

Note to requester: Attachments to this email are immediately following.

From: [Hiser, Matthew](#)
To: [Frankl, Istvan](#)
Subject: FW: Harvesting Workshop
Date: Monday, January 23, 2017 4:19:00 PM
Attachments: [Harvesting Workshop intro slides 1-23-17.pptx](#)
[Workshop Planning 1-23-17.docx](#)

From: Hiser, Matthew
Sent: Monday, January 23, 2017 12:18 PM
To: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: Harvesting Workshop

Hi Rob and Pat,

Thank you for meeting this morning to discuss the latest on the harvesting workshop planning.

I have updated the workshop planning document and the intro slides (attached). Please take a look at the slides and provide edits.

Action Items:

- Matt: follow-up with Energy Solutions, Dominion, ENSI, Ahluwalia, AV/transcription
- Rob: Follow-up with GRS, MAI, JNRA/CRIEPI
- Rob and Pat: review slides and provide feedback

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

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

From:

Sent: Wednesday, January 18, 2017 9:05 AM

To: Hiser, Matthew; Tregoning, Robert; Purtscher, Patrick

Subject: Harvesting Workshop

When: Monday, January 23, 2017 9:00 AM-10:00 AM (UTC-05:00) Eastern Time (US & Canada).

Where: HQ-TWFN-10A73-8p

Adding latest workshop planning document and draft workshop intro slides.

Following my call with DOE and EPRI last week and additional contacts we've made, let's look at the agenda and try to finalize speakers for each slot.

<< File: Workshop Planning 1-17-17.docx >> << File: Harvesting Workshop intro slides.pptx >>

Ex-Plant Materials Harvesting Workshop

March 7-8, 2017

USNRC HQ

Rockville, MD, USA

Motivation

- With plants shutting down both in the U.S. and internationally, there are increasing opportunities to harvest components from decommissioning plants
 - Past harvesting efforts generally more reactive and ad hoc as opportunities arose, rather than proactively planned
- Ex-plant materials are valuable because they have been exposed to actual in-service plant operating conditions
 - Reduces the uncertainty associated with the applicability of the aging conditions
- Insights from research on harvested materials can address technical data needs identified for extended plant operation
- Lessons learned from past harvesting programs can help improve future harvesting efforts
 - Challenges encountered in previous programs can be shared and mitigated or avoided in future programs

Approach

- Domestic and international researchers, industry, regulators, and decommissioning companies' discuss benefits and challenges with ex-plant harvesting
 - Encourage sharing of lessons learned as well as areas of common interest for potential new research programs
- Workshop consists of topical sessions with short presentations and significant time for open discussion
 - Goal is to maximize engagement among all meeting participants, rather than presenter/audience mentality
- Scope includes any materials aging issue that could benefit from harvesting: metals, cables, and concrete

Expected Outcome

- Participants are better informed and aware of the benefits and challenges associated with ex-plant harvesting
- Discussions help identify areas of common interest for harvesting to address technical data needs
- Presentations and discussions provide the starting point for a “database” of harvested materials and future harvesting opportunities
- Contacts are made among research organizations to allow for further discussion of specific harvesting projects

Session Expectations

- Session 1 Motivation for Harvesting
 - Perspective from panel participants on their organizations' interest in and motivation for harvesting
 - Brief (5-10 minute) presentation from each panel member followed by open and panel discussion
- Session 2 Technical Data Needs for Harvesting
 - Presenters share high-priority data needs that are best addressed by harvesting from their organization's perspective
 - Where does harvesting hold particular value compared to other sources of technical data
 - 15-20 minute presentations followed by open discussion of technical data needs for harvesting

Session Expectations

- Session 3 Sources of Materials
 - Information on previously harvested materials and future harvesting opportunities
 - Materials in “boneyards” at research and vendor facilities
 - Decommissioning plants that may allow for future harvesting
 - Short 5-10 minute presentations followed by open discussion
 - Starting point for potential database of previously harvested materials and future harvesting opportunities
- Session 4 Harvesting Experience: Lessons Learned and Practical Aspects
 - Forward-looking lessons learned from past harvesting programs
 - Pitfalls to avoid and strategies to improve likelihood of success
 - Practical perspective from non-researchers on how harvesting interfaces with the decommissioning process
 - International decommissioning and harvesting experience
 - 20-30 minute presentations followed by open discussion

Session Expectations

- Session 5 Future Harvesting Program Planning
 - Technical and logistical information needed when planning a specific harvesting program
 - Perspective from panel participants on their organizations' future harvesting planning
 - Next steps and actions from workshop
 - Potential areas of common interest for future harvesting programs
 - Brief (5-10 minute) presentation from each panel member followed by open and panel discussion

Workshop Contacts

Name	Organization	Email	Contact Through
Naoki Soneda	CRIEPI	soneda@criepi.denken.or.jp	Rob
Rachid Chaouadi	SCK-CEN	rachid.chaouadi@sckcen.be	Rob
Kazunobu Sakamoto	JNRA	kazunobu_sakamoto@nsr.go.jp	Rob
Gerry van Noordennen	Energy Solutions	gpvannoordennen@energysolutions.com	Pat/Tom R.
Chuck Tomes	Dominion	charles.a.tomes@dom.com	Matt
Sherry Bernhoft	EPRI	sbernhof@epri.com	
Robin Dyle	EPRI	rdyle@epri.com	
Jean Smith	EPRI	jmsmith@epri.com	
Al Ahluwalia	EPRI	kahluwal@epri.com	
Tom Rosseel	DOE	rosseeltm@ornl.gov	
Rich Reister	DOE	Richard.Reister@nuclear.energy.gov	
Keith Leonard	DOE	leonardk@ornl.gov	
Mikhail A. Sokolov	DOE	sokolovm@ornl.gov	
Leo Fyfeld	DOE/PNNL		
Pat Purtscher	NRC	Patrick.Purtscher@nrc.gov	
Rob Tregoning	NRC	Robert.Tregoning@nrc.gov	
Matt Hiser	NRC	Matthew.Hiser@nrc.gov	
Anders Jenssen	Studsvik	anders.jenssen@studsvik.se	Matt/Jean
Daniel Tello	CNSC	daniel.tello@canada.ca	Matt
Heather Malikowski	PWROG	Heather.Malikowski@exeloncorp.com	Matt
Jim Molkenhuth	PWROG	molkenjp@westinghouse.com	Matt
Regis Nhili	MAI	regis.nhili@edf.fr	Rob
Uwe Jendrich	GRS	Uwe.Jendrich@grs.de	Rob
Pradeep Ramuhalli	PNNL	Pradeep.Ramuhalli@pnnl.gov	

Session	NRC Lead	DOE Lead	EPRI Lead
1	Rob Tregoning	Rich Reister	Sherry Bernhoft/Robin Dyle
2	Pat Purtscher	Keith Leonard (ORNL)	Sherry Bernhoft/Robin Dyle
3	Matt Hiser	Tom Rosseel (ORNL)	Sherry Bernhoft/Robin Dyle
4	Matt Hiser	Tom Rosseel (ORNL)	Sherry Bernhoft/Robin Dyle
5	Rob Tregoning	Rich Reister	Sherry Bernhoft/Robin Dyle

NRC Presentations

Session	Topic	Speaker
1	Why our organization is interested in harvesting	Tregoning
2	Overview of data needs best addressed by harvesting	Pradeep / PNNL
3	Available materials from decommissioning plants and past harvesting programs	Hiser
4	Perspective on Harvesting Lessons Learned / Prior Experience	TBD
5	Technical information needed for informed harvesting decisions	Pradeep / PNNL
5	Perspective on future harvesting planning	Tregoning

Session	Topic	Organization	Speaker	Status
1	Why our organization is interested in harvesting	EPRI		
		DOE	Rich Reister	
		NRC	Robert Tregoning	
		MAI		Emails exchanged
		JNRA/CRIEPI/JAEA		Emails exchanged
	PANEL DISCUSSION			
2	Overview of data needs best addressed by harvesting	PNNL (for NRC)	Pradeep Ramuhalli	
	Perspective on detailed data needs from harvesting	EPRI		
		DOE	Keith Leonard	
		SCK-CEN	CNSC?	Emails exchanged
		JNRA/CRIEPI/JAEA		Emails exchanged
3	Available materials from decommissioning plants and past harvesting programs	NRC	Matt Hiser	
	Available materials from operating reactors and past harvesting programs	EPRI		
	Available materials at DOE labs from past harvesting programs	PWROG		Emails exchanged
		DOE	Tom Rosseel	
	Upcoming decommissioning sites	Energy Solutions	Gerry van Noordennen	Contact through Tom R.
	International sources of materials	MAI		Emails exchanged
		JNRA/CRIEPI/JAEA		Emails exchanged
4	Perspective on Harvesting Lessons Learned / Prior Experience	Korea		Need to work w/ Ahluwalia
		EPRI		
		DOE	Tom Rosseel	
	Decommissioning process and harvesting: schedule, site-specific, timing for different components	NRC		
	Utility-Owner perspective on harvesting and decommissioning	Energy Solutions	Gerry van Noordennen	Contact through Tom R.
		Dominion or Exelon		Emails exchanged
	International decommissioning and harvesting experience	Germany?		Emails exchanged
5	Technical information needed for informed harvesting decisions			
	Perspective on future harvesting planning	PNNL (for NRC)	Pradeep Ramuhalli	
		EPRI		
		DOE	Rich Reister	
		NRC	Robert Tregoning	
		MAI		Emails exchanged
		JNRA/CRIEPI/JAEA		Emails exchanged
	PANEL DISCUSSION			
	Discussion of Next Steps / Actions			

Note to requester: Attachments to this email are immediately following.

From: [Salley, MarkHenry](#)
To: [Koshy, Thomas](#); [Hiser, Matthew](#)
Cc: [Taylor, Gabriel](#); [Melly, Nicholas](#); [Stroup, David](#); [Gonzalez, Felix](#); [Thaggard, Mark](#); [Cheok, Michael](#)
Subject: FW: Harvesting Workshop
Date: Wednesday, February 22, 2017 4:33:43 PM
Attachments: [NRC Technical Data Needs for Harvesting.pptx](#)
[NRC Perspective on Harvesting Experience and Lessons Learned.pptx](#)
[Sources of Materials.pptx](#)
[image001.jpg](#)
[image002.jpg](#)
Importance: High

Tom,
Thanx for bringing this to my attention!!
Matt,
Couple points:

- 1) For your success story, we had a very important one, and that is the Zion Bus duct Gabe Taylor procured a couple years ago from Zion Solutions through Oak Ridge Nat. Labs. Testing the duct in our International High Energy Arc Fault (HEAF) program illustrated the problems with Aluminum HEAFs and is now going through the Generic Issues program. Please see Nick Melly and he can show you the test video.
- 2) There is a large number of items we could use for further testing, namely, any Electrical component (Bus duct, switchgear, etc.) containing aluminum or aluminum clad components. Switchgear and other assorted electrical enclosures for HRR testing. Installed electrical cables protected with fire retardant coating.

