access and Management Systems [(ADAMS) Accession Nos. ML16274A389 and ML16274A399, respectively], "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" and the draft NUREG-2192, [ADAMS Accession No. ML16274A402] "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants") were issued for public comment in December 2015.

As preparation for drafting these guidance documents, the Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research (RES) 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" (ADAMS Accession No. 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). RES also published on June 15, 2016, the "Review of Aging Management Programs: Compendium of Insights from License Renewal Applications and from AMP Effectiveness Audits Conducted to Inform Subsequent License Renewal Guidance Documents," a report prepared by the RES contractor, Argonne National Laboratory, that includes NRC staff input (ADAMS Accession No. ML16167A076).

RES also completed the Expanded Materials Degradation Assessment (EMDA) in cooperation with the Department of Energy (DOE) Light Water Reactor Sustainability Program. The resultant reports, NUREG/CR-7153, EMDA, Vol. 1-5 (ADAMS Accession Nos. ML14279A321, ML14279A331, ML14279A349, ML14279A430, and 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 four most significant technical issues identified below were also outlined in the staff requirements memorandum (SRM) on SECY 14-0016, "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" (ADAMS Accession No. ML14241A578):

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

ENCLOSURE

The audits and EMDA volumes provided NRC with over 800 suggestions for changes to the license renewal guidance and aging management program activities found acceptable for operation from 60 to 80 years.

Staff in several NRR divisions and RES' Division of Engineering (DE) participated in over 90 expert panels to review these suggestions along with the staff's own suggestions for changes to license renewal guidance documents for the first license renewal. The expert panels dispositioned the recommendations for the guidance for SLR and drafted NUREG-2191 and NUREG-2192.

After the draft guidance documents were issued for public comment, the staff held several public meetings with stakeholders and the public to discuss the proposed revisions and the bases for the revisions. In these meetings the staff provided information and clarifications on the proposed changes to the guidance documents, and solicited feedback on the documents. The NRC staff has responded to the public comments and will publish the documents in final form in mid-2017.

To support their SLR applications, applicants need to demonstrate that the effects of aging will be adequately managed for an operating period from 60 to 80 years. The NRR staff would like RES' assistance in holding meetings on these issues, participating and interacting with the DOE and other industry organizations, cataloguing the materials needed for research, and documenting the status and products of research for SLR.

Description of Scope and Tasks

1. Hold NRC/industry workshop(s) 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

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 No. 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 systems, structures, and components (SSCs) for an SLR period. The International Atomic Energy Agency will sponsor the "Fourth International Conference on Nuclear Power Plant Life Management" in France in October 2017.

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 SLR applications, 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 the most significant technical issues outlined in the GALL-SLR and the SRM.

Request: RES is requested to facilitate a minimum of two domestic and international activities (either a workshop, conference, symposium, or meeting), one in the early fall 2018 on the mechanical issues and one in late spring 2020 on the concrete and cables issues. These meetings should address:

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

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

Deliverable: The deliverables include the international activities (either 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. 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) and research insights and knowledge, due 6 months after each meeting.

Schedule: The effort should continue until the completion of the deliverables from the second activity, tentatively scheduled for late spring 2020.

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

Need: The NRC performs confirmatory research to inform and develop the technical bases for regulatory decisions related to AMPs 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 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 can 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 an information tool using Microsoft products which identifies and prioritizes the materials, components, and operating conditions that are needed to address the four significant issues 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.
- E. In coordination with Task 3, pursue domestic and international partnerships to pursue cooperational cost-sharing on retrieval and testing of ex-plant harvested material.

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.

Schedule: Items 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 36 months from the issuance of this user need request.

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

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 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. The scope of this

coordination includes cooperation and cost-sharing on retrieval and testing of ex-plant harvested material in Task 2.

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 applications. RES should evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues.

Deliverable: RES should provide to interested NRR branch chiefs (from DE and the Division of License Renewal (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, the status, and future plans should be discussed as a standing agenda item during the quarterly interface meetings between RES/DE, NRR/DLR, and NRR/DE.

Schedule: These products should be provided to NRR in a timely manner; the effort should continue until the closure of this user need request. A quarterly report (or slides) for presentation at the Director/Deputy Director Quarterly Interface Meeting should be provided 5 days before the meeting.

4. Documentation and Compilation of Results from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff

Need: In the SRM to SECY 14-0016, the Commission directed the staff to keep 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.

Request: RES is requested to annually prepare a document summarizing the products from tasks 1, 2, and 3 of this user need request to discuss the accomplishments of RES and national and international partners in addressing the four major technical issues in the SRM and other research activities that may be used in reviewing applications for SLR.

The annual report should 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.

Schedule: Annual report to 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.

COMMENTS ON DRAFT UNR NRR 2017-006

TASK 1

- Two RPV experts said it is too early to have an international meeting on neutron embrittlement in 2018. One electrical expert said it would be good to have an electrical meeting in 2020 as NIST will have completed their work at that time. RES should ask staff experts in reactor pressure vessels, internals, concrete, and cables in NRR and RES what would be an appropriate time for international meetings in their areas of expertise. Consideration should be given to times when new information from research will be available and times when no other organizations might be holding large meetings/workshops or symposiums. We do not need to hold a meeting when other organizations have plans for similar meetings.
- It wasn't clear to new readers of the UNR what the purpose and goals of the meetings were and what would be discussed at the meeting. RES needs to include the topics (bullets) in the NRR UNR, including the purpose and goals of any meetings, and what RES intends to provide back to NRR.

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? 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.
 - Why just decommissioned plants? An explanation is required as to why this has been limited in scope.
 - 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.
- (b)(5) • seems like a lot to develop an Excel or Access database. Does this include collecting and inputting information on materials needed and the sources of materials expected to be available? This tasking must be better defined.

TASK 3

- RES staff participate in a lot of domestic and international meeting and activities in partnership with other research organizations. NRR recognizes the importance of these activities and collaborative research. What other UNRs contain a task for partnerships

with other domestic and international research organizations? What are the FTE and contract dollars associated with each of these UNRs. An explanation needs to be included that reflects work being done for other program offices.

-

TASK 4

- Task 4 should be focused on providing an annual report for use by RES and NRR as a document annually summarizing the status and the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM.

Task 5? (Starting with the paragraph (“building upon the extensive work”))

- RES might propose an unfunded Task 5 to provide confirmatory analyses and expert technical assistance with the review of technical documents to be submitted with SLR applications or to be available for assistance in the review of SLR applications. The task would be activated as needed by NRR and scoped and cost estimated as the SLR applications are accepted and RES assistance is needed. At this time, NRR does not see a need for this task.
- Delete the paragraph “As an example.” Assessing the “trend in critical risk-significant electrical equipment” is not the role of DMLR. RES might discuss this with DE in their UNR.
- Provide task estimates for Task 4 alone without additions.

[I just heard today that DE is setting up a request for informal support (less than 100 hours) with RES to do a technical evaluation of Seabrook’s proposal for a testing program to determine the modulus of elasticity of their ASR-infected containment. I don’t know if this proposal is for their license amendment request or their application for first license renewal. Brian Wittick, Angie Buford, and Bryce Lehman were in the meeting. This is the type of thing I would see RES doing in Task 5. BMB]



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

August 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.

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 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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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 a workshop, conference, symposium, or meeting), one ~~in early autumn 2018~~tentatively planned for spring 2019 on mechanical issues and one ~~in late spring~~tentatively planned for summer 2020 on concrete and cables issues. 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, 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. 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.

Mechanical Issues – As part of the requested autumn 2018 workshop/ conference/ symposium/ meeting on mechanical issues, the NRC staff will coordinate a session, or sessions, concerning issues associated with reactor vessel embrittlement 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 quarter of FY20 (spring 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 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 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, 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 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 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.

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.

As an example, RES will develop a process to evaluate 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 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 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, 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.

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 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 FTE/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.

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, 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 \$
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	[] year	[] for FY 18 and FY 21 [] (b)(5) (b)(5) (b)(5)
Total (Task 1)			[]	[] (b)(5)
2	Develop a strategy for harvesting materials/components from decommissioned plants			
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 []	[] (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)
3	Participate in relevant domestic and international activities (e.g., IFRAM, IAEA, DOE LWRS, EPRI LTO, codes & standards)	FY 18-21	[]/year []	[] (b)(5) [] (b)(5) (total for 4 years IFRAM dues) (b)(5)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	[] year []	[] (b)(5) [] (b)(5)
Total (Tasks 1-4, over 4 years)			[]	[] (b)(5)

Note to requester: This record includes
the next two pages.

~~Internal use only – no distribution outside NRC;~~
May contain proprietary material

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Baran, Jeff

From: Castelveter, David
Sent: Thursday, July 05, 2018 5:01 PM
To: Castelveter, David
Subject: Tomorrow's News Tonight

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May contain proprietary material

July 5, 2018

Traditional Media

Non Responsive Record

OYSTER CREEK – A reporter for *RadWaste Monitor* asked OPA Region I if NRC was interested in the “harvesting” of components from the plant following its permanent shutdown. We responded that there are no current plans to conduct an autopsy of the site.

Non Responsive Record

News Releases

Non Responsive Record

Baran, Jeff

From: Harrington, Holly
Sent: Friday, April 13, 2018 5:00 PM
To: Harrington, Holly
Subject: Tomorrow's News Tonight

~~Internal use only – no distribution outside NRC~~
May contain material proprietary to news agencies

April 13, 2018

Traditional Media



Non Responsive Record

OYSTER CREEK – The Lacey Patch sought more information from OPA Region I on whether the NRC might want to “autopsy” the plant following its shutdown later this year. After checking with staff in the Office of Research, we said there are no current plans to “harvest” materials from the facility, based on cost and other considerations.

News Releases

None

~~Internal use only – no distribution outside NRC~~
May contain material proprietary to news agencies

Materials Harvested by the LWRS Program

Session 3: Source of Materials

Thomas M. Rosseel, Deputy Lead, Materials Pathway
And Materials Pathway Research Staff
U.S. NRC (cables and concrete)
EPRI (cables)



Ex-Plant Materials Harvesting Workshop
U.S. Nuclear Regulatory Commission
Rockville, MD
7-8 March 2017

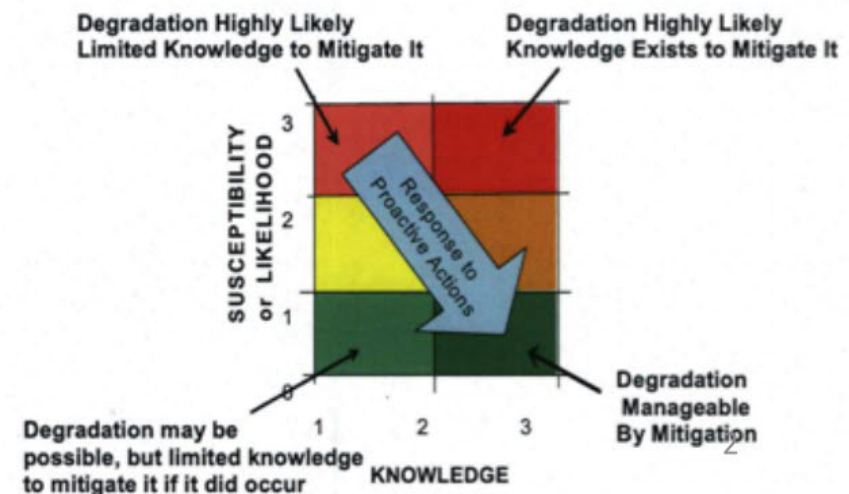
Light Water Reactor Sustainability R&D Program



Given the complexity of reactor systems & materials degradation, a prioritization tool for research was developed to address knowledge gaps

- Joint DOE / US NRC organized approach similar to the NRC's **Proactive Materials Degradation Assessment (PMDA)** on Internals and Primary Piping (**NUREG/CR-6923**) for life extension to 60 years.
- Leveraged EPRI Materials Reliability Program / Issue Management Tables.
- Panels composed of Experts from DOE National Labs, Industry, Universities, and International Organizations **Results** (EPRI: AMP & SLR /NRC: GALL & SLR /LWRS: *Research Prioritization*)
- **EMDA: An important component of understanding materials degradation is the examination of service-aged materials.**
- Effort encompassed broader systems & longer lifetimes 80 Years
 - Core internals and primary piping
 - Pressure Vessel
 - Concrete
 - Cabling

PUBLISHED version of NUREG / CR-7153 is available on-line (NRC ADAMS)
Extended Materials Degradation Assessment (2011-2013)



An important component of understanding Materials degradation is the examination of service-aged materials.

- Access to materials from active or decommissioned nuclear power plants provides:
 - **An invaluable resource for which there *is limited operational data or experience to inform relicensing decisions* and**
 - **To inform assessments of current degradation models to further develop the scientific basis for understanding and predicting long-term environmental degradation behavior.**
- **Two important sources of service-aged materials** for the LWRS Program:
 - **Zion Harvesting Project** (cables, RPV, records, electrical) and

(b)(4)

(b)(4)

Crystal River 3: EPRI led effort in collaboration with LWRS and NRC (Cables)

(b)(4)

(b)(4)

(b)(4)

The Decommissioning of the Zion Unit 1& 2 NPPs Provided a Timely Opportunity to Examine Service-Aged Materials Degradation

- In support of extended service (and current operations), ORNL coordinated and contracted activities with *EnergySolutions*.
- **May 5, 2011, Workshop at Zion with attendees from: Energy Solutions, Industry, NRC, and DOE LWRS to discuss opportunities and constraints.**
- In collaboration with the US NRC, EPRI, and others, a list of materials for “harvesting” has been compiled and feasibility examined.
- **Structures and components of interest:**
 - ★ **Thru-wall RPV sections**
 - **Cabling**
 - **Concrete (timing & dose issue)**

Rosseel, ORNL



Zion Unit 1 Containment Cables acquired in the Spring 2012

Harvested 6 sets of cables, ~ 25' in length, and each containing two cable types - CRDM DC power and position indicator. Also harvested 8 thermocouple cables identified during 2011 containment tour

The LWRS Program and NRC are studying cables harvested from the Zion NPPs in an attempt to understand and predict cable degradation at extended lifetimes.

Some thermocouple cables may still be available for collaborative studies



Rosseel, ORNL



Zion Records Harvested from Vault 2013

- **Zion Records:** The acquisition of key records from the Zion nuclear power plants provide critical information about the **initial materials properties, in service inspection, and operational history of the Zion Nuclear Generating Station** necessary to evaluate the degradation of in service materials.
- **Records are stored at ORNL (Zion National Library), available for on site review and copying.**



Rosseel, ORNL

Zion Cables Part 2 (2013-2017)

- Harvested 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.
 - 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'**



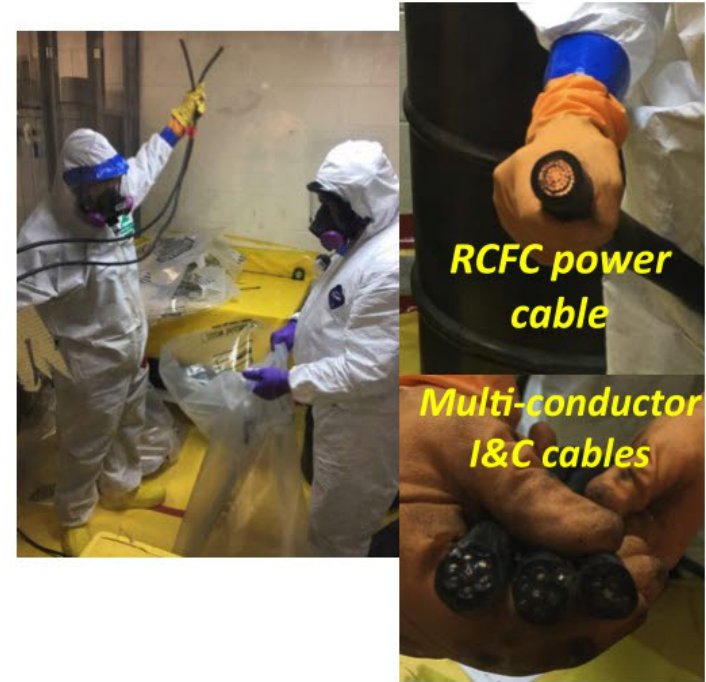
Rosseel, ORNL

Harvested I&C cables from Crystal River and Zion supports improvement of cable monitoring and maintenance

- Harvested I&C cables play a critical role in developing models to quantify the influence of environmental degradation and develop practical NDE techniques to track the degradation in current NPPs
 - Many of the manufacturers no longer exist
 - Formulations from when cables were installed in 70's and 80's have evolved through supplier changes and functional improvements
- In collaboration with EPRI & NRC in 2016, over 5,000 feet of I&C cable inside containment (**Zion Unit 2**) and *outside of containment* from **Crystal River NPPs** have been harvested and environmental degradation studies on highest priority materials has begun at ORNL and PNNL.
- **Some Zion cables may be available (low activity Rad, Rad and asbestos, asbestos, no activity or asbestos)**

GOALS

- Quantify/ model remaining useful life
- Demonstrate practical NDE techniques
- Disseminate results to improve current NPP cable aging management programs



Zion Harvesting 2013: Electrical Components for the US NRC

- **Zion Electrical Components:** Based on the information gathered during the February 25, 2013, visit to Zion to assess certain electrical components, the US NRC and SNL identified an L shaped bus bar that was harvested in 2013 for fire protection testing.
- Consumed in NRC fire protection study

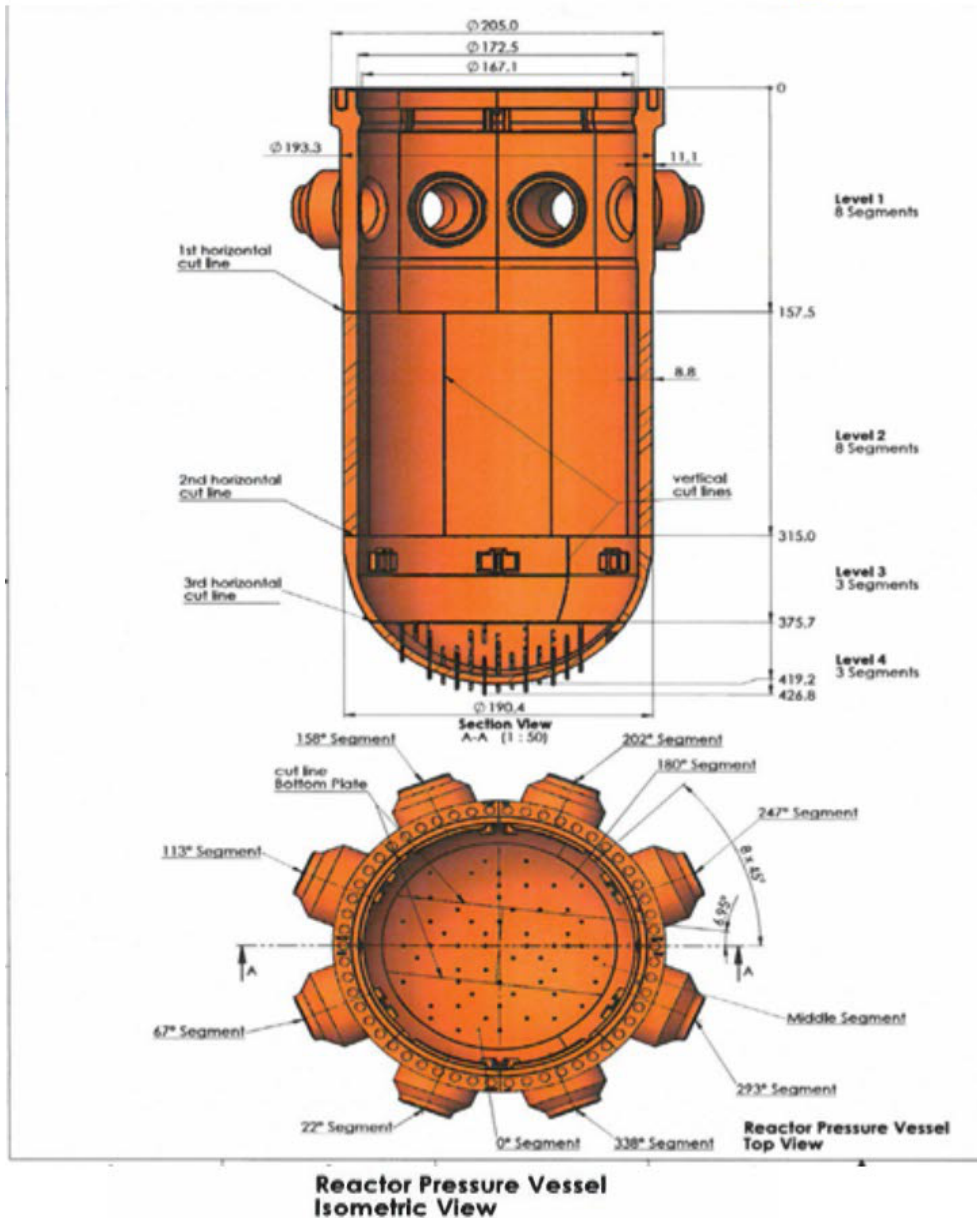


Rossee, ORNL



Zion Solutions RPV Segmentation Plan

RPV by the numbers



D. Pryor, Energy Solutions

The Zion RPV had a total height without the head plate of approximately **353 in. (10.6 meters)**.

The vessel wall has an **inner diameter of 173 inches (4.4 m)** and **thickness of 8.8 inches (22 cm)** over the beltline region. The **nozzle section** was approximately **11 inches (28 cm)** thick.

The reactor vessel weighed ~ **700,000 lbs. (317 ton)** and has a total activity of about **400 curies**.

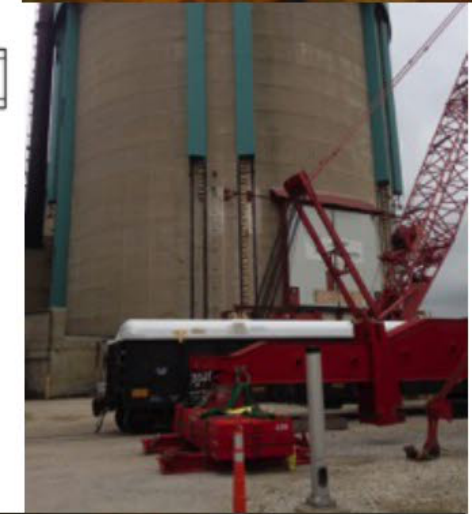
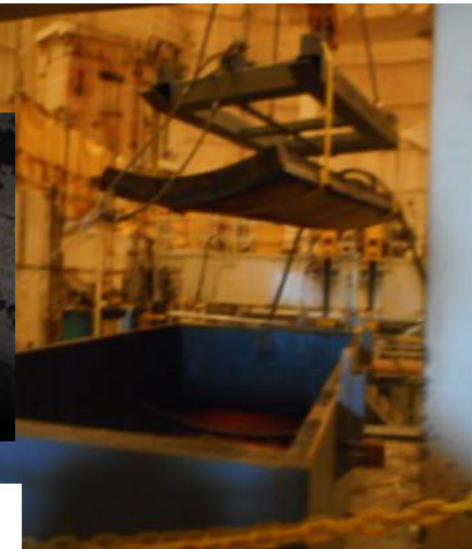
The stainless steel **cladding** has a nominal thickness of **5/16 inch (8 mm)**

The vessel was cut, using an oxy-propane torch into **17 segments over 3 levels**

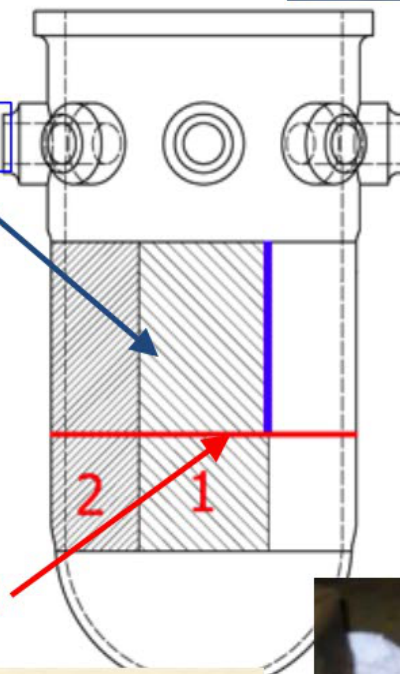
Zion Unit-1 RPV Harvesting (2013-2017)

In support of extended service and aging management ... procurement of 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

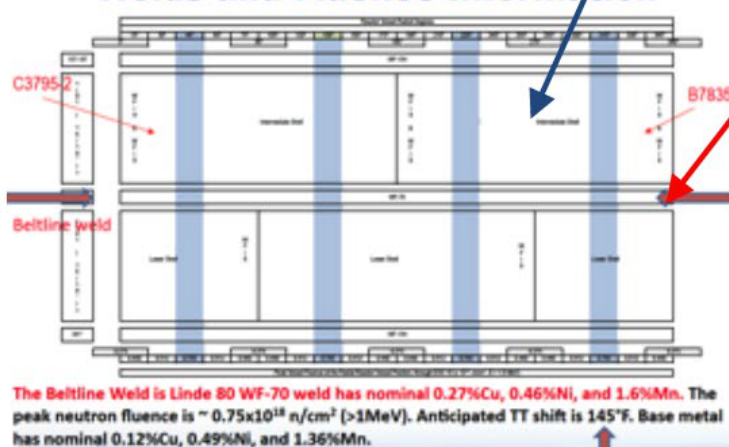
- One panel section, ~14 tons, was harvested in November 2015, cut into blocks that are now being machined into individual test specimens.
- Goal of research:
 - Evaluation of radiation damage models
 - Comparison to surveillance and high flux reactor experiments
 - Attenuation and through wall variation in base and weld metal.
 - Mitigation techniques - annealing / re-irradiation studies.



B7835-1 Base Metal

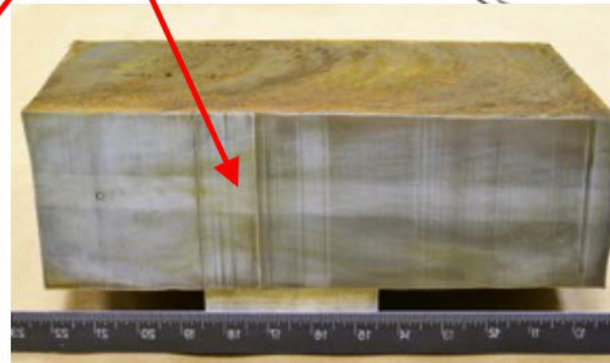


Zion Unit 1 RPV Segmentation Plan B Welds and Fluence Information



The Beltline Weld is Linde 80 WF-70 weld has nominal 0.27%Cu, 0.46%Ni, and 1.6%Mn. The peak neutron fluence is $\sim 0.75 \times 10^{18} \text{ n/cm}^2$ ($>1\text{MeV}$). Anticipated TT shift is 145°F. Base metal has nominal 0.12%Cu, 0.49%Ni, and 1.36%Mn.

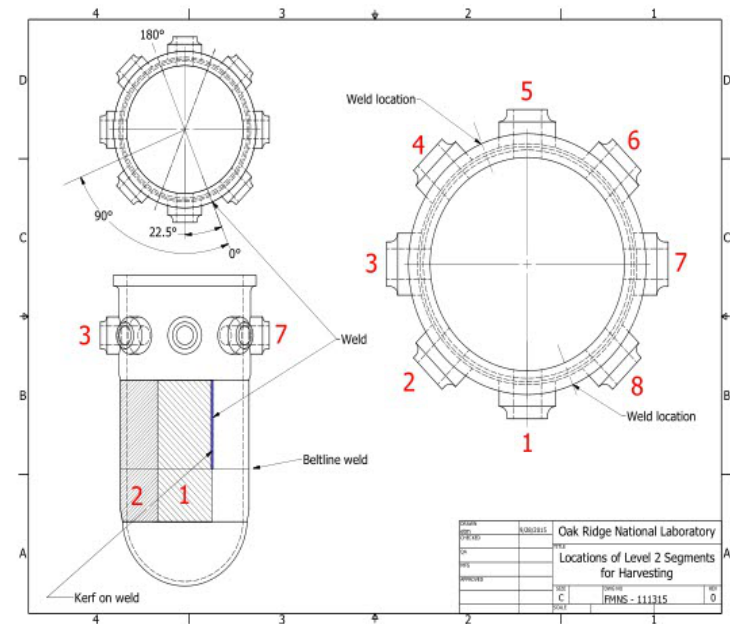
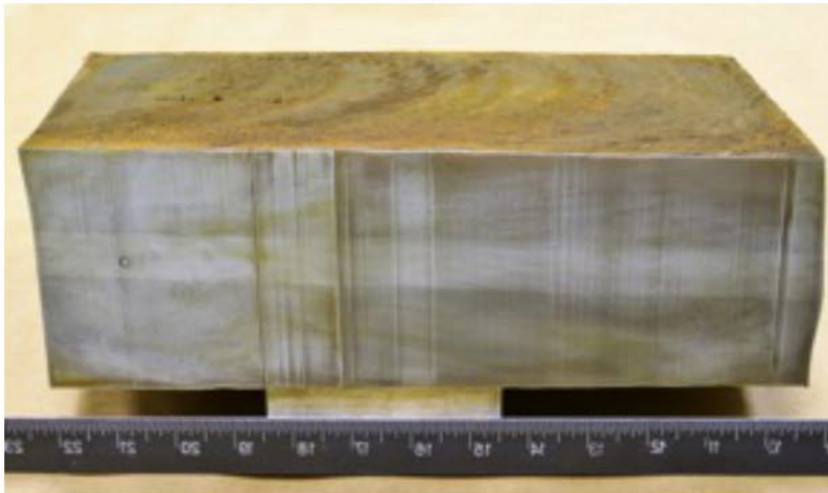
WF-70, Belt-line Weld



22/09/2016 12

LWRS Research plans for harvested Zion RPV material

- Comparison of harvested material to surveillance, computer models & high flux reactor experiment data.
- Determination of variations in base metal and weldment: influence of attenuation, compositional variations, microstructure and property changes.
- Specimen size effects: bias of the pre-cracked Charpy specimen, and testing of m-CT specimen
- Mitigation techniques - annealing / re-irradiation
- Re-irradiation of materials through fast flux irradiations to higher doses



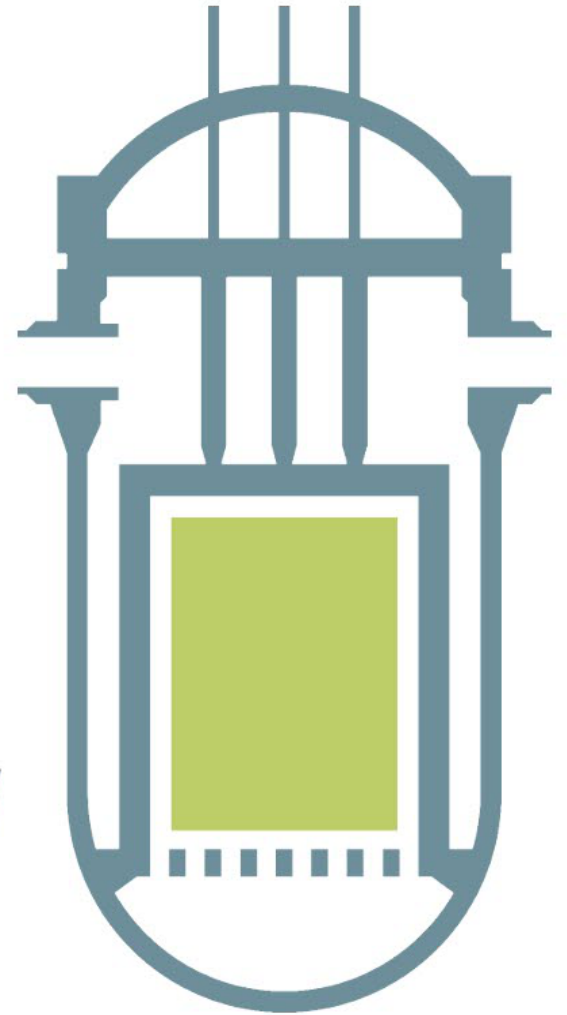
Collaborations and opportunities:

- **Current collaboration: CRIEPI (CNWG): mini C(T) evaluation**
- **Research that supports LWRS goals and is collaborative**

Discussion?