Gabe, could you please take the lead for our branch and contact Matt to discuss?
Please let me know if you require any additional information from me.

Thanx

MHS

Mark Henry Salley P.E.

Chief, Fire and External Hazard Analysis Branch (FXHAB)

U.S. Nuclear Regulatory Commission

Office of Nuclear Regulatory Research

Division of Risk Analysis

Washington, D.C. 20555-0001

Mail Stop: TWFN-10A12

Telephone: (301) 415-2474

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E-Mail: markhenry.salley@nrc.gov

From: Koshy, Thomas

Sent: Wednesday, February 22, 2017 2:28 PM

To: Salley, MarkHenry <MarkHenry.Salley@nrc.gov>

Subject: FW: Harvesting Workshop

[Get into the process](#)



Thomas Koshy,

Email: Thomas.Koshy@nrc.gov

Note to requester: The two images above Thomas Koshy's name did not save when uploaded into NRC's redaction software. The images are a photo of Thomas Koshy and the NRC seal.

Tel: Number: 301-415-2154
Room no: TWFN-10B48
MS TWFN-10A36
Instrumentation, Controls & Electrical Engineering Branch
Division of Engineering, Office Of Research,
USNRC

Note to requester: The yellow highlighted portions were on the document as they were provided to the NRC FOIA staff.

From: Hiser, Matthew

Sent: Wednesday, February 22, 2017 8:36 AM

To: Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>

Subject: Harvesting Workshop

Hi Mita and Tom,

Just to follow up from our discussions yesterday, I've attached the slides for the 3 presentations in Sessions 2-4 of the workshop. The slides are fairly brief and intended to quickly lay out our ideas and input, but leave plenty of time for discussion.

For data needs and sources of materials, please fill in any additional input you have for electrical or concrete topics. For harvesting experience and lessons learned, please take a look and add any additional insights you think we should include in our presentation.

I've also copied below the expectations we have provided to participants for each session for your reference and awareness:

- Session 2 Technical Data Needs for Harvesting
 - Presenters share high-priority data needs that may be best addressed by harvesting
 - Where does harvesting hold particular value compared to other sources of technical data
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 - Information on previously harvested materials and future harvesting opportunities
 - Materials located at research and vendor facilities
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 - Pitfalls to avoid and strategies to improve likelihood of success
 - Practical perspective from non-researchers on how harvesting interfaces with the decommissioning process
 - International decommissioning and harvesting experience
 - 20-30 minute presentations followed by open discussion

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

NRC Perspective on Harvesting Experience and Lessons Learned

NRC Harvesting Experience

- RPV materials
 - Shoreham, Midland
- Reactor vessel head CRDM penetrations
 - North Anna, Davis-Besse
- Pressurizer from St. Lucie
- Piping from VC Summer, NMP, Oconee
- Reactor internals from Zorita
 - Joint harvesting and testing project with EPRI and international
- Neutron absorbers from Zion
 - Harvesting coordinated with DOE and EPRI; Independent NRC testing
- Concrete from Zorita
- Cables from Zion and Crystal River

Previous Benefits of Harvesting

- Reduce unnecessary conservatism
 - Flaw distributions and Master Curve information came from harvested materials to support PTS rule
- Understand in-service flaws
 - Mockups for NDE qualification
 - Leak rate methodology from studying in-service flaws

Technical Lessons Learned

- Harvesting can provide highly representative aged materials for research
 - May be only practical source of representative aged materials, particularly if irradiation and temperature are important factors
 - Achieving high fluence levels with representative irradiation conditions through other means is very challenging
 - May be able to use limited harvested materials to validate larger accelerated aging data set
- Important to gain as much information as possible in advance before committing to specific harvesting project
 - Ideally a bounding, yet broadly representative, material/environment
 - Understand material information (CMTRs if available) and plant operating conditions

Logistical Lessons Learned

- Harvesting is an expensive, time-consuming effort
 - Must balance cost with potential benefits carefully
 - High technical relevance of materials is needed to ensure value
- Leveraging resources with other research organizations helps mitigate cost challenges
 - Can introduce challenges for testing when aligning research priorities and interests of multiple organizations
 - May be needed, particularly for expensive testing of irradiated materials
- Transporting irradiated materials, particularly internationally, is cumbersome and time-consuming
 - Avoiding extra transport, especially between countries, is highly recommended

NRC High-Priority Data Needs for Harvesting

Metals

- Selected areas of interest for harvested materials:
 - High fluence reactor internals
 - >50 dpa 304 SS from high core outlet temp plant
 - Bounding temperature and high fluence for void swelling
 - Thermally aged unirradiated CASS
 - >30 years at ~320°C; Validate accelerated aging data
 - Moderate fluence (1-2 dpa) CASS
 - Bolster technical basis for embrittlement in this fluence range

Metals

- RPV
 - High fluence vessel with relatively high levels of minor alloying elements (Mn, P, etc.)
 - Through thickness section
 - Measure fluence, toughness, and chemistry as a function of depth
 - Validate fluence calculations
- Components with known flaws
 - Example: weld overlays over known flaws
 - Could be used for NDE evaluations or to assess effectiveness of mitigation techniques
- Components with limiting fatigue life
 - Confirm fatigue calculations are accurate by inspecting for flaws

Electrical

- Cables
 - Power cables energized and energized in normal operation
 - Cables from in containment applications
- Electrical components
 - 1E MOVs from harsh and mild environments
 - 1E Air operated valves
 - 4160 1E breakers
 - 1E Molded case breakers 480V, 250V DC, 125 VDC,
 - 1E Relays from mild environment GE – HFA, Agastat timing relays, any from Westinghouse, Potter Brumfield, Stuthers Dunn etc.,
- Other
 - Electrical penetrations
 - Batteries

Concrete

- High fluence irradiated concrete?
- ASR?
- Large sections for structural testing?

Sources of Materials

Metals

- Examples of harvested materials used in NRC research programs:
 - Boral from Zion
 - SS plate and welds from Zorita
 - 304SS ranging from <1 to 50 dpa
 - SS weld up to 1 dpa
 - PWSCC
 - Alloy 600 J-groove weld from Davis-Besse
 - Alloy 600 CRD nozzle from North Anna
 - Alloy 182/82 from VC Summer
 - RPV
 - Shoreham, Midland

Electrical

Concrete

Recently Shutdown U.S. Plants

Plant	Design	Size (MWt)	Years in Operation	Shutdown Date	Notes
Kewaunee	W 2-loop	1772	39	2013	
SONGS 2/3	CE 2-loop	3438	31/30	2013	
Crystal River 3	B&W	2609	36	2013	
Vermont Yankee	BWR-4/Mark-1	1912	42	2015	
Fort Calhoun	CE 2-loop	1500	43	2016	

Planned Shutdown U.S. Plants

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Oyster Creek	BWR-2/Mark-1	1930	50	2019	
Indian Point 2/3	W 4-loop	3216	48/46	2021	
Diablo Canyon 1/2	W 4-loop	3411	40	2024-5	

Additional Information from Plants

- Point of Contact
- Material information
 - Fabrication records, CMTRs
- Operating history
 - Temperature and fluence for components of interest
- Inspection records
 - Components with known flaws

From: [Koshy, Thomas](#)
To: [Hiser, Matthew](#)
Cc: [Sircar, Madhumita](#)
Subject: FW: Harvesting Workshop
Date: Wednesday, February 22, 2017 2:36:08 PM
Attachments: [NRC Technical Data Needs for Harvesting.pptx](#)
[NRC Perspective on Harvesting Experience and Lessons Learned.pptx](#)
[Sources of Materials.pptx](#)
[image005.jpg](#)
[image006.jpg](#)

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For electrical, the slides cover the areas of interest
Getting relevant documentation would be of great value



Thomas Koshy,
Email: Thomas.Koshy@nrc.gov
Tel: Number: 301-415-2154
Room no: TWFN-10B48
MS TWFN-10A36
Instrumentation, Controls & Electrical Engineering Branch
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From: Sent: Wednesday, February 22, 2017 8:36 AM
To: Sircar, Madhumita <Koshy, Thomas <Thomas.Koshy@nrc.gov>>
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Materials Engineer

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are immediately following.

From: [Tregoning, Robert](#)
To: [Hiser, Matthew](#)
Subject: FW: Harvesting Workshop Slides
Date: Wednesday, March 01, 2017 3:12:03 PM
Attachments: [NRC Perspective on Harvesting Experience and Lessons Learned.pptx](#)
[NRC Technical Data Needs for Harvesting.pptx](#)
[Sources of Materials.pptx](#)

So have we gotten everything we need from everyone?

Robert Tregoning

Technical Advisor for Materials

US Nuclear Regulatory Commission

Two White Flint North, M/S T-10 A36

11545 Rockville Pike

Rockville, MD 20852-2738

ph: 301-415-2324

fax: 301-415-6671

From: Hiser, Matthew

Sent: Wednesday, March 01, 2017 3:06 PM

To: Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>; Philip, Jacob <Jacob.Philip@nrc.gov>; Ray, Sheila <Sheila.Ray@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Taylor, Gabriel <Gabriel.Taylor@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Kirk, Mark <Mark.Kirk@nrc.gov>

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

Subject: Harvesting Workshop Slides

Thank you for your input on the NRC slides for the harvesting workshop. I have incorporated all comments and input received and attached the latest version of the slides to be presented next week.

Thanks!