Light Water Reactor Sustainability



LWRS Program: Harvesting Lessons Learned

Session 4: Harvesting Experience

**Thomas M. Rosseel, Deputy Lead, Materials Pathway
And Materials Pathway Research Staff
U.S. NRC (cables and concrete)
EPRI (cables)**



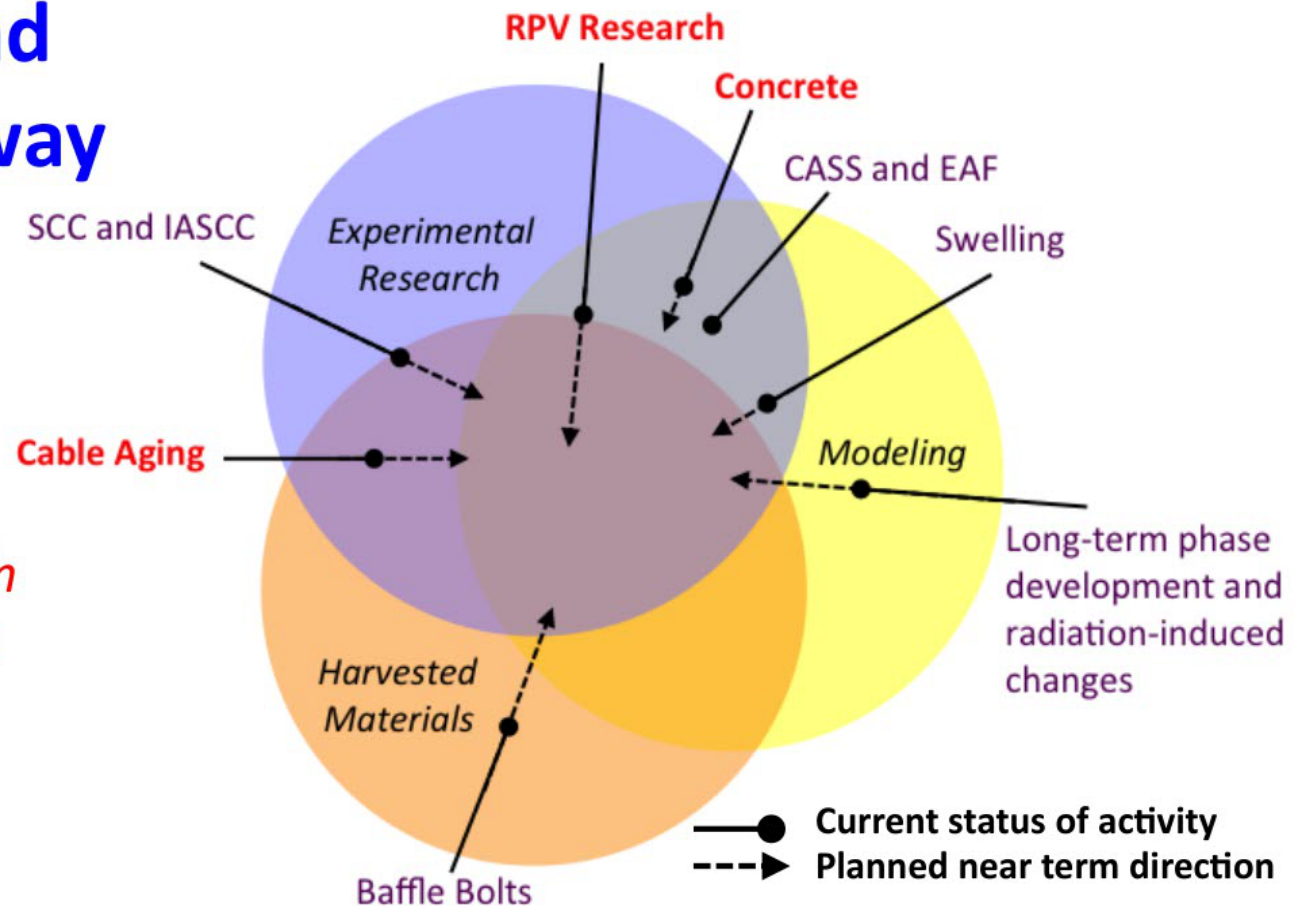
**Ex-Plant Materials Harvesting Workshop
U.S. Nuclear Regulatory Commission
Rockville, MD
7-8 March 2017**

Light Water Reactor Sustainability R&D Program



Materials Aging and Degradation Pathway Methodology

Addressing scientific gaps in knowledge of extended life predictions, requires a multidirectional approach.



- Individual tasks within the pathway provide contributions to the overall pathway goal through high quality scientific measurement of materials performance to understand the active modes and mechanism of degradation.

An important component of understanding Materials degradation is the examination of service-aged materials.

- Access to materials from active or decommissioned nuclear power plants provides:
 - **An invaluable resource for which there is limited operational data or experience to inform relicensing decisions** and
 - **To inform assessments of current degradation models to further develop the scientific basis for understanding and predicting long-term environmental degradation behavior.**
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(b)(4)

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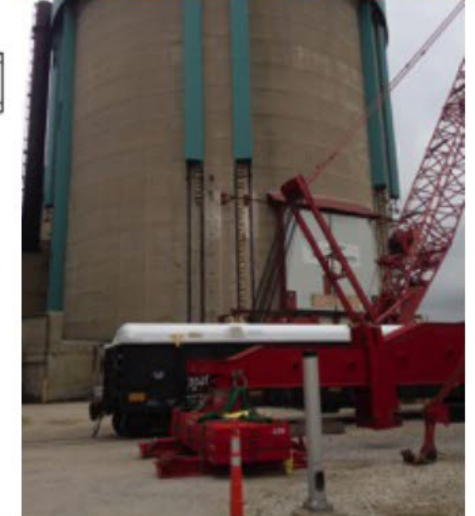
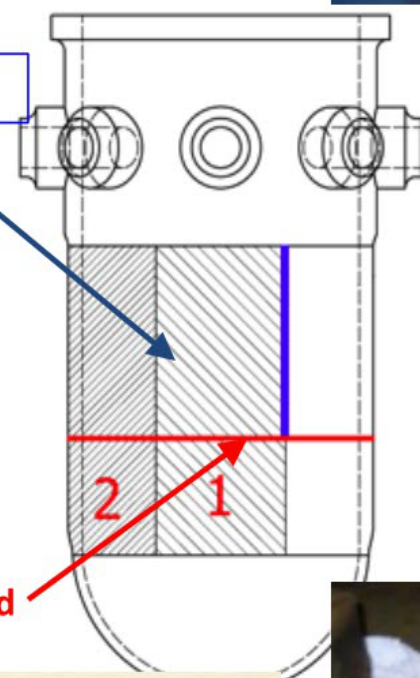
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Zion Unit-1 RPV Harvesting 2011-2017

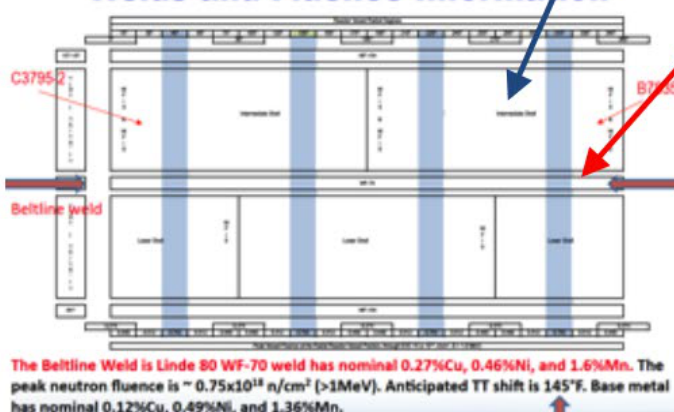
Multiple contracts (4 vendors), 4 changes in acquisition plans, 3 changes in cutting plans, and 2 changes in machining plans over a 5-year period (2013-2017)

- One panel segment, ~14 tons, was harvested in November 2015, (4 segments) shipped to MPF, cut into blocks, and are being machined into individual test specimens.
- Goal of research:
 - Evaluation of radiation damage models
 - Comparison to surveillance and high flux reactor experiments
 - Attenuation and through wall variation in base and weld metal.
 - Mitigation techniques - annealing / re-irradiation

B7835-1 Base Metal

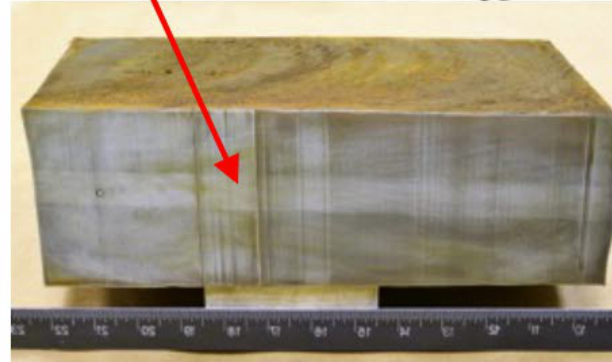


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WF-70, Belt-line Weld



Lessons Learned and Issues to Consider (1)

- **Long range goals, objectives, framework, partners**
 - **Work shop at Zion NPP, May 5, 2011** including DOE National Labs, Industry, NRC, and EPRI
 - Discussions with Zion/Energy Solutions, NRC, Westinghouse, EPRI)
- **Partnerships (Leverage resources, opportunities for collaboration, publish and share results)**
 - Cables (DOE led joint effort with NRC at Zion U1 and U2)
 - Cables (EPRI led effort with NRC and DOE (ORNL and PNNL)
 - Cables from operating plants (EPRI led and shared with DOE: ORNL and PNNL)
 - RPV (CNWG Collaboration with CRIEPI to test mini C(T) specimens from Zion)
- **Limited opportunities**
 - **Previous attempts to obtain RPV material from Trojan, SONGS 1 via the US NRC HSSI Program were unsuccessful**
 - **Attempts to obtain surveillance capsules from Zion Unit 2 [capsule X (2e19)](LWRS) and Palisades [high Ni] (HSSI and LWRS) were unsuccessful**
 - Future US opportunities (SONGS 2, Ft. Calhoun, & closure of older, smaller NPPs)
 - Future International opportunities (Japan, Sweden, others?)
- **Research value**
 - Compromise between availability and value (EFPY/fluence)
- **Scheduling issues**
 - Working within the critical path of the decommissioning organization (priv. vs. gov.)
 - Discussions and meetings with D&D Organization since this not their highest priority (not a reflection of lack of cooperation)
 - **Requires regular site visits and contacts!**

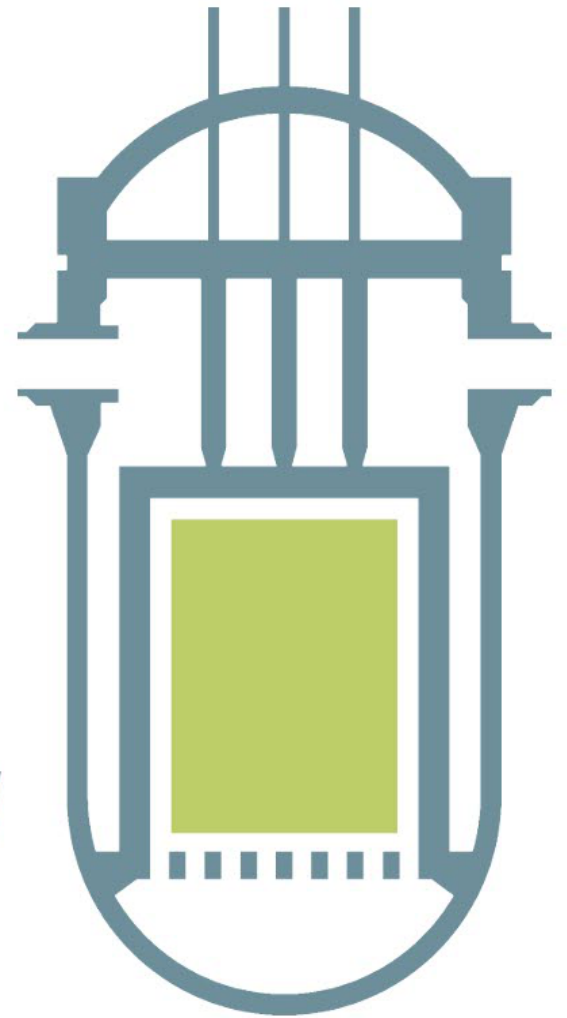
Lessons Learned and Issues to Consider (2)

- **Flexibility**
 - Ability to modify plans to maintain objectives, adjust to schedule changes and stay within cost constraints)
- **Quantity of material harvested**
 - Sufficient material to validate models and compare with accelerated experiments
 - Sufficient to support agreed upon collaborations and partnerships
- **Material Pedigree**
 - Records (composition and initial properties), reports (including inspection, qualification, and surveillance results)
 - Characterization after harvesting
- **Hazardous Materials**
 - Handling at site, transportation, handling at testing site, disposal, time, and costs
- **Logistics**
 - Contracts (8 for Zion materials), liability, shipping, disposal of waste
- **Costs (harvesting, handling, storage, fabrication, testing, & managing)**
 - **Yes; it is very expensive from planning to execution and testing!**

Discussion?



Light Water Reactor Sustainability



Note to requester: There are 2 attachments to this email, they are both immediately following this email. Portions of this record are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: [Hull, Amy](#)
To: [Hiser, Matthew](#)
Subject: FW: SLR UNR response 07-24-2017_abh.cln (IF) cm.abh..docx
Date: Tuesday, August 01, 2017 4:40:26 PM
Attachments: [SLR UNR response 07-24-2017_abh.cln \(IF\) cm.abh..docx.docx](#)

Matt, please can you look at the comments from Steve that affect you in Task 2?
Such as about information tool and PNNL reports?

From: Hull, Amy
Sent: Tuesday, August 01, 2017 9:20 AM
To: Pires, Jose <Jose.Pires@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: SLR UNR response 07-24-2017_abh.cln (IF) cm.abh..docx

Please can you (or Mita or Jake) take a look at the attached comments concerning the following paragraphs and help us improve the following?

Based on information gleaned from **discussions** on the potential for harvesting and testing of concrete from decommissioned reactors, RES will provide a database to NRR on the possibilities for this activity and prioritize testing in a technical letter report (TLR). As an example, the TLR 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.

RES will provide the database for NRR review and will summarize the priority listing in a TLR. A separate TLR will be submitted to NRR on the process for harvesting and testing of concrete samples from decommissioned plants.



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

August xx, 2017

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

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

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

Commented [F11]: Please replace with Acting Director

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 technical assistance with facilitate the evaluation of the 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 supercedes overlaps with 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."

Commented [F12]: ...provide technical assistance with?

Commented [HA3]: Actually I was quoting from the request...

Commented [CM4]: Disagree with deletion

For tracking purposes, RES has designated this UNR as NRR-2017-006 (ML16358A427). (ML16358A427). The purpose of this memorandum is to respond to the request in NRR-2017-006 with RES's plans to accomplish the requested tasks:

Commented [F15]: The work on UNR 2014-001 is essentially complete, so I suggest deleting this sentence. If there is overlap with UNR NRR-2017-001 then that should be stated here, including a statement on what we will do to prevent duplication in effort.

Commented [HA6]: I am quoting from the request and from the earlier UNRs. I want to keep this paragraph as it is.

Commented [F17]: This the ADAMS number for the UNR: ML16358A427

Commented [HA8]: That is for 2017-001.

Task 1 requests RES to hold NRC/industry workshop(s) on the status of domestic and international research activities to address and evaluate the status of aging degradation issues identified in in the SRM on SECY 14-0016 and in the GALL-SLR Report. Task 2 requests RES to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants, as well as from ex-plant components harvested/recovered from operating plants. Task 3 requests RES to continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research. Task 4 requests RES to develop documentation and compile results evaluating significant technical issues germane to the review of SLR applications from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff. Based on later alignment between NRR/DMLR and RES/DE staff, Task 5 was added by RES to provide confirmatory analyses and expert technical assistance with the reviewing of anticipated industry reports and SLR applications with of potentially significant technical issues on a tight review schedule, such as the SLR applications to be submitted with plant specific gap analyses.

Commented [CM9]: Or harvested?

Commented [F110]: At a minimum we will need to claim division level alignment for adding Task 5. The DE management briefing on SLR next week will be a good opportunity to bring Brian and Chris up-to-date on this, including the need, if any, for them to align on this with their counterparts.

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 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.

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

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

RES staff appreciates the coordination with NRR technical staff 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

Commented [F113]: The memo template has changed, so memo content is not shown on concurrence page

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

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User Need Request (UNR) Response 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 a workshop, conference, symposium, or meeting), one in early autumn 2018 on ~~the~~ mechanical issues and one in late spring 2020 on ~~the~~ concrete and cables issues. 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 aging management of these issues, as discussed in the GALL-SLR, and any new operating experience from the initial license renewal period (or the long term operation period for international plants). These activities will be specifically targeted toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables include the international activities (either 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. Prior to the meetings, RES will provide a draft agenda and proposed presenters. The information from these activities will 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) and research insights and knowledge, provided within 6 months after each meeting.

As part of the requested Autumn 2018 workshop/ ~~conference/~~ symposium/ meeting on mechanical issues, the NRC staff will coordinate a session, or sessions, concerning issues associated with reactor vessel embrittlement during the ~~period of SLR period~~. The staff will seek participation from the NRC staff, the regulated US industry, and international industry and regulatory representatives. The product of these sessions (presentations and/or papers) will be ~~documented in~~ included as part of the NUREG/CP a report ~~as described above~~.

RES will ~~also plan to~~ hold an NRC/industry workshop with international participation in the third quarter of FY20 (spring of 2020) on the state of knowledge for the technical issues in concrete and containment 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 the workshop will need to address several concrete-related issues where related research is still active, RES will plan for a three-day workshop that may include breakout sessions for ~~specifics~~ specialty 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 in a

NUREG/CP report, which will include a summary of the workshop, presentations and workshop insights and conclusions. Task 1 will continue until the completion of the deliverables from ~~this~~~~the second~~ activity, tentatively scheduled for late spring 2020.

Task 2

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

Under a long-term research project preceding ~~this~~~~the current~~ request from NRR, RES ~~has~~ 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 under Task 2,~~ RES, with contractor support from Pacific Northwest National Laboratory (PNNL), ~~has~~ developed an approach to prioritize technical issues best addressed by harvesting. ~~The deliverable provides~~~~provided~~ criteria to assess the need for harvesting to address a particular technical issue. ~~The report then applies~~~~applied~~ these criteria to assess four example 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 covers~~~~covered~~ the background on the need for harvesting, and past harvesting efforts and experience. ~~The purpose of this report is was~~ to serve as a tool for NRC staff ~~to apply~~ to prioritize technical issues best addressed by harvesting. ~~The final report for this research is expected to be published in August, 2017. Final reporting for this effort is expected by August 2017.~~

In the second ~~preceding~~ activity, ~~the NRC-RES closely coordinated~~~~collaborated~~ with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) ~~on ex-plant materials harvesting and, as mentioned above, hosted 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 well-attended by representatives from DOE, the 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 August, 2017. As part of the second activity under Task 2,~~ RES will be pursuing further engagement with interested workshop participants on two ~~outstanding~~ workshop action items: ~~identifying~~ data needs for harvesting and ~~creating~~ a 'sources of materials' database.

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, as requested in UNR Subtask 2.A. As an example, RES will develop a database ~~which identifies and prioritizes the concrete materials, components and operating conditions needed to address the significant issues. RES will develop a process to evaluate concrete samples harvested from decommissioned plants, and RES will follow through with implementing the process as~~

Commented [F114]: Please add sub-sections for Sub-tasks 2A – 2E. This will improve clarity and will better align the response with the UNR.

Commented [F115]: Is this 2.A?

Commented [F116]: Will the final PNNL report be shared with NRR or is RES staff going to use the PNNL report and provide added value as part of this UNR?

Commented [F117]: Is this 2.B?

Commented [F118]: Would this be an MS-Access application? Under 2.A, the UNR talks about "an information tool". Would a database alone "foot the bill"?

Commented [CM19]: "Information tool" is often another term for database (so, it would fit the bill), while skirting some database constraints.

concrete materials become available from additional plants. The scope of the harvesting strategy includes: 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; concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects); and concrete structures exposed to high radiation (typically bio-shield structures of certain PWR designs).

~~In addition, for irradiation effects on concrete materials, RES will focus on IAD of stainless steel. This is also addressed in UNR NRR-2017-001.~~

Based on information gleaned from discussions on the potential for harvesting and testing of concrete from decommissioned reactors, RES will provide a database to NRR on the possibilities for this activity and prioritize testing in a technical letter report (TLR). As an example, the TLR will document the process to evaluate the concrete samples from nuclear power plants undergoing decommissioning or ex-plant samples from operating plants (and its suitability) that would be appropriate candidates for harvesting will be documented in the letter report to NRR. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

RES will provide the database developed for NRR review and will summarize the priority listing in a TLR letter report. A separate TLR letter report will be submitted to NRR on the process for harvesting and testing of concrete samples from decommissioned plants.

In addition to irradiation effects on concrete materials, RES will continue research on IAD of stainless steel. (This is also addressed in UNR NRR 2017-001.) Under Task 2 of this UNR, RES will seek potential sources of reactor internals that may become available for harvesting, to evaluate their utility to advance research being conducted under NRR-201-001.

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', which identifies and prioritizes the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool to be a living document that can be updated to reflect the latest operating experience and research, so that users may ~~to~~ understand which data needs may be best addressed by harvesting.

Subtask 2.B.

In parallel with the information tool activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting, as requested in Subtask 2.B. Based on past experience and insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from the plant to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in the 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 technical letter report documenting the information tool 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 remain in close contact with

Commented [FI20]: If there is overlap with other UNRs we need to be more specific to assure that there is no duplication in effort. Also, this should be mentioned in the memo.

Commented [FI21]: With whom?

Commented [FI22]: Please clarify.

Commented [FI23]: Please combine this with the previous paragraph. Are we talking about two or three TLRs?

Commented [FI24]: If there is overlap with other UNRs we need to be more specific to assure that there is no duplication in effort. Also, this should be mentioned in the memo.

Commented [FI25]: Please see my comment on this on the previous page.

Commented [FI26]: Please clarify.

NRR on the latest developments as this process is implemented.

The ~~evaluation development~~ process will identify confirmatory needs that ~~the use of~~ harvested samples can effectively address, will consider decommissioned ~~plants in the U.S. plants as well as decommissioned plants and~~ abroad, and will leverage to the extent possible domestic and international cooperative research opportunities, as stipulated in Subtask 2.E. Through their national and international contacts, ~~the~~ RES staff will maintain alertness for harvesting opportunities ~~in relating to~~ various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the ~~Microsoft~~ information tool.

Commented [CM27]: How is Subtask 2.E. distinct from Task 3?

Task 3

RES staff will continue to develop domestic and international partnerships to share expertise, capabilities and resources related to aging management research for long-term operation. These exchanges are critical for the confirmatory review of ~~the industry research or research that the industry uses~~ to justify the adequacy of their aging management programs (AMPs), as well as for ~~the NRC independent confirmatory research~~. The DOE Light Water Reactor Sustainability (LWRS) and the EPRI Long-term Operation (LTO) programs support most of the domestic research to support 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 long-term operations. RES staff ~~have has~~ frequent technical interchange meetings with DOE and EPRI staff, which have concentrated on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

Commented [FI28]: Is this wording correct?

Commented [CM29]: The resultant wording looks OK.

~~RES will continue to nurture. The following paragraphs illustrate a few of the~~ emerging domestic and international partnerships ~~that RES is nurturing. RES and will plans to~~ continue to develop those partnerships, ~~other existing partnerships not included here,~~ as well as other suitable opportunities that may emerge to address the aging degradation issues. ~~RES is a participant in several multi-national cooperative research programs, including the Halden Research Program and many others. For example,~~

Commented [CM30]: What has concentrated on these topics – meetings, DOE & EPRI staff, ...?

Commented [CM31]: As suggested, these examples could be omitted.

1. The RES Office Director signed in 2015 a multilateral 4-year memorandum of understanding (MOU) for the International Forum on Reactor Aging Management (IFRAM). IFRAM is envisioned to enable appropriate exchange of information among those parties and organizations around the world that are presently, or are planning on addressing issues of NPP SSC aging management. IFRAM is 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. Four objectives support this purpose: cooperating to achieve common objectives, sharing information, identifying joint research or demonstration projects that can be pursued under separate agreements, and identifying and promoting best practices.
2. In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned nuclear power plants 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 joint Halden Research Program proposing research on irradiation effects on steel-concrete bond, and on creep

effects on irradiation damage. RES is working to finalize a bilateral agreement with the French Institut de Radioprotection et de Surete Nucleaire (IRSN), 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 has an ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete and will continue participating under the international Organization for Economic Cooperation and Development (OECD) and Nuclear Energy Agency (NEA) Committee on the Safety of Nuclear Installations OECD/NEA/CSNI to develop modeling expertise for ASR effected concrete structures.

Commented [FI32]: In my opinion, this is too much detail for a UNR response. Let's discuss.

Through their national and international contacts, and through Ccodes and Sstandards developing 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 NRR 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 to NRR in a timely manner; the 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 the interface meetings between RES/DE, NRR/DMLR and NRR/DE. A quarterly report (or slides) for presentation at any-Director/Deputy Director interface meetings will be provided 5 days before the meeting.

Commented [CM33]: This sentence could be omitted.

Task 4

RES staff will document and compile results 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. The 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.

Task 5

RES staff will continue to provide confirmatory analyses and expert technical assistance with the review of reviewing the technical documents to be for submitted with SLR subsequent license renewal applications, overlapping with and building upon the extensive work done for under UNR NRR 2014-001. RES will support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. Process optimization has resulted in the proposed review time for SLR applications (SLRAs) to be reduced to 18 months from the 22 months allowed for LRAs to 18 months. Thus the expected work may be more intensive. In addition, the initial SLRAs are expected to require the review of plant-

Commented [FI34]: As discussed work under UNR 2014-001 is essentially complete, so I suggest deleting this.

specific gap analyses, especially before critical documents, such as MRP-227 Rev 2 (upon which AMP XI.M16A for PWR vessel internals is based), have been finalized and approved by NRC. In the absence of an acceptable generic methodology that considers an operating period of 80 years, the gap analysis is used to ensure that aging management for a specified SSC is appropriate for 80 years of operation.

RES will ~~assist with the technical evaluation of~~ evaluate SLR-related licensing products and reports (e.g., topical reports, SLR applications, LERs) that may be ~~submitted~~ provided to NRC in support of emerging generic or plant-specific issues. Representative ~~miscellaneous~~ examples include issues such as baffle-former bolt degradation, other concerns related to vessel internals, carbon segregation ~~in vessels, or and~~ concrete degradation. RES subject matter experts (SMEs), as requested by NRR/DMLR, will participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders. ~~Based on the latest assessment of projected needs in this area~~ The RES staff has ~~been involved in discussions with your staff on your needs~~, RES proposes that the estimate of ~~FTE/year for this task may need to be adjusted increased or decreased~~ 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~~ should continue until the closure of this UNR.

(b)(5)

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

RES staff 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.

Deliverables and schedule for UNR NRR-2017-006 are shown in the following table.

-Developing information tool may require more FTE and/or contractor support. Does PNNL have tool that could be modified for this purpose? If so, funds should be added for 2 A.

- Please add estimated travel costs for participating in domestic and international meetings under Task 3.
- We may need contractors to assist us with Task 5, so please add some funds for contractor support related to work on Task 5.

Schedule and Resources for the Various Tasks					
Period of Performance (FY18-21)					
Task Numbr	Task Description	Completion Date	FTE	Contract \$	
1	Hold NRC/industry workshops (2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY21	(b)(5) (b)(5) year (b)(5) (b)(5)	FY21 (b)(5) for FY18 and (b)(5)	
Total (Task 1)			(b)(5)	(b)(5)	
2	strategy for harvesting materials/components from decommissioned plants				
2.A	Develop a database	FY18	(b)(5)		
2.B	Develop a process to evaluate the components from plants	FY18	(b)(5)	(b)(5)	
2.C	Use the process developed in item B to evaluate the suitability of components from plants	FY19	(b)(5)		
2.D	Continue to implement the process developed in item B as components become available from additional plants	Ongoing (FY20-FY21)	(b)(5) year (b)(5)		
2.E	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant harvested material	Ongoing (FY18-FY21)	part of Task 3, below		
Total (Task 2)			(b)(5)	(b)(5)	
3	Participate in relevant Domestic and International activities (e.g., IFRAM, DOE LWRS, EPRI LTO, codes & standards)	FY18-FY21	(b)(5) year (b)(5)	(b)(5) (total for 4 years IFRAM dues)	
4	Prepare annual report documenting and compiling results from three preceding tasks	FY18-FY21	(b)(5) year (b)(5)		
5	Provide expert technical assistance with reviewing documents for subsequent license renewal (e.g. SLRAs, topical reports)	FY18-FY21	(b)(5) year (b)(5)		
Total (all 5 tasks over 4 years)			(b)(5)	(b)(5)	

Schedule and Resources for the Various Tasks

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	year	for FY 18 and FY 21	(b)(5)
(b)(5)					(b)(5)
(b)(5)	Total (Task 1)				(b)(5)
(b)(5) 2	Develop a strategy for harvesting materials/ components from decommissioned plants				
(b)(5) 2.A.	Develop a database	FY 18			
(b)(5) 2.B.	Develop a process to evaluate plant components	FY 18			(b)(5)
(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		
(b)(5) 2.E.	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials				
(b)(5)	Total (Task 2)				(b)(5)
(b)(5) 3	Participate in relevant domestic and international activities	FY 18-21	year		(b)(5)
(b)(5) 4	Develop documentation evaluating significant technical issues germane to the review of SLR applicationsPrepare annual report documenting results from Tasks 1-3	FY 18-21	year		
(b)(5) 5	Develop documentation evaluating significant technical issues germane to the review of SLR applicationsProvide expert technical assistance with reviewing documents for SLR, including topical reports	FY 18-21	year		
(b)(5)	Total (Tasks 1-4, over 4 years)				(b)(5)



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

August xx, 2017

MEMORANDUM TO: ~~William M. Dean~~ **Brian E. Holian, Acting** Director
Office of Nuclear Reactor Regulation

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

SUBJECT: RESPONSE TO 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 technical assistance with facilitate the evaluation of the future applications for a 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 supercedes overlaps with 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). (~~ML+++~~). The purpose of this memorandum is to respond to the request in NRR-2017-006 with RES's plans to accomplish the requested tasks:

Task 1 requests RES to hold NRC/industry workshop(s) 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. **Task 2** requests RES to develop and implement a long-term strategy for obtaining information on materials degradation from decommissioned nuclear power plants, as well as from ex-plant components harvested recovered from operating plants. **Task 3** requests RES to continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research. **Task 4** requests RES to develop documentation and compile results evaluating significant technical issues germane to the review of SLR applications from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff. Based on later alignment between NRR/DMLR and RES/DE staff, Task 5 was added by RES to provide confirmatory analyses and expert technical assistance with the reviewing of anticipated industry reports and SLR applications with of potentially significant technical issues on a tight review schedule, such as the SLR applications to be submitted with plant specific gap analyses.

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.

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Commented [F12]: ...provide technical assistance with?

Commented [HA3]: Actually I was quoting from the request...

Commented [CM4]: Disagree with deletion

Commented [F15]: The work on UNR 2014-001 is essentially complete, so I suggest deleting this sentence. If there is overlap with UNR NRR-2017-001 then that should be stated here, including a statement on what we will do to prevent duplication in effort.

Commented [HA6]: I am quoting from the request and from the earlier UNRs. I want to keep this paragraph as it is.

Commented [F17]: This is the ADAMS number for the UNR: ML16358A427

Commented [HA8]: That is for 2017-001.

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Commented [CM9]: Or harvested?

Commented [F110]: At a minimum we will need to claim division level alignment for adding Task 5. The DE management briefing on SLR next week will be a good opportunity to bring Brian and Chris up-to-date on this, including the need, if any, for them to align on this with their counterparts.

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.

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

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

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RES staff appreciates the coordination with NRR technical staff 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

Commented [F113]: The memo template has changed, so memo content is not shown on concurrence page**DISTRIBUTION:**

B. Thomas, RES
G. Wilson, NRR
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RidsNrrMailCenter

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OFFICE	RES/DE/CMB	RES/DE/CMB	RES/DE/CMB	RES/DE/CIB	RES/DE/ICEEB
NAME	C. Moyer	A. Hull	I. Frankl	R. Iyengar	T. Koshy
DATE	/ /2017	/ /2017	/ /2017	/ /2017	/ /2017

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

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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 a workshop, conference, symposium, or meeting), one in early autumn 2018 on ~~the~~ mechanical issues and one in late spring 2020 on ~~the~~ concrete and cables issues. 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 aging management of these issues, as discussed in the GALL-SLR, and any new operating experience from the initial license renewal period (or the long term operation period for international plants). These activities will be specifically targeted toward the resolution of technical issues for effective aging management of systems, structures, and components (SSCs) during the SLR period.

The deliverables include the international activities (either 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 ~~—~~. Prior to the meetings, RES will provide a draft agenda and proposed presenters. The information from these activities will 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) and research insights and knowledge, provided within 6 months after each meeting.

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As part of the requested Autumn 2018 workshop/ ~~conference~~/ symposium/ meeting on mechanical issues, the NRC staff will coordinate a session, or sessions, concerning issues associated with reactor vessel embrittlement during the ~~period of~~ SLR ~~period~~. The staff will seek participation from the NRC staff, the regulated US industry, and international industry and regulatory representatives. The product of these sessions (presentations and/or papers) will be ~~documented in~~ included as part of the NUREG/CP ~~a~~ report ~~as described above~~.

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RES will ~~also plan to~~ hold an NRC/industry workshop with international participation in the third quarter of FY20 (spring of 2020) on the state of knowledge for the technical issues in concrete and containment 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 the workshop will need to address several concrete-related issues where related research is still active, RES will plan for a three-day workshop that may include breakout sessions for ~~specific~~ specialty 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 in a

NUREG/CP report, which will include a summary of the workshop, presentations and workshop insights and conclusions. Task 1 will continue until the completion of the deliverables from ~~this~~the second activity, tentatively scheduled for late spring 2020.

Task 2

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

Under a long-term research project preceding ~~this~~the current request from NRR, RES ~~has~~ 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~~under Task 2, RES, with contractor support from Pacific Northwest National Laboratory (PNNL), ~~has~~ developed an approach to prioritize technical issues best addressed by harvesting. The deliverable ~~provides~~provided criteria to assess the need for harvesting to address a particular technical issue. The report then ~~applies~~applied these criteria to assess four example 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 ~~covers~~covered the background on the need for harvesting, and past harvesting efforts and experience. The purpose of this report ~~is~~was to serve as a tool for NRC staff ~~to~~apply to prioritize technical issues best addressed by harvesting. ~~The final report for this research is expected to be published in August, 2017. Final reporting for this effort is expected by August 2017.~~

In the second ~~preceding~~ activity, ~~the NRC~~RES ~~closely coordinated~~collaborated with the Department of Energy (DOE) and Electric Power Research Institute (EPRI) ~~on ex-plant materials harvesting and, as mentioned above, hosted 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 well-attended by representatives from DOE, ~~the~~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 August, 2017. ~~As part of the second activity under Task 2,~~RES will be pursuing further engagement with interested workshop participants on two ~~outstanding~~ workshop action items: ~~identifying~~ data needs for harvesting and ~~creating~~ a 'sources of materials' database.

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, as requested in ~~UNR~~ Subtask 2.A. As an example, RES will develop a database which identifies and prioritizes the concrete materials, components and operating conditions needed to address the significant issues. RES will develop a process to evaluate concrete samples harvested from decommissioned plants, ~~and~~RES will follow through with implementing the process as

Commented [F114]: Please add sub-sections for Sub-tasks 2A – 2E. This will improve clarity and will better align the response with the UNR.

Commented [F115]: Is this 2.A?

Commented [F116]: Will the final PNNL report be shared with NRR or is RES staff going to use the PNNL report and provide added value as part of this UNR?

Commented [F117]: Is this 2.B?

Commented [F118]: Would this be an MS-Access application? Under 2.A, the UNR talks about "an information tool". Would a database alone "foot the bill"?

Commented [CM19]: "Information tool" is often another term for database (so, it would fit the bill), while skirting some database constraints.

concrete materials become available from additional plants. The scope of the harvesting strategy includes: 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; concrete cores from PWR spent fuel pool or transfer canals (for boric acid effects); and concrete structures exposed to high radiation (typically bio-shield structures of certain PWR designs).

In addition, for irradiation effects on concrete materials, RES will focus on IAD of stainless steel. This is also addressed in UNR NRR 2017-001.

Based on information gleaned from discussions on the potential for harvesting and testing of concrete from decommissioned reactors, RES will provide a database to NRR on the possibilities for this activity and prioritize testing in a technical letter report (TLR). As an example, the TLR will document the process to evaluate the concrete samples from nuclear power plants undergoing decommissioning or ex-plant samples from operating plants (and its suitability) that would be appropriate candidates for harvesting will be documented in the letter report to NRR. Concurrently, RES will pursue domestic and international partnerships for cooperative cost sharing on the retrieval and testing of concrete samples.

RES will provide the database developed for NRR review and will summarize the priority listing in a TLR letter report. A separate TLR letter report will be submitted to NRR on the process for harvesting and testing of concrete samples from decommissioned plants.

In addition to irradiation effects on concrete materials, RES will continue research on IAD of stainless steel. (This is also addressed in UNR NRR 2017-001.) Under Task 2 of this UNR, RES will seek potential sources of reactor internals that may become available for harvesting, to evaluate their utility to advance research being conducted under NRR-201-001.

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', which identifies and prioritizes the materials, components, and environmental conditions that should be pursued for harvesting. The intent is for this information tool to be a living document that can be updated to reflect the latest operating experience and research, so that users may to understand which data needs may be best addressed by harvesting.

Subtask 2.B.

In parallel with the information tool activity, RES will develop an effective process to evaluate the applicability of materials available for harvesting, as requested in Subtask 2.B. Based on past experience and insights from the harvesting workshop, the greatest challenge in this area is expected to be acquiring sufficient information from the plant to make an informed decision on harvesting. In many cases, this information may not exist, or it may be challenging to find in the 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 technical letter report documenting the information tool 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 remain in close contact with

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Commented [F122]: Please clarify.

Commented [F123]: Please combine this with the previous paragraph. Are we talking about two or three TLRs?

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Commented [F126]: Please clarify.

NRR on the latest developments as this process is implemented.

The ~~evaluation~~development process will identify confirmatory needs that ~~the use of~~ harvested samples can effectively address, will consider decommissioned ~~plants in the U.S. plants as well as decommissioned plants and~~ abroad, and will leverage to the extent possible domestic and international cooperative research opportunities, as stipulated in Subtask 2.E. Through their national and international contacts, ~~the~~ RES staff will maintain alertness for harvesting opportunities ~~in relating to~~ various critical areas, such as reactor vessel embrittlement. Information on these opportunities will be retained in the ~~Microsoft~~ information tool.

Commented [CM27]: How is Subtask 2.E. distinct from Task 3?

Task 3

RES staff will continue to develop domestic and international partnerships to share expertise, capabilities and resources related to aging management research for long-term operation. These exchanges are critical for the confirmatory review of ~~the industry research or research that the industry uses~~ to justify the adequacy of their aging management programs (AMPs), as well as for ~~the NRC~~ independent confirmatory research. The DOE Light Water Reactor Sustainability (LWRS) and the EPRI Long-term Operation (LTO) programs support most of the domestic research to support 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 long-term operations. RES staff ~~have has~~ frequent technical interchange meetings with DOE and EPRI staff, which have concentrated on irradiation effects on concrete, ASR effects, aging management, and supporting technologies like non-destructive examination (NDE).

Commented [FI28]: Is this wording correct?

Commented [CM29]: The resultant wording looks OK.

~~RES will continue to nurture. The following paragraphs illustrate a few of the~~ emerging domestic and international partnerships ~~that RES is nurturing. RES and will plans to~~ continue to develop those partnerships, ~~other existing partnerships not included here,~~ as well as other suitable opportunities that may emerge to address the aging degradation issues. ~~RES is a participant in several multi-national cooperative research programs, including the Halden Research Program and many others. For example,~~

Commented [CM30]: What has concentrated on these topics – meetings, DOE & EPRI staff, ...?

Commented [CM31]: As suggested, these examples could be omitted.

1. The RES Office Director signed in 2015 a multilateral 4-year memorandum of understanding (MOU) for the International Forum on Reactor Aging Management (IFRAM). IFRAM is envisioned to enable appropriate exchange of information among those parties and organizations around the world that are presently, or are planning on addressing issues of NPP SSC aging management. IFRAM is 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. Four objectives support this purpose: cooperating to achieve common objectives, sharing information, identifying joint research or demonstration projects that can be pursued under separate agreements, and identifying and promoting best practices.
2. In relation to concrete irradiation, NRC is exploring opportunities to harvest irradiated concrete from decommissioned nuclear power plants 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 joint Halden Research Program proposing research on irradiation effects on steel-concrete bond, and on creep

effects on irradiation damage. RES is working to finalize a bilateral agreement with the French Institut de Radioprotection et de Surete Nucleaire (IRSN), 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 has an ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete and will continue participating under the international Organization for Economic Cooperation and Development (OECD) and Nuclear Energy Agency (NEA) Committee on the Safety of Nuclear Installations OECD/NEA/CSNI to develop modeling expertise for ASR effected concrete structures.

Commented [F132]: In my opinion, this is too much detail for a UNR response. Let's discuss.

Through their national and international contacts, and through Gcodes and Sstandards developing 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 NRR 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 to NRR in a timely manner; the 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 the interface meetings between RES/DE, NRR/DMLR and NRR/DE. A quarterly report (or slides) for presentation at any-Director/Deputy Director interface meetings will be provided 5 days before the meeting.

Commented [CM33]: This sentence could be omitted.

Task 4

RES staff will document and compile results 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. The 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.

Task 5

RES staff will continue to provide confirmatory analyses and expert technical assistance with the review of reviewing the technical documents to be for submitted with SLR subsequent license renewal applications, overlapping with and building upon the extensive work done for under UNR NRR 2014-001. RES will support tighter SLR application review schedules as well as the review of plant-specific gap analyses expected with the first applications. Process optimization has resulted in the proposed review time for SLR applications (SLRAs) to be reduced to 18 months from the 22 months allowed for LRAs to 18 months. Thus the expected work may be more intensive. In addition, the initial SLRAs are expected to require the review of plant-

Commented [F134]: As discussed work under UNR 2014-001 is essentially complete, so I suggest deleting this.

specific gap analyses, especially before critical documents, such as MRP-227 Rev 2 (upon which AMP XI.M16A for PWR vessel internals is based), have been finalized and approved by NRC. In the absence of an acceptable generic methodology that considers an operating period of 80 years, the gap analysis is used to ensure that aging management for a specified SSC is appropriate for 80 years of operation.

RES will assist with the technical evaluation of evaluate SLR-related licensing products and reports (e.g., topical reports, SLR applications, LERs) that may be submitted provided to NRC in support of emerging generic or plant-specific issues. Representative miscellaneous examples include issues such as baffle-former bolt degradation, other concerns related to vessel internals, carbon segregation in vessels, or and concrete degradation. RES subject matter experts (SMEs), as requested by NRR/DMLR, will participate in technical discussions, independent reviews, development of technical bases, and support of meetings with internal and external stakeholders. Based on the latest assessment of projected needs in this area The RES staff has been involved in discussions with your staff on your needs, RES proposes that the estimate of FTE/year for this task may need to be adjusted increased or decreased 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 should continue until the closure of this UNR.

(b)(5)

Deliverables and Schedules

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

RES staff 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.

Deliverables and schedule for UNR NRR-2017-006 are shown in the following table.

Schedule and Resources for the Various Tasks				
Period of Performance (FY18-21)				
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	FY21	(b) year	(b) for FY18 and FY21 (reduced with DOE support)
Total (Task 1)			(b)	(b)(5)
2	strategy for harvesting materials/components from decommissioned plants			
2.A	Develop a database	FY18	(b)	
2.B	Develop a process to evaluate the components from plants	FY18	(b)	(b)(5)
2.C	Use the process developed in item B to evaluate the suitability of components from plants	FY19	(b)	
2.D	Continue to implement the process developed in item B as components become available from additional plants	Ongoing (FY20-FY21)	(b) year (b)(5)	
2.E	Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant harvested material	Ongoing (FY18-FY21)	part of Task 3, below	
Total (Task 2)			(b)(5)	(b)(5)
3	Participate in relevant Domestic and International activities (e.g., IFRAM, DOE LWRS, EPRI LTO, codes & standards)	FY18-FY21	(b) year (b)(5)	(b)(5) (total for 4 years IFRAM dues)
4	Prepare annual report documenting and compiling results from three preceding tasks	FY18-FY21	(b) year (b)(5)	
5	Provide expert technical assistance with reviewing documents for subsequent license renewal (e.g. SLRAs, topical reports)	FY18-FY21	(b) year (b)(5)	
Total (all 5 tasks over 4 years)			(b)(5)	(b)(5)

Commented [F135]: Quarterly counterpart meetings should be sufficient. Obviously the staff will interact more frequently, as needed.

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- Developing information tool may require more FTE and/or contractor support. Does PNNL have tool that could be modified for this purpose? If so, funds should be added for 2.A.
- Please add estimated travel costs for participating in domestic and international meetings under Task 3.
- We may need contractors to assist us with Task 5, so please add some funds for contractor support related to work on Task 5.

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(b)(5)

Schedule and Resources for the Various Tasks
Period of Performance (FY 18-21)

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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	[] year	[] for FY 18 and FY 21 []	(b)(5)
(b)(5)	Total (Task 1)		[]	[]	(b)(5)
(b)(5)	2 Develop a strategy for harvesting materials/ components from decommissioned plants				
(b)(5)	2.A. Develop a database	FY 18	[]		
(b)(5)	2.B. Develop a process to evaluate plant components	FY 18	[]	[]	(b)(5)
(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 []		
(b)(5)	2.E. Pursue partnerships for cooperative cost-sharing on retrieval and testing of ex-plant materials				
(b)(5)	Total (Task 2)		[]	[]	(b)(5)
(b)(5)	3 Participate in relevant domestic and international activities	FY 18-21	[] year []	[]	(b)(5)
(b)(5)	4 Develop documentation evaluating significant technical issues germane to the review of SLR applicationsPrepare annual report documenting results from Tasks 1-3	FY 18-21	[] year []		
(b)(5)	5 Develop documentation evaluating significant technical issues germane to the review of SLR applicationsProvide expert technical assistance with reviewing documents for SLR, including topical reports	FY 18-21	[] year []		
(b)(5)	Total (Tasks 1-4, over 4 years)		[]	[]	(b)(5)

From: [Smith, Jean](#)
To: [Hiser, Matthew](#)
Subject: [External_Sender] RE: [External] RE: Ex-plant Materials Harvesting Workshop Presentations
Date: Friday, March 3, 2017 9:02:12 AM
Attachments: [Lessons Learned from Zorita Crystal River JSmith.pdf](#)

Matt,

Please note the minor change to the title. I've included some information on the cable harvesting from Crystal River.

Thanks,
Jean

From: Hiser, Matthew [mailto:Matthew.Hiser@nrc.gov]
Sent: Wednesday, March 1, 2017 8:45 AM
To: Bernhoft, Sherry <sbernhof@epri.com>; Dyle, Robin <rdyle@epri.com>; Smith, Jean <jmsmith@epri.com>; Ahluwalia, Kawaljit <kahluwal@epri.com>; 'Richard Reister (Richard.Reister@nuclear.energy.gov)' <Richard.Reister@nuclear.energy.gov>; 'leonardk@ornl.gov' <leonardk@ornl.gov>; 'Rosseel, Thomas M.' <rosseeltm@ornl.gov>; 'William F Zipp (Generation - 4)' <william.f.zipp@dom.com>; 'Gerard P. Van Noordennen' <gpvan Noordennen@energysolutions.com>; 'Ramuhalli, Pradeep (Pradeep.Ramuhalli@pnnl.gov)' <Pradeep.Ramuhalli@pnnl.gov>; 'daniel.tello@canada.ca' <daniel.tello@canada.ca>; 'Uwe.Jendrich@grs.de' <Uwe.Jendrich@grs.de>; 'rachid.chaouadi@sckcen.be' <rachid.chaouadi@sckcen.be>; 'arait@criepi.denken.or.jp' <arait@criepi.denken.or.jp>; 'alpanfa@westinghouse.com' <alpanfa@westinghouse.com>; Jackson, John Howard <john.jackson@inl.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: [External] RE: Ex-plant Materials Harvesting Workshop Presentations

Dear Presenters:

Thank you for sending presentation titles. I have all but a couple at this point and have attached the updated agenda.

I know many of you are working on finalizing your slides for the workshop (I already have 2 submitted as of today!). Please provide slides by Friday if at all possible. It will be very challenging to load presentations onto the computer via thumb drive the day of the workshop due to NRC computer security restrictions, so sending them in advance is greatly preferred. Again, best options for sending are either email or upload to Google Drive:

<https://drive.google.com/drive/folders/0B5DWMLch5YSXcnpZZ0JOS055QUU?usp=sharing>.

I am looking forward to a productive workshop next week and appreciate your participation. Please let me know if you have any questions or suggestions for the workshop.

Thanks!
Matt

From: Hiser, Matthew
Sent: Thursday, February 23, 2017 9:07 AM
To: Bernhoft, Sherry (<sbernhof@epri.com>) <sbernhof@epri.com>; Dyle, Robin (<rdyle@epri.com>); Jean Smith (<jmsmith@epri.com>) <jmsmith@epri.com>; Ahluwalia, Kawaljit (<kahluwal@epri.com>); Richard Reister (<Richard.Reister@nuclear.energy.gov>) <Richard.Reister@nuclear.energy.gov>; 'leonardk@ornl.gov' <leonardk@ornl.gov>; 'Rosseel, Thomas M.' <rosseeltm@ornl.gov>; 'William F Zipp (Generation - 4)' <william.f.zipp@dom.com>; 'Gerard P. Van Noordennen'

<gpvan Noordennen@energysolutions.com>; Ramuhalli, Pradeep (Pradeep.Ramuhalli@pnnl.gov)
<Pradeep.Ramuhalli@pnnl.gov>; 'daniel.tello@canada.ca' <daniel.tello@canada.ca>;
'Uwe.Jendrich@grs.de' <Uwe.Jendrich@grs.de>; 'rachid.chaouadi@sckcen.be'
<rachid.chaouadi@sckcen.be>; 'arait@criepi.denken.or.jp' <arait@criepi.denken.or.jp>;
'alpanfa@westinghouse.com' <alpanfa@westinghouse.com>; Jackson, John Howard
<john.jackson@inl.gov>; desire.ndomba@canada.ca

Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

Subject: RE: Ex-plant Materials Harvesting Workshop Presentations

Dear Presenters:

Friendly reminders:

- Please provide presentation title by February 28.
- Please send me your slides (either via email or upload to Google Drive:
<https://drive.google.com/drive/folders/0B5DWM1Ch5YSXcnpZZ0JOS055QUU?usp=sharing>)
by March 3.

I have attached the workshop agenda to this email. Please let me know if you have any questions or corrections.

Thanks!

Matt

From: Hiser, Matthew

Sent: Wednesday, February 15, 2017 10:47 AM

To: Bernhoft, Sherry (sbernhof@epri.com) <sbernhof@epri.com>; Dyle, Robin <rdyle@epri.com>;
Jean Smith (jmsmith@epri.com) <jmsmith@epri.com>; Ahluwalia, Kawaljit <kahluwal@epri.com>;
Richard Reister (Richard.Reister@nuclear.energy.gov) <Richard.Reister@nuclear.energy.gov>;
'leonardk@ornl.gov' <leonardk@ornl.gov>; 'Rosseel, Thomas M.' <rosseeltm@ornl.gov>; 'William F
Zipp (Generation - 4)' <william.f.zipp@dom.com>; 'Gerard P. Van Noordennen'
<gpvan Noordennen@energysolutions.com>; Ramuhalli, Pradeep (Pradeep.Ramuhalli@pnnl.gov)
<Pradeep.Ramuhalli@pnnl.gov>; 'daniel.tello@canada.ca' <daniel.tello@canada.ca>;
'Uwe.Jendrich@grs.de' <Uwe.Jendrich@grs.de>; 'rachid.chaouadi@sckcen.be'
<rachid.chaouadi@sckcen.be>; 'arait@criepi.denken.or.jp' <arait@criepi.denken.or.jp>;
'alpanfa@westinghouse.com' <alpanfa@westinghouse.com>

Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

Subject: Ex-plant Materials Harvesting Workshop Presentations

Dear Harvesting Workshop Presenters:

If you are receiving this email, then I have you down on the agenda to present at the upcoming Ex-plant Materials Harvesting Workshop on March 7-8. I have attached the workshop introduction slides that have been shared with most, if not all, of you. These slides cover meeting logistics, motivation, approach, expected outcome, and session expectations. We are hoping these slides provide a common vision for the workshop that will allow for a focused, productive discussion. Please take a look at these slides and try to tailor your presentation to the focus and length of the respective session.

There are two actions I request from presenters:

1. I have attached the confirmed list of speakers in an Excel document. Please take a look at this list to confirm you are presenting in the session you expected and if I have made any mistakes in the list of speakers. If you have not already done so, please provide me with a presentation title.

2. Please send me your slides (either via email or upload to Google Drive:

<https://drive.google.com/drive/folders/0B5DWMLch5YSXcnpZZ0JOS055QUU?usp=sharing>)

by the end of February if possible.

Thank you for your participation in the workshop. We are looking forward to the discussion and engagement and appreciate your contribution to a productive and interesting meeting!

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

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A collage of images related to nuclear energy and safety. The collage features several triangular and rectangular frames containing various scenes: large yellow cooling towers emitting white steam, a power plant with a tall lattice tower, a person in a white lab coat working on a computer, a person in a white lab coat working on a computer, a person in a white lab coat working on a computer, and a person in a white lab coat working on a computer. The images are arranged in a grid-like pattern with some overlapping.

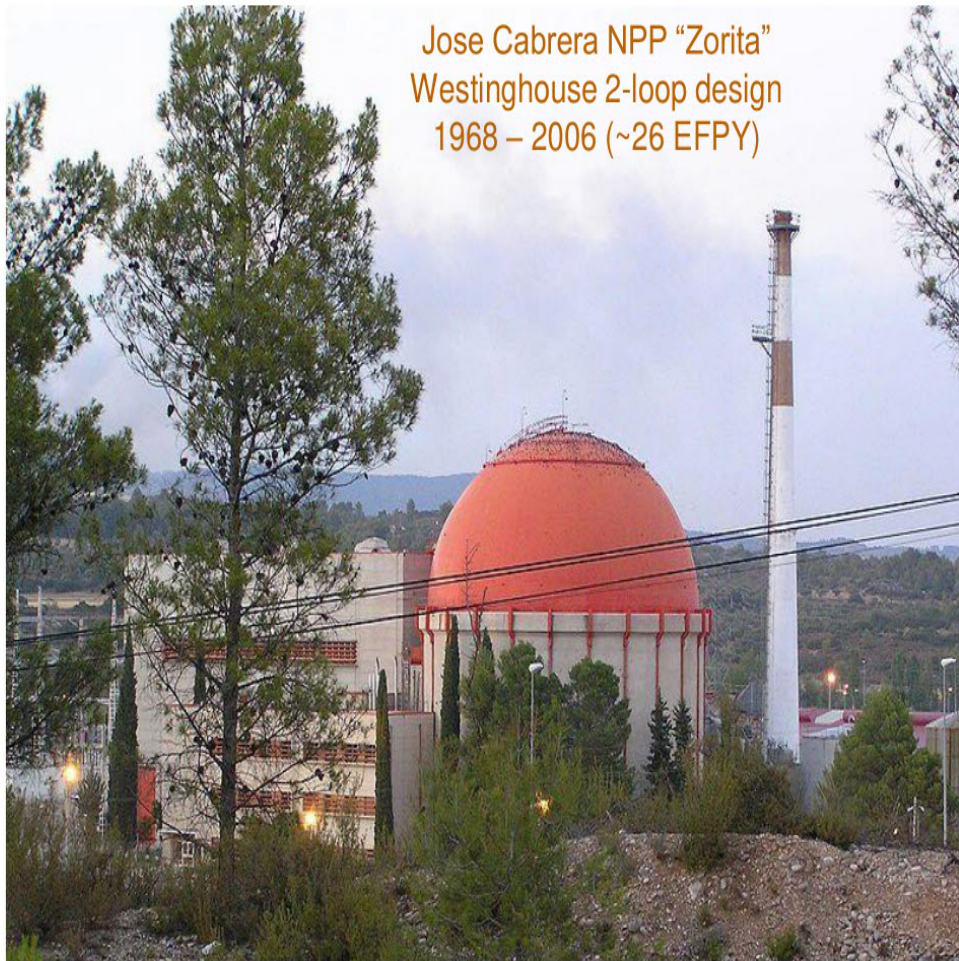
EPRI Primary Systems Corrosion Research
Principal Technical Leader

March 7-8, 2017

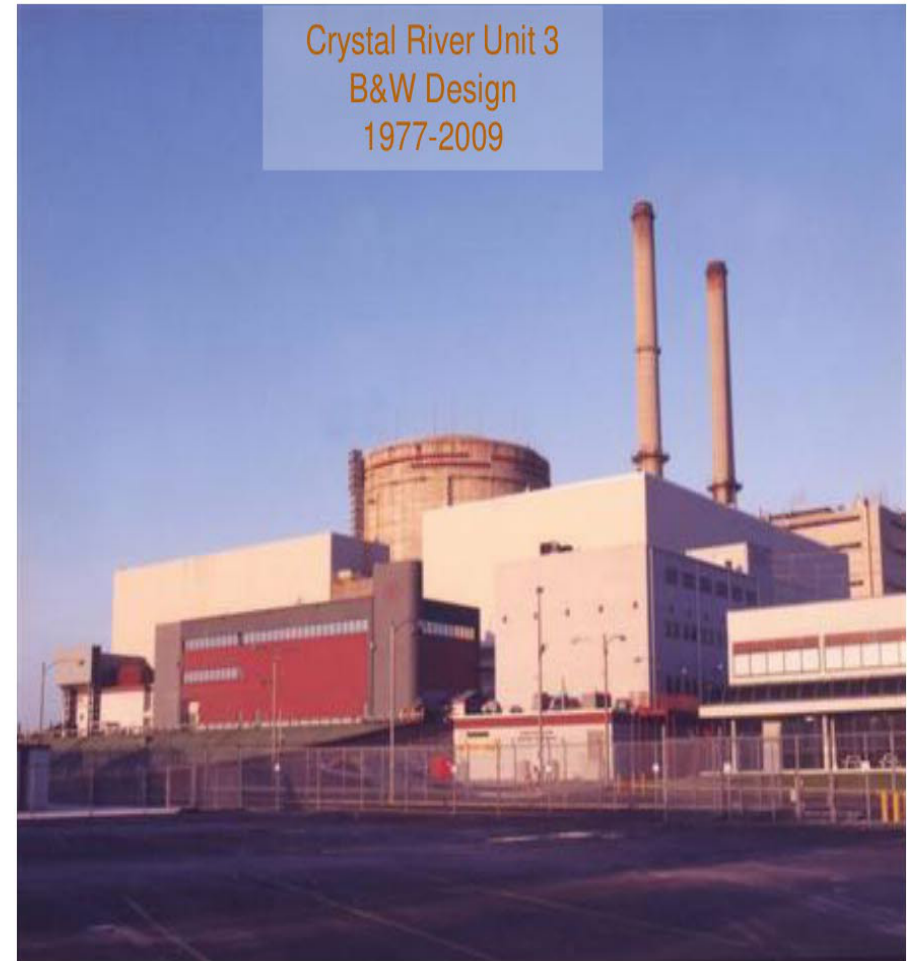
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EPRI Harvesting Projects