Matt

NRC Perspective on Harvesting Experience and Lessons Learned

NRC Harvesting Experience

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- Concrete from Zorita
- Cables from Zion and Crystal River

Previous Benefits of Harvesting

- Reduce unnecessary conservatism
 - Flaw distributions and Master Curve information came from harvested materials to support PTS rule
- Understand in-service flaws
 - Mockups for NDE qualification
 - Leak rate methodology from studying in-service flaws
- Identify and better understand safety issues
 - High-energy arc fault tests on aluminum electrical components

Technical Lessons Learned

- Harvesting can provide highly representative aged materials for research
 - May be only practical source of representative aged materials, particularly if irradiation and temperature are important factors
 - Achieving high fluence levels with representative irradiation conditions through other means is very challenging
 - May be able to use limited harvested materials to validate larger accelerated aging data set
- Important to gain as much information as possible in advance before committing to specific harvesting project
 - Ideally a bounding, yet realistic, material/environment
 - Understand material information (CMTRs if available) and plant operating conditions

Logistical Lessons Learned

- Harvesting is an expensive, time-consuming effort
 - Must balance cost with potential benefits carefully
 - High technical relevance of materials is needed to ensure value
- Leveraging resources with other research organizations helps mitigate cost challenges
 - Can introduce challenges for testing when aligning research priorities and interests of multiple organizations
 - May be needed, particularly for expensive testing of irradiated materials
- Transporting irradiated materials, particularly internationally, is cumbersome and time-consuming
 - Avoiding extra transport, especially between countries, is highly recommended

NRC High-Priority Data Needs for Harvesting

Metals

- RPV
 - High fluence & high shift vessel with well-established unirradiated properties (or a means to estimate them)
 - Through thickness section to validate fluence & attenuation models
 - Measure fluence, toughness, & chemistry as a function of through-thickness position
 - Samples from virtually any vessel
 - Of sufficient size to enable measurement of both the Charpy transition curve and master curve transition temperature T_0
 - This testing
 - Enables demonstration of the conservatism of regulatory approaches for transition temperature prediction
 - Provides data supporting evolution from the use of correlative (Charpy-based) to direct measurement (fracture toughness-based) approaches

Metals

- CASS and Internals
 - High fluence reactor internals
 - >50 dpa 304 SS from high core outlet temp plant
 - Bounding temperature and high fluence for void swelling
 - Thermally aged unirradiated CASS
 - >30 years at ~320°C; Validate accelerated aging data
 - Moderate fluence (1-2 dpa) CASS
 - Bolster technical basis for embrittlement in this fluence range
- Components with known flaws
 - Example: weld overlays over known flaws
 - NDE evaluations or to assess effectiveness of mitigation techniques
- Components with limiting fatigue life
 - Confirm fatigue calculations are accurate by inspecting for flaws

Electrical

- Cables
 - Power cables energized and de-energized in normal operation
 - Cables from in containment applications
 - Cables protected with fire retardant coating
- Electrical components
 - 1E MOVs from harsh and mild environments
 - 1E Air operated valves; 4160 1E breakers
 - 1E Molded case breakers 480V, 250V DC, 125 VDC,
 - 1E Relays from mild environment GE – HFA, Agastat timing relays, any from Westinghouse, Potter Brumfield, Stuthers Dunn etc.,
 - Electrical penetrations; Batteries
- Fire research interest
 - Electrical enclosures
 - Distribution : switchgear, MCCs, LCs | Control : Horseshoe, SSCP, ASP, etc.

Concrete

- Structures exposed to high radiation
- Post-tensioned structures
- Corrosion of reinforcing steel, tendon, liner, embedment
- Spent fuel pool and transfer canal-boric acid attack on concrete in PWRs
- Alkali Aggregate Reaction
- Large structural sections for testing

Sources of Materials

Metals

- Examples of harvested materials used in NRC research programs:
 - Boral from Zion
 - SS plate and welds from Zorita
 - 304SS ranging from <1 to 50 dpa; SS weld up to 1 dpa
 - PWSCC
 - Alloy 600 J-groove weld from Davis-Besse
 - Alloy 600 CRD nozzle from North Anna
 - Alloy 182/82 from VC Summer
 - RPV
 - Shoreham, Midland

Electrical

- Zion
 - 4.16kV non-segregated bus duct
 - Used in NRC / OECD High Energy Arc Fault Testing
- Bellefonte
 - 8 Electrical enclosures
 - Used in NRC very early warning fire detection testing (NUREG-2180)
 - Used in NRC heat release rate testing (NUREG/CR-7197)

Recently Shutdown U.S. Plants

Plant	Design	Size (MWt)	Years in Operation	Shutdown Date
Kewaunee	W 2-loop	1772	39	2013
SONGS 2/3	CE 2-loop	3438	31/30	2013
Crystal River 3	B&W	2609	36	2013
Vermont Yankee	BWR-4/Mark-1	1912	42	2015
Fort Calhoun	CE 2-loop	1500	43	2016

Planned Shutdown U.S. Plants

Plant	Design	Size (MWt)	Years in Operation	Planned Shutdown
Palisades	CE	2565	47	2018
Pilgrim	BWR-3/Mark-1	2028	47	2019
Oyster Creek	BWR-2/Mark-1	1930	50	2019
Indian Point 2/3	W 4-loop	3216	48/46	2021
Diablo Canyon 1/2	W 4-loop	3411	40	2024-5

Additional Information from Plants

- Point of Contact
- Drawings and plant design information
 - To understand location of components within plant
 - Size and dimensions of components
- Operating history
 - Environmental information (e.g., temperature, fluence, humidity, pressure, etc.) for components of interest
- Material information
 - Fabrication records, CMTRs
- Inspection records
 - Components with known flaws

Note to requester:
Attachment to this email
is immediately following.

From: [Frankl, Istvan](#)
To: [Thomas, Brian](#)
Cc: [Tregoning, Robert](#); [Nakoski, John](#); [Hiser, Matthew](#); [Purtscher, Patrick](#)
Subject: FW: Harvesting Workshop talking points.docx
Date: Monday, March 06, 2017 1:13:00 PM
Attachments: [Harvesting Workshop talking points.docx](#)
Importance: High

Brian,

Rob and CMB staff have provided the attached draft talking points for Mike Weber's use tomorrow.

Please let me know if you need additional information or clarifications.

Thanks,

Steve

From: Tregoning, Robert
Sent: Monday, March 06, 2017 11:33 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: Harvesting Workshop talking points.docx

Steve:

Here are some talking points that Mike can use to introduce the workshop tomorrow. I think it's best if it comes through your branch so please forward it to Brian/John so that they can send it along to Mike. Let me know if you have any questions.

Cheers,

Rob

Ex-Plant Materials Harvesting Workshop

Motivation:

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

Purpose and Objective:

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

Workshop Topics:

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

Workshop Approach:

- Each session will consist of solicited presentations followed by lengthy discussion and Q&A period.

From: [Frankl, Istvan](#)
To: [Hiser, Matthew](#); [Purtscher, Patrick](#)
Subject: FW: Harvesting Workshop talking points.docx
Date: Monday, March 06, 2017 11:38:00 AM
Attachments: [Harvesting Workshop talking points.docx](#)
Importance: High

Note to requester: Attachment to this email is immediately following.

Matt, Pat,

Are you OK with Rob's inputs? Any revisions/ additions?

Please let me know ASAP.

Thanks,

Steve

From: Tregoning, Robert
Sent: Monday, March 06, 2017 11:33 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: Harvesting Workshop talking points.docx

Steve:

Here are some talking points that Mike can use to introduce the workshop tomorrow. I think it's best if it comes through your branch so please forward it to Brian/John so that they can send it along to Mike. Let me know if you have any questions.

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 - Communication and coordination between decommissioning and researchers

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From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#); [Purtscher, Patrick](#)
Subject: FW: ACTION: One-pager on the Harvesting Workshop
Date: Friday, March 24, 2017 11:44:34 AM
Attachments: [Harvesting One Pager.docx](#)

Note to requester: Attachment to this email is immediately following. The email document was provided to the NRC FOIA staff with the yellow text highlighted.

Hi Rob and Pat,

Here is my first stab at the harvesting one-pager Steve mentioned below. Please take a look and edit as needed and I'll send back to Steve.

Thanks!

Matt

From: Frankl, Istvan

Sent: Monday, March 20, 2017 5:24 PM

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

Subject: ACTION: One-pager on the Harvesting Workshop

Matt,

One of the action items that came out of the bi-weekly CMB/CIB status meeting today was Brian's request for a DE "one-pager" on the harvesting workshop.

Please align on this with Rob and get a draft to me for review **by next Monday.**

Thanks,

Steve

Ex-Plant Materials Harvesting One-Pager

Motivation:

- 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, which reduces the uncertainty associated with the applicability of the aging conditions.
 - With the wave of plants shutting down both in the U.S. and Europe, there are increasing opportunities to harvest components from decommissioning plants.
- Insights from ex-plant harvesting research would support regulatory decisions for subsequent license renewal (SLR), and could have implications for the current license period depending on the findings.
 - There is a task in the new draft UNR for SLR from NRR/DLR requesting RES to investigate opportunities for harvesting where appropriate.

Purpose and Objective:

- For NRC staff and interested stakeholders to have greater awareness and knowledge of the benefits and challenges associated with ex-plant harvesting.
- Facilitate contacts and communication to enable specific cooperative ex-plant harvesting programs to be initiated, leveraging limited NRC resources to produce highly representative technical data of materials degradation for extended plant operation.

Workshop Summary:

- NRC staff hosted a 2-day workshop with interested stakeholders, including domestic and international utilities and research organizations, to discuss benefits and challenges associated with ex-plant harvesting. Views and insights from various parties contributed to the discussion
- Workshop participants gave presentations and actively engaged in open discussion of different aspects of ex-plant materials harvesting
 - Sessions covered motivation for harvesting, data needs, sources of materials, lessons learned, the practical aspects of harvesting, and harvesting decision-making and planning
- The discussion focused on the importance of clearly identifying the need and purpose for performing a harvesting project.
 - All participants agreed harvesting is a complex and expensive proposition, but one that can be worthwhile if the need to be addressed is clearly defined and addressed by the planned harvesting project.
- The insights from the utility and decommissioning contractor perspective were extremely valuable to the discussion.
 - NRC staff and stakeholders are better informed and aware of the benefits and challenges associated with ex-plant harvesting.

Path Forward:

- Detailed workshop summary report to be distributed among meeting participants by May 2017
- PNNL report on a strategic approach to ex-plant harvesting to be complete by May 2017
- Internal alignment within NRC on prioritization of harvesting data needs in four primary areas:
 - RPV, internals and other metals, electrical, concrete
- RES staff will engage with interested workshop participants on prioritizing data needs and sources of materials database

Note to requester: Attachment to this email is immediately following.

From: [Iyengar, Raj](#)
To: [Hiser, Matthew](#)
Cc: [Hull, Amy](#)
Subject: FW: 2016-NRR-UNR-Draft-May 2016.docx
Date: Wednesday, May 18, 2016 10:40:45 AM
Attachments: [2016-NRR-UNR-Draft-May 2016.docx](#)

Matt,

This is a draft UNR prepared for DLR. Task C is on strategic harvesting.

Raj

From: Iyengar, Raj
Sent: Monday, May 16, 2016 3:21 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: 2016-NRR-UNR-Draft-May 2016.docx

Steve/Amy,

Attached is a draft version of the new UNR, prepared for NRR. This is only the enclosure for the UNR memo. The memo will contain information about staff-level and management-level coordination and the POCs. I will prepare the memo, if NRR wants us to.

For now, please take a look at the five tasks in the attached.

The background section has more information than needed. We can let NRR tailor the background section to fit their style.

I have discussed this with Amy. (Steve, Perhaps, you can wait until Amy reviews it).

I may provide a courtesy copy to Rob after I incorporate CMB comments.

Raj

Research Request

Evaluate Aging Management of systems, structures, and components (SSCs) during a Subsequent License Renewal (SLR) Period

Background:

Although the NRC staff can accept subsequent license renewal applications now, the review would be based on guidance provided in NUREGs-1800 and -1801. Because the guidance in these NUREGs is based on plant operation from 40-60 years, additional review would be needed to ensure that the applicant addressed issues unique to 60-80 years of plant operation for subsequent license renewal. Such reviews would be longer and more resource-intensive.

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

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

For SLR, the staff used NUREG-1800 and NUREG-1801 as the basis for developing the guidance for SLR applicants and NRC staff. The development of the guidance was based on an evaluation of domestic and international operating experience of nuclear plants, lessons learned from staff review of previous license renewal applications, and assessment of recent research findings. The guidance documents were issued in mid-December of 2015, as draft "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," (NUREG-2191, Volumes 1 and 2) and draft "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants" (SRP-SLR) (NUREG-2192).

Since the draft guidance documents were issued, the staff has held several public meetings with stakeholders and the public to discuss the proposed revisions and bases for the revisions. The most recent meetings were held on January 21 and February 19, 2016. Going forward, the NRC staff will continue to lead outreach activities to stakeholders and the public in order to provide information on the proposed changes to the guidance documents, solicit feedback on the documents, and revise the documents, as appropriate, to reflect stakeholder and public feedback. The final guidance documents are expected to be issued in mid-2017.

To support the review of an SLR application, an applicant will need to demonstrate how the effects of aging will be managed, including those associated with the technical issues listed above. Although the industry is conducting research to address these major technical issues for

SLRs, not all the research will be completed before the first application is submitted. For those issues that the industry has not yet developed a generic technical basis to support its resolution, the NRC will request applicants to address the technical issues with plant-specific programs in their SLR applications. The staff will review these plant-specific programs that address the SLR technical issues, but anticipates a longer application review process in these cases.

The requested research described below would provide information to support the staff in effectively evaluating aging management practices and developing staff positions to augment staff's preparedness for the evaluation of the feasibility of future applications for an SLR period. These requested products should build upon analysis methods, tools, and expertise developed as part of ongoing research activities and new research activities focused specifically on aging effects during an SLR period of extended operation (i.e., 60 to 80 years).

Description of Scope and Tasks

A. Hold NRC/industry workshop(s) on status of domestic and international research activities and operating experience to address and evaluate the status of materials degradation issues, identified in the EMDA reports, for a subsequent license renewal

Technical Need: In February 2008, the NRC and DOE co-sponsored a "Workshop on U.S. Nuclear Power Plant Life Extension Research and Development" (ADAMS Accession Number ML080570419), which requested stakeholder input into aging management research areas for "Life Beyond 60." Since then, there have been multiple workshops/meetings on the research activities, as well as on operating experience, regarding aging management of SSCs for a SLR period of operations. These meetings have been helpful in facilitating technical discussions, disseminating knowledge and information, and 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 of operations. As the NRC staff prepare for the review of the future SLR submittals, there is a need for continued engagement with domestic nuclear industry and other industries, DOE and other federal organizations, academia, international partners, and interested public stakeholders, through workshops targeted toward the status and resolutions of major technical issues outlined in the SRM and identified in EMDA.

Deliverable: RES staff should facilitate several workshops/meetings on operating experience from the initial license renewal period, research results on materials degradation issues and aging management of SSCs during a SLR period of operations. These meetings should specifically be targeted toward the resolution of technical issues for effective aging management of SSCs for a SLR period of operations. RES staff should provide an annual technical letter report summarizing the understanding gained through the workshops/meetings. The summary should include the status of domestic and international research activities in addressing materials degradation issues and aging management practices for an SLR period of operations. The report should also discuss (1) areas of progress and issues resolution, (2) areas of insufficient progress that may warrant additional NRC interactions, and (3) any newly identified technical issues that should be considered for an SLR period of operations.

Schedule: The effort should last no more than 36 months from the period of inception of this user need request.

B. Provide RES staff assessments of the current knowledge and disposition of materials degradation issues identified in the EMDA documents

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

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

The NRC, DOE, and industry are addressing the key technical issues related to materials degradation at NPPs, in order to gain better understanding of the materials aging and degradation mechanisms and their implications of structural and component integrity. DOE/LWRS and the industry have initiated numerous research activities on the four major technical areas. The NRC staff conducts confirmatory research, through several user need requests on specific technical issues, to independently verify licensee data, determine safety margins, and explore uncertainties. Results from NRC's research will be used, in part, to confirm the adequacy of industry's technical basis for SLR and the associated AMPs. The AMPs are cornerstones for managing materials degradation in SSCs during SLR. In addition, the NRC research will support and increase the efficiency of staff review of SLR applications. To fully support the staff review of the SLR applications, RES should develop staff assessments of the current knowledge and disposition of materials degradation issues related to the four major technical areas. The assessments should also include recommendations on the need for:

- any interim staff guidance (ISG) to address aging management issues, and
- new regulatory guidance and/or revision of existing ones to address uncertainties in knowledge and/or potential non-conservativisms.

Deliverable: Deliver a technical letter report that summarizes the state-of-knowledge and current knowledge and disposition of materials degradation issues identified in EMDA. The report should also include recommendations on the need for any new or revised guidance to address component integrity of aging structures.

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

C. Develop a long-term strategy for obtaining information from decommissioned NPPs as well as from ex-plant components from operating plants.

Technical Need: The NRC maintains operating experience databases and also has access to industry and international operating experience databases which deal

with failures of SSCs experienced during plant operation. Because the first plants have just recently entered the initial renewed license operating period, there is limited operating experience information specifically related to aging management issues. To address this gap, research activities are in place to obtain materials degradation data through laboratory tests. However, obtaining data from materials harvested from decommissioned plants and ex-plant components will be crucial bridging the gap between data obtained from simulated experiments in laboratory and service-life components. This 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. Thus, the NRC needs to keep abreast of opportunities to recover materials from plants that are being decommissioned or from ex-plant components.

Based on the recent experience of recovering materials from the decommissioned plants, such as Zion and Crystal River, the efforts of planning, coordination and eventual collection of these materials could be resource-intensive and time-challenging. Future efforts to retrieve materials from decommissioned plants could be accelerated by pro-actively developing a strategic database for obtaining unique and significant materials aging degradation information from diverse sources. Such a database will enable the NRC to expeditiously obtain materials and components from plants to be decommissioned in the near future and develop information and knowledge to access the efficacy of the AMPs.

Deliverable: RES should develop a strategic database containing information on:

- unique and significant materials aging degradation diverse sources (operating experience, other nuclear facilities, other long-lived industrial plants, other materials organizations such as ASM and NACE), and
- materials that can be harvested from to-be-decommissioned NPPs and ex-plant components from operating plants to better inform the NRC's AMPs and aging-related regulatory oversight and to better plan research activities.

RES should deliver periodic reports assessing the effectiveness of such programs and recommending any improvements for a subsequent license renewal period.

Schedule: The effort should last no more than 36 months from the period of inception of this user need request.

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

Technical Need: Various domestic and foreign research organizations, government agencies, utilities and research organizations are presently engaged in aging management research, the results of which may be of value to the NRC regarding plant operations during a subsequent license renewal period. Additionally, the Electric Power Research Institute (EPRI) is engaged with various international research organizations to develop data on aging mechanisms/effects. As such, it benefits the agency 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 agency to develop partnerships with these entities such that the various research programs could be better coordinated and focused on high-priority needs.

Deliverable: Continue to develop agreements with domestic and international partners to collaborate on aging management research that results in information to help inform agency decisions regarding a subsequent license renewal and long-term operations. Integrate as appropriate the results of these collaborative research and information exchanges from international partnerships into Tasks A and B. Provide an annual summary of international collaborative research results and status of interactions (e.g., references to meeting minutes, presentations, technical reports, etc.), highlighting international activities and results that may affect a subsequent license renewal.

Schedule: The effort should continue until the closure of this user need request.

G. Provide technical assistance, as needed, for preparation of review of SLR applications.

Technical Need: As the NRR staff prepares for the anticipated SLR application in FY18, technical assistance from RES staff on emergent issues may be needed. Such issues may include, but not restricted to, technical support for aging management program audits, public meetings related to communication efforts, and confirmatory reviews of licensee submittals.

Schedule: The effort, as needed, should continue until the closure of this user need request.

From: [Hiser, Matthew](#)
To: [Purtscher, Patrick](#)
Subject: FW: Request: Need a couple of bullets on Harvesting workshop
Date: Thursday, May 18, 2017 8:26:00 AM
Attachments: [Draft Talking Points for Brian Thomas for EPRI R2.docx](#)

Notes to requester: Attachment to this email is immediately following. The email that was provided to the NRC FOIA staff contained the red text.

How do these look Pat?

- Workshop well-attended by DOE, EPRI, NRC, US industry, and international participants. Participants discussed motivation for harvesting, data needs best addressed by harvesting, sources of materials for harvesting and future harvesting program planning.
 - Workshop discussion emphasized the high cost and complexity of performing harvesting, which requires a clearly defined objective to justify the level of effort and demonstrate value.
- Workshop summary report will be shared among meeting participants. Future activities from the workshop include cooperative discussion of prioritized data needs for harvesting and development of a sources of materials database.

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: Moyer, Carol

Sent: Thursday, May 18, 2017 8:15 AM

To: Hiser, Matthew ; Purtscher, Patrick

Subject: Request: Need a couple of bullets on Harvesting workshop

Hi Matt and Pat,

In preparation for a management meeting at EPRI, Brian Thomas needs some talking points on DE programs. I have copied out the parts of the agenda that pertain to DE, in the attached outline file.

Can you please provide some high-level bullets (3-4?) on the Harvesting workshop from March, and any plans for follow-on work? I would appreciate your response by around noon today (Thurs), if possible.

Thank you,

Carol

Carol Moyer

Sr. Materials Engineer

RES/DE/CMB

carol.moyer@nrc.gov

301-415-2153

Draft Talking Points for Brian Thomas for EPRI-NRC Meeting (6/6/2017)

9:30 AM – Long Term Operation (LTO) Beyond 60 Years, Subsequent License Renewal

- The MOU for Long Term Operations Beyond 60 Years extends through Sept., 2021
- NRC appreciates EPRI's active participation in the April Commission briefing
- Biweekly coordination calls (EPRI/NRC/DOE) are successful

Progress and readiness for SLR applications

- As reported at the April 26th Commission briefing, NRC is ready to accept applications.
- Confirmatory research continues, to reduce uncertainty associated with key technical issues.

Public workshop on SLR topics

- At least two workshops are proposed, to include domestic and international participants.
- Fall 2018 – Focused on reactor pressure vessels, vessel internals, and piping
- Spring 2020 – Focused on concrete and electrical cable degradation
- Proposed scope of the workshops:
 - State of knowledge on the technical issues
 - Status of on-going research on materials degradation and aging management
 - New operating experience with implications for LR and SLR

Technical reports on continued adequacy of RG 1.99

- ...
- ...

Highlights of harvesting workshop

- ...
- ...