Zorita Internals Research Project
Zorita Biological Shield Concrete Harvesting



Crystal River Cable Harvesting



Zorita Internals Research Project Timeline

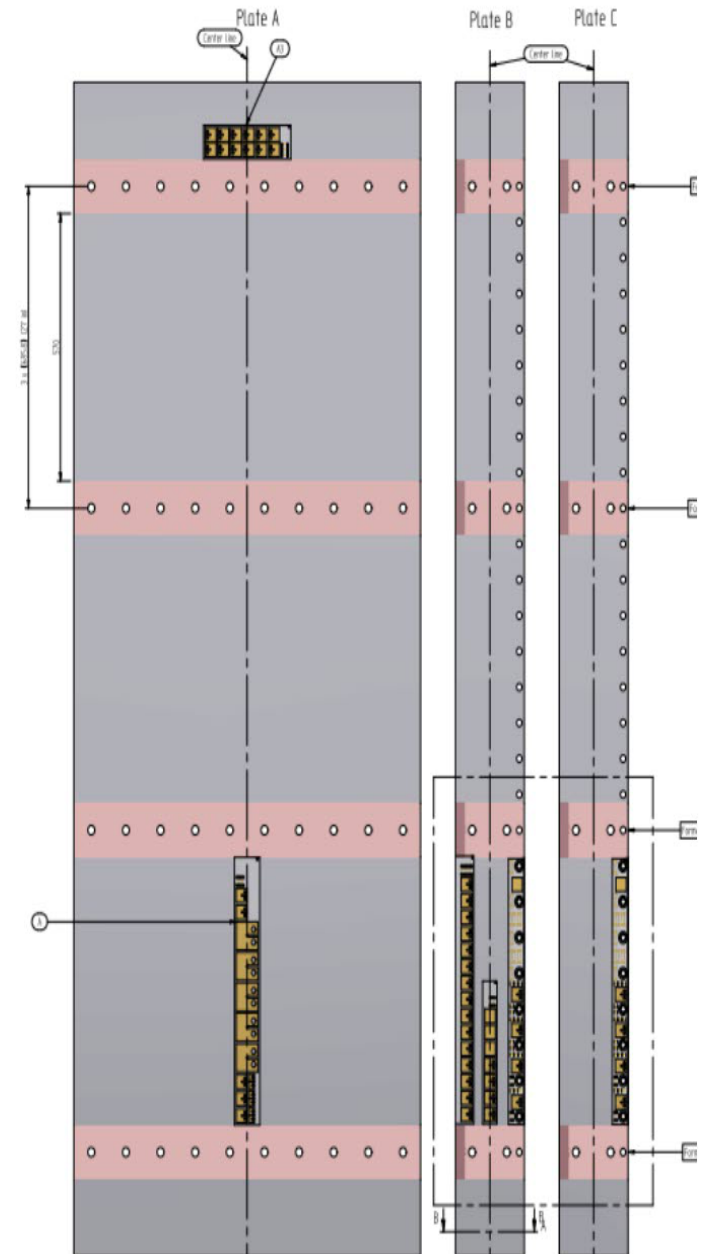
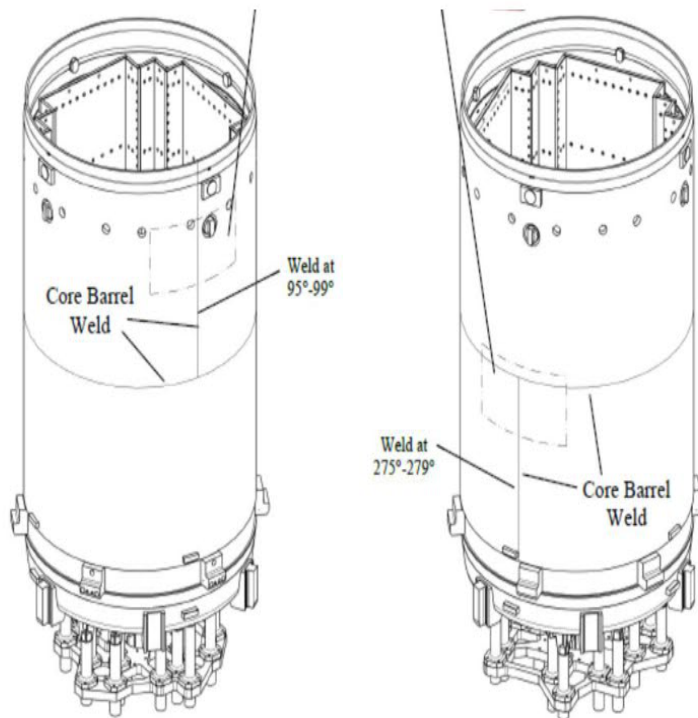
Harvesting projects take time

- Extensive effort on the front end of the project
- Testing represents a minority portion of the project timing

Task	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Project Inception	★										
Feasibility Study											
Project Planning											
Cutting Plans											
Equipment Design & Manufacturing											
On-site Preparations											
Material Extraction											
On-site Logistics											
Shipping											
Radiation and Temperature Analyses											
Material Inspection, Inventory, Documentation											
Materials Testing											
Reporting											★

Zorita Internals Research Project

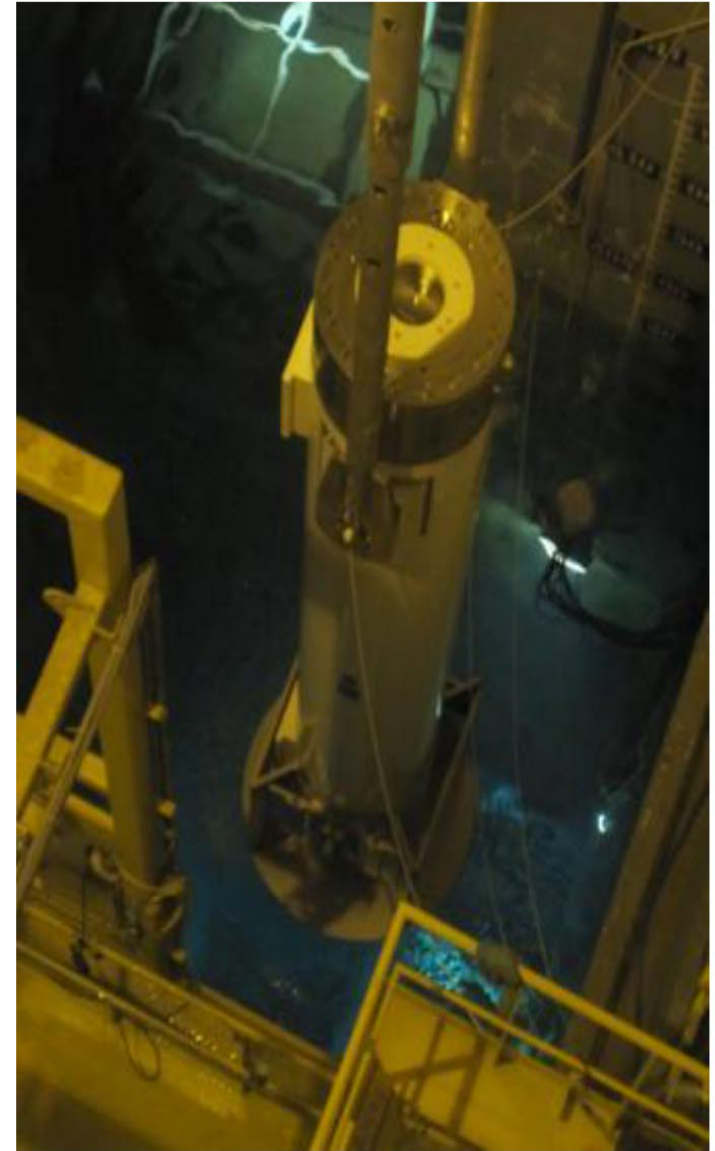
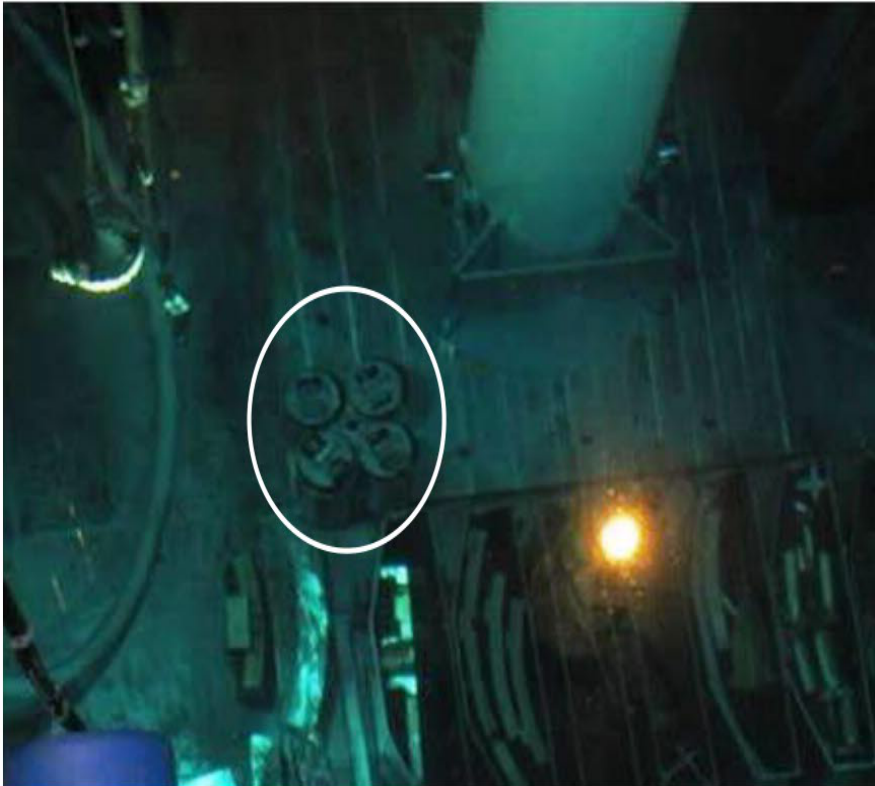
- Baffle plate and core barrel weld materials
- Type 304 stainless steel
- Doses ranging from 1-2 dpa (welds) to ~50 dpa
- Pieces 12-25" long x 2" wide x 1" thick



Zorita Internals Research Project

Material Retrieval Challenges

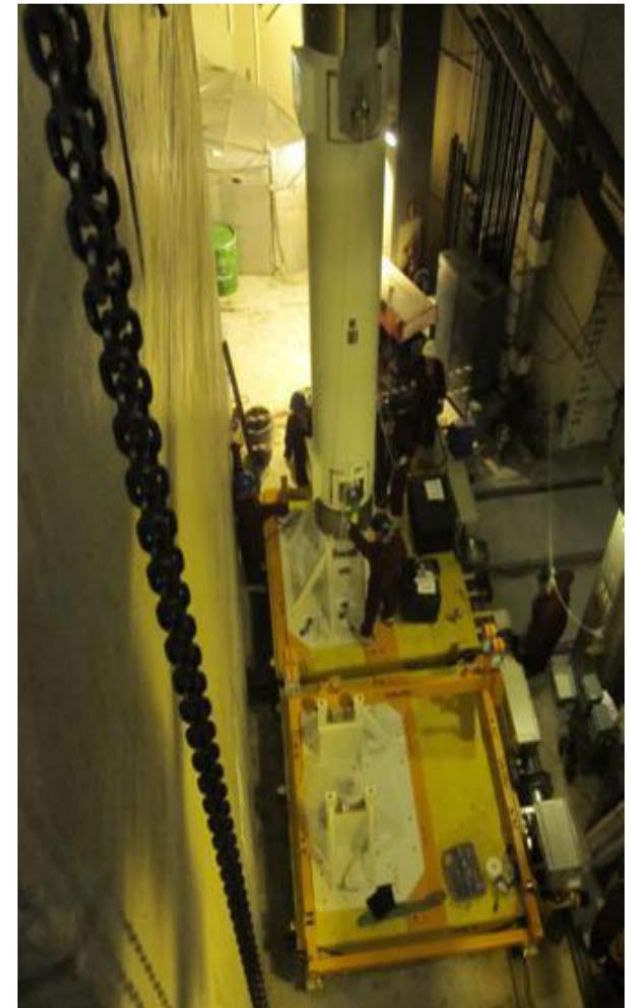
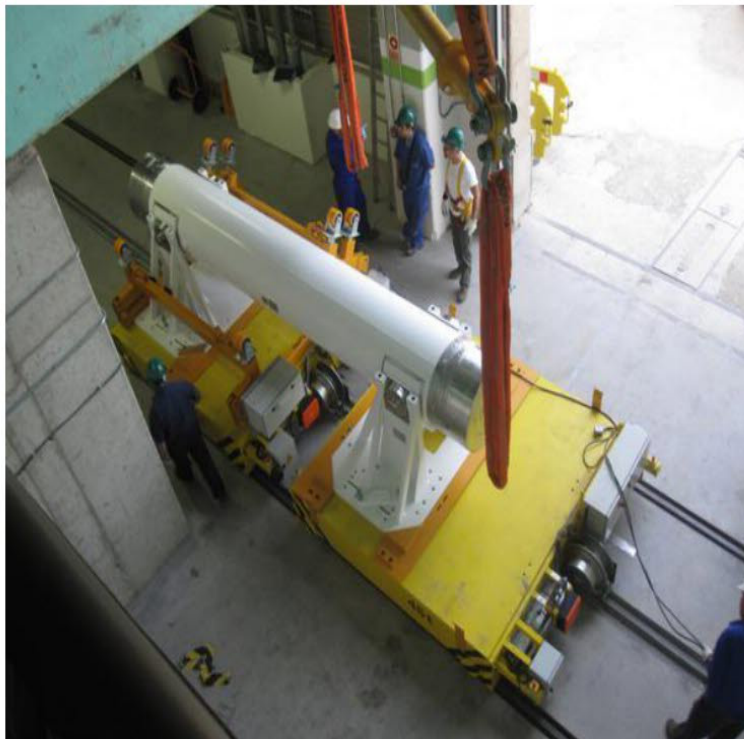
- Decommissioning activities were top priority
- Harvesting tasks could not impact critical path
- Highly-active materials required special handling & equipment
- On-site coordinator was essential and valuable



Zorita Internals Research Project

On-Site Challenges

- Newly designed equipment required extensive modeling to ensure clearances throughout containment for all maneuvers
- Three-dimensional simulations used to map all areas and activities



Zorita Internals Research Project

Shipping Issues

- Highly-active materials required fuel-type shipping container
- Changes to shipping dates needed to be accommodated
- Approvals required from numerous authorities in multiple countries



Zorita Internals Research Project

Shipping Issues



Zorita RI materials (and other materials such as flux thimble tubes) have been classified as

WASTE

Zorita Internals Research Project

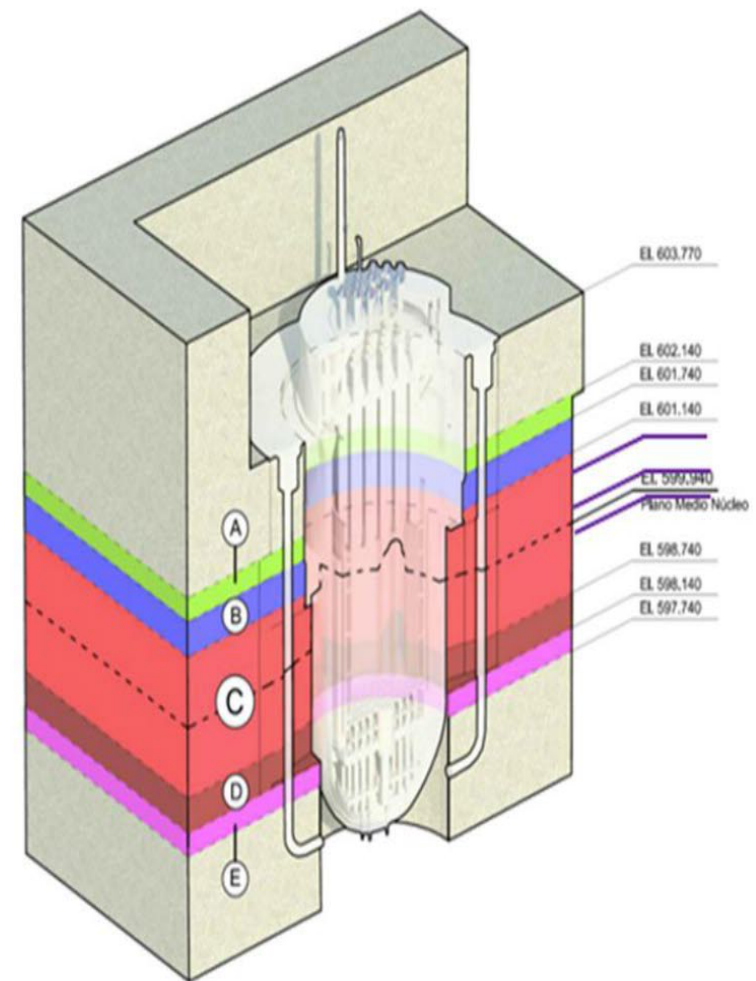
The Bright Side

- Excellent cooperation between many international organizations
 - Contractors
 - Engineering firms
 - Regulators
- Zorita reactor internals currently included in multiple projects
 - EPRI MRP, BWRVIP, PSCR
 - U.S. NRC



Zorita Biological Shield Concrete Harvesting

- Large blocks of the Zorita concrete biological shielding have been removed from the reactor cavity
 - Core samples at variable elevations from the beltline (maximum neutron flux) were extracted from the blocks
 - Samples have a range of neutron exposure
 - Maximum fluence expected to be $\sim 10E19$ n/cm² ($E > 1$ MeV)
- Core samples broke apart during extraction drilling
 - Affects how the mechanical properties will be characterized
- Samples are contaminated and must be stored and tested appropriately
 - ENRESA will be performing characterization of the radioactive samples.
- Procedure for extracting the cores was successful and may be applied in the future to other plants undergoing decommissioning



Crystal River Cable Harvesting Lessons Learned

Material Concerns

- Cable availability is not unlimited
- Systems must be “retired” before cables can be harvested
- Widespread, fixed contamination (>2000 counts) of desired cables in containment resulted in them not being used for research
- Cable jackets and fillers had asbestos
 - Increased harvesting/handling cost
 - Usability concerns of labs had to be addressed



Crystal River Cable Harvesting Lessons Learned

Utility and Site Support

- Site engineers have “local” knowledge and access to information
 - Cable availability
 - Service conditions (temperature and radiation levels)
 - Design data
 - Manufacturer’s test reports
- Site staff support required
 - Work package planning
 - Craft support for harvesting cables
 - Rad-worker and Operations support for craft
- Interfacing with a site from a distance is inefficient
 - No control over priorities, availability of site support
 - Communications with hired support sometimes are miscommunications
 - Sometimes you just need to see things for yourself



Crystal River Cable Harvesting Lessons Learned

Harvesting is Expensive!

- (b)(4)
- Project Management Time (EPRI)
 - Interface with site engineering and research partners to evaluate and select cables to be harvested
 - Site visit to walkdown cables
 - Distributing cables to labs
- Harvesting cost
 - Utility picked up cost initially
 - Engineers, planners
 - Lead site engineer left in middle of project
 - Engineering support over 6 months (not full-time, but close)
 - Planning, maintenance craft, other support





Together...Shaping the Future of Electricity

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.

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 to prioritize limited resources to provide best value for harvesting. The database is not an end unto itself, but the means to pursue high 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: 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.

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: 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
NRR-2017-001 ML16300A303 ✓ RES Response to NRR-2017-001 ML17110A202 ✓	Request for Assistance to Evaluate Irradiation-Assisted Degradation of Rx Vessel Internals	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. 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: (b)(5) FY17: (b)(5) FY18: (b)(5) (b)(5) and FY19: (b)(5) FTEs: FY17: (b)(5) FY18: (b)(5) and FY19: (b)(5)
NRR-2014-007 ML14126A818 ✓ RES Response to NRR-2014-007 ML14212A127 (package) ✓	Reactor Pressure Vessel Integrity Issues	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. Funding: (b)(5) FY15: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FTEs: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5)
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	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. Accelerated aging of the cable samples is expected to commence toward the end of FY2017. The amendment extends the cable testing period up to 80 years (up from 60 years in the previous UNR). Funding: (b)(5) Prior FY total: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5) FTEs: Prior FY total: (b)(5) FY18: (b)(5) FY19: (b)(5) FY20: (b)(5)
NRR-2012-004 ML12109A324 ✓ RES Response to NRR-2012-004 ML12152A107 ✓	Alkali-Silica Reaction (ASR) Research	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) FY14: (b)(5) FY15: (b)(5) FY16: (b)(5) FY17: (b)(5) FTEs: FY14: (b)(5) FY15: (b)(5) FY16: (b)(5) FY17: (b)(5)
NRR-2015-007 ML15076A217 ✓ RES Response to NRR-2015-007 ML15229A100 ✓	Effects of Irradiation on Concrete Structures	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 Funding: (b)(5) FY16: (b)(5) FY17: (b)(5) FY18: (b)(5) FTEs: FY16: (b)(5) FY17: (b)(5) FY18: (b)(5)

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 FTE/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	[]/year	[] for FY 18 and FY 21 []	(b)(5) (b)(5) (b)(5) (b)(5) (b)(5)
Total (Task 1)			[]	[]	(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 []		(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		(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	[]/year []	[] (total for 4 years IFRAM dues)	(b)(5) (b)(5) (b)(5)
4	Develop documentation evaluating significant technical issues germane to the review of SLR applications	FY 18-21	[]/year []		(b)(5) (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	(b)(5)
Total (Tasks 1-4, over 4 years)			[]	[]	(b)(5)

¹ Note that the resources associated with this UNR include RES/DE/SGSEB (b)(5) FTE/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: Portions of this record are redacted under FOIA Exemption 3, Federal statute 41 U.S.C. §253b(m)(1) to protect contractor proposal information that has not been set forth or incorporated by reference into the final contract.



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August 6, 2015

Michael Turner
Contracting Officer
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Turner:

Subject: Proposal for Agreement Number NRC-HQ-25-14-D-0001, “Technical Assistance in Support of Agency Environmental Reactor Programs”, Task Order No. NRC-HQ-60-15-T-0023 “Strategic Approach for Obtaining Material and Components Aging Information”, under EWA No. 65559

Our cost proposal for the work statement for Pacific Northwest National Laboratory (PNNL) Project No. 66419, Task Order No. NRC-HQ-60-15-T-0023, “Strategic Approach for Obtaining Material and Components Aging Information”, under EWA 65559, NRC Agreement Number NRC-HQ-25-14-D-0001 “Technical Assistance in Support of Agency Environmental Reactor Programs” is attached. The cost proposal covers the cost of the labor and expenses associated with the work statement included in your request for proposal (RFP) dated July 22, 2015. Critical to this effort is a scoping study (Task 1) that reviews relevant literature to identify and assess the needs with respect to SLR, based on which a gaps assessment and additional research to address key gaps (Optional Tasks 2-4) are defined. PNNL staff will use their technical knowledge and experience to propose additions, deletions, or deviations from the proposed research plan as research progresses, to address any emergent issues. The work plan for Tasks 2-4 is expected to evolve, depending on the findings from Task 1.

Ms. Eva Eckert Hickey is the PNNL Program Manager for the EWA and Dr. Pradeep Ramuhalli is the Task Project Manager.

This task proposal includes the cost proposal for Task No. NRC-HQ-60-15-T-0023 (attachment 1), the schedule of deliverables (attachment 2), a proposed staffing plan (attachment 3), and Conflict of Interest Information (attachment 4). Upon request from NRC, the professional qualifications for staff that have previously been submitted will be resubmitted.

The proposed period of performance for this task order is September 1, 2015 – August 31, 2019.

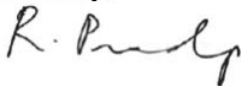
PNNL, to the best of its knowledge and belief, asserts that it has no current work, planned work, and where appropriate, past work for DOE and others (to mean - organizations in the same and/or similar technical area as the present and/or ongoing NRC project scope of work); and PNNL hereby asserts that it is not aware of any same/similar technical work that would give rise to any potential OCOI as defined in the Atomic Energy Act of 1954, as amended, and in the NRC/DOE MOU. See Attachment 4 for disclosed projects.

Consistent with DOE's full cost recovery policy, DOE collects, as part of its standard indirect cost rate, a Laboratory Directed Research and Development (LDRD) cost levied on all monies received at the laboratory. The estimated amount of LDRD costs is identified in the proposal cost estimate section. DOE believes that LDRD efforts provide opportunities in research that are instrumental in maintaining cutting edge science capabilities that benefit all of the customers at the laboratory.

DOE will conclude that by approving and providing funds to DOE to perform the work under this proposal, you acknowledge that such activities are beneficial to your organization and consistent with appropriations acts that provide funds to you. Please note that the LDRD costs do not represent a new charge. Rather, the new Congressional requirement is for DOE to separately identify this indirect cost element.

If you have any questions, feel free to contact me at 509-375-2763.

Sincerely,



Dr. Pradeep Ramuhalli
Task Project Manager
Applied Physics Group
Pacific Northwest National Laboratory

cc w/attach: Lori Bisping, PNNL
Eva Hickey, PNNL
Matthew Hiser
Amy Hull, NRC
Tonya Keller, PNNL
Katie Knobbs, PNNL
Steve Schlahta, PNNL
Steve Unwin, PNNL

ATTACHMENT 1 - COST PROPOSAL

PART 1: DOE Laboratory Cost and Technical Proposal for NRC Work Cover Sheet			Date Proposal Sent: August 2015	
			X	New
			Revision No. _____	
Project Title: Strategic Approach for Obtaining Material and Components Aging Information			DOE Contractor Account Number	
NRC Requisitioning Office: Office of Nuclear Regulatory Research			NRC Agreement Number: NRC-HQ-25-14-D-0001	
DOE Laboratory: Pacific Northwest National Laboratory			NRC Agreement Modification Number:	
DOE Site Address: Richland, WA			NRC Task Order Number: NRC-HQ-60-15-T-0023	
COGNIZANT PERSONNEL	E-MAIL ADDRESS	TELEPHONE NUMBER	NRC Task Order Modification Number:	
NRC COR: Amy B. Hull	amy.hull@nrc.gov	301-251-7656	NRC Common Cost Center Code	
Other NRC Staff: Matthew Hiser	matthew.hiser@nrc.gov	301-251-7601	NRC B&R Number:	
DOE Project Manager: Jeffrey W. Day	jeffrey.day@pnso.science.doe.gov	509-372-4629	NRC BOC	
Laboratory Project Manager: Pradeep Ramuhalli	pradeep.ramuhalli@pnnl.gov	509-375-2763	PERIOD OF PERFORMANCE	
Principal Investigator(s): Pradeep Ramuhalli Katie Knobbs	pradeep.ramuhalli@pnnl.gov katie.knobbs@pnnl.gov	509-375-2763 509-372-4560	Estimated Start Date: September 1, 2015	
			Estimated End Date: August 31, 2019	
PROPOSED COST BY FISCAL YEAR				
(b)(3):41 U.S.C. § 253b(m)(1)				
Signature - Approval Authority			Date	
Approval Authority - Name, Email and Phone				

NOTE: OPTIONAL TASKS 2-4 ARE INCLUDED IN THIS COST PROPOSAL

PART 2: TOTAL PROPOSED COST BREAKDOWN				
NRC Requisition Number	NRC Agreement Number: NRC-HQ-25-14-D-0001	NRC Agreement Modification Number	NRC Task Order Number NRC-HQ-ED-19-7-0023	NRC Task Order Modification Number
Project Title: Strategic Approach for Obtaining Material and Components Aging Information				
(b)(3):41 U.S.C. § 253b(m)(1)				

PART 3: SPENDING PLAN				
	NRC Agreement Number: NRC-HQ-25-14-D-0001	NRC Agreement Modification Number	NRC Task Order Number: NRC-HQ-60-15-T-0023	NRC Task Order Modification Number
Project Title: Strategic Approach for Obtaining Material and Components Aging Information				

(b)(3):41 U.S.C. § 253b(m)(1)

Project Title: Strategic Approach for Obtaining Material and Component Aging Information

NRC Task Order Number: NRC-HQ-60-15-T-0023

Task 1	Scoping Study and technical literature review
Task 2 - Option	Decision Making on Specific Confirmatory Research Needed to Address Gaps
Task 3 - Option	Confirmatory Research Addressing Technical Gaps
Task 4 - Option	Development of Independent Decision Making Tools
Task 5	Project Management
SUM ALL	
Options Only (highlighted in Blue)	

(b)(3):41 U.S.C. § 253b(m)(1)

COST ELEMENT INFORMATION

(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41 U.S.C. § 253b(m)(1)

ATTACHMENT 2

NRC Agreement Task Order No.: NRC-HQ-60-15-T-0023 - Proposal

Strategic Approach for Obtaining Material and Components Aging Information

As requested in the Statement of Work for Task Order No. NRC-HQ-60-15-T-0023, the scope is provided below.

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	NRC-HQ-60-15-T-0023	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 checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Proprietary Information <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.

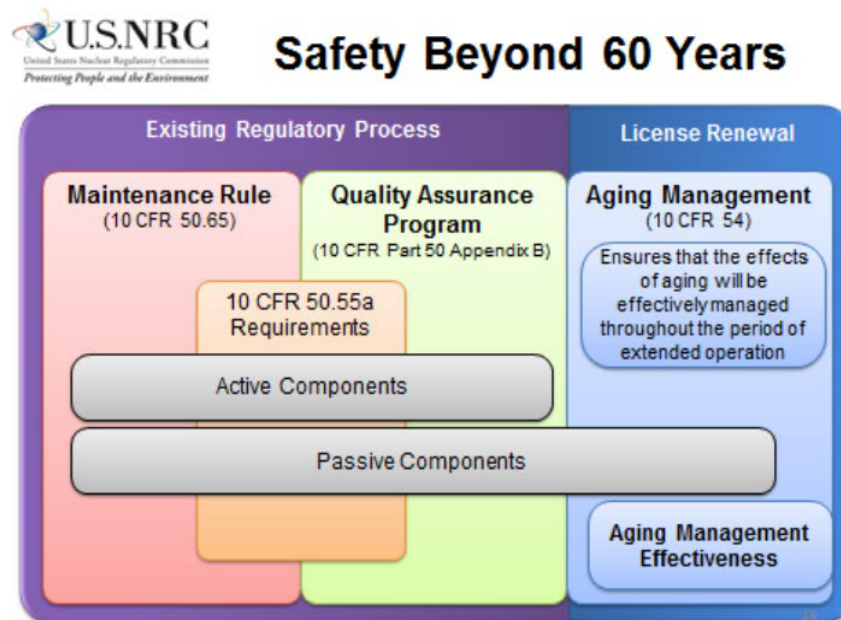


Figure 1: Relationship between aging management of active and passive components (from NRR/RES presentation to ACRS, 2014)

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.

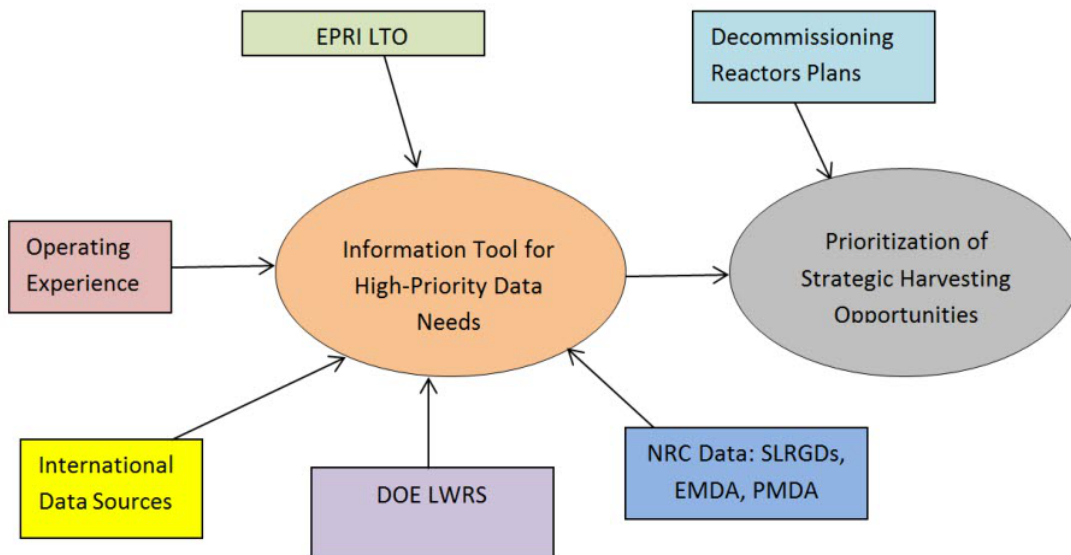


Figure 2: Pre-conceptual Architecture of prognostic tool to track and resolve critical technical issues for SLR

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.

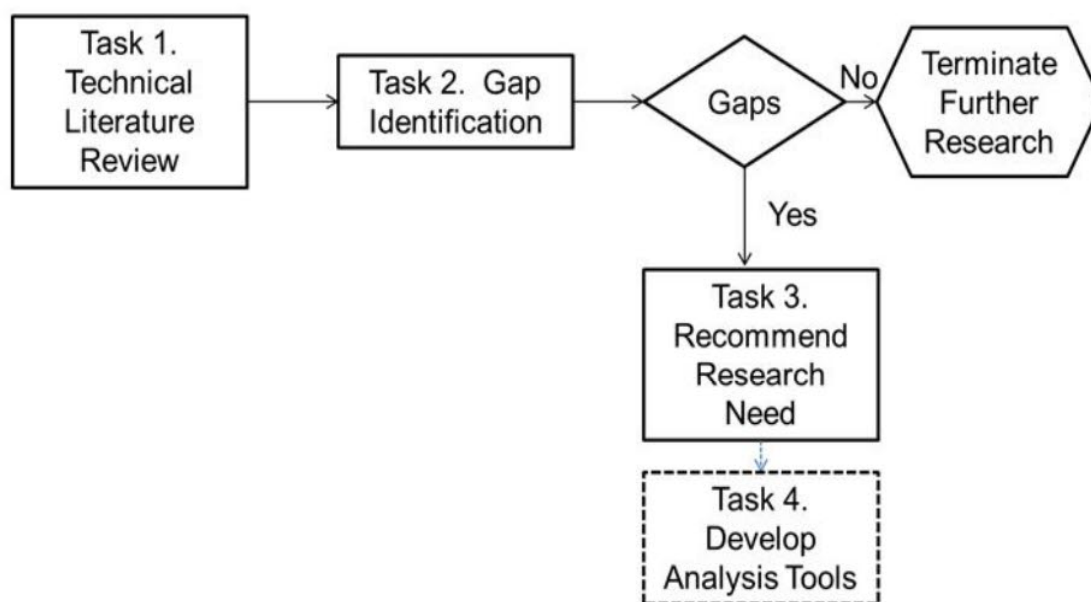


Figure 3: Schematic of the Overall Research

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:

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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.

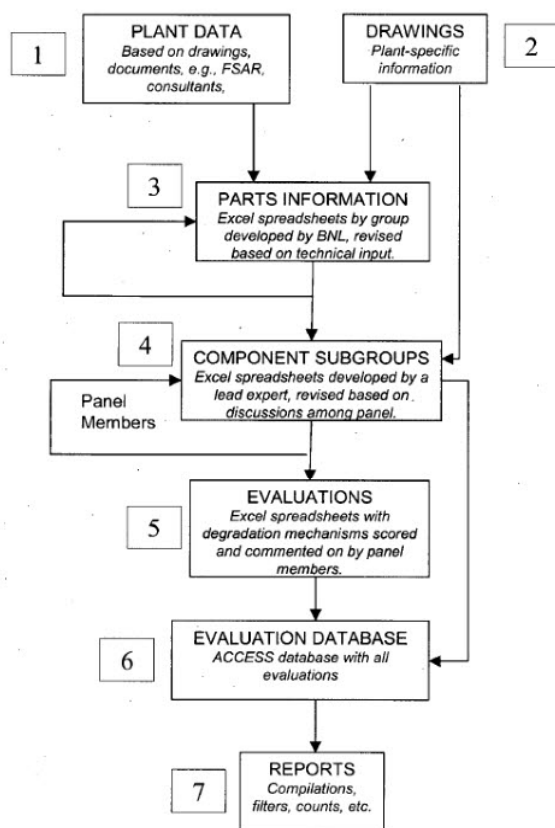


Figure 4. Flowchart for files created and used in PMMD infotool

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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).

(b)(3):41 U.S.C. § 253b(m)(1)

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).

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

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 [] months after contract award	(b)(3):41 U.S.C. § 253b(m)(1)
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. (b)(3):41 U.S.C. § 253b(m)(1)	NLT 1 month after receiving NRC comments	
(b)(3):41 U.S.C. § 253b(m)(1)	1.2 PNNL to provide Report 1.2. Draft TLR to NRC on [] concerning availability of ex-plant material and information []	NLT [] months after contract award	(b)(3):41 U.S.C. § 253b(m)(1)
(b)(3):41 U.S.C. § 253b(m)(1)	[] (b)(3):41 U.S.C. § 253b(m)(1)		
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	
(b)(3):41 U.S.C. § 253b(m)(1)	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	
(b)(3):41 U.S.C. § 253b(m)(1)	PNNL to provide Report [] 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	
	NRC to provide comments to contractor on Report [] 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	(b)(3):41 U.S.C. § 253b(m)(1)

Note to requester: The crossed out content on this page is in the final version of the contract (public at ML19129A329), but in the final version it is not crossed out.

(b)(3):41 U.S.C. § 253b(m)(1)

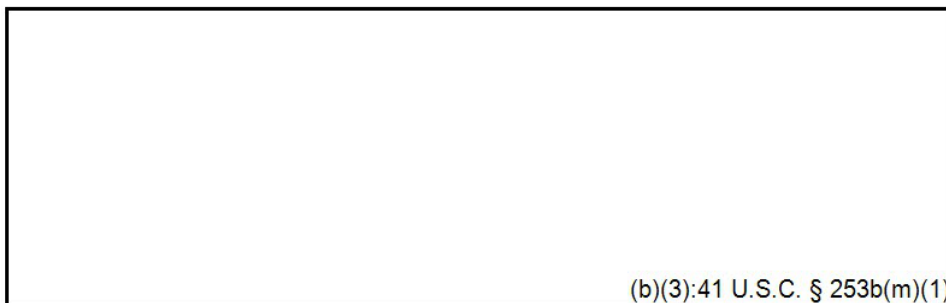
(b)(3):41 U.S.C. § 253b(m)(1)	Summary Report 1.6. Draft [] to NRC including information from Reports 1.1 through 1.5.2. (Note: At the discretion of COR, a decision may also be made to publish Summary Report 1 as a TLR rather than as an NUREG/CR, depending on the significance of the literature review and research assessment results).	NLT 20 months after contract award
	The Contractor will make a technical presentation to the NRC staff on Summary Report [] at NRC Headquarters in Rockville, MD. (b)(3):41 U.S.C. § 253b(m)(1)	When the draft Summary Report [] is delivered to NRC.
	NRC to provide comments to contractor on Summary Report [] (b)(3):41 U.S.C. § 253b(m)(1)	NLT 2 months after receiving draft Summary Report [] from PNNL
	DOE Contractor to publish Summary Report [] as [] 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, [] (b)(3):41 U.S.C. § 253b(m)(1)	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

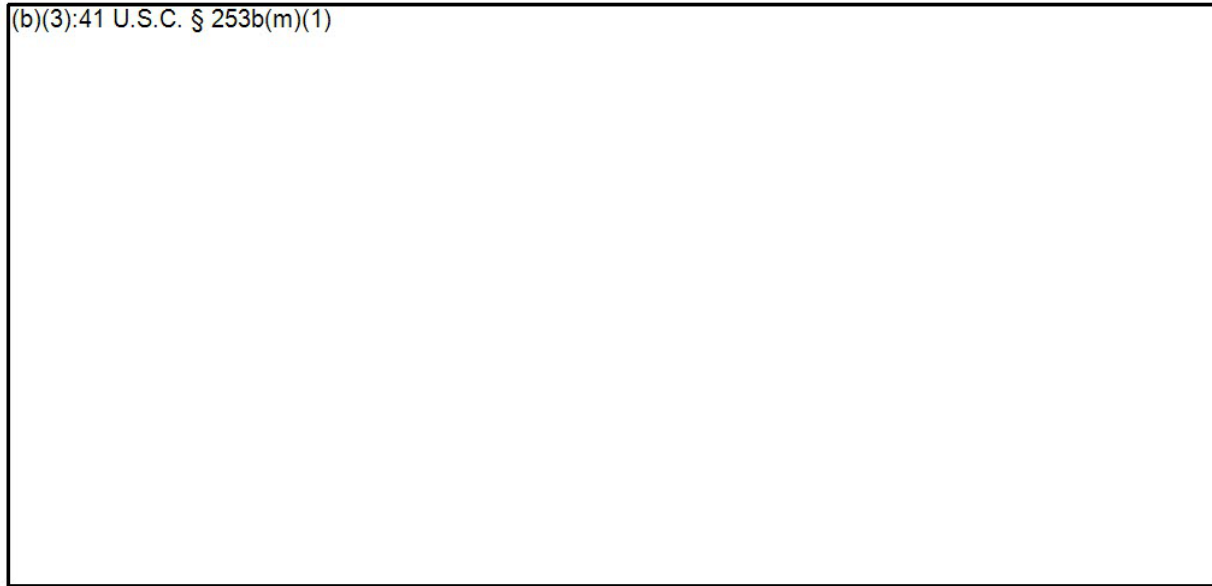
Specific qualifications for this effort include senior materials engineers and metallurgists who have in-depth knowledge of reactor pressure vessel and core internal materials subjected to irradiation and stress at elevated temperature, and effects of water chemistry on structural reactor materials. 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.



(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41 U.S.C. § 253b(m)(1)



(b)(3):41
U.S.C. § 253b
(m)(1)



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.

(b)(3):41 U.S.C. § 253b(m)(1)



(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41
U.S.C. § 253b
(m)(1)

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.

(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41 U.S.C. § 253b(m)(1)



PERIOD OF PERFORMANCE

(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41
U.S.C. § 253b
(m)(1)



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

(b)(3):41
U.S.C. § 253b
(m)(1)



MATERIALS REQUIRED

N/A

(b)(3):41 U.S.C. § 253b(m)(1)

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(b)(3):41
U.S.C. § 253b
(m)(1)



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.

(b)(3):41 U.S.C. § 253b(m)(1)

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RESEARCH QUALITY

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.



STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS

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.

(b)(3):41 U.S.C. § 253b(m)(1)

OTHER CONSIDERATIONS

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

N/A

Applicable Publications

N/A


Controls over document handling and non-disclosure of materials

N/A

ATTACHMENT 3 – STAFFING PLAN
NRC Agreement Task Order No.: NRC-HQ-60-15-T-0023

(b)(3):41 U.S.C. § 253b(m)(1)

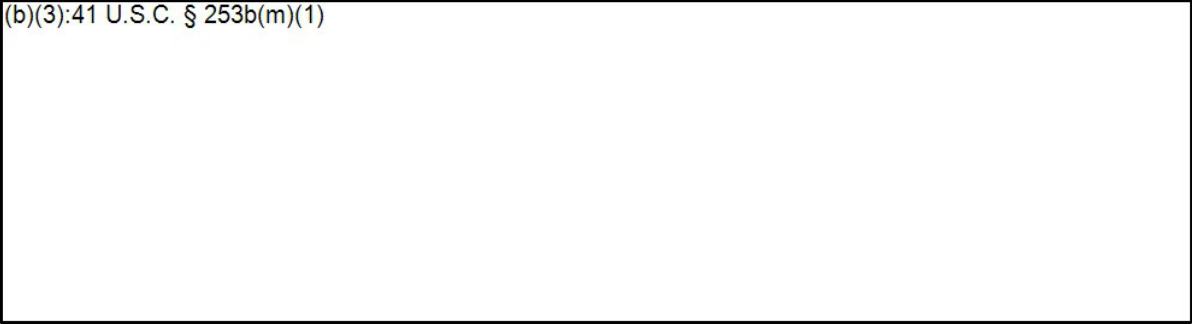
(b)(3):41 U.S.C. § 253b(m)(1)




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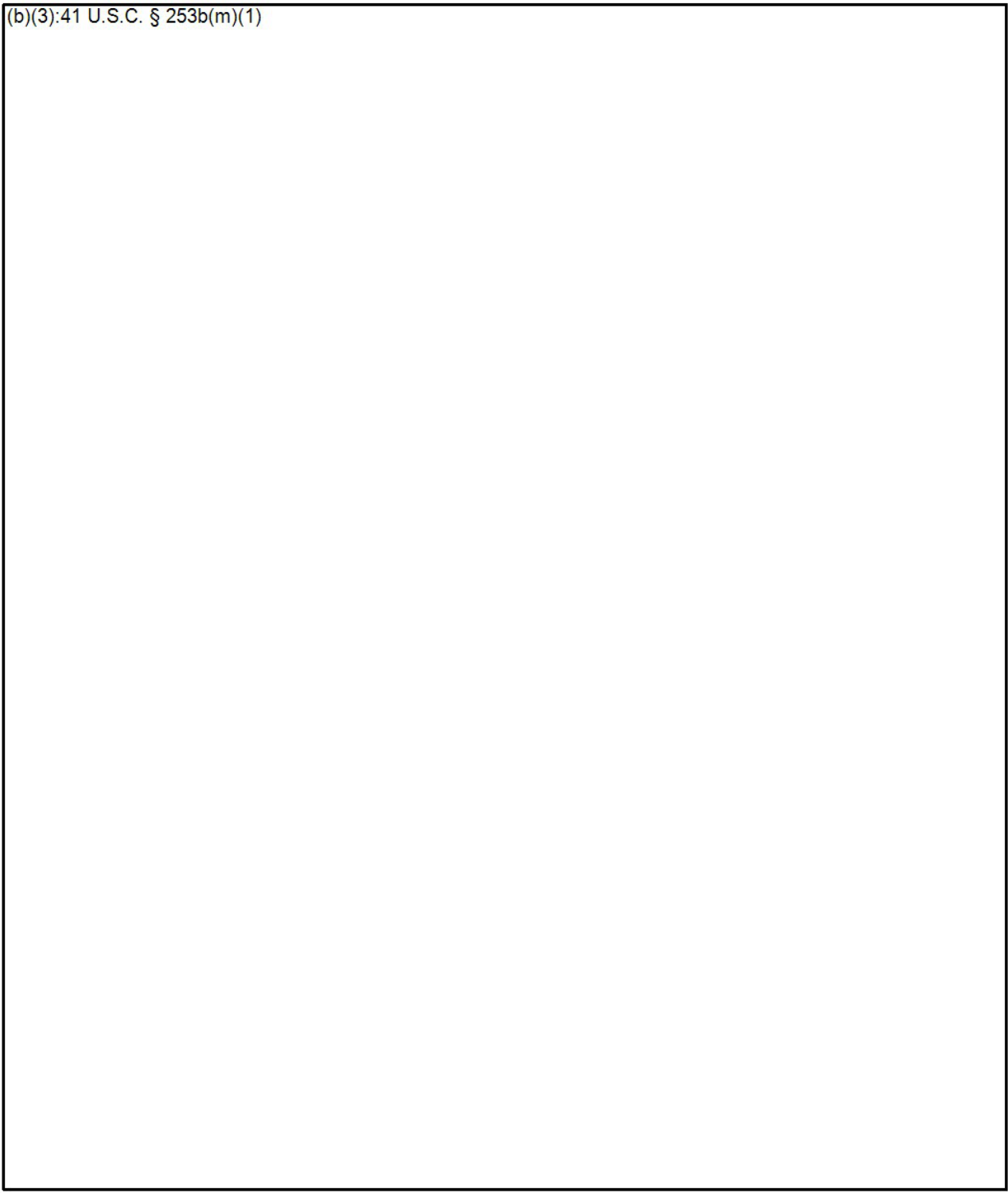
ATTACHMENT 4
NRC Agreement Task Order No.: NRC-HQ-60-15-T-0023

Strategic Approach for Obtaining Material and Components Aging Information

ORGANIZATIONAL CONFLICT OF INTEREST INFORMATION

(b)(3):41 U.S.C. § 253b(m)(1)

(b)(3):41 U.S.C. § 253b(m)(1)



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

From: Hull, Amy
Sent: Tue, 5 Sep 2017 17:41:29 +0000
To: Hiser, Matthew;Purtscher, Patrick
Cc: Moyer, Carol;Frankl, Istvan (Istvan.Frankl@nrc.gov)
Subject: Action: Rewrite in response to Feedback on UNR Response Task 2
Attachments: Final draft - Response to User Need Request NRR-2017-006.docx, UNR NRR-2017-006.pdf, Comments on draft UNR NRR 2017-006.docx

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? 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.
- Why just decommissioned plants? An explanation is required as to why this has been limited in scope.
- 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.
- (b)(5) [redacted] seems like a lot to develop an Excel or Access database. Does this include collecting and inputting information on materials needed and the sources of materials expected to be available? This tasking must be better defined.

Amy B. Hull, Ph.D
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Note to requester: This email, and its attachments (that are immediately following), are the "Final draft- Response to User Need Request NRR-2017-006.docx" attachment from the previous page.

From: Hull, Amy
Sent: Wed, 16 Aug 2017 13:49:38 +0000
To: Brady, Bennett; Stuchell, Sheldon
Cc: Frankl, Istvan (Istvan.Frankl@nrc.gov); Moyer, Carol
Subject: Final draft - Response to User Need Request NRR-2017-006.docx
Attachments: Response to User Need Request NRR-2017-006.docx, SLR UNR response Memo 08-14-2017 cln ML17227A483.docx
Importance: High

Good Morning Sheldon and Bennett,

Attached is the final draft of the SLR UNR response that Steve Frankl asked me to share with both of you. You mentioned yesterday having a meeting tomorrow with DMLR management concerning this work. Please feel free to use the attached documents.

Thanks,
Amy

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 a workshop, conference, symposium, or meeting), one in early autumn 2018 on mechanical issues and one in late spring 2020 on concrete and cables issues. 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, 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. 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.

Mechanical Issues – As part of the requested autumn 2018 workshop/ conference/ symposium/ meeting on mechanical issues, the NRC staff will coordinate a session, or sessions, concerning issues associated with reactor vessel embrittlement 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 quarter of FY20 (spring 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 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 2020.

Enclosure

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, 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 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 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.

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.

As an example, RES will develop a process to evaluate 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 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 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, 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.

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 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 [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.

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, 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 \$
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) [] year (b)(5)	[] for FY 18 (b)(5) and FY 21 [] (b)(5)
Total (Task 1)			[]	[] (b)(5)
2	Develop a strategy for harvesting materials/components from decommissioned plants (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) (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)	
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 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.

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 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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ADAMS Package Accession No.: ML17227A483

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DATE	/ /2017	/ /2017	/ /2017

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

May 4, 2017

Note to requester: This record is the "UNR NRR-2017-006" attachment to Amy Hull's 9/5/2017 Email, "Action: Rewrite in response to Feedback on UNR Response Task 2".

MEMORANDUM TO: Michael F. Weber, Director
Office of Nuclear Regulatory Research

FROM: William M. Dean, Director *W. M. Dean*
Office of Nuclear Reactor Regulation

SUBJECT: RESEARCH ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED
OPERATION

The purpose of this memorandum is to request 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.

In a previous user need request, UNR-NRR-2010-006, "Request for Office of Nuclear Regulatory Research Support in Developing Technical Information to Support Evaluating the Feasibility of License Renewal Beyond 60 Years," Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML092470525), the Office of Nuclear Regulatory Research (RES) assisted the Office of Nuclear Reactor Regulation (NRR) in developing information for consideration in the SLR guidance documents.

This new user need request focuses on research activities on the technical issues discussed in the SLR guidance documents and in the staff requirements memorandum to SECY 14-0016 (ADAMS Accession No. ML14241A578).

Specifically, NRR is requesting RES support to:

- Hold NRC/industry workshop(s) on the status of domestic and international research activities and operating experience to address issues discussed in the SLR guidance documents;
- Develop and implement a long-term strategy and information tool for harvesting ex-plant components from decommissioning as well as from operating plants;
- Continue to develop domestic and international partnerships to share expertise, capabilities, and resources related to aging management research for SLR; and
- Use the products from the above three tasks to develop documentation of the status of research for the significant technical issues for SLR.

CONTACT: Bennett M. Brady, NRR/DLR
(301) 415-2981

Additional details are provided in the Enclosure, "Research Assistance on Potential Significant Technical Issues during the Subsequent Period of Extended Operation."

Resources

NRR requests RES to provide the specific resources (contract dollars and full-time equivalent staff) needed to complete the various tasks during the period of activity.

Intended Use of RES Products

The requested RES products will provide confirmatory research on the technical bases for industry research products related to aging degradation and identified in the staff's review of SLR applications.

Coordination and Schedules

This request has been coordinated with RES staff in the Division of Engineering (DE). Based on this, we expect that the requested work could be completed within the requested timeframe. We are prepared to work with your staff to further develop a mutually acceptable technical approach and schedule for this activity and to engage industry on this important matter. In addition, the directors of the lead divisions in each of our offices, George Wilson (NRR/Division of License Renewal (DLR)) and Brian Thomas (RES/DE), have discussed and agreed with the scope and schedules of the tasks in this request.

Priority

This request is rated as high priority based on NRR office priority ranking for reactor activities.

Points of Contact

For NRR, the contact is Bennett Brady, Subsequent Renewal, Guidance, and Operations Branch, DLR.

For RES, the contact is Amy Hull, Corrosion and Metallurgy Branch, DE.

Additional Information

None.

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

RESEARCH ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED OPERATION

Background:

The U.S. Nuclear Regulatory Commission staff (NRC or staff) has recently completed the draft guidance documents for subsequent license renewal (SLR). The draft guidance documents (draft NUREG-2191, Volumes 1 and 2, Agencywide Documents access and Management Systems [(ADAMS) Accession Nos. ML16274A389 and ML16274A399, respectively], "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" and the draft NUREG-2192, [ADAMS Accession No. ML16274A402] "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants") were issued for public comment in December 2015.

As preparation for drafting these guidance documents, the Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research (RES) 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" (ADAMS Accession No. 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). RES also published on June 15, 2016, the "Review of Aging Management Programs: Compendium of Insights from License Renewal Applications and from AMP Effectiveness Audits Conducted to Inform Subsequent License Renewal Guidance Documents," a report prepared by the RES contractor, Argonne National Laboratory, that includes NRC staff input (ADAMS Accession No. ML16167A076).

RES also completed the Expanded Materials Degradation Assessment (EMDA) in cooperation with the Department of Energy (DOE) Light Water Reactor Sustainability Program. The resultant reports, NUREG/CR-7153, EMDA, Vol. 1-5 (ADAMS Accession Nos. ML14279A321, ML14279A331, ML14279A349, ML14279A430, and 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 four most significant technical issues identified below were also outlined in the staff requirements memorandum (SRM) on SECY 14-0016, "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal" (ADAMS Accession No. ML14241A578):

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

ENCLOSURE

The audits and EMDA volumes provided NRC with over 800 suggestions for changes to the license renewal guidance and aging management program activities found acceptable for operation from 60 to 80 years.

Staff in several NRR divisions and RES' Division of Engineering (DE) participated in over 90 expert panels to review these suggestions along with the staff's own suggestions for changes to license renewal guidance documents for the first license renewal. The expert panels dispositioned the recommendations for the guidance for SLR and drafted NUREG-2191 and NUREG-2192.

After the draft guidance documents were issued for public comment, the staff held several public meetings with stakeholders and the public to discuss the proposed revisions and the bases for the revisions. In these meetings the staff provided information and clarifications on the proposed changes to the guidance documents, and solicited feedback on the documents. The NRC staff has responded to the public comments and will publish the documents in final form in mid-2017.

To support their SLR applications, applicants need to demonstrate that the effects of aging will be adequately managed for an operating period from 60 to 80 years. The NRR staff would like RES' assistance in holding meetings on these issues, participating and interacting with the DOE and other industry organizations, cataloguing the materials needed for research, and documenting the status and products of research for SLR.

Description of Scope and Tasks

1. Hold NRC/industry workshop(s) 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

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 No. 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 systems, structures, and components (SSCs) for an SLR period. The International Atomic Energy Agency will sponsor the "Fourth International Conference on Nuclear Power Plant Life Management" in France in October 2017.

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 SLR applications, 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 the most significant technical issues outlined in the GALL-SLR and the SRM.

Request: RES is requested to facilitate a minimum of two domestic and international activities (either a workshop, conference, symposium, or meeting), one in the early fall 2018 on the mechanical issues and one in late spring 2020 on the concrete and cables issues. These meetings should address:

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

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

Deliverable: The deliverables include the international activities (either 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. 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) and research insights and knowledge, due 6 months after each meeting.

Schedule: The effort should continue until the completion of the deliverables from the second activity, tentatively scheduled for late spring 2020.

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

Need: The NRC performs confirmatory research to inform and develop the technical bases for regulatory decisions related to AMPs 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 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 can 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 an information tool using Microsoft products which identifies and prioritizes the materials, components, and operating conditions that are needed to address the four significant issues 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.
- E. In coordination with Task 3, pursue domestic and international partnerships to pursue cooperational cost-sharing on retrieval and testing of ex-plant harvested material.

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.

Schedule: Items 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 36 months from the issuance of this user need request.

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

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 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. The scope of this

coordination includes cooperation and cost-sharing on retrieval and testing of ex-plant harvested material in Task 2.

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 applications. RES should evaluate products and reports from these organizations that may be provided to NRC in support of generic or plant-specific issues.

Deliverable: RES should provide to interested NRR branch chiefs (from DE and the Division of License Renewal (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, the status, and future plans should be discussed as a standing agenda item during the quarterly interface meetings between RES/DE, NRR/DLR, and NRR/DE.

Schedule: These products should be provided to NRR in a timely manner; the effort should continue until the closure of this user need request. A quarterly report (or slides) for presentation at the Director/Deputy Director Quarterly Interface Meeting should be provided 5 days before the meeting.

4. Documentation and Compilation of Results from Tasks 1, 2, and 3 on the status of research results in support of the Commission's direction to the staff

Need: In the SRM to SECY 14-0016, the Commission directed the staff to keep 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.

Request: RES is requested to annually prepare a document summarizing the products from tasks 1, 2, and 3 of this user need request to discuss the accomplishments of RES and national and international partners in addressing the four major technical issues in the SRM and other research activities that may be used in reviewing applications for SLR.

The annual report should 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.

Schedule: Annual report to 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.


COMMENTS ON DRAFT UNR NRR 2017-006

TASK 1

- Two RPV experts said it is too early to have an international meeting on neutron embrittlement in 2018. One electrical expert said it would be good to have an electrical meeting in 2020 as NIST will have completed their work at that time. RES should ask staff experts in reactor pressure vessels, internals, concrete, and cables in NRR and RES what would be an appropriate time for international meetings in their areas of expertise. Consideration should be given to times when new information from research will be available and times when no other organizations might be holding large meetings/workshops or symposiums. We do not need to hold a meeting when other organizations have plans for similar meetings.
- It wasn't clear to new readers of the UNR what the purpose and goals of the meetings were and what would be discussed at the meeting. RES needs to include the topics (bullets) in the NRR UNR, including the purpose and goals of any meetings, and what RES intends to provide back to NRR.

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? 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.
- Why just decommissioned plants? An explanation is required as to why this has been limited in scope.
- 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.

- (b)(5)  seems like a lot to develop an Excel or Access database. Does this include collecting and inputting information on materials needed and the sources of materials expected to be available? This tasking must be better defined.

TASK 3

- RES staff participate in a lot of domestic and international meeting and activities in partnership with other research organizations. NRR recognizes the importance of these activities and collaborative research. What other UNRs contain a task for partnerships

with other domestic and international research organizations? What are the FTE and contract dollars associated with each of these UNRs. An explanation needs to be included that reflects work being done for other program offices.

•
TASK 4

- Task 4 should be focused on providing an annual report for use by RES and NRR as a document annually summarizing the status and the accomplishments of RES and national and international partners in addressing the major technical issues in the SRM.

Task 5? (Starting with the paragraph (“building upon the extensive work”))

- RES might propose an unfunded Task 5 to provide confirmatory analyses and expert technical assistance with the review of technical documents to be submitted with SLR applications or to be available for assistance in the review of SLR applications. The task would be activated as needed by NRR and scoped and cost estimated as the SLR applications are accepted and RES assistance is needed. At this time, NRR does not see a need for this task.
- Delete the paragraph “As an example.” Assessing the “trend in critical risk-significant electrical equipment” is not the role of DMLR. RES might discuss this with DE in their UNR.
- Provide task estimates for Task 4 alone without additions.

[I just heard today that DE is setting up a request for informal support (less than 100 hours) with RES to do a technical evaluation of Seabrook’s proposal for a testing program to determine the modulus of elasticity of their ASR-infected containment. I don’t know if this proposal is for their license amendment request or their application for first license renewal. Brian Wittick, Angie Buford, and Bryce Lehman were in the meeting. This is the type of thing I would see RES doing in Task 5. BMB]

Note to requester: Portions of this record are redacted under FOIA Exemption B5, Deliberative Process Privilege. The first attachment is immediately following, the second attachment is withheld in full under FOIA Exemption 5, Deliberative Process Privilege.

From: Moyer, Carol
Sent: Wed, 29 Aug 2018 15:53:40 +0000
To: Frankl, Istvan
Cc: Hull, Amy
Subject: Budget question
Attachments: SLR Program at a Glance 20180129cm.abh.pptx, FY19 BE Plan Input Sheet - DE - CMB.xlsx

Steve,

I am looking at updating the LTO (SLR) Research program at a glance. Currently, it covers FY'17 – FY'19. For FY'19, the estimated budget is shown as (b)(5)

(b)(5) I pulled up the most recent file in the G-drive Budget folder, and it shows a FY'19 estimate of (b)(5) Is this the budget number that I should use?

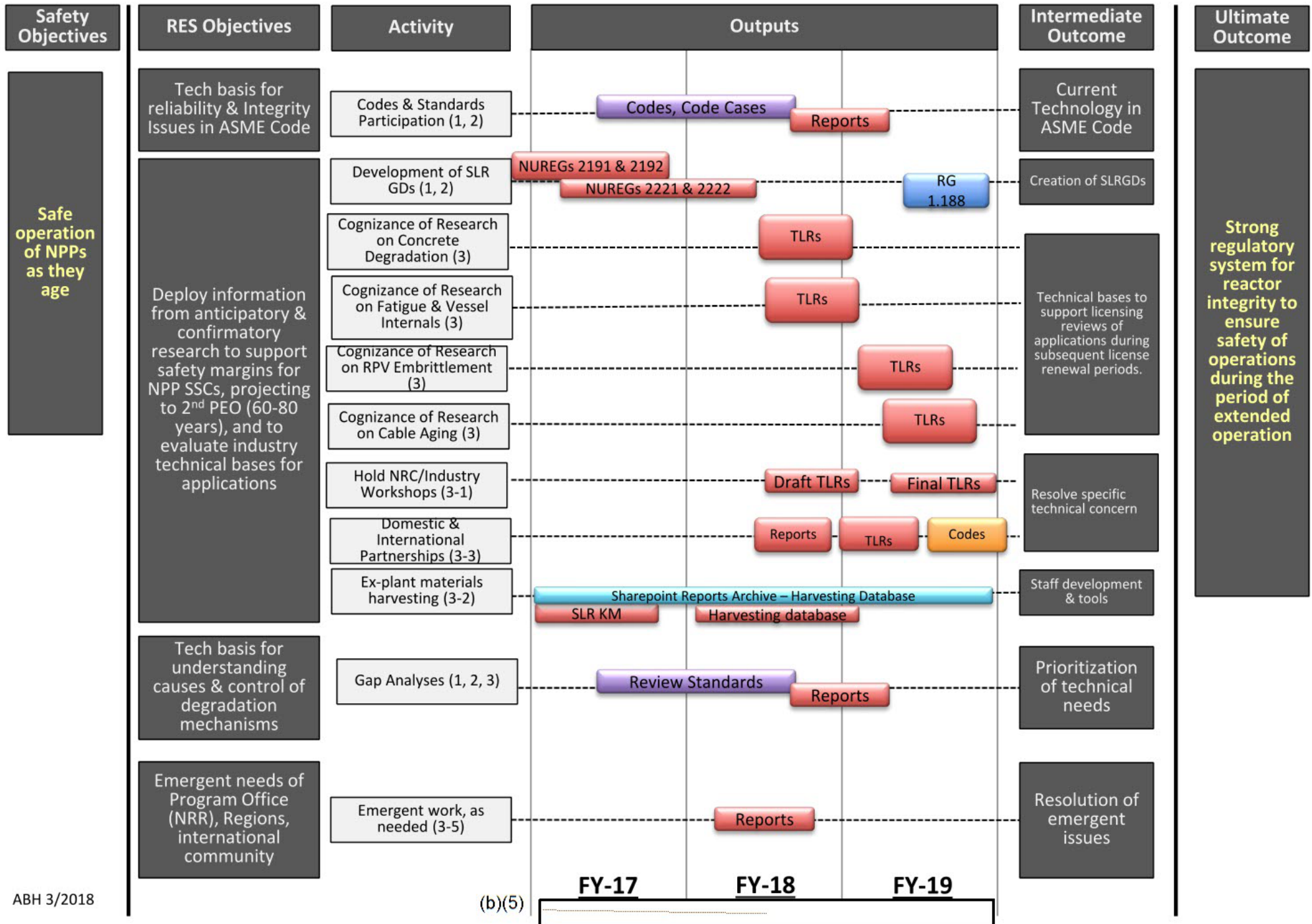
We had some discussions about whether we should be reporting resources (\$ + FTE) that are designated only for LTO/SLR research, or whether we should attempt to roll up all of the related research projects into one grand total for materials degradation in long term operation. While that might be an informative number to generate, I think that the Program at a Glance chart should remain focused on the coordination efforts – reporting, workshops, gap analyses – and not roll up all things that could be called aging-related, as this would be confusing and would entail a lot of double counting with other RES/DE projects.