Research priorities for 2017-2018

- ...
- ...

10:45 – Advanced Reactor Safety Research

- ...
- ...

IAP status

- RES/DSA is supporting IAP-2 (computational codes)
- RES/DE is supporting IAP-2 (materials issues) and IAP-4 (codes and standards)
- ...

Computational codes for non-LWRs

- ...
- ...

Advanced manufacturing

- Advanced processes, such as additive manufacturing (3D printing), diffusion bonding, friction-stir welding, and powder metallurgy (PM-HIP) have been proposed for use in new reactors.
- Some advanced manufacturing processes may introduce uncertainty in component inspections (pre-service and in-service). Components may be susceptible to flaw types or degradation mechanisms previously unseen in LWRs.
- ...

Gen IV materials

- RES/DE (and NRO) are participating in ASME B&PV Code committees working on high temperature materials needed for some advanced reactor designs.
 - Alloy 617
 - Graphite
- ASME Code is also seeking to expand the temperature range for use of some materials by supplying confirmed materials property data under a broader range of test conditions.
- NRC is collaborating with DOE-NE to avoid surprises in material selection and the establishment of technical bases for the use of newer materials and processes.
- ...

11:15 – xLPR and Leak-Before-Break (LBB) Analyses

- ...
- ...

Current status of MOU development

- ...
- ...

2:00 – Digital Instrumentation & Control Collaboration

- ...
- ...

Progress during previous year

- ...
- ...

Priorities for 2017-2018

- ...
- ...

Note to requester:
Attachment to this email
is immediately following.

From: [Hiser, Matthew](#)
To: [Murdock, Darrell](#)
Subject: FW: Ex-Plant Materials Harvesting
Date: Wednesday, May 27, 2015 9:55:00 AM
Attachments: [Harvesting Efforts Hiser June NRC-Industry materials mtg 5-27-15.pptx](#)

Hi Darrell,
Could you take a quick look at Slide 9 on cable harvesting?
Thanks!
Matt

Matthew Hiser

*Materials Engineer
Corrosion and Metallurgy Branch
Division of Engineering
Office of Nuclear Regulatory Research
301-251-7601*

From: Hiser, Matthew
Sent: Thursday, May 21, 2015 3:51 PM
To: Focht, Eric; Murdock, Darrell; Sircar, Madhumita
Cc: Hull, Amy
Subject: RE: Ex-Plant Materials Harvesting

Hi All,
Here is the current draft of the presentation. Can you fill in the relevant information for your projects on slides 7-9? Amy, can you fill in your slides as appropriate related to approach and engagement?

Thanks!

Matt

Matthew Hiser

*Materials Engineer
Corrosion and Metallurgy Branch
Division of Engineering
Office of Nuclear Regulatory Research
301-251-7601*

From: Hiser, Matthew
Sent: Friday, May 15, 2015 8:21 AM
To: Focht, Eric; Murdock, Darrell; Sircar, Madhumita
Cc: Hull, Amy
Subject: Ex-Plant Materials Harvesting

Hi Mita, Darrell, and Eric,

I am working with Amy Hull in my branch on an effort associated with strategic harvesting of ex-plant materials. This effort is just getting underway, but we would like to present the concept at an NRC-industry materials meeting in early June (see attached email). The purpose of this effort is to develop a more systematic proactive "strategic" approach to ex-plant material harvesting, rather than the more reactive opportunistic approach to date. It is important to share this concept with industry, since they will be vital in providing connections/communication to allow future harvesting projects to take place.

I am putting together a slide or two on the reactor internals materials harvesting project at Zorita that I am involved with. I understand each of you have been / are involved with other harvesting efforts at Zion and Zorita on cables, concrete, and neutron absorbers. If you could just provide a slide or two with a high-level overview of the harvesting project and at least briefly touch on how the harvesting opportunity came together, that would be great.

Thanks!

Matt

Strategic Approach for Obtaining Material and Component Aging Information

Amy Hull and Matthew Hiser
Division of Engineering
Office of Nuclear Regulatory Research

Outline

- Purpose
- Background
- Harvesting Experience
- Approach
- Engagement with Other Stakeholders

Purpose

- Create a framework for a strategic approach to harvesting ex-plant materials
 - Ex-plant materials offer unique environmental exposure that cannot be entirely replicated by laboratory testing with fresh materials
- Combine high priority data needs identified in SLR/LTO activities with harvesting opportunities from decommissioning plants

Background

- To date, harvesting opportunities have been limited due to few decommissioning plants
 - Zion in U.S., Zorita in Spain
- However, several U.S. plants have already shut down or are planning to do so in the near future
 - Kewaunee, SONGS, Crystal River, Vermont Yankee, Oyster Creek
- This provides a unique opportunity to plan harvesting for the maximum utility to address the highest priority technical issues

Harvesting Experience

- Past harvesting efforts have generally involved a reactive decision-making process
 - Limited opportunities to acquire ex-plant materials
 - Limited strategic planning for harvesting
- Harvesting projects with NRC involvement:
 - Reactors internal materials from Zorita
 - Concrete from Zorita
 - Neutron absorber material from Zion
 - Cables from Zion and Crystal River

Zorita Internals Research

- **Materials Harvested:**
 - Baffle plate and core barrel weld materials
- **Scope:**
 - Mechanical testing (tensile, CGR, FT)
 - Microstructural characterization (void swelling)
- **Purpose:**
 - High-fluence (up to 50 dpa) IAD effects with representative LWR exposure conditions
- **Timeline:**
 - Initial discussions in 2006, harvesting in 2013, testing ongoing
- **Coordination:**
 - EPRI, international consortium, Studsvik, Halden

Neutron Absorbers from Zion

- **Materials Harvested:**
 - Select Boral® NAM panels from Regions 1 and 2 of the Zion SFP
- **Scope:**
 - Visual and microstructural examinations (incl. areal density)
 - Corrosion testing
- **Purpose:**
 - Identify degradation mechanisms
 - Estimate degradation rate
 - Confirm results of in-situ areal density measurements
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing in 2015-2016
- **Coordination:**
 - EPRI, ZionSolutions, SRNL

Concrete from Zorita (Plan)

- **Materials Harvested:**
 - Concrete from structures that are in close proximity to RPV
- **Scope:**
 - Mechanical testing (compressive, tensile, modulus of elasticity)
 - Microstructural characterization
 - Physical change
- **Purpose:**
 - High fluence in combination with temperature and humidity that are representative of LWR environment effects on structural and shielding performance
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing 2016-2018
- **Coordination:**
 - NRC , ENRESA and CSN

Cables from Zion and Crystal River

- **Materials Harvested:**
 - Cables (high / low voltage??)
- **Scope:**
 - Condition monitoring to assess cable performance under normal operating conditions (accelerated aging) and accident conditions
- **Purpose:**
 - Cable degradation due to normal operating environment and accident conditions
- **Timeline:**
 - Initial discussions in ????, harvesting in 2013/2015, testing ongoing - 2017
- **Coordination:**
 - ORNL, Zion Solutions, NIST, EPRI

Approach

Stakeholder Engagement

Acknowledgements

- Robert Tregoning, RES/DE
- Eric Focht, RES/DE
- Darrell Murdock, RES/DE
- Mita Sircar, RES/DE

Notes to requester:
Attachment to this email is immediately following. The email was provided to the NRC FOIA staff with the highlighted portions.

From: [Hull, Amy](#)
To: [Hiser, Matthew](#)
Subject: FW: ACTION: Division Review of EPRI MOU Addenda & Response Timeline
Date: Tuesday, June 14, 2016 7:39:40 AM
Attachments: [Cover Letter for NRC-EPRI MOU 2016 Renewal.docx](#)
[DRAFT NRC EPRI MOU Renewal 2016.docx](#)
[ADDENDUM Template.docx](#)
[EPRI MOUs_06-13-16.xlsx](#)
Importance: High

Do you want something in here for harvesting?

From: Frankl, Istvan
Sent: Monday, June 13, 2016 4:09 PM
To: Focht, Eric <Eric.Focht@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>
Subject: ACTION: Division Review of EPRI MOU Addenda & Response Timeline
Importance: High

All,
Please review the enclosed request from our TA and let me know ASAP if the addendum/addenda for which you are the POC, needs revision, and if so, please provide update to me no later than **Monday, June 20**.
Based on our earlier communication on this topic my current understanding is that our addenda do not need revisions but please confirm to me ASAP.
Thanks,
Steve

From: Berrios, Ilka
Sent: Monday, June 13, 2016 3:53 PM
To: Rudland, David <David.Rudland@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>; Ake, Jon <Jon.Ake@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>; Burke, John <John.Burke@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Cc: Focht, Eric <Eric.Focht@nrc.gov>; Miller, Kenneth A <Kenn.Miller@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Oberson, Greg <Greg.Oberson@nrc.gov>
Subject: Division Review of EPRI MOU Addenda & Response Timeline
All,

Attached are the draft cover letter and EPRI MOU that is being developed to support the renewal activity. As you are aware, there are a number of Addenda that expire on Sept 30, 2016, that maybe renewed, modified or cancelled as part of this activity. Hopefully, most addenda will only require updating the expiration date and POCs. A few may require scope modifications to complete these updates and interaction with EPRI counterparts on those revisions. Last attachment contains a list of recent EPRI Addenda. Attached is also a template for a simple Addendum renewal (it is based on [ML101270008](#)).

Could you please provide you input by 06/28/2016? Please let me know if you have any questions.

Acquisition and Testing of Zion Spent Fuel Pool Neutron Absorber Materials	September 30, 2016	Eric Focht, DE
Aging, Qualification and Condition Monitoring of Electrical Cables	September 30, 2016	Kenn Miller, DE
Digital I&C and Human Factors	September 30, 2016	Ian Jung, DE / Sean Peters, DRA
Long Term Operations Beyond 60 Years	September 30, 2016	Amy Hull, Raj Iyengar DE
Primary Water Stress Corrosion Cracking - Crack	September 30, 2016	Erick Focht, Greg

Initiation Testing		Oberson DE
Primary Water Stress Corrosion Cracking Expert Panel Activities	September 30, 2016	Greg Oberson, DE Rob Tregoning, DE
Seismic Risk (renewal)	September 30, 2016	Jon Ake, DE
Cooperative Nuclear Safety Research, Extremely Low Probability of Rupture (XLPR) V2		Matthew Homiack, DE

Note to requester: This document is how it was provided to the NRC FOIA Team, with the highlighted portions.

ADDENDUM
to
MEMORANDUM OF UNDERSTANDING
between
U.S. NUCLEAR REGULATORY COMMISSION
and
ELECTRIC POWER RESEARCH INSTITUTE, INC.
on
COOPERATIVE NUCLEAR SAFETY RESEARCH

[Technical Area e.g Probabilistic Risk Assessment]

The Memorandum of Understanding (MOU) **[Technical Area]** Addendum between the U.S. Nuclear Regulatory Commission (NRC) and the Electric Power Research Institute, Inc., (EPRI) which provides for the cooperative **[PRA]** research and accompanying exchange of information, concluded on **[prior agreement date – e.g. December 31, 2009.]**

Guided by their desire to continue the cooperative effort, the participants hereby extend the MOU **[Technical Area]** Addendum period of performance to expire on **[termination date or the expiration date of the renewal which is September 30, 2021.]**

New contact information for NRC and EPRI staff is as follows:

[example]

<u>PRA Quality, Modeling and Methodology</u>	<u>PRA Quality, Modeling and Methodology</u>
<p>Peter Appignani U.S. Nuclear Regulatory Commission M/S C4A07M Washington, DC 20555-0001 Knoxville, TN 37922-5400 (301) 251-7608 Peter.Appignani@nrc.gov</p> <p>Etc.</p>	<p>Stuart Lewis Electric Power Research Institute 1627 Nighbert Ln. (865) 246-9715 slewis@epri.com</p>

All other MOU **[Technical Area]** Addendum provisions remain in full force and effect.

Michael F. Weber
Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

Date

Neil Wilmschurst
Vice President and Chief Nuclear
Officer
Electric Power Research Institute

Date

Title	Expiration Date	RES Contact	Accession #	Comments & Related links	Period of Performance	Current Status
Extremely Low Probability of Rupture	December 31, 2015	Dave Rudland, DE	ML12263A043	non-public		Expired
Welding Residual Stress Model Development and Validation Project	December 31, 2015	Michael Benson, DE	ML13247A228	non-public		Expired
Pressurized-Water Reactor Spent Fuel Heatup and Propagation Phenomena Experiments	February 29, 2016	Sergio Gonzalez, DSA	ML13191B256	non-public		Expired
MOU between EPRI and NRC on Collaborative Nuclear Safety Research	September 30, 2016	Brett Rini	ML092290122	public		Currently being updated
Acquisition and Testing of Zion Spent Fuel Pool Neutron Absorber Materials	September 30, 2016	Eric Focht, DE	ML15015A021	public ML14217A410 (unsigned)	The period of performance of this project extends until the expiration of the umbrella Memorandum of Understand that governs this Addendum.	No need for extension - should be reviewed
Aging, Qualification and Condition Monitoring of Electrical Cables	September 30, 2016	Kenn Miller, DE	ML12261A368	public	The period of performance of this project is from the effective date of this Addendum through September 30, 2016	Needs to be reviewed to determine if extension is needed.
Benchmarking of Emergency Planning and Response Radiological Assessment Software Tools Using Fukushima Accident Radiological Data	September 30, 2016	Anthony Huffert, DSA	ML14226A903	public	?? (Tasks are indicated through December 2016)	
Digital I&C and Human Factors	September 30, 2016	Ian Jung, DE / Sean Peters, DRA	ML090440352	public	The initial period of performance will be from the effective date through September 30, 2016, to be extended in writing if mutually agreeable to EPRI and RES.	Needs to be reviewed to determine if extension is needed.
Fire Risk	September 30, 2016	Mark Salley, DRA	ML101450467	public	The initial period of performance will be from the effective date through September 30, 2016, to be extended in writing if mutually agreeable to EPRI and RES.	Needs to be reviewed to determine if extension is needed.
Long Term Operations Beyond 60 Years	September 30, 2016	Amy Hull, Raj Iyengar DE	ML100970003	public	The initial period of performance will be from the effective date through September 30, 2016, to be extended in writing if mutually agreeable to EPRI and RES.	Needs to be reviewed to determine if extension is needed.
Primary Water Stress Corrosion Cracking - Crack Initiation Testing	September 30, 2016	Erick Focht, Greg Oberson DE	ML14217A006	non-public	...effective through September 30, 2016	Needs to be reviewed to determine if extension is needed.

Title	Expiration Date	RES Contact	Accession #	Comments & Related links	Period of Performance	Current Status
Primary Water Stress Corrosion Cracking Expert Panel Activities	September 30, 2016	Greg Oberson, DE Rob Tregoning, DE	ML14279A001	public	The period of performance for this Addendum shall be September 1, 2014 through September 30, 2016, or the applicable MOU extension renewal date.	Needs to be reviewed to determine if extension is needed.
Probabilistic Risk Assessment (renewal)	September 30, 2016	Peter Appignani Sean Peters John Lane Nathan Siu, DRA	ML101270008	public	...the participants hereby extend the MOU Probabilistic Risk Assessment Addendum period of performance to expire on September 30, 2016.	Needs to be reviewed to determine if extension is needed.
Seismic Risk (renewal)	September 30, 2016	Jon Ake, DE	ML100060724	public	Guided by their desire to continue the cooperative effort, the participants hereby extend the MOU Seismic Risk Addendum period of performance to expire on September 30, 2016.	Needs to be reviewed to determine if extension is needed.
Nondestructive Examination	April 30, 2018	Carol Nove, DE	ML14112A187	public ML14065A003 (unsigned)		OK
Steam Generator Tube Base Research Program	December 31, 2019	Mica Baquera, DE Matt Rossi, DE	ML13357A155	non-public		OK
Cooperative Nuclear Safety Research, Extremely Low Probability of Rupture (XLPR) V2		Matthew Homiack, DE		ML15364A076		



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

Note to requester: The public version of this letter is publicly available in ADAMS at ML16223A496.

Mr. Neil Wilmshurst
Vice President and Chief Nuclear Officer
Electric Power Research Institute
1300 West W.T. Harris Blvd.
Charlotte, NC 20262

Dear Mr. Wilmshurst:

Please find enclosed the signed Memorandum of Understanding (MOU) and Addenda between the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC/RES) and the Electric Power Research Institute (EPRI) on Cooperative Nuclear Safety Research. The enclosed MOU renews our 2007 agreement and continues Cooperative Nuclear Safety Research in [redacted] technical areas. The Addenda updates to the MOU outlines the specific nature of our cooperation in these technical areas.

The MOU and Addenda were developed through collaboration between the staff of NRC/RES and Mr. Ken Canavan of your staff. Our two organizations have worked well together over many years, and I believe the cooperation has been mutually beneficial. We look forward to many more successful years for this partnership.

Please sign the enclosed copies, and return one signed copy to the NRC Office of Nuclear Regulatory Research at your earliest convenience. If you have any questions, please feel free to contact Mr. Nicholas DiFrancesco of my staff at 301-415-1115.

Sincerely,

Michael F. Weber, Director
Office of Nuclear Regulatory Research

Enclosure:
As stated

Mr. Neil Wilmshurst
Vice President and Chief Nuclear Officer
Electric Power Research Institute
1300 West W.T. Harris Blvd.
Charlotte, NC 20262

Dear Mr. Wilmshurst:

Please find enclosed the signed Memorandum of Understanding (MOU) and Addenda between the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC/RES) and the Electric Power Research Institute (EPRI) on Cooperative Nuclear Safety Research. The enclosed MOU renews our 2007 agreement and continues Cooperative Nuclear Safety Research in [X] technical areas. The Addenda updates to the MOU outlines the specific nature of our cooperation in these technical areas.

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Please sign the enclosed copies, and return one signed copy to the NRC Office of Nuclear Regulatory Research at your earliest convenience. If you have any questions, please feel free to contact Mr. Nicholas DiFrancesco of my staff at 301-415-1115.

Sincerely,

Michael F. Weber, Director
Office of Nuclear Regulatory Research

Enclosure:
As stated

DISTRIBUTION:

BThomas, RES/DE KBrock, RES/DE RCorreia, RES/DRA MThaggard, RES/DRA
MCase, RES/DSA KWebber, RES/DSA MWeber, RES EHackett, RES
NDiFrancesco, RES

ADAMS Accession No.: ML

OFFICE	RES/TA	Tech Editor	RES/DE/D	RES/DE/DRA
NAME	NDiFrancesco	J. Zabel	BThomas	RCorreia
DATE	07/ /2016	07/ /2016	07/ /16	07/ /16
OFFICE	RES/DE/DSA	OGC	RES/D	
NAME	MCase		MWeber	
DATE	07/ /16	07/ /16	07/ /16	

OFFICIAL RECORD COPY

MEMORANDUM OF UNDERSTANDING
between
U.S. NUCLEAR REGULATORY COMMISSION
and
ELECTRIC POWER RESEARCH INSTITUTE,
INC.
on
COOPERATIVE NUCLEAR SAFETY
RESEARCH

PURPOSE

The U.S. Nuclear Regulatory Commission ("NRC") and the nuclear power industry ("Industry") each conduct research on nuclear reactor safety. The NRC's Office of Nuclear Regulatory Research ("RES") conducts independent research in all areas regulated by the NRC, including ongoing and potential safety issues, risk-informed and performance-based regulation, and operating experience analysis. The Electric Power Research Institute, Inc. ("EPRI") is engaged in research and development in the public interest and on behalf of Industry with respect to the production, transmission, distribution, and utilization of electric power, including research designed to improve the safety, reliability, and economy of nuclear power plants. While the research efforts of the NRC and EPRI may be conducted for different purposes, the underlying data and the results obtained have common value to both the NRC and EPRI. Accordingly, to conserve resources and to avoid unnecessary duplication of effort, both the NRC and EPRI agree to cooperate in selected research efforts and to share information and/or costs related to such research, whenever such cooperation and cost sharing is appropriate and mutually beneficial.

This Memorandum of Understanding ("MOU") is authorized pursuant to Section 31 of the Atomic Energy Act and/or Section 205 of the Energy Reorganization Act. The roles, responsibilities, terms and conditions of this MOU should not be interpreted in a manner inconsistent with, and shall not supersede, applicable federal laws and regulations.

This MOU describes the parameters within which cooperative research programs between the NRC and EPRI will be considered and conducted. Individual cooperative research programs are described in addenda to this document ("Cooperative Research Programs").

PRINCIPLES OF COOPERATION

Article 1-Responsibility of the Parties

- 1.1 Organizational Accountability within the NRC and EPRI: This MOU will be implemented by the NRC's Office of Nuclear Regulatory Research ("RES") on behalf of the NRC and by EPRI's Nuclear Power Sector ("NPS") on behalf of EPRI. RES and NPS are responsible for conducting cooperative research with third parties in the field of nuclear energy for the NRC and EPRI, respectively.
- 1.2 Contacts: The NRC's Senior Management Contact shall be the Director of the Office of Nuclear Regulatory Research and EPRI's Senior Management Contact shall be its Chief Nuclear Officer ("Senior Management Contacts"). RES and EPRI will each identify their respective overall coordination contacts ("Overall

Coordination Contacts") to serve as the primary interfaces for routine interactions between the NRC and EPRI.