Do we have any guesses at the FY'20 budget target? I found this file in the G-drive CMB Budget folder, "RES FY20 Budget Request 3-16-18.xlsx," but I do not seem to be able to open the file.

Thank you,
Carol

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

Subsequent License Renewal Research



UNR	FY-17		FY-18		FY-19	
	Contract (\$K)	FTE	Contract (\$K)	FTE	Contract (\$K)	FTE
NRR-2010-006	(b)(5)					
NRR-2014-001						
NRR -2017-006						

EPID: Materials Degradation, Analysis and Mitigation Techniques

Following are referenced above under activity:

- 1) UNR NRR-2010-006 *"Support in Developing Technical Information to Support Evaluating the Feasibility of License Renewal Beyond 60 Years"*
- 2) UNR NRR-2014-001 *"Provide Expert Assistance with Revising the Guidance Documents for Subsequent License Renewal"*
- 3) UNR NRR-2017-006 *"Research Assistance on Potential Significant Technical Issues during the Subsequent Period of Extended Operation"*

Reg Product

Code / Standard

Report

Database

Computer Code

(b)(5)

(b)(5)

DECLASSIFIED

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

(b)(5)

Note to requester: Attachments are immediately following this email.

From: Hull, Amy
Sent: Wed, 24 Jan 2018 20:29:48 +0000
To: Warren, Brenett
Cc: Hiser, Matthew;Frankl, Istvan
Subject: completed but under Division Review: Gentle Reminder for Presentation Submissions to OGC/QTE
Attachments: FINAL - ePoster and Digital Presentation Development Flowchart as of 010418 (excel).xlsx, Poster 6 has wrong information: QTE Comments Digital ePosters
Importance: High

Hi Brennett,

Our posters are completed but we do not yet have Division level approval. Please give us a couple more days for the following two posters.

Also please note that the abstract for Poster 6, **Evaluation of Additive Manufacturing of Metallic Parts via Direct Metal Laser Melting**, as available on the RIC site, is still wrong. (<https://ric.nrc.gov/poster>) Please see attached for how it should be written

1. **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 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 environments. The NRC has recently undertaken an effort, with the assistance of Pacific Northwest National Laboratory, 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 NPPs and those undergoing decommissioning.
2. **Evaluation of Additive Manufacturing of Metallic Parts via Direct Metal Laser Melting**

From: RICMST Resource
Sent: Wednesday, January 24, 2018 8:09 AM
To: Bernardo, Robert <Robert.Bernardo@nrc.gov>; Hall, Victor <Victor.Hall@nrc.gov>; Wilson, Joshua <Joshua.Wilson@nrc.gov>; Jones, Heather <Heather.Jones@nrc.gov>; Bridge, Joanna <Joanna.Bridge@nrc.gov>; Mendiola, Mary <Mary.Mendiola@nrc.gov>; Zuberi, Sardar <Sardar.Zuberi@nrc.gov>; Dembek, Stephen <Stephen.Dembek@nrc.gov>; Yadav, Priya <Priya.Yadav@nrc.gov>; Gifford, Ian <Ian.Gifford@nrc.gov>; Smith, Todd <Todd.Smith@nrc.gov>; Orf, Tracy <Tracy.Orf@nrc.gov>; Cruz, Holly <Holly.Cruz@nrc.gov>; Morey, Dennis <Dennis.Morey@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Savoy, Joanne <Joanne.Savoy@nrc.gov>; Ralph, Melissa <Melissa.Ralph@nrc.gov>; King, Shannon <Shannon.King@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Armstrong, Kenneth <Kenneth.Armstrong@nrc.gov>
Cc: RICMST Resource <RICMST.Resource@nrc.gov>; Kipfer, Lorna <Lorna.Kipfer@nrc.gov>
Subject: Gentle Reminder for Presentation Submissions to OGC/QTE
Importance: High

Good Morning ePoster and Digital Presenters,

This is a gentle reminder to do the following:

- Obtain managerial approval for your ePoster and Digital Presentation
- If your poster has been selected for OGC Review please submit and cc RICMST.Resource@nrc.gov
- Submit your poster to QTE for Level 1 review (note all ePosters and Digital Presentations should be submitted to QTE for final reviews)

Refer to ePoster and Digital Presentation Flowchart for further guidance (also attached). It is important that you adhere to the due dates as close as possible. If you are unable to meet this deadline please contact me as soon as possible via email Brenett.warren@nrc.gov or call me at 415-3114.

Once again thank you,

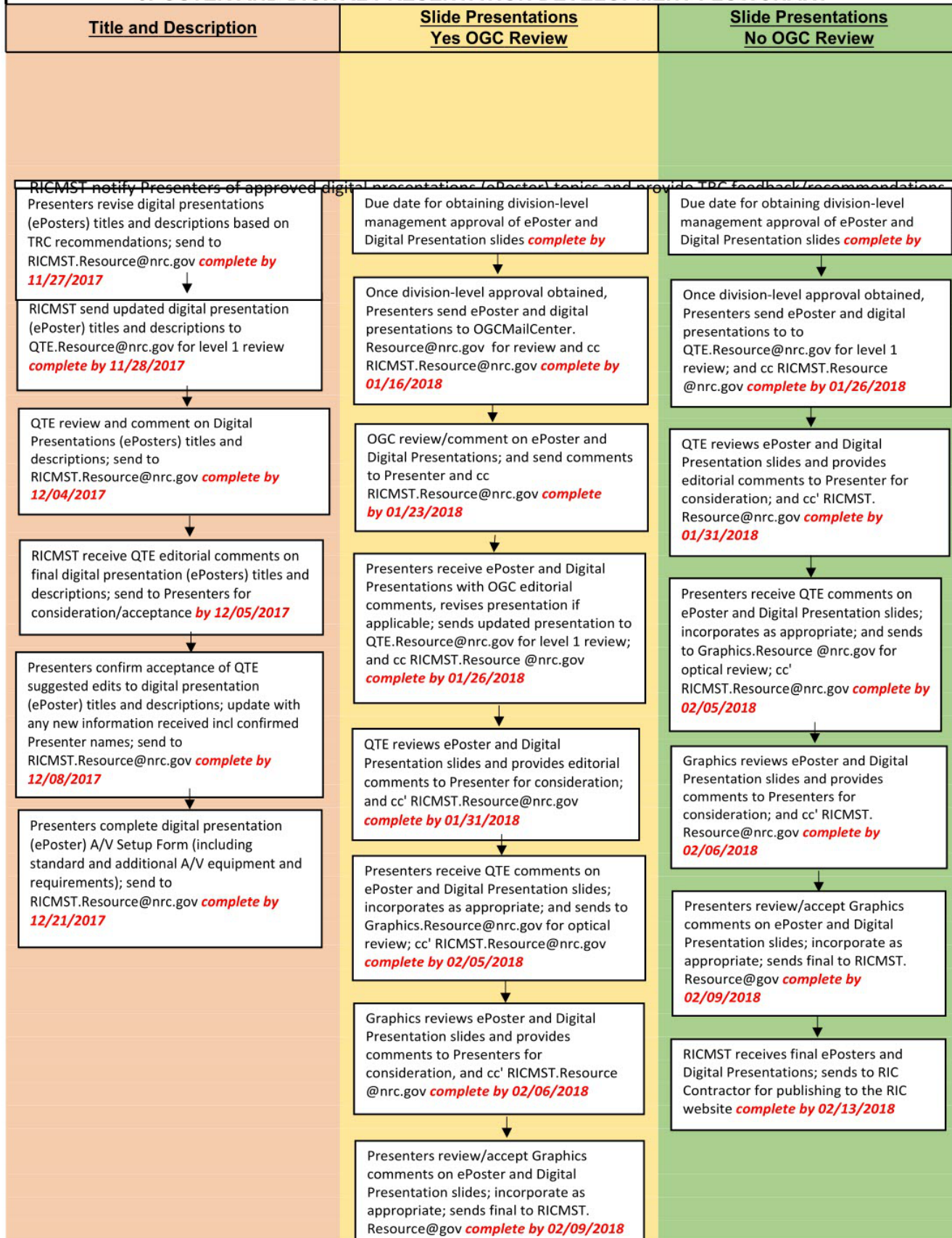
Brenett (Bren) U. Warren

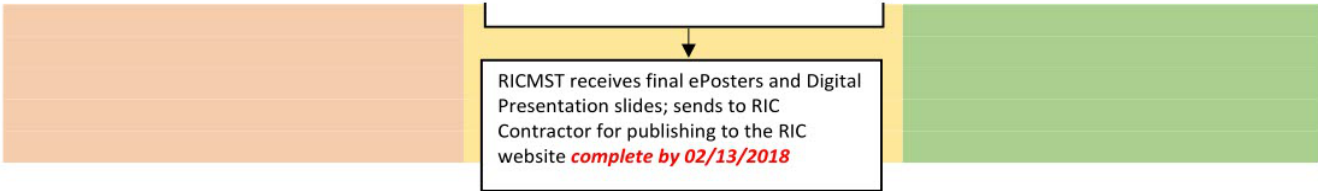
Program Specialist
Office of Nuclear Reactor Regulation
NRR/DMPS/RISB
Location: O13D5
301-415-3114
Brenett.Warren@nrc.gov



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ePOSTER AND DIGITAL PRESENTATION DEVELOPMENT FLOWCHART





The diagram consists of a horizontal bar divided into three sections: a light orange section on the left, a light yellow section in the middle, and a light green section on the right. A black arrow points downwards from the top of the yellow section to a white rectangular box with a black border. This box contains the text describing the process step.

RICMST receives final ePosters and Digital
Presentation slides; sends to RIC
Contractor for publishing to the RIC
website ***complete by 02/13/2018***

Note to requester: This email and its attachments (that are immediately following this email) is the second attachment to the January 24, 2018 Email from Amy Hull to Brenett Warren.

From: Hull, Amy
Sent: Thu, 7 Dec 2017 16:44:09 +0000
To: Warren, Brenett;RICMST Resource
Cc: Oberson, Greg;Moyer, Carol;Hiser, Matthew
Subject: Poster 6 has wrong information: QTE Comments Digital ePosters
Attachments: Consolidated ePoster Titles and Descriptions from QTE (in alpha order) as of 120417_compare.docx, NRC 1102 - AM.PDF
Importance: High

Hi Brenett,

Please correct the following ---

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 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.~~

-

It should read---

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

The NRC has been informed that Additively Manufactured (AM) parts are being considered for applications in the operating fleet as early as calendar year 2018. The first industry alert in June 2017 concerned using the DMLM method to manufacture parts for reactor components. A subsequent scoping study by RES staff provided more insight into the technical issues that must be addressed to assure reliability of specific DMLM-produced components 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.

From: Moyer, Carol
Sent: Wednesday, December 06, 2017 6:13 PM
To: Hull, Amy <Amy.Hull@nrc.gov>
Subject: FW: QTE Comments Digital ePosters
Importance: High

Amy,

Have you had a chance to look at this mark-up of the RIC poster abstracts? There is a title for a poster on AM, but the text is about harvesting. (There is also one on harvesting, about

harvesting – so it's not as simple as 2 descriptions being swapped.) Your text on the AM poster seems to have been lost.

Carol

From: Oberson, Greg
Sent: Monday, December 04, 2017 2:32 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: FW: QTE Comments Digital ePosters

Hello,
Please respond to the action.

Thanks,
Greg

From: RICMST Resource
Sent: Monday, December 04, 2017 11:34 AM
To:
Subject: QTE Comments Digital ePosters

We have received the attached comments and recommendations from QTE for each Digital ePoster title and description. Please scroll down and review the comments for your eposter. If you accept all of the recommended changes please send an email to RICMST.Resource@nrc.gov to that effect. However, if you choose not to accept the changes let us know that also. Please respond by 12:00 noon on December 6, 2017. You can refer to your eposter by the number located in front of the title.

If you have further questions please contact Bren Warren at 301-415-3114 or via email at RICMST.Resource@nrc.gov or Brenett.Warren@nrc.gov.

Thank you,

Brenett (Bren) W. Warren

Program Specialist
Office of Nuclear Reactor Regulation
NRR/DMPS/RISB
Location: O13D5
301-415-3114
Brenett.Warren@nrc.gov



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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.

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Non Responsive Record



Non Responsive Record



Non Responsive Record



Non Responsive Record



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.

Evaluation of Additive Manufacturing of Metallic Parts via Direct Metal Laser Melting (DMLM)

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 calendar year 2018. The first industry alert in June 2017 concerned using the DMLM method to manufacture parts for reactor components. A subsequent scoping study by RES staff provided more insight into the technical issues that must be addressed to assure reliability of specific DMLM-produced components 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.

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

Due Date:

11/27/2017

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

From: Moyer, Carol
Sent: Thu, 7 Jun 2018 22:33:07 +0000
To: Hull, Amy;Rao, Appajosula;Purtscher, Patrick;Focht, Eric;Audrain, Margaret
Cc: Frankl, Istvan
Subject: DMLR User Need Request review meeting, 6/6
Attachments: DMLR's UNRs Status FY18 Q2.docx

All,

On behalf of Steve, I attended a meeting yesterday with NRR/DMLR management, DMLR branch chiefs, DMLR UNR points-of-contact, RES/DE management, and RES/DE BCs for CIB and CMB. The purpose of this 1-hour meeting was a quarterly, high-level status review of all open user need requests between the two divisions.

The status table attached was provided by DMLR. It corresponds approximately to the EPID summary sheets that Steve has been asking each PM to update, but this table has less detail and more emphasis on the current status of each UNR. Some of the resource values (\$ / FTE) may not line up exactly with what is in your EPID sheets.

There were no new Action Items identified for CMB in the meeting. Please review the attached table to ensure that the information related to your individual UNRs is accurate. If not, please communicate changes to your counterpart POC. Also, Brian Thomas requested that this table include in the "Notes/Status" column a mention of near-term and significant deliverables, such as a NUREG that will soon enter concurrence or a test that will be delayed, as these items should be highlighted during the status review meeting.

It was not entirely clear why DMLR chose to have the POCs attend the meeting and present each UNR, while DE had only BCs and above there. There was a disconnect in the communications on this point, it seems. Next quarter, RES/DE will host the meeting, and we will plan to have a better match-up.

Carol

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

**DMLR/RES User Needs Requests (UNRs) Management Meeting
June 6, 2018**

UNR No./Title	ADAMS References	DMLR POC	RES POC	Notes/Status
NRR-2017-006 Research Assistance on Potential Significant Technical Issues During the Subsequent PEO	ML16357A689 RES Response ML17227A483	Allen Hiser	Amy Hull	<ul style="list-style-type: none"> • Focus on research activities on the tech issues discussed in the SLRGDs and the SRM to SECY-14-0016. • Task 1: Hold two NRC/industry workshop(s) (est.2019 and 2020) 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. PNNL has provided the first deliverable under this task, "Criteria and Planning Guidelines for Ex-Plant Harvesting to Support Subsequent License Renewal. DMLR staff will provide comments to RES. • 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). • Replaces NRR-2010-006 and NRR-2014-001 UNRs.

Non Responsive Record

DMLR/RES User Needs Requests (UNRs) Management Meeting
June 6, 2018

UNR No./Title	ADAMS References	DMLR POC	RES POC	Notes/Status
Non Responsive Record				

DMLR/RES User Needs Requests (UNRs) Management Meeting
June 6, 2018

UNR No.	ADAMS References	DMLR POC	RES POC	Notes
Non Responsive Record				

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UNR No.	ADAMS References	DMLR POC	RES POC	Notes
Non Responsive Record				

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UNR No.	ADAMS References	DMLR POC	RES POC	Notes
Non Responsive Record				

DMLR/RES User Needs Requests (UNRs) Management Meeting
June 6, 2018

UNR No.	ADAMS References	DMLR POC	RES POC	Notes
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Non Responsive Record

From: Hull, Amy
Sent: Fri, 3 Apr 2015 08:52:28 -0400
To: Hiser, Matthew
Cc: Frankl, Istvan
Subject: done: ACTION: Request of FY15 Reprommed Funds

I went in and did this. Wrote justification and Added another [REDACTED] for another subtask I am (b)(5) working on.

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)

(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.

(b)(5)

(b)(5)

Please input the information requested below in sheet

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,



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 this email are redacted under FOIA Exemption B5, Deliberative Process Privilege.

From: Hull, Amy
Sent: Wed, 15 Jul 2015 14:41:04 -0400
To: Frankl, Istvan
Cc: Hiser, Matthew; Prokofiev, Iouri
Subject: followup...

(b)(5)

(b)(5)

(b)(5)

Attachments: StratHarv SOW 7-6-15.docx, SOW PARENT-2 draft 07 10 2015 CLEAN.DOC
Importance: High

Hi Steve,

(b)(5)

Thanks,
Amy

From: Frankl, Istvan
Sent: Tuesday, July 14, 2015 8:59 AM
To: Hull, Amy

(b)(5)

(b)(5)

Subject:

Amy,

(b)(5)

Thanks,

Steve

From: Hull, Amy
Sent: Friday, July 10, 2015 3:42 PM
To: Frankl, Istvan
Cc: Prokofiev, Iouri; Lin, Bruce

(b)(5)
(b)(5)

Subject: [REDACTED]

Hi Steve,

[REDACTED] (b)(5)

The SOW is attached. [REDACTED] (b)(5)

Thanks,
Amy

From: Hull, Amy
Sent: Wednesday, July 01, 2015 6:28 PM
To: Frankl, Istvan
Cc: Focht, Eric; Oberson, Greg; Hiser, Matthew; Tregoning, Robert; Prokofiev, Iouri
Subject: everything in STAQS and routed to you, Kathryn, and Kathleen [REDACTED] (b)(5)

(b)(5)

Hi Steve,

[REDACTED] (b)(5)

From: Hull, Amy
Sent: Monday, July 06, 2015 1:24 PM
To: Frankl, Istvan (Istvan.Frankl@nrc.gov)
Cc: Hiser, Matthew; Iyengar, Raj

(b)(6)
(b)(5)

Subject: [REDACTED] ORNL presentation info sent to Raj [REDACTED] (b)(5)

Hi Steve,

[REDACTED] (b)(5)

(b)(6)
(b)(6)
(b)(6)

[REDACTED] I have transferred the ORNL presentation and background to Raj and have told him all about the purpose and format. [REDACTED] (b)(6)

Sri Rao is working at home this afternoon. Matt Hiser agreed to be acting branch chief for remainder of afternoon.

Amy B. Hull, Ph.D

Senior Materials Engineer
RES/DE/CMB (office T10-D49)
US Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, Maryland 20852
Telephone: (301) 415-2435
e-mail: amy.hull@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 checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Proprietary Information <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.

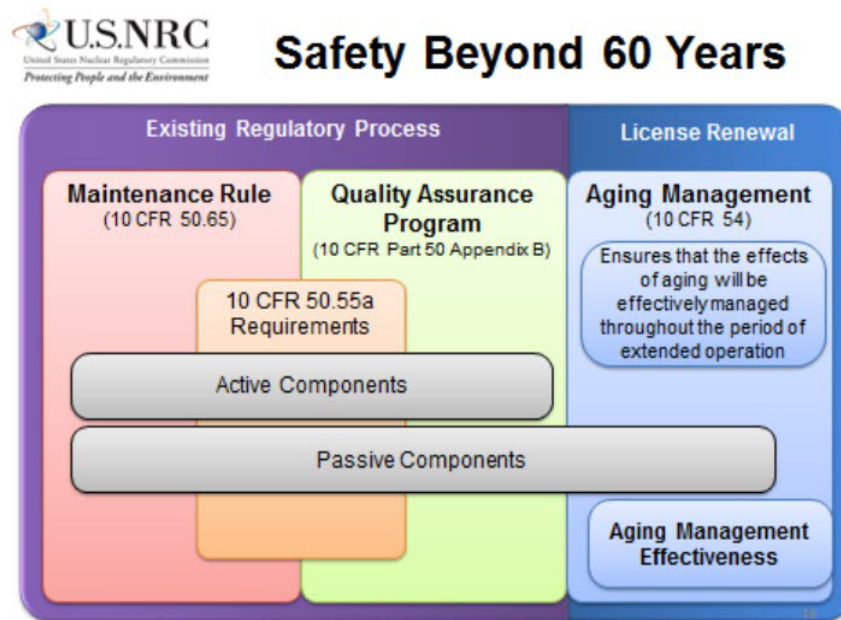


Figure 1: Relationship between aging management of active and passive components (from NRR/RES presentation to ACRS, 2014)

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.

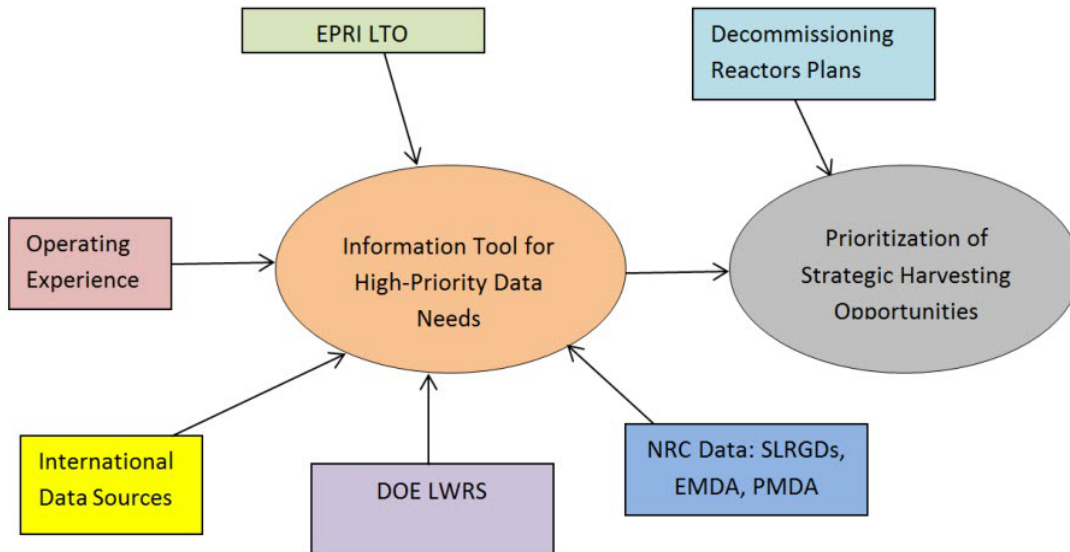


Figure 2: Pre-conceptual Architecture of prognostic tool to track and resolve critical technical issues for SLR

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.

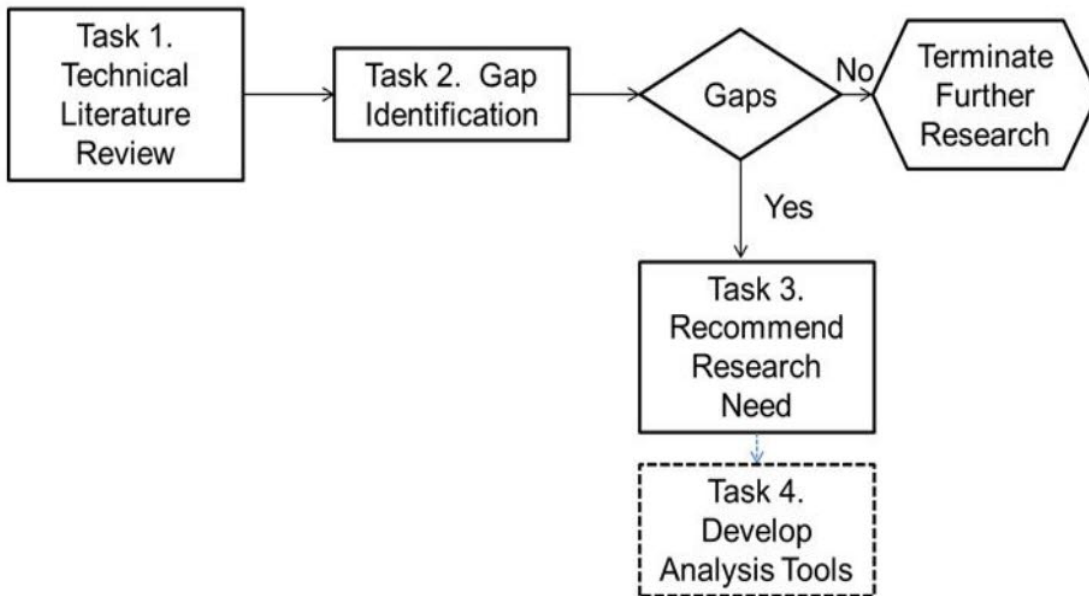


Figure 3: Schematic of the Overall Research

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.

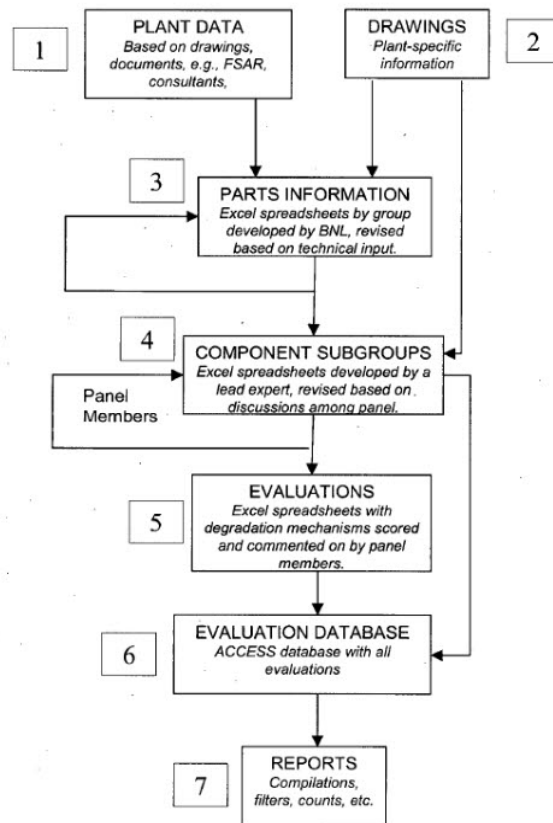


Figure 4. Flowchart for files created and used in PMMD infotool

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

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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

STATEMENT OF WORK

NRC Agreement Number	NRC Agreement Modification Number N/A	NRC Task Order Number (If Applicable) NEW	NRC Task Order Modification Number (If Applicable) N/A
Project Title PARENT 2, Program to Assess the Reliability of Emerging NDE Techniques and Results			
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 checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Proprietary Information <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

For over the past 30 years, NRC has maintained active research programs to generate confirmatory data for independent safety evaluations of proposed industry Code actions and inspection relief requests related to nondestructive evaluation (NDE) and in-service inspection (ISI). Earlier NRC-supported work at PNNL related to the proposed project, such as the Program for the Inspection of Steel Components (PISC), the Program to Inspect Nickel-Alloy Components (PINC) and the Program to Assess the Reliability of Emerging Nondestructive Techniques (PARENT), have provided important insights on parameters that affect primary water stress corrosion cracking (PWSCC) detectability, such as the effects of crack geometry/size, material microstructure and welding defects. Nevertheless, given the complexity of the crack morphology, NRC staff recognizes that key knowledge gaps remain, particularly for potential reactor operation during subsequent license renewal (SLR) up to 80 years.

Domestic and international events, in recent years have made it apparent that additional research is needed to address the issue of cracking in welds. Examples of evidences include the operation experience with Palo Verde bottom-mounted instrumentation (BMI) leak, five

missed cracks resulting in leakage at North Anna, and a missed crack in a control rod drive mechanism nozzle in Sharron Harris.

The NRC has limited international NDE data for stress corrosion cracking (SCC) under conditions relevant to nuclear power plant (NPP) extended operation and PNNL analysed available information under the auspices of NRC contracts (e.g., JCN N6593, V6286). To date, PARENT (conducted has provided results from round-robin (RR) inspections and international NDE experience that can be used by NRC Program Offices (such as the Office of Nuclear Reactor Regulation (NRR) and the Office of New Reactors (NRO)) in the development of regulatory requirements and by the nuclear industry in the development of international consensus standards, for example, through the ASME Boiler & Pressure Vessel (BPV) Code. The research products of the PARENT RRTs satisfied elements of NRR-2013-09 User Need Request (UNR) related to NDE of pressurized water reactor (PWR) component degradation. The PARENT-generated information related to new emerging techniques and detection of fabrication flaws will be applicable to new builds for which NRO would be the primary user. The research results already accruing from PARENT may prompt changes in codes and standards governing ISI, such as 10CFR50.55a and Reg. Guide 1.147.

PINC and PARENT have provided research results in the form of an engineering information technology tool (i.e. Atlas) to support technical justifications for ISI requirements, proven useful to Region-based NRC inspectors who verify the proper implementation of ISI programs. In the context of PINC, fourteen teams from Japan, Korea and Europe participated in RR inspections of dissimilar metal welds (DMWs) and BMI samples. The NRC report NUREG/CR-7019, published in 2010, provided the PINC results to detect and measure the size of cracks in DMWs. This international knowledge base was archived through the information technology tool, the PINC Atlas, on cracking in Alloy 600 and similar nickel-based alloys in NPPs. The public version of the PINC Atlas of crack morphology was also completed in 2010.

To date, PARENT applied international RR testing of welded components/samples results to provide valuable insight into the reliability of detection and accuracy of sizing of PWSCC in DMW samples. A total of 23 teams performed 219 inspections for Open tests using 30 procedures. In Blind testing 14 teams performed 71 inspections for a total of 421 flaw observations on DMW, and 77 flaw observations on BMI samples. Previously, under the auspices of NRC contracts (e.g., JCN N6593, V6286), PNNL analyzed the large amount of data generated by participants in the PARENT RR Blind and Open tests. The PARENT follow-on will focus on the RRT results to evaluate various NDE techniques for ISI of DMWs susceptible to PWSCC in PWRs.