1.3 Management of Cooperative Research Programs:

- a. Meetings: The Senior Management Contacts will confer, either via conference call or in meetings¹ as needed throughout the year, but will formally meet a minimum of once each year to ~~review the status of ongoing Cooperative Research Programs, to identify opportunities, if any, for additional Cooperative Research Programs, and to expand, modify, or close-out existing Cooperative Research Programs~~ exchange views on the strategic direction of the respective research programs and identify opportunities to enhance cooperation. On a periodic basis, normally semiannually, the Senior Management Contacts will confer to identify areas of cooperation warranting greater management attention and resolve any conflicts. The Senior Management Contacts shall agree on the priority, terms and conditions of new Cooperative Research Programs and shall provide direction on ongoing work and other matters, as necessary. The Overall Coordination Contacts and appropriate Cooperative Research Program personnel may meet more frequently as necessary to manage the Cooperative Research Programs.
- b. Selection of Potential Cooperative Research Programs: The NRC and EPRI shall identify potential Cooperative Research Programs of interest to the NRC and the Industry. Factors to be considered when selecting potential programs shall include:
- mutual interest in the subject matter;
 - applicability of research results;
 - contribution to plant safety;
 - impact upon risk reduction;
 - opportunity to leverage resources; and
 - timeliness.

Once an area of potential cooperative research is identified, a Cooperative Research Program may be pursued if mutual agreement is reached on the technical requirements of the project, including objectives, scope, approach and quality assurance requirements, and the roles and responsibilities of each party.

- c. Documentation of Cooperative Research Programs: Once approved by the Senior Management Contacts, each Cooperative Research Program will be documented in an Addendum to this MOU. Each Addendum shall set forth in detail the goals and objectives of the Cooperative Research Program, the scope of work to be performed or undertaken by the NRC and EPRI, and, as appropriate, the contractors to be employed, the technical requirements, the

¹ NRC published its complete policy statement on meetings open to the public in the Federal Register on May 28, 2002 (67 FR 36920-36924). In general, meetings related to Cooperative Research Programs will not be open to public attendance if the subject matter to be discussed includes discussions related to proprietary information or could result in the inappropriate disclosure and dissemination of preliminary, unverified information.

financial responsibility and resource commitment of the NRC and EPRI, and the anticipated schedule. Each addendum shall also include an affidavit, in accordance with the requirements of 10 CFR §2.390, "Public inspections, exemptions, requests for withholding," which provides the basis for withholding from public release EPRI reports that may be shared with the NRC in the process of performing the work associated with the specific Addendum². The affidavit will generally describe the documents or information expected to be exchanged for the specific research program for each addenda.

- d. Management of Cooperative Research Programs: Each Cooperative Research Program will be managed by cognizant program managers and/or a technical review group comprised of NRC staff and EPRI employees.
- e. Termination of a Cooperative Research Programs: Either the NRC or EPRI may elect to terminate a Cooperative Research Program due to unsatisfactory contractor performance, lack of funds, changes in priority, or other reason. To effect a termination, the Senior Management Contact of the terminating party shall provide at least 30-days written notice of the intent to terminate continued participation in the specified Cooperative Research Program to the other party's Senior Management Contact. The terminating party shall provide confirmation of termination and the effective date thereof to the other party. The non-terminating party may continue with the research which is the subject of the Cooperative Research Program and shall have sole control over and use of the results and information obtained from the Cooperative Research Program subsequent to the effective termination date. Results obtained prior to the effective date of termination are governed by Article 2.2.
- f. No Conflict with Federal Rules or Regulations: The NRC's role as an independent agency shall be maintained. Notwithstanding anything to the contrary herein or in any addendum to this Agreement, the cooperation, approval, involvement or guidance of the NRC staff with regard to the Cooperative Research Programs shall not bind the NRC in any manner, especially its rulemaking, licensing or adjudicatory processes. The occasional use of the term "agree" or mandatory language, such as "shall" or "will" in this MOU, or any addendum hereto, is not intended to constitute a binding obligation and does not create an enforceable right of action on the part of either party. EPRI shall not function as an advisory entity to the NRC. To maintain NRC's regulatory independence, the parties shall not jointly interpret the results or implications of the data derived from the Cooperative Research Programs. EPRI shall not claim or publish in its studies, releases, reports, or publications any statements that indicate the NRC's approval or endorsement of any Cooperative Research Program or any related study, report, or publication without the prior written approval of the NRC's Senior Management Contact.

² This is applicable only to final reports or other intellectual property that EPRI has already developed. Data acquired during the course of the subject collaborative work is considered privileged information and thus will be routinely withheld from release until the final report(s) on this work is/are made publicly available.

DRAFT

Article 2 - Guidelines for Cooperative Research

- 2.1 The purpose of each Cooperative Research Program shall be to produce research data and results related to nuclear safety. To maintain independence and to avoid conflicts of interest, or even the appearance of any conflicts of interest, the NRC and EPRI shall not jointly derive any conclusions regarding the data or results obtained from a Cooperative Research Program or the application of such data or results to any regulation or regulatory guidance. The NRC and EPRI may cooperate in the validation and verification of data to ensure it is ready for use by decision-makers. Any regulatory analysis of the data to determine applicability to and impact on existing or new regulation shall be done independently.
- 2.2 All non-proprietary data produced by the cooperative programs will be shared by and between all participants in the cooperative program, consistent with each Party's legal obligations. Data produced or used under the cooperative programs or supplied to support the conduct of the research will be handled in accordance with the applicable statutes (e.g., Freedom of Information Act – FOIA), rules, regulations, policies, and procedures of the NRC and EPRI. The Parties recognize that Federal law may require release of this data.
- 2.3 If an electronic reading room is established, the following conditions will be maintained throughout the duration of this MOU.
- The electronic reading room will be password protected and passwords will be assigned to staff directly involved in cooperative research on a need-to-know basis
 - The electronic reading room will be sufficiently secure to prevent staff from printing, saving, or downloading any documents
 - Conditions of use of the electronic reading room will be displayed on the log-in screen and will require concurrence by each user of the electronic reading room
- 2.4 All final data or results produced by a Cooperative Research Program shall be shared by all participants, and each party shall be free to disseminate them to whomever they choose at no additional cost. Proprietary information supplied by EPRI to support conduct of the research will be marked and protected in accordance with applicable Federal laws, rules, and/or regulations, including 10 CFR §2.390. The addenda to this MOU will describe the documents or information to be exchanged for the specific research program involved. In accordance with 10 CFR §2.390, and prior to or contemporaneous with such exchange, EPRI will submit an affidavit covering such material and stating the basis for withholding it from public disclosure if the information has not been described in a previous affidavit.
- 2.5 Publication of privileged data or results from Cooperative Research Programs in journals or conference proceedings, by any party or contractor, prior to its public release in the final report(s) on this work, shall require the written approval of each of the Senior Management Contacts.
- 2.6 The NRC and EPRI will determine on a project-by-project basis if appropriate

patent or copyright applications should be filed with regard to the data or results generated by a Cooperative Research Program.

- 2.7 Upon request, each party shall have access, contingent upon meeting any required security clearances, to the contractors' facilities, separately or jointly, and may review the data developed by the other party's contractor that is associated with a specific Cooperative Research Program.
- 2.8 Either the NRC or EPRI may, at its own expense, conduct additional research beyond the scope of the Cooperative Research Program using the same contractor or facility employed with respect to a Cooperative Research Program if it so desires, or may employ such other contractors or facilities as it deems appropriate.

Article 3-Terms of Agreement

- 3.1 The term of this MOU shall commence effective upon signing by both NRC and EPRI Senior Management Contacts and shall expire on September 30, 2021. The addenda that were active as of September 30, 2016, remain as such until they are terminated in accordance with the requirements of this MOU. A list of addenda that were active as of September 30, 2016 is attached hereto as Exhibit A.
- 3.2 Either party may terminate this MOU at any time upon 90 days prior written notice of such termination.
- 3.3 This MOU supersedes and replaces the Memorandum of Understanding dated March 14, 2007.

The parties hereto acknowledge that this MOU is non-binding and is solely intended to promote cooperative relationships between the parties.

Michael Weber, Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Date: _____

Neil Wilmschurst, Vice President and Chief
Nuclear Officer
Electric Power Research Institute, Inc.
Date: _____

Exhibit A

Addenda to NRC-EPRI MOU on Cooperative Nuclear Safety
Research that were active and in effect on 30 Sept. 2016³

Title	NRC Contact	EPRI Contact	Accession #
Acquisition and Testing of Zion Spent Fuel Pool Neutron Absorber Materials	Eric Focht, Matt Rossi DE		ML15015A021
Aging, Qualification and Condition Monitoring of Electrical Cables	Kenn Miller DE		ML12261A368
Benchmarking of Emergency Planning and Response Radiological Assessment Software Tools Using Fukushima Accident Radiological Data	John Tomon DSA		ML14226A903
Cooperative Nuclear Safety Research, External Flooding Hazards	Joseph Kanney DRA		ML15321A365
Digital I&C and Human Factors	Ian Jung DE, Sean Peters DRA		ML090440352
Fire Risk	Mark Salley DRA		ML101450467
Long Term Operations Beyond 60 Years	Amy Hull, Raj Iyengar DE		ML100970003
Nondestructive Examination	Carol Nove DE		ML14112A187
Pressurized-Water Reactor Spent Fuel Heatup and Propagation Phenomena Experiments	Sergio Gonzalez DSA		ML13191B256
Primary Water Stress Corrosion Cracking - Crack Initiation Testing	Erick Focht, Greg Oberson DE		ML14217A006
Primary Water Stress Corrosion Cracking Expert Panel Activities	Greg Oberson, Rob Tregoning DE		ML14279A001
Probabilistic Risk Assessment (renewal)	Peter Appignani Sean Peters, John Lane, Nathan Siu DRA		ML101270008
Seismic Risk (renewal)	Jon Ake, DE		ML100060724
Steam Generator Tube Base Research Program	Matt Rossi, Pat Purtscher DE		ML13357A155
Cooperative Nuclear Safety Research, Extremely Low Probability of Rupture (XLPR) V2	Matthew Homiack, DE		ML15364A076

Exhibit A

³ This listing is a one-time compilation of active Addenda as of 30 Sept. 2016, provided for information. It does not commit the parties to future revisions of this MOU as addenda are added, revised or deleted. Subsequent updates to this list will be managed separately by the overall coordination contacts.

Danoff, Karen

From: Tregoning, Robert
Sent: Monday, June 20, 2016 8:51 AM
To: Kirk, Mark; Rao, Appajosula; Hiser, Matthew
Cc: Frankl, Istvan; Rudland, David
Subject: FW: NRC-NRAJ 2016 Materials Meeting Agenda.docx
Attachments: NRC-NRAJ 2016 Materials Meeting Agenda.docx

Note to requester:
Attachment to this email is
immediately following.