In-service inspection requirements for nickel-base alloys in the primary system are found in Section XI of the ASME Boiler and Pressure Vessel Code, referenced in Title 10 of the Code of Federal Regulations, Part 50.55a, as well as approved Code Cases. The technical bases for the inspection requirements are, in part, derived by NDE testing of samples and side specific mock-ups with electrical discharge machining (EDM) or laser notches, laboratory prepared PWSCC growth flaws or with simulated cracks implanted or growth by thermal cycling.

Understanding the causes and control of degradation mechanisms, such as PWSCC, forms the basis for developing aging management programs (AMPs) to ensure the functionality and safety margins of NPP systems, structures, and components (SSC) during the period of extended operation. The resolution to these issues should provide reasonable assurance of safe operation of the components in the scope of license renewal during both the first (40-60 years)

period and the second (60-80 years) period of extended operation (PEO). In that sense, the ongoing Program to Assess the Reliability of Emerging NDE Technology addresses both aging management of passive components under the license renewal rule, 10 CFR 54, as well as maintenance of active components covered by the maintenance rule, 10CFR50.65.

2.0 OBJECTIVES

PARENT-2 has three major objectives as reflected in Sections 3 – 5 of this statement of work (SOW):

- Provide the experimental data and correlations necessary for the NRC staff to independently evaluate licensees' ISI programs for assessing the integrity of DMWs
- Evaluate current and emerging NDE methods that licensees may be planning to apply for ISI of passive components
- Review and update the format and the technical basis used in developing the information database for Atlas.

3.0 SCOPE OF WORK

In the proposed work, the analysis of open testing results will assess the capability of emerging NDE methods for detecting PWSCC at early stages and evaluate techniques suitable for monitoring degradation during reactor operation. In addition, these testing results have data images so that individual NDE responses will be analysed. The further analysis of Blind test results will evaluate the reliability of established NDE techniques and will assess current issues on the uncertainty of the depth-sizing abilities of NDE techniques in large-bore (Reactor inlet and outlet piping) DMWs including welds with smooth ID surfaces.

The preceding PARENT activities (e.g., V6286), were successful in answering many questions about the effectiveness of some techniques at finding cracks in, particularly DMWs. However, not all issues were addressed in sufficient detail. The international participants of PARENT defined further the anticipated work to be completed within the scope of PARENT follow-on work. PARENT members recently identified a limited scoped, timely, and focused RRT matrix to address specific technical issues. This includes more focus on real flaw evaluation. The general tasks for this SOW and their duration are described in Table 1. Table 2 provides a high-level summary of the written products (generally technical letter report (TLR) or concise analytical white paper (WP)) expected associated with information gained from subtasks referenced from Task 1, Task 2, and Task 3.

Table 1: PARENT-2 Task Description and Duration

Task	Task Title/Description	Duration (Months)
Task 1	Support to NRC for PARENT activities and follow-on program	36
Task 2	Extended Research Studies on NDE Effectiveness	36
Task 3	Information Tool Development (Atlas)	36

Table 2: Summary of PARENT-2 Written Deliverables

ID	Subtask	Title/Description	Due
TLR 1.1.1	1.1.1	Review for Atlas Needs and Identification of Technical Data Gaps	FY16
TLR 1.1.2	1.1.2	Confirmatory Research to Address Gaps Related to NDE of DMW	FY16
TLR 1.1.3	1.1.3	Recommended Laboratory Experiments and Analytical Model Development	FY16
TLR 1.1.4	1.1.4	Development of International NDE Program Proposal and Protocol for RR Tests	FY16
WP 1.1.5	1.1.5. 2.1.1	Analysis of results from preliminary scoping study of International NDE Blind RRTs of BMI Proposal and Protocol with cost estimation (J groove weld optional),	FY17
WP 1.1.6	1.1.6. 2.2.2	Analysis of results from preliminary scoping study of International NDE Open RRTs of CASS Proposal and Protocol with cost estimation (with narrow weld optional)	FY17
WP 1.1.7	1.1.7. 2.3.3	Analysis of results from preliminary scoping study for international NDE RRT proposal for confirmatory narrow gap welds (with narrow weld repairing optional)	FY17
TLR 2.1.1	1.1.5, 2.1.1	Status of test plans for both additional BMI testing, and for blind testing for promising open testing techniques, including the results of technique level analysis of blind testing data <u>Input for reviewed NUREG</u>	FY17
TLR 2.2.1	1.1.7, 2.2.1	Status of additional BMI testing related to peening (optional) and the blind test assessment of open techniques from PARENT <u>Input for reviewed NUREG</u>	FY16 FY17 (opt)
TLR 2.2.2	1.1.6, 2.2.2	status of additional Open NDE CASS RR testing (optional) and then the blind test assessment of open techniques from PARENT	FY17
TLR 2.2.3	1.1.6, 2.2.3	Results of implementation of Open NDE CASS RR confirmatory tests	FY18
TLR 2.3.1	1.1.4, 2.3.1	Promising Emerging Techniques from PARENT Open Testing Techniques for Blind Assessment." <u>Input for reviewed NUREG</u>	FY16
TLR 2.3.3	1.1.7, 2.3.3	Open NDE Narrow gap welds RR confirmatory tests	FY18

4.0 SPECIFIC TASKS

Task 1 - Support to NRC for PARENT and Follow-on Program

PNNL shall support the NRC contracting officer representative (COR) with both an extensive scoping study (Task 1.1) and with implementing and maintaining the international cooperative research project PARENT. This is Task 1.2.

Task 1.1: Scoping Study

PNNL shall conduct the Task 1.1 scoping study and provide all resources necessary to accomplish the subtasks and deliverables. Task 1.1 shall be performed in stages. Decision on further execution of other subtasks (1.1.2-1.1.4) will be made after the end of the subtask 1.1.1 (Table 3).

Table 3. Summary of Task 1.1. Scoping Study

Subtask	Subtask Title/Description	Duration (Months)
1.1.1	Conduct scoping Study and NDE Technical Information Review for Atlas Needs and Identification of Technical Data Gaps; submit related TLR 1.1.1	NLT 4 months ACA
1.1.2	Determine Significance and Disposition of Technical Gaps Related to NDE of DMW (J groove and Narrow welds (optional); submit related TLR 1.1.2	NLT 7 months ACA
1.1.3	Recommend Laboratory Experiments and Analytical Model Development for Confirmatory Research Addressing Technical Gaps- (optional)); submit related TLR 1.1.3	NLT 10 months ACA
1.1.4	Develop International NDE Program Proposal and Protocol for Round Robin Tests (RRTs) (optional)); submit related TLR 1.1.4	NLT 13 months ACA
1.1.5	Conduct Scoping Studies for International NDE Blind RRTs of BMI Proposal and Protocol with Cost Estimation (J groove weld peening optional), (more detailed information under subtask 2.1.1)	NLT 15 months ACA
1.1.6	Conduct Scoping Studies for International NDE Open RRTs of Cast Austenitic Stainless Steel (CASS) Proposal and Protocol with Cost Estimation (with narrow weld optional),(more detailed information under subtask 2.2.2)	NLT 18 months ACA
1.1.7	Conduct Scoping Studies for International NDE RRT Proposal for Confirmatory Narrow Gap Welds (with narrow weld repairing optional), (more detailed information under subtask 2.2.1)	NLT 20 months ACA

This scoping study will be conducted, as per tasks detailed below for subtasks 1.1.1 and 1.1.2. A decision on further optional research outlined in subtasks 1.1.3, and 1.1.4 will be made after completion of subtask 1.1.1 depending on the recommendation from the conclusion of the preceding tasks. Subtasks 1.1.5, 1.1.6, and 1.1.7 are each precursors to subtasks in Task 2.

Subtask 1.1.1 – Gap Identification

PNNL shall identify specific information from the execution of Subtask 1.1.1 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 cracking during the NPP PEO. TLR 1.1.1 “Review for Atlas Needs and Identification of Technical Data Gaps” will be drafted at the end of this subtask.

Subtask 1.1.2 – Determine Significance and Disposition of Technical Gaps

PNNL shall determine whether or not there are any technical gaps from the execution of Subtask 1.1.1. If there are no gaps and if it is determined that the current ASME Code or other US industry or international practice ensure that the design margin for components are adequate, NRC COR has the option of recommending termination of Task 1.1. If specific information and technical gaps are identified then proceed to Subtask 1.1.3 after getting approval from the NRC Contract Officer (CO).

Subtask 1.1.3 – Recommend Specific Laboratory Experiments and Analytical Model Development

PNNL shall work with the PARENT NDE Task Group experts and NRC subject matter experts (SMEs) to recommend specific laboratory experimentation and analytical model development, which may address the information gap identified in Subtask 1.1.1.

Subtask 1.1.4 – Develop international program proposal for confirmatory tests

If novel NDE methods become available and are identified by the time of subtask inception, PNNL shall implement this Subtask to independently confirm the licensee’s technical basis for long-term operation (LTO) and recommend ISI technology which will be suitable to identify the progression of incipient cracking. A deliverable related to this subtask is TLR 1.1.4 which is further referenced in subtasks 2.1.3 and 2.3.2.

Subtask 1.1.5 – Conduct Scoping Studies for International NDE Blind RRTs of BMI Proposal and Protocol with cost estimation (J groove weld peening optional)

PNNL shall investigate the viability of applying NDE J-groove weld RRT proposal for confirmatory tests. If novel NDE methods become available by this time for J-groove weld examination, PNNL shall implement this Subtask to independently confirm the licensee’s technical basis for long term operation (LTO) and recommend ISI technology. The research shall attempt to identify a monitoring procedure to detect size-based cracking indicators and thus enable a peening-based methodology to prevent crack progression. PNNL shall assist the NRC COR in selecting test specimens for peening and Blind RRTs. Planning for this research is addressed as Subtask 2.1.1 and 2.1.4 (optional)

Subtask 1.1.6 – Conduct Scoping Studies for NDE CASS RRT proposal for confirmatory tests

If novel NDE methods become available by this time for CASS (or narrow weld) examination (EPRI RRTs), PNNL shall implement this Subtask to independently confirm the licensee’s technical basis for LTO and recommend ISI technology. The research shall determine how to prevent progressing cracking by detecting the indication changes resulting from size of cracks.

PNNL shall assist the NRC COR in selecting test specimens for weld repairing and Open RRTs. Planning for this research is addressed as Subtask 2.2.2 (optional)

Subtask 1.1.7 – Conduct Scoping Studies for NDE RRT proposal for confirmatory tests of narrow gap welds

If novel NDE methods become available by this time for the narrow gap weld examination (EPRI, Areva's Tests for EPR reactors), PNNL shall implement this Subtask to independently confirm the licensee's technical basis for LTO and recommend ISI technology. The research shall determine how to identify progressing cracking prevention by repairing of flaws detected with emerging technique for crack location and sizing. PNNL shall assist the NRC COR in selecting test specimens for weld repairing and Open RRTs. Planning for this research addressed as Subtask 2.2.1 and 2.3.2 (optional).

Task 1.2: Support COR in maintaining effective cooperation in PARENT

The NRC contracting officer representative (COR) requires support in implementing and maintaining the international cooperative research project PARENT.

As part of this task, PNNL shall organize two meetings per year for the PARENT participants. PNNL shall attempt to ensure that the rotating meeting locations include the home country or continent of each group participating in the program. The next PARENT meeting is scheduled to be held at PNNL, October 26-30, 2015. Other meetings proposed by the international PARENT steering committee are tabulated in Section 8.0 of this SOW.

PNNL shall aid the NRC COR in identifying companies and institutes that are interested in participating in the international cooperative. After key individuals have been identified at those organizations, assistance will be provided in coordinating meetings and incorporating the in-kind contributions of program participants into reports and work products for the program. PNNL shall provide presentations as directed by the NRC and send appropriate participants to the PARENT meetings. PNNL shall provide expert advice to the NRC staff regarding operational events related to the PWSCC cracking and leak of welds at nuclear power plants. Through PNNL's continuing participation in the international PARENT meetings, workshops, codes and standards activities, PNNL staff already understands NDE/ISI issues and advancements in NDE technologies that could address problems arising in operating nuclear power plants.

Task 2 – Extended Research Studies on NDE Effectiveness

In this task, PNNL shall assign and carry out additional round-robin tests to enhance BMI test results and shall perform blind test assessment of open techniques from PARENT participants. In addition, PNNL shall perform a technique-level analysis of blind test data from PARENT participants. PNNL shall participate as lead technical staff on the PARENT NDE task group (TG-NDE), the data analysis group (DAG), and shall function as the invigilator for participating US teams. PNNL shall help design, plan and schedule additional round robin testing activities. In addition, PNNL shall assist in the design and procurement of test blocks necessary for additional round robin testing. PNNL shall analyze NDE test data from the additional round-robin tests. The analysis will include frequency of detection as a means of estimating probability of detection and estimation of depth sizing bias and root mean squared error (RMSE). PNNL shall

work with the TG-NDE in identifying teams, techniques, and procedures for the BMI testing and blind evaluation of open techniques from PARENT.

Associated with Task 2, PNNL shall prepare six TLRs. In FY17, PNNL shall develop TLR 2.1.1 describing status of test plan for additional BMI testing, status of plan for blind testing for promising open testing techniques from PARENT, and including the results of technique level analysis of blind testing data from PARENT. This is defined further in Table 4. In FY17, PNNL shall develop TLR 2.2.1 describing the status of additional BMI testing related to peening (optional) and the blind test assessment of open techniques from PARENT. This is described further in Table 5. In FY18, PNNL shall develop TLR 2.2.2 describing the status of additional Open NDE CASS RR testing (optional) and the blind test assessment of open techniques from PARENT. This is also described further in Table 5. IN FY18, PNNL shall prepare TLRs 2.2.3, 2.3.1, and 2.3.3 as shown in Table 1.

Task 2.1: Enhancement of BMI Test Results

The objective of this task is to enhance test results for BMI test blocks in PARENT. Limited testing was performed on BMI test blocks in PARENT (ten inspections of J-groove weld surfaces and two inspections of tube IDs) in comparison to the DMW test blocks. As a consequence, conclusions that may be drawn for BMI test results in PARENT are limited, as well. In the earlier PINC and PARENT studies, it was noted that no techniques were applied with the capability to depth size flaws in the J-groove weld region. In addition, the PINC round robin tests did not achieve strong evaluation of the effectiveness of examinations of the interior of BMI penetration tubes. Only two teams examined the interiors of three flawed tubes. In PARENT, limited testing was conducted on tube IDs. Three main subtasks are proposed:

Subtask 2.1.1 - Combining PINC and PARENT BMI test data to improve statistical significance of results

Subtask 2.1.2 - Develop testing plan for additional detection and depth sizing evaluation of flaws in j-groove weld materials and tube IDs

Subtask 2.1.3 - Assessing methods for detection and depth sizing flaws in j-groove weld materials and tube IDs

Initial steps for subtask 2.1.2 would include reviewing BMI test blocks in inventory to determine the relevancy and adequacy of test block geometries, materials, and flaws. Another required initial step will be to develop testing objectives and the testing plan (e.g. to perform blind or open testing).

Table 4 below further summarizes Task 2.1 in terms of describing subtasks and their duration. The explicit deliverables are prefaced with italicized alphanumeric annotation in square brackets.

Table 4. Summary of Task 2.1., Enhancement of BMI Test Results

Subtask	Subtask Title/Description	Duration (Months)
2.1.1	Combining PINC and PARENT BMI test data to improve statistical significance of results in Final report.	NLT 1 months after contract award (ACA)
	[2.1.1. a] PNNL shall provide draft Final Report to NRC on Task 2.1.1 for NRR review with improved statistical results	1
	[2.1.1. b] NRC to provide comments to contractor on TLR 2.1.1. The NRC meeting (March 2016) will discuss the Final report	1
2.1.2	Develop testing plan for additional detection and depth sizing evaluation of flaws in j-groove weld materials and tube IDs and include test plan in draft TLR 1.1.3	1
	[2.1.2. a] PNNL to provide draft TLR 1.1.3 to NRC with Recommended Laboratory Experiments and Analytical Model Development (optional)	NLT 9 months ACA
	[2.1.2. b] NRC to provide comments to contractor on TLR 1.1.3. The last PARENT-12 meeting (July 2016) will discuss the test plan	NLT 1 month after receiving TLR 1.1.3
2.1.3	Assessing methods for detection and depth sizing flaws in j-groove weld materials and tube IDs (optional)	NLT 12 months ACA
	[2.1.3. a] PNNL to provide input for TLR 1.1.4 to NRC on Development International NDE Program Proposal and Protocol for RR (optional) to NRC for NRR review	2
	[2.1.3. b] NRC to provide comments to contractor on TLR 1.1.4. The new Program kick off meeting (November 2016, NRC DC) will discuss the TLR 1.1.4 International NDE Program Proposal and Protocol for RR (optional)	NLT 1 month after receiving TLR 1.1.4
2.1.4	PNNL to Plan tests for International NDE Blind RRTs of BMI Proposal and Protocol with cost estimation (as mentioned in subtask 1.1.5)	NLT 15 months ACA
2.1.5	PNNL to implement International NDE Blind RR tests of BMI Proposal and Protocol with cost estimation (as mentioned in subtask 1.1.5)	NLT 24 months ACA

Task 2.2: Perform analysis of blind test data from PARENT at the technique level

The current analysis of PARENT blind test data has been performed at the procedure level (procedures can consist of multiple techniques). This has resulted in limited eddy current technology (ECT) data for analysis (data obtained from one procedure – ECT.135) and has limited comparisons between the “Quick” blind test results and results from the rest of blind testing. Therefore, conducting additional analysis of PARENT blind data at the technique level will provide more data to supplement existing ECT results as ECT data from procedures UT.ECT.144 and UT.TOFD.ECT.101 may be evaluated along with ECT data from ECT.135. Also, a technique level analysis will enable more direct comparisons between the “Quick” blind study and the rest of the blind testing as the UT and PAUT data from the “Quick” blind test procedures UT.PAUT.108 and UT.PAUT.126 can be compared to data obtained from UT and PAUT procedures in the rest of blind testing.

Table 5 below further summarizes Task 2.2 in terms of describing subtasks and their duration. The explicit deliverables are prefaced with italicized alphanumeric annotation in square brackets.

Table 5. Summary of Task 2.2., Analysis of PARENT blind test data at the technique level,

Subtask	Subtask Title/Description	Duration (Months)
2.2.1	Review test data to conduct additional analysis of PARENT blind data at the technique level resulting in TLR 2.2.1	1
	[2.2.1 a] PNLL to provide the Blind Test Final Report to NRC for NRR review with additional analysis of PARENT blind data at the technique level (TLR 2.2.1)	NLT 2 months ACA
	[2.2.1 b] NRC to provide comments to contractor on Blind Test Final Report. The NRC meeting (March 2016) will discuss the Final report	NLT 1 month after receiving TLR 2.2.1
2.2.2	PNLL to prepare plan for Open NDE CASS RR confirmatory tests (as mentioned previously in subtask 1.1.6) and submit as TLR 2.2.2	NLT 15 months ACA
2.2.3	PNLL implement Open NDE CASS RR confirmatory tests (as mentioned previously in subtask 1.1.6) and submit as TLR 2.2.3	NLT 24 months ACA

Task 2.3: Conduct Blind Test Assessment of Promising Open Testing Techniques

As reactors age, an increasing number of components are becoming vulnerable to stress corrosion cracking. With new reactor construction, it is possible that the new materials used will experience new forms of materials degradation. Some forms of degradation, such as stress corrosion cracking, are typified by a long incubation period followed by rapid crack growth and provide a challenge to periodic inspections using standard NDE techniques. To deal with rapidly-growing forms of degradation the nuclear NDE community needs to either find a new

NDE technique that is able to detect the degradation precursors or use continuous online monitoring.

Open testing is useful for performing a basic capability assessment of novel and emerging NDE technologies but the testing format does not facilitate a realistic measure of detection performance. In addition, bias may exist in sizing results. Conducting a blind test of novel and emerging NDE techniques that exhibited high performance in open testing will enable measurement of detection performance for such techniques and a more accurate estimate of sizing capabilities.

Task 2.3.1 - Identify promising emerging techniques from PARENT open testing techniques for blind assessment/Planning for blind test assessment

Task 2.3.2 - Execute blind test assessment of promising open testing techniques

Table 6 below further summarizes Task 2.3 in terms of describing subtasks and their duration. The explicit deliverables are prefaced with italicized alphanumeric annotation in square brackets.

Table 6. Task 2.3, Conduct blind test assessment of promising open testing techniques

Subtask	Subtask Title/Description	Duration (Months)
2.3.1	Combine comments on PARENT Open RRT Final Report and review test data to identify promising emerging techniques, TLR 2.3.1	1
	<i>[2.3.1a]</i> PNNL to provide the Open RRT TLR 2.3.1 to NRC for NRR review with identification of promising emerging techniques	NLT 2 months ACA
	<i>[2.3.1b]</i> NRC to provide comments to contractor on TLR 2.3.1 "Promising Emerging Techniques from PARENT Open Testing Techniques for Blind Assessment." The NRC meeting (March 2016) will discuss the Final report	NLT 1 month after receiving TLR 2.3.1
2.3.2	Develop testing plan for additional detection and depth sizing evaluation of flaws for blind test assessment and include test plan in draft TLR 1.1.4 on Development International NDE Program Proposal. This is closely related to Subtask 2.1.3.	NLT 12 months ACA
	<i>[2.3.2a]</i> PNNL to provide draft TLR 1.1.4 to NRC with Recommended Laboratory Experiments and Analytical Model Development (optional)	NLT 15 months ACA
	<i>[2.3.2b]</i> NRC to provide comments to PNNL on TLR 1.1.4. The last PARENT-12 meeting (July 2016) will discuss the test plan	NLT 1 month after receiving TLR 1.1.4

2.3.3	Execute blind test assessment of promising open testing techniques for DMW, BMI, or CASS	2
	[2.3.3a] PNNL to provide input for TLR 1.1.4 to NRC on Development International NDE Program Proposal and Protocol for RR (optional) to NRC for NRR review.	2
	[2.3.3b] NRC to provide comments to PNNL on TLR 1.1.4. The new Program kick off meeting (November 2016, NRC DC) will discuss the TLR 1.1.4 International NDE Program Proposal and Protocol for RR (optional)	NLT 1 month after receiving Report 1.1.4
	PNNL implement Open NDE Narrow gap welds RR confirmatory tests (as mentioned previously in subtask 1.1.7) and submit as TLR 2.3.3	NLT 36 months ACA

Task 3 – Information Tool Development (Atlas)

According to international agreements governing PARENT collaboration, PNNL is to develop and maintain the PARENT Atlas information tool. PNNL shall add data that is offered by the participants – collecting and organizing it in the PARENT Atlas. PNNL shall build the Atlas, making it a reference tool for NRC staff and PARENT participants. PNNL shall design the Atlas database to contain information (excluding that which is determined to be proprietary data that PARENT participants want protected) on the PARENT test blocks and their artificially-implemented cracks and machined reflectors. This Task 3 addresses issues such as competition of the review and analysis of the Open RRT results and preparation of Atlas data. The project assists in developing the engineering information technology tool (PARENT Atlas) and internal NRC Website necessary to support technical justifications for ISI requirements.

Task 3.1: Add and organize documentation of field occurrences of SCC into the PARENT Atlas information tool including the results of metallographic analysis when available.

The goal of this effort is to provide a reference database of NDE techniques applied in the field and the types of flaws detected by the NDE techniques. In addition, another objective of this task is to compile metallographic results of field flaws that have been analyzed. The focus is on primary water stress corrosion cracking/internal diameter stress corrosion cracking (PWSCC/IDSCC). The initial step for this task will be to review potentially relevant existing databases to focus on filling information gaps in existing databases.

Task 3.2: Compare morphologies of laboratory grown SCC flaws with documented characteristics of field SCC flaws

Accurate representation of field PWSCC/IDSCC flaws in laboratory studies of NDE performance is necessary to ensure generation of useful results. Knowledge of field PWSCC/IDSCC flaw morphologies is limited to data obtained from a handful of failure analysis reports. It may be possible to supplement this limited set of data pertaining to field PWSCC/IDSCC flaw morphologies through analysis of PWSCC/IDSCC flaws grown in laboratories. Thus, laboratory grown PWSCC/IDSCC flaw morphologies will be compared with field PWSCC/IDSCC flaw

morphologies to confirm the relevancy of laboratory grown flaws for simulating field flaws. In addition, if relevancy is confirmed, data collected from laboratory flaws can be used to enhance the database obtained from field flaws.

Task 3.3: Compare signal responses from different flaw types from open testing data and incorporate into the PARENT Atlas

Open testing was conducted using test blocks with a variety of simulated flaw types including weld solidification cracks, EDM notches, laboratory grown stress corrosion cracks, mechanical fatigue cracks, and welding defects. A comparison of NDE responses for the different flaw types will help provide insight with respect to which flaw features are significant for NDE response and which simulated flaw types are most suitable for assessing the performance of specific NDE techniques. The PARENT Atlas information tool provides a convenient means to navigate signal responses and view comparisons.

Task 3.4 Update the PARENT Atlas with information collected as part of Tasks 3.1, 3.2, and 3.3.

Table 7 below further summarizes Task 3 in terms of describing subtasks and their duration. The explicit deliverables are prefaced with italicized alphanumeric annotation in square brackets.

Table 7. Summary of Task 3 Subtasks, Information Tool Atlas

Subtask	Subtask Title/Description	Duration (Months)
3.1.1	Review result of Task 1.1.1 – Gap Identification and include review of NDE Technical Information in Atlas	0.5
3.1.2	PNNL to provide Draft presentation to NRC on Task 1.1.1 and 1.1.2 with Review for of NDE Technical Information for Atlas.	NLT 5 months ACA
3.1.3	NRC to provide comments to contractor on TLR 1.1.2. The NRC meeting (March 2016) will discuss the Review of Atlas needs and results of gaps analysis	NLT 1 month after receiving TLR 1.1.2
3.1.4	Adding and organizing documentation of field occurrences of PWSCC/IDSCC into the PARENT Atlas information tool including the results of metallographic analysis when available.	1
3.2	Comparison of morphologies of laboratory grown SCC flaws with documented characteristics of field SCC flaws	2
3.3	Comparison of signal responses from different flaw types from open testing data and incorporate into the PARENT Atlas	2
3.4	PNNL to provide Draft of PARENT Atlas to NRC for review, to be discussed at PARENT 12 (July 2016) meeting	NLT 8 months ACA

5.0 DELIVERABLES AND/OR MILESTONES SCHEDULE

ALL deliverables shall be in the form of technical letter reports (TLRs), concise authoritative report ("white paper"), or alternatives previously discussed and determined acceptable by the COR. Based on the detailed tasks provided in Section 2.0 of this SOW, 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.

In the table below as in the preceding ones, the Due date is expressed in terms of no later than (NLT) x months after contract awarded (ACA).

Task Number	Deliverable/Milestone Description for Task 1 <i>(include NRC acceptance criteria if applicable)</i>	Due Date <i>(if any)</i>
All	Monthly Letter Status Report (MLSR)	20 th day of each month
1.1.1	PNNL to provide Draft <u>TLR 1.1.1</u> to NRC on Subtask (1.1.1) Review for Atlas Needs and Identification of Technical Data Gaps	NLT 2 months ACA
1.1.1	NRC to provide comments to contractor on TLR 1.1.1 Review for Atlas Needs and Identification of Technical Data Gaps. The PARENT 12 meeting will discuss the Review results	NLT 1 month after receiving draft TLR 1.1.1 from PNNL
1.1.1	PNNL to publish TLR 1.1.1. Deliver copies to the PARENT participants, in addition to an electronic file to the NRC COR	NLT 1 month after receiving NRC comments
1.1.2	PNNL to provide draft <u>TLR 1.1.2</u> to NRC on Subtask (1.1.2) concerning Confirmatory Research to Address Gaps Related to NDE of DMW (J groove and Narrow welds optional)	NLT 5 months ACA
1.1.2	NRC to provide comments to contractor on TLR 1.1.2. The NRC meeting (March 2016) will discuss the Review of Atlas needs and results of gaps analysis	NLT 1 month after receiving draft TLR 1.1.2 from PNNL
1.1.2	PNNL to publish TLR 1.1.2 concerning Confirmatory Research Address Gaps Related to NDE of DMW. Deliver copies to the PARENT participants, in addition to an electronic file to the NRC COR.	NLT 1 month after receiving NRC comments
1.1.3	PNNL to provide draft <u>TLR 1.1.3</u> to NRC with Recommended Laboratory Experiments and Analytical Model Development (optional)	NLT 9 months ACA
1.1.3	NRC to provide comments to contractor on TLR 1.1.3 The last PARENT-12 meeting (July 2016) will discuss the Review of Atlas needs, results of gaps analysis and TLR 1.1.3	NLT 1 month after receiving TLR 1.1.3 from PNNL
1.1.4	PNNL to provide draft <u>TLR 1.1.4</u> to NRC on Development of International NDE Program Proposal and Protocol for RR (optional)	NLT 12 months ACA

1.1.4	NRC to provide comments to contractor on TLR 1.1.4 The new Program kick off meeting (November 2016, NRC HQ, DC) will discuss the Review of Atlas needs, results of gaps analysis and TLR 1.1.4 International NDE Program Proposal and Protocol for RR (optional)	NLT 1 month after receiving TLR 1.1.4 from PNNL
1.1.5	Provide WP 1.1.5 analyzing results from preliminary scoping study of International NDE Blind RRTs of BMI Proposal and Protocol with cost estimation (J groove weld optional), this is input to subtask 2.1.1	NLT 15 months ACA
1.1.6	Provide WP 1.1.6 analyzing results from preliminary scoping study of International NDE Open RRTs of CASS Proposal and Protocol with cost estimation (with narrow weld optional), this is input to subtask 2.2.2	NLT 18 months ACA
1.1.7	Provide WP 1.1.7 analyzing results from preliminary scoping study for international NDE RRT proposal for confirmatory narrow gap welds (with narrow weld repairing optional), this is input to subtask 2.3.3	NLT 20 months ACA
1.2	PNNL to provide support for maintaining PARENT teamwork, including but not limited to, preparing materials for semiannual international meetings and coordinating contributions of partners from international institutes (e.g., in Finland, Japan, Korea, Sweden, Switzerland, U.S.)	Throughout 36 month period
2.1.1	PNNL to provide Draft Blind RRT Final <u>TLR 2.1.1</u> for NRR review with improved statistical results (this integrates deliverable from subtask 1.1.5)	NLT 3 months ACA
2.2.1	PNNL to provide the Blind Test Final TLR 2.2.1 to NRC for NRR review with additional analysis of PARENT blind data at the technique level (this integrates deliverable from subtask 1.1.7 about narrow gap welds)	NLT 4 months ACA
2.2.2	PNNL to provide <u>TLR 2.2.2</u> describing the status of additional Open NDE CASS RR testing (optional) and the blind test assessment of open techniques from PARENT. (this integrates deliverable from subtask 1.1.6)	NLT 15 months ACA
2.2.3	PNNL to provide draft <u>TLR 2.2.3</u> discussion implementation of Open NDE CASS RR confirmatory tests (as mentioned previously in subtask 1.1.6)	NLT 24 months ACA
2.3.1	PNNL to provide the Open RRT <u>TLR 2.3.1</u> for NRR review with identification of promising emerging techniques, this is incorporates insights from TLR 1.1.4	NLT 4 months ACA
2.3.3	PNNL to provide draft <u>TLR 2.3.3</u> discussion of implementation of Open NDE Narrow gap welds RR confirmatory tests (as mentioned previously in subtask 1.1.7)	NLT 30 months ACA

2	The Contractor will make a technical presentation on Summary RRT TLRs. The NRC meeting (March 2016) will discuss the Final reports at NRC Headquarters in Rockville, MD.	When the Reports are delivered to NRC, NLT 32 months after contract date
2	PNNL provide all TLRs and WPs from Tasks 1 and 2 to review for compilation as possible NUREG/CR. Deliver 5 hard copies to the NRC COR, in addition to an electronic file.	NLT 2 months after receiving NRC comments
3	PNNL to provide Draft presentation to NRC on Task 1.1.1 and 1.1.2 with Review of NDE Technical Information for Atlas.	NLT 5 months after original contract award
3	PNNL to provide Draft of PARENT Atlas to NRC for review The PARENT 12 meeting (July 2016) will discuss the Review results	NLT 8 months ACA
The following tasks are optional pending outcome of Task 1.1.		
1.1.3	PNNL to provide WP 1.1.3 to NRC based on results from Subtask 1.1.3 concerning <u>specific</u> laboratory experimentation and analytical model development	NLT 9 months ACA
1.1.3	NRC to provide comments to contractor on WP 1.1.3 concerning <u>specific</u> laboratory experimentation and analytical model development	NLT 1 month after receiving WP 1.1.3 from PNNL
1.1.3	PNNL and NRC COR to coauthor conference article concerning <u>specific</u> laboratory experimentation and analytical model development.	NLT 1 month after receiving NRC comments
1.1.4	PNNL to provide <u>TLR 1.1.4, rev 1</u> to NRC on Development International NDE Program Proposal and Protocol to RES for distribution to OIP and NRR	NLT 18 months ACA
1.1.4	NRC to provide comments to PNNL on TLR 1.1.4, Rev 1.	NLT 1 month after receiving draft Report from PNNL
1.1.4	PNNL to publish TLR 1.1.4, Rev 1 concerning International NDE Program Proposal and Protocol. Deliver 10 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 materials engineers who have in-depth knowledge of reactor materials and stress corrosion cracking. The personnel involved should have in-depth experience, knowledge, and demonstrated contributions in the areas of NDE as pertinent to reactor material degradation phenomena. The PNNL staff should be well-versed in the use of NPP ASME B&PV Codes and Standards, Industry Guidance Documents, such as those of NEI, EPRI, NRC's Regulatory Guides Information Notice (IN), Regulatory Issue Summary (RIS), Generic Letter (GL), and Generic Issue (GI) for licensing review by the NRC staff. The PNNL staff should have previous experience working with the ATLAS information tool.

7.0 ESTIMATED LABOR CATEGORIES AND LEVELS OF EFFORT

Task	Labor Category	FY16 (hours)	FY17 (hours)	FY18 (hours)	Total
1	Project Manager	120	120	100	340
1	Senior Key Staff	64	24	24	112
1	Key Staff	160	160	40	360
1	Support Staff	40	40	40	120
2	Project Manager	120	160	180	460
2	Senior Key Staff	36	80	80	196
2	Key Staff	200	400	520	1120
2	Support Staff	40	40	40	120
3	Project Manager	120	120	120	360
3	Senior Key Staff	20	36	16	72
3	Key Staff	40	40	40	120
3	Support Staff	40	40	40	120
	TOTAL	1000	1260	1240	3500

Task Order Labor Breakdown				
Labor Category	FY16 (hours)	FY17 (hours)	FY18 (hours)	Total
Project Manager	360	400	400	1160
Senior Key Staff	120	140	120	380
Key Staff	400	600	600	1600
Support Staff	120	120	120	360
Total	1000	1260	1240	3500

8.0 MEETINGS AND TRAVEL

The PNNL Principal Investigator and one other senior 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. The travel anticipated for this task order is listed in the table below for planning purposes only. All travel is subject to the availability of funds and requires written Government approval from the Contracting Officer (CO), unless otherwise delegated to the COR. Foreign travel for the PNNL personnel requires a 60-day lead time for NRC approval. For prior approval of foreign travel, PNNL shall submit an NRC Form 445, "Request for Approval of Official Foreign Travel." NRC Form 445 is available in the MD 11.7 Documents library and on the NRC Web site at: <http://www.nrc.gov/reading-rm/doc-collections/forms/>. All foreign travel

must be first approved by the NRC Director of the Office of International Programs (OIP) and the Director of RES.

Task Order Anticipated Travel			
Location	Purpose	Travelers	Dates
Washington, DC	NRR/RES Review Meeting in conjunction with RIC 2016, PARENT Atlas demo presentation	2	March, FY16 (2 days)
Zurich, Switzerland	PARENT 12, Switzerland Final program meeting	1	Spring/Summer, FY16 (6 days)
TBD (likely Washington, DC)	International PARENT Follow-on Kick-off Program Meeting	2	Autumn, FY17 (5 days)
TBD, Helsinki, Finland	International Follow-on Program Meeting VTT with STUK/Industry	1	Spring/Summer, FY17 (6 days)
TBD (Seoul, Korea)	International Follow-on Program Meeting; KINS with Industry or Universities	1	Spring, FY 18 (6 days)
TBD (likely Washington, DC)	NRR/RES International Follow-on Program Review Meeting	1	Autumn, FY18 (5 days)

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 Dr. Iouri Prokofiev, the Contracting Officer Representative (COR), and to Stephen E. Cumblidge, the technical monitor, 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, Component Integrity Branch, and 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 36 months from date of agreement award. The expected contract beginning date is October 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. Iouri G. Prokofiev
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Alternate Contracting Officer's Representative

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Office: Office of Nuclear Regulatory Research
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Telephone: (301) 415-2446
Fax: (301) 415-6671

12.0 MATERIALS REQUIRED (TYPE N/A IF NOT APPLICABLE)

N/A

13.0 NRC-FURNISHED PROPERTY/MATERIALS

PNNL shall transfer NRC furnished property and materials acquired under previous contract (i.e., JCN N6593, JCN V6286) to this task order. NRC will provide additional information as necessary and agreed-upon.

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 (Type N/A if not applicable)

1. Braatz, B.G. S.E. Cumblidge, S.R. Doctor, and I.G. Prokofiev, *Primary Water Stress Corrosion Cracks in Nickel Alloy Dissimilar Metal Welds: Detection and Sizing Using Established and Emerging Nondestructive Examination Techniques*, Third International Conference on NPP Life Management (PLiM) for Long Term Operations (LTO) (Proc Conf. Salt Lake City, Utah, 2012) IAEA-CN-194-025
2. EPRI 3002000576, *Long-Term Operations: Assessment of R&D Supporting AMPs for LTO*, Aug. 2013 (80pp).
3. NEI, *Roadmap for Subsequent License Renewal*, Dec. 2013. (45pp)
4. NEI, *Second License Renewal Roadmap*, May 2015. (22pp).
5. NUREG/CR-6923, *Expert Panel Report on Proactive Materials Degradation Assessment*, 2007 (3895pp, ML063520517)

6. NUREG/CR-7019, *Results of the Program for the Inspection of Nickel Alloy Components*, August 2010. (576 pp).
7. NUREG/CR-7153, *Expanded Materials Degradation Assessment*, 5 volumes, October 2014 (861pp)
8. Prokofiev, I.G, S.E. Cumblidge, and S.R. Doctor, *Inspection of Nickel Alloy Welds: Results from Five-Year International Program*, in Review of Progress in Quantitative Nondestructive Evaluation, Vol 30B. 2011, American Institute of Physics, Melville, New York: San Diego, California, p. 1055-1062.
9. SECY-14-0016, *Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal*, January 31, 2014 (25pp)

(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

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

From: Moyer, Carol
Sent: Wed, 20 Sep 2017 18:14:38 +0000
To: Tregoning, Robert
Subject: FW: ACTION: Request for Expeditious Review of the Final Draft Response to the new SLR UNR
Attachments: SLR UNR response 09-19-2017_cem (IF).docx
Importance: High

Rob,

In the DOE meeting today, you mentioned a PNNL report on harvesting prioritization. Did you say it was not yet published? It is referenced in our SLR UNR response (attached), and Steve asked for the ML# to be inserted. I can do that, if there's a watermarked-draft version of it, I suppose. Thoughts?

[Under Task 2] 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" (MLXXXXX).

Also, please feel free to give this another read-through and add any comments that you would like.

Many thanks,
Carol

From: Frankl, Istvan
Sent: Wednesday, September 20, 2017 1:23 PM
To: Seber, Dogan <Dogan.Seber@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>
Cc: Moyer, Carol <Carol.Moyer@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>
Subject: ACTION: Request for Expeditious Review of the Final Draft Response to the new SLR UNR
Importance: High

Dear Colleagues,

As you may know NRR had additional questions/comments after we completed our draft response. These comments have been addressed in the attached draft.

Please review the attachment and send your comments/ revisions, if any, to Carol Moyer and copy me and Amy Hull **by COB tomorrow**.

I would appreciate your quick response.

Thanks,

Steve



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. 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:

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

B. Holian

- 3 -

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

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

OFFICIAL RECORD COPY

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 Cables 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 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 are described in the September 2017 TLR "Criteria and Planning Guidance for ExPlant Harvesting to Support Subsequent License Renewal" \(MLXXXXX\)](#). 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

Commented [F11]: Please add ML# for this TLR.

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

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 (b)(5)	[] for FY 18 and FY 21 [] (b)(5)
Total (Task 1)			[]	[] (b)(5)
2	Develop a strategy for harvesting <u>Ex-Plant</u> materials/components		(b)(5)	(b)(5)
2.A.	Develop an information tool/database	FY 18	[]	[]
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)	<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)

From: Moyer, Carol
Sent: Thu, 19 Oct 2017 20:03:16 +0000
To: Cole, Cassandra
Subject: FW: ACTION: Revised Draft Response to SLR UNR
Attachments: Response to User Need Request NRR-2017-006 (002).response BT comments
abh (IF) EMF cem (IF).docx
Importance: High

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

Email concurrence from S. Frankl.

From: Frankl, Istvan
Sent: Thursday, October 19, 2017 3:29 PM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: ACTION: Revised Draft Response to SLR UNR
Importance: High

Thanks, Carol.

The memo is OK and I have only two minor fixes for Table 1 in the attached Enclosure.

I concur with the memo and the revised enclosure. Please return this package into concurrence review/approval.

As discussed, Amy can concur by email.

Steve

From: Moyer, Carol
Sent: Thursday, October 19, 2017 2:33 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: RE: ACTION: Revised Draft Response to SLR UNR
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) [REDACTED] 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?

Package Name: RESPONSE TO USER NEED REQUEST FOR RESEARCH ASSISTANCE ON
POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT PERIOD
OF EXTENDED OPERATION: NRR-2017-006
Accession Number: ML17227A483

Package Properties

Paste into Package Add Document Unfile View Profile Download Check Out Refresh Close

	Name	Accession Number	Official Record?	Availability	Document Date	ADAMS Date Added
	SLR UNR response 08-14-2017 cln (002).docx	ML17227A484	No	Non-Publicly Available		Aug 15, 2017 3:00 PM
	Response to User Need Request NRR-2017-006.docx	ML17227A485	No	Non-Publicly Available		Aug 15, 2017 3:00 PM

There are 2 Documents in this Package

Page 1 of 1

Reorder

<https://adamsxt.nrc.gov/AdamsXT/packagecontent/packageContent.faces?id={355A2500-E6F3-4E19-A8D8-C627FDDE9FFB}&objectStoreName=MainLibrary&wId=1506629912784>

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	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 have RES to perform confirmatory evaluation and support ASME code case on new EPRI IASCC crack growth rate curves. Funding Contract: (b)(5) FY17: [redacted] FY18: [redacted] [redacted] and FY19: [redacted] (b)(5) FTEs: FY17: [redacted] FY18: [redacted] and FY19: [redacted] (b)(5) (b)(5)
NRR-2014-007 ML14126A818 ✓ RES Response to NRR-2014-007 ML14212A127 (package) ✓	Reactor Pressure Vessel Integrity Issues	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: \$: [redacted] FY15: [redacted] FY16: [redacted] FY17: [redacted] FY18: [redacted] FTEs: FY16: [redacted] FY17: [redacted] FY18: [redacted] (b)(5)
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	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. Accelerated aging of the cable samples is expected to commence toward the end of FY2017. 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: [redacted] (b)(5) Prior FY total: [redacted] FY16: [redacted] FY17: [redacted] FY18: [redacted] FY19: [redacted] FY20: [redacted] FTEs: Prior FY total: [redacted] FY16: [redacted] FY17: [redacted] FY18: [redacted] FY19: [redacted] FY20: [redacted] (b)(5)
NRR-2012-004 ML12109A324 ✓ RES Response to NRR-2012-004 ML12152A107 ✓	Alkali-Silica Reaction (ASR) Research	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: [redacted] FY15: [redacted] FY16: [redacted] FY17: [redacted] FTEs: FY14: [redacted] FY15: [redacted] FY16: [redacted] FY17: [redacted] (b)(5)
NRR-2015-007 ML15076A217 ✓ RES Response to NRR-2015-007 ML15229A100 ✓	Effects of Irradiation on Concrete Structures	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: [redacted] FY17: [redacted] FY18: [redacted] FTEs: FY16: [redacted] FY17: [redacted] FY18: [redacted] (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.

Commented [IF5]: Same as above

Commented [CM6R6]: Confirmed with UNR response.

Commented [IF7]: Same as above

Commented [IF8]: Same as above

Commented [CM9]: Input from T. Koshy

Commented [IF10]: Same as above.

Commented [CM11R11]: Input from J. Philip & D. Seber

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 \$
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) year	(b)(5) for FY 18 and FY 21
Total (Task 1)			(b)(5)	(b)(5)
2	Develop a strategy for harvesting Ex-Plant materials/components		(b)(5)	(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)	(b)(5)
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	(b)(5)	(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))	(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)	(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))	(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)

From: Hiser, Matthew
Sent: Wed, 6 Sep 2017 13:39:31 +0000
To: Tregoning, Robert
Subject: FW: Action: Rewrite in response to Feedback on UNR Response Task 2

FYI

From: Hiser, Matthew
Sent: Tuesday, September 05, 2017 2:23 PM
To: Hull, Amy ; Purtscher, Patrick
Cc: Frankl, Istvan ; Moyer, Carol
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

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: 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

Senior Materials Engineer
 RES/DE/CMB (office T10-D49)
 US Nuclear Regulatory Commission
 11545 Rockville Pike
 Rockville, Maryland 20852
 Telephone: (301) 415-2435
 FAX: 301-415-6671
 e-mail: amy.hull@nrc.gov

From: Purtscher, Patrick
Sent: Mon, 9 Jul 2018 12:34:58 +0000
To: Hiser, Matthew
Subject: FW: Cost estimate

We should talk today.

Pat

From: Ramuhalli, Pradeep [mailto:Pradeep.Ramuhalli@pnnl.gov]
Sent: Tuesday, July 03, 2018 3:38 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: [External_Sender] Cost estimate

Pat,

As we discussed last week, the new tasking for assembling the database of available harvested materials at PNNL could use additional funds. A ballpark cost estimate for this effort is about [REDACTED] though the (b)(4) exact value will depend on the specifics of the scope. Let me know if you have any questions on this.

Please note that the material contained herein, including the cost estimate, is submitted for informational purposes and is not binding on Pacific Northwest National Laboratory or the U.S. Department of Energy. Binding commitments can only be made by the submission of a formal proposal that sets forth a specific statement of work, estimated cost, and that is signed by a Pacific Northwest National Laboratory Contracts Representative and approved by the U.S. Department of Energy.

With best regards,

Pradeep

Pradeep Ramuhalli, PhD
Senior Research Scientist,
Applied Physics Group
Pacific Northwest National Laboratory
902 Battelle Blvd.
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Richland, WA 99352
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<http://www.pnnl.gov>

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

From: Moyer, Carol
Sent: Wed, 29 Aug 2018 15:20:29 +0000
To: Frankl, Istvan
Cc: Tregoning, Robert
Subject: Consolidated list of Recommendations for DOE Engagement
Attachments: NRC DOE Engagement List 20180829.docx

Steve,

The attached document consolidates the lists of topics and "research asks" for DOE from our internal meetings. Please review, as this is the focus of tomorrow's meeting with DE management.

Thank you,
Carol

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

NRC – DOE Engagement Recommendations & Requests

In cooperation with the LWRS Materials Aging and Degradation (MAaD) Pathway:

Reactor Internals

- Overarching request – identify opportunities to have meaningful input on the objectives for research pursued by DOE. Our staff recommends that we agree with DOE on several topics of mutual interest, and both organizations fund research (to different levels), so that we can have more meaningful engagement.
- Further irradiation of ex-plant welds harvested from Zorita reactor
 - Further irradiation of these materials is sought up to ~5 and ~8 dpa followed by mechanical testing, including crack growth rate and fracture toughness
 - Target irradiation from 2020 – 2022 with 5 dpa testing beginning in 2021 and 8 dpa testing in 2023.
 - Seeking DOE contribution of [redacted] along with NRC and EPRI cooperation to assure effective program (b)(5)
- Environmentally Assisted Fatigue (EAF) of Irradiated Stainless Steel
 - NRC seeks to plan a joint testing program with material irradiated up to ~10 dpa, over a multi-year period, with NRC and EPRI cooperation to assure an effective program.
- Irradiation-Assisted Stress Corrosion Cracking (IASCC) and Void Swelling of Highly-Irradiated Stainless Steel
 - Irradiation of stainless steel plate material is sought, in excess of 50 dpa, followed by material evaluation of SCC crack growth rate and void formation, and post-irradiation examination of microstructure.
 - We request that DOE significantly leverage facilities, expertise, and direct costs. Detailed cost and schedule information would be developed as a part of the collaboration. However, it is expected that such a program would be resource (b)(5) intensive [redacted] and require a multi-year [redacted] effort. (b)(5)
- Stress Corrosion Cracking Mechanisms in Nickel-base Alloys
 - The meeting participants expressed that there is a gap in understanding of SCC in Ni-base alloys subject to irradiation.
- Mechanistic Modeling of Environmentally Assisted Fatigue
 - NRC staff questioned what experimental work is planned for validation of the mechanistic model.
- Long-Term Thermal Aging of Cast Austenitic Stainless Steel (CASS) and Austenitic Stainless-Steel Welds (ASSW)
 - NRC staff recommends that DOE integrate findings of previous Government-supported research on CASS and ASSW into the current work.
- Evaluation of Ex-Service Baffle Former Bolts
 - NRC staff suspects that cracking in baffle former bolts (BFBs) is likely related to corrosion fatigue, not IASCC (focus of the DOE work). This research could be valuable in assessing competing theories of the underlying mechanisms of failure among the NRC, DOE, and industry.
- Modeling Radiation-Induced Swelling
 - As a regulator, NRC needs to document a more validated relationship between voids and mechanical properties. The modeling work described is of the sort that NRC might support with a grant, but it is not a priority for collaborative research.

Reactor Pressure Vessels (RPV)

- Low-temperature irradiation effects
- Validity of mini-CT fracture toughness tests
- Fluence modeling beyond the beltline region
- Properties modeling, e.g., using GRIZZLY; validating with experimental data
- Identifying and harvesting relevant RPV materials for benchmarking data
- Experimental plans and results from the ATR experiment, including embrittlement trend modeling

Concrete

- Effects of irradiation on steel-concrete bond strength
 - Expanded study that builds on the NRC limited scope study to establish steel-concrete bond degradation trends, verify repeatability, and reduce uncertainties
- Harvesting and testing of concrete samples from decommissioned NPPs to verify radiation damage and for confirmatory research on:
 - Validating predictive models based on accelerated aging studies using empirical data from concrete aged in the field with in-situ radiation fields, temperature and other environmental conditions
 - Evaluating concrete radiation gradients and damage in the biological shield
 - Irradiating harvested cores to higher fluence
- Improvement of aging management strategies – Access to the RPV supports and CBS structures is very limited and development of suitable inspection methodologies would be advantageous
 - Development of suitable inspection strategies including detection of direct and indirect evidence of degradation
 - Development of monitoring technologies using, for example, remotely controlled instruments and NDE.
- Irradiation effects on structural steel and rebar (carbon steel)
 - Start with literature review of existing studies and understanding
 - Harvesting and testing of harvested steel components for laboratory examination
- Risk-informed aspects of irradiation effects on the RPV support structures and CBS (under the RISMIC program)
- Modeling of concrete damage mechanisms
 - Modeling of cement paste under irradiation to include creep effects (likely to involve irradiation testing of cement paste)
 - Modeling of concrete material damage combining cement and aggregate damage (may need further irradiation testing of aggregates)
- Concrete models for structural analysis and incorporation in DOE structural analysis codes

Cables

- DOE has invited NRC input on experimental test plans for cable aging, including synergistic effects of thermal and radiation aging, compared with sequential exposures.
- DOE work on activation energy will complement NRC's planned work.
- The actual radiation dose rate in NPPs is a knowledge gap. DOE and NRC are doing some modeling, but both look to EPRI for detector data.

Additional “research asks” from ICEEB input to RES FO for DOE engagement:

- Research is needed to confirm that safety related cables in nuclear power plants operating beyond 60 years of operation have sufficient margin and will continue to perform their intended safety function during and after a design basis accident. The NRC also wishes to better understand the extent to which uncertainties could have a detrimental effect on the environmental qualification of safety related cables beyond 60 years of plant operation.
 - Assessment of Condition Monitoring Methods for medium voltage cable in harsh environment with aging (including electrical stressor degradation) and accident testing.
 - Assessment of Condition Monitoring Methods for low/medium voltage cable in mild environments.
 - Studies involving degradation of mild environment Class 1E 4160V and 480 distribution equipment (breakers, relays, switches, etc.,) with thermal and cyclic aging to determine if such components can be relied on to perform their intended safety function beyond vendor recommended design/service life.

In cooperation with the LWRS Risk Informed Systems Analysis (RISA) Pathway:

- Fragility and performance of flood-resistant features (doors, seals, etc.) in NPPs.
 - Experimental testing of flooding barriers to refine testing procedures
 - Harvesting of flooding barriers from decommissioning plants
 - If harvesting is not feasible, in-situ testing of flooding barriers

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

From: Moyer, Carol
Sent: Fri, 11 Aug 2017 16:01:16 +0000
To: Frankl, Istvan
Cc: Hull, Amy
Subject: RE: SLR UNR Response, 8/10/17, 4:55 PM
Attachments: SLR UNR response 08-07-2017 jap jp kam cem.docx, SLR UNR response 08-11-2017.docx

Steve,

The updated response (w/ today's date), as well as the preceding mark-up, are attached to this message for your review. Let me know if you have any questions on this. Meanwhile, I will ask the AAs to put the draft into ADAMS.

Carol

From: Frankl, Istvan
Sent: Friday, August 11, 2017 11:13 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: SLR UNR Response, 8/10/17, 4:55 PM
Importance: High

Carol,

Amy is on concurrence, so she should definitely review the final draft.

(b)(6)

(b)(6)

My recommendation is that once you get input from Kenn Miller, ask the AA to prepare concurrence package that Amy can review/initial on Monday. I will do my part on Tuesday.

Should I review the draft you sent yesterday or should I wait for the update with Kenn's additions?

Thanks,

Steve

From: Moyer, Carol
Sent: Thursday, August 10, 2017 5:01 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>
Subject: SLR UNR Response, 8/10/17, 4:55 PM

Steve,

The latest version of the UNR response is attached (& also on G:), incorporating SGSEB comments. If possible, I would like Amy to look at the way I addressed their suggestions. If you

want to deliver it to Brian tomorrow, however, I will finalize the comments (i.e., clean up some "multiple choice" suggestions). Let me know tomorrow, please.

As we discussed, your comments have already been addressed, and CIB had no comments. ICEEB comments are still pending (I have not received a response from Kenn Miller yet today). As soon as I do get something, I will fold in those comments. From what I understand, they propose to add one or two examples of specific activities, similar to those now in the document: IFRAM, HRP, ODOBA.

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

August 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 this UNR 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.
- **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.

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 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

B. Holian

- 3 -

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	/ /2017

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NAME	D. Seber	B. Thomas	K. Johnson	M. Weber	
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 a workshop, conference, symposium, or meeting), one in early autumn 2018 on mechanical issues and one in late spring 2020 on concrete and cables issues. 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, 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. 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.

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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 intent is for this information tool and its Excel precursor is to be a living document that can be updated to reflect the latest operating experience and research, so that users may understand which data needs may be best addressed by harvesting. RES will provide the information tool precursor for NRR review. RES also will submit to NRR a companion Technical Letter Report (TLR) that will document:

- how, if applicable, each of the significant issues can be best addressed through harvesting.
- the process to evaluate samples from nuclear plants and their suitability for harvesting.
- processes for harvesting and testing of harvested materials and components, and
- harvesting priorities for each significant issues, as applicable.

This TLR will closely relate to the information tool contents and have standalone parts for each of the four significant issues in the SRM, as applicable.

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.

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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

Commented [PJ1]: Maybe this part could first address what is applicable to all issues and then illustrate it with examples for some issues (in this case concrete and stainless steel).

Commented [CM2R2]: Agreed. In response to this suggestion, I propose moving the last paragraph of this section up to the 2nd paragraph position. By creating a new 2nd paragraph, instead, the SGSEB comment introduces redundancy and implies an additional TLR, causing some confusion.

Commented [CM3]: Recommend rejecting this inserted text.

Commented [CM4]: I agree with the SGSEB comment to make a general statement, followed by the specific CNSC example. But something else is needed in the first sentence. Proposals: "...from discussions with regulatory counterparts on the potential..." or, "...from discussions with international counterparts on the potential..."

conducted under UNR NRR-2017-001.

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Commented [CM5]: Supplied by K. Miller, 8/10/17

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 ~~will continue to develop~~pursues domestic and international partnerships to share expertise, capabilities and resources related to aging management research for LTO. These

exchanges are critical for the confirmatory review 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 nurturecultivate 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. RES will continue to nurture 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.—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 will continue to nurture emerging domestic and international partnerships and will continue to develop those partnerships, as well as other suitable opportunities that may emerge to address aging degradation issues.—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), the OECD Halden Reactor Project (HRP), and many others. For example, 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.

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 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

Commented [CM6]: I think this is not the best word here. In our review function, we are not confirming, we are assessing, evaluating, appraising, judging the industry safety case, including underlying research.
Proposals: Delete “confirmatory,” or, “...critical for the review and assessment of industry research...,” or, “...critical for evaluation of industry research...”

Commented [CM7]: “Nurture” sounds like it applies to existing partnerships (keeping them going), but the word “emerging,” and later, “existing,” makes a distinction between future and present programs mentioned in this sentence.
The 1st half of this sentence may not be necessary, since the following sentence says we will build on existing partnerships with new ones.

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 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. Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [REDACTED] year (b)(5) 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.

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, 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 \$
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) year	(b)(5) for FY 18 and FY 21 (b)(5)
Total (Task 1)			(b)(5)	(b)(5)
2	Develop a strategy for harvesting materials/components from decommissioned plants			
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 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))	

Total (Tasks 1-4, over 4 years)	(b)(5) <div></div>	(b)(5) <div></div>
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 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 this UNR 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.
- **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.

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 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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NAME	D. Seber	B. Thomas	K. Johnson	M. Weber	
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](#)).

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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 2020.

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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.

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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 OECD Halden Reactor Project (HRP), the International Forum on Reactor Aging Management (IFRAM), and many others. For example, 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.

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 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 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. Based on the latest assessment of projected needs in this area, RES proposes that the estimate of [redacted] year (b)(5) 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.

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, 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 \$
1	Hold NRC/industry workshops (est. 2018, 2020) and prepare NUREG/CP and summary reports on four SRM topics	FY 21	(b)(5) [redacted]/year	[redacted] for FY 18 and FY 21 (b)(5)
Total (Task 1)			[redacted] (b)(5)	[redacted] (b)(5)
2	Develop a strategy for harvesting materials/components from decommissioned plants			
2.A.	Develop an information tool/database	FY 18	[redacted] (b)(5)	[redacted] (b)(5)
2.B.	Develop a process to evaluate plant components	FY 18	[redacted] (b)(5)	
2.C.	Use the process from 2.B. to evaluate the suitability of plant components	FY 19	[redacted] (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)	
Total (Tasks 1-4, over 4 years)			[] (b)(5)	[] (b)(5)

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

From: Frankl, Istvan
Sent: Wed, 25 Jul 2018 14:01:51 +0000
To: Moyer, Carol
Subject: RE: SLR meeting references
Attachments: Response to User Need Request NRR-2017-006 response 20171024.docx
Importance: High

Sorry, I did not answer your last question.

I meant Table 1 on page 6 from the RES response to the SLR UNR. (Attached the enclosure that has the table.). You can also show Chris a summary version of this info if you wish.

Thanks,

Steve

From: Frankl, Istvan
Sent: Wednesday, July 25, 2018 9:54 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: SLR meeting references

Thanks, Carol.

Regarding "version control" I have attached the last version of the exec table I have in my SLR folder. Did you start revising this version for today's briefing?

Steve

From: Moyer, Carol
Sent: Wednesday, July 25, 2018 9:45 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: SLR meeting references

Hi Steve,
Thank you for the comments. I'll respond to questions below.
-Carol

From: Frankl, Istvan
Sent: Wednesday, July 25, 2018 9:22 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: SLR meeting references
Importance: High

Carol,

Good plan. I have a few questions/ comments:

1. Are the exec table and the SLR briefing file the only two documents that you updated/ revised?
Yes.
2. Regarding the exec table, I noticed that AM is back as an open sub-issue under Vessel Internals. I thought Brian did not want AM discussed under the SLR topic as an “open issue” but for now, leave it as is. (Obviously there is synergism for SLR in terms of replacement components).
Agreed, and I will concede this point. Partly it's a version control problem, and partly I left it in there just for discussion today. I do not intend to include that topic in inter-office communications on SLR.
3. The IAD UNR supports all work under Vessel Internal (sub-issues 1 – 4) , not just sub-issue 1, so this UNR could be shown right next to “Vessel Internals”. **OK**
4. Did Matt/Sri review “Remaining Work” under Vessel Internals? Some info may be missing. (You can follow up on this after the briefing.)
I used their input in updating the table, but I have some uncertainty about version control that I could not sort out last night. This is another reason for the “work in progress” disclaimer in the header!
5. Although several technical UNRs are supporting SLR, I noticed that only a few are shown in the exec table. Is this because work on others were completed? **No, they should be included where relevant. I'll continue working on this.**
6. I recommend that you also leave with Chris the printout of the table from the response to the SLR UNR that lists all technical UNRs with associated budgets and FTEs.
Do you mean the Excel table that I used to get the numbers in the speaker note for Brian's Commissioner briefing slide? Again, I am not fully satisfied with data quality on that, but I can bring it to the discussion for reference.

Thanks,

Steve

From: Moyer, Carol
Sent: Wednesday, July 25, 2018 8:38 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: SLR meeting references

Hi Steve,

I plan to bring the attached references and examples with me to the discussion with Chris today on SLR/LTO research. I plan to focus on the Exec Summary Table and the SLR Briefing (6 pg, detailed) documents.

Carol

*Carol Moyer
Sr. Materials Engineer*

RES/DE/CMB
301-415-2153

carol.moyer@nrc.gov

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

Enclosure

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.

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 to prioritize limited resources to provide best value for harvesting. The database is not an end unto itself, but the means to pursue high 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: 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.

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: 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>(b)(5) (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] 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>(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) 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) Prior FY total - [redacted] FY18 - [redacted] FY19 - [redacted] FY20 - [redacted] (b)(5) 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) (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) (b)(5) (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] (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	(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)

¹ Note that the resources associated with this UNR include RES/DE/SGSEB (b)(5) FTE/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.