All:

Attached is the draft agenda for the NRC/NRAJ meeting on August 8-9. Could you please review the agenda and let me know if you have any issues supporting the meeting? The idea is for each side to have a presentation on research activities associated with these topics and then have a discussion on ways to collaborate and share information related to the topic. Could you also let me know the following w.r.t. the agenda:

1. Will Mark lead the RPV discussion or will Matt or someone else lead this discussion?
2. Will Pat Purtscher lead the material harvesting discussion?
3. Who will lead the CASS discussion?

Thanks for your help,

Rob

From: Tregoning, Robert
Sent: Friday, June 17, 2016 8:36 AM
To: 坂本 一信 <kazunobu_sakamoto@nsr.go.jp>
Subject: NRC-NRAJ 2016 Materials Meeting Agenda.docx

Kazu:

Attached is a rough draft for our meeting agenda. I've developed this based on the topics that we agreed to last month in our email exchanges. I've tried to group the topics in ways that make sense and I've put some estimates for times as well as speakers. Here's what I think we need to agree on.

1. Do you agree with all the topics and the order of the topics?
2. Do you agree with the meeting starting and ending times on both days? We could start and end at whatever times are convenient for you.
3. Do you agree with the scheduled breaks and lunch times? We could make these shorter or longer depending on your needs.
4. Do you agree with the length of time devoted to each topic?

Please feel free to modify the attached agenda to address these four questions.

After we agree on the agenda topics and times, the final step will be to confirm the speakers on the NRC and NRAJ side. Please let me know who your speakers will be for each topic. I have put some ideas down for the NRC speakers but I will still need to confirm this.

As always, thank you for your help with this meeting.

Warm regards,

Rob

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
Two White Flint North, M/S T-10 A36
11545 Rockville Pike
Rockville, MD 20852-2738
ph: 301-415-2324
Blackberry: [REDACTED] (b)(6)
fax: 301-415-6671

AGENDA

NRC/NRAJ Bilateral Meeting on Materials Issues

NRC Headquarters, Rockville, MD, USA

August 8 - 9, 2016

Monday, August 8th, 2016

Location: Room O7-B4

<u>Time</u>	<u>Topic</u>	<u>Speaker</u>
8:00 am	Introductions	All
8:05 am	Welcome	B. Thomas, NRC
8:15 am	Opening Remarks	R. Tregoning, NRC K. Sakamoto, NRAJ
	<u>Metals Aging</u>	
8:30 am	RPV embrittlement studies	M. Kirk, NRC NRAJ
10:00 am	Break	
10:15 am	Irradiated Assisted Degradation	S. Rao/M. Hiser, NRC NRAJ
11:30 am	Technical and Regulatory Concerns	All
12:00 pm	Lunch	
	<u>Cable Aging</u>	
1:30 pm	NRC Research Activities	D. Murdock, NRC
2:30 pm	NRAJ Research Activities	NRAJ
3:30 pm	Break	
3:45 pm	Technical and Regulatory Concerns	All
4:30 pm	Adjourn	

AGENDA

NRC/NRAJ Bilateral Meeting on Materials Issues

NRC Headquarters, Rockville, MD, USA
August 8 - 9, 2016

Tuesday, August 9th, 2016
Location: Room O7-B4

<u>Time</u>	<u>Topic</u>	<u>Speaker</u>
	<u>Concrete Aging</u>	All
8:00 am	Radiation Effects on Concrete Structures	M. Sircar, NRC M. Nakano, NRAJ
8:45 am	NDE for Thick Concrete Sections	M. Sircar, NRC M. Nakano, NRAJ
9:30 am	Monitoring and Aging Management of ASR Affected Concrete Structures	M. Sircar, NRC M. Nakano, NRAJ
10:15 am	Break	
10:30 am	Technical and Regulatory Concerns	All
12:00 pm	Lunch	
	<u>Possible Future Collaboration Areas</u>	
1:30 pm	Environmentally Assisted Fatigue	R. Tregoning, NRC NRAJ
2:00 pm	Aging of CASS	Rao/Purtcher, NRC NRAJ
2:30 pm	Peening	J. Collins, NRC NRAJ
3:00 pm	Break	
3:15 pm	Material Harvesting	P. Purtcher, NRC NRAJ
3:45 pm	Actions and Next Meeting	R. Tregoning, NRC K. Sakamoto, NRAJ
4:15 pm	Closing Remarks	R. Tregoning, NRC K. Sakamoto, NRAJ
4:30 pm	Adjourn	

Note to requester:
Attachment to this email is
immediately following.

From: [Moyer, Carol](#)
To: [Hull, Amy](#)
Cc: [Philip, Jacob](#)
Subject: FW: Draft UNR response.
Date: Tuesday, June 27, 2017 10:12:00 AM
Attachments: [UNR-6-26-17.docx](#)

Amy,

Jake has provided input on the concrete-related tasks for the SLR UNR in the attached file. Can you work with it in this format, to fold his input into the draft on the G-drive?

[G:\DE\CMB\2017-006 UNR NRR 2017-006\draft collective SLR UNR response 05-20-2017.abh.docx](#)

Jake – I thank you for sharing a copy of this with me. Since Amy is working on pulling together the various inputs to write our response, I am forwarding your file to her now. Just curious, why did you send this up to Brian Thomas at this stage, bypassing your branch chief?

Thank you,
Carol

From: Philip, Jacob
Sent: Tuesday, June 27, 2017 9:47 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Cc: Thomas, Brian <Brian.Thomas@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: FW: Draft UNR response.
FYI....preliminary draft of UNR response.
This write up is for concrete and has to be revised to include the 3 other topics in the SRM. The cover letter covers all 4 topics.

From: Philip, Jacob
Sent: Monday, June 26, 2017 3:06 PM
To: Pires, Jose <Jose.Pires@nrc.gov>; Sock, Frederick <Frederick.Sock@nrc.gov>; Candra, Hernando <Hernando.Candra@nrc.gov>; Li, Huan <Huan.Li@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>
Subject: Draft UNR response.

Folks,

I am enclosing a preliminary draft of the cited subject. This response covers concrete degradation only. The 3 other topics in the SRM are from other branches (not SGSEB) and need to be added to this response. We can ask Amy Hull to help in that effort.

Please let me know if you have any comments and suggestions. Some parts of this response has to be filled in by others in the branch as indicated.

Thanks....Jake

DRAFT

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

FROM: Michael F. Weber, Director
Office of Nuclear regulatory Research

SUBJECT: RESPONSE TO USER NEED REQUEST, "RESEARCH
ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL
ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED
OPERATION."

By memorandum dated May 4, 2017, the Office of Nuclear Regulatory Regulation (NRR) requested assistance from the Office of Regulatory research (RES) to develop specific research products to facilitate the evaluation of future applicants for a license to operate during the subsequent license renewal period (SLR) i.e. 60 to 80 years. RES is pleased to accept the subject request (UNR) For tracking purposes, RES has designated the UNR as as NRR-2017-xxxx, which is available in the Agency wide Documents Access and management systems (ADAMS) under accession number, MLxxxxxxAxxx.

As stated in the NRR request, in a previous user need request, UNR-NRR-2010-006, "Request for Office of Nuclear Regulatory Research in developing Technical Information to Support Evaluating the Feasibility of License Renewal Beyond 60 years, ADAMS accession No. ML092470525, RES assisted NRR in developing information for consideration in the SLR guidance documents. This new UNR focuses on research activities discussed in the SLR guidance documents and in the staff requirements memorandum (SRM) to SECY 14-0016 (ADAMS Accession No. ML 14241A578).

RES accepts the scope, schedule and priority described in the UNR, with some additional comments, noted in the RES response to the UNR included in the enclosure. During the course of the research work, RES will inform the Division of License renewal (DLR) of any changes, if required, to arrive at a reasonable solution.

Enclosure:

As stated

CONTACT: Xxxxxxxx Xxxxx, RES/DE/SGSEB

301-415-xxxx

ENCLOSURE

RESPONSE TO NRR USER NEED REQUEST, "RESEARCH ASSISTANCE ON POTENTIAL SIGNIFICANT TECHNICAL ISSUES DURING THE SUBSEQUENT PERIOD OF EXTENDED OPERATION."

Technical Issue

The four most significant technical issues identified by this new UNR were also outlined in the SRM on SECY 14-0016, "Ongoing Staff activities to ASSESS Regulatory Considerations for Power Reactor Subsequent License Renewal" (ADAMS Accession No. ML 14241A578):

- 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

The four significant issues noted above were the conclusions from an expert elicitation process to identify the most significant aging degradation technical issues for nuclear power plant operation beyond 60 years. They are described in the Expanded Materials Degradation Assessment (EMDA) reports, developed in cooperation with the Department of Energy (DOE) Water Sustainability Program. The resultant reports, NUREG/CR-7153, EMDA, vol. 1-5 (ADAMS Accession Nos, ML 14279A321, ML 14279A331, ML 14279A3491, ML 14279A430, and ML 14279A461). NRC staff has also recently completed draft guidance documents for SLR. They include draft NUREG-2191, Volume 1 and 2, (ADAMS Accession Nos. ML16274A389 and ML 16274 A2399), the Draft Aging lessons learned for Subsequent license Renewal (GALL_SLR) Report and the draft NUREG 2192, (ADAMS Accession No, ML1627A402), "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants", all issued for public comments in December 2015.

In the Concrete and containment degradation arena, EMDA identified the four issues that needed to be addressed for SLR: These were:

- Irradiation of concrete (shield walls and concrete reactor support)
- Concrete degradation due to Alkali-Silica Reaction (ASR)
- Boric acid attack and chloride corrosion of reinforcing bars
- Creep in post tensioned containment structures

RES agrees with the scope of the research outlined in the UNR, with comments. The **concrete degradation research** response to the UNR request addresses the four areas in concrete noted above. A summary of the UNR tasks **for the area of concrete and containment degradation** and the RES response to develop the research requested in the UNR follows.

- Task 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
- Task 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
- Task 3: Continue to develop Domestic and International Partnerships to share expertise capabilities and resources related to Aging management research for Long-term Operations
- Task 4: Documentation and compilation of results from tasks 1, 2, and Task 3 on the status of research results in support of the Commission's direction to staff

The RES response to the UNR request (for concrete degradation) follows.

- **Task 1**: Hold NRC/Industry workshop and prepare NUREG/CP and summary report.

RES will plan to hold an international workshop in early spring 2020 on the state of knowledge on the technical issues in concrete degradation requested in the SRM SECY 14-0016. The international workshop will help RES in securing information on research insights and knowledge from other countries and domestic partners on issues related to concrete materials degradation and aging management as discussed in SECY 14-0016. A draft agenda and a list of presenters at the workshop will be provided to DLR. The results of the workshop will be documented in a NUREG/CP report which will include a summary of the workshop, presentations and workshop insights and conclusions

- **Task 2**: Develop and implement a strategy for harvesting materials/components on concrete materials from decommissioned nuclear power plants as well (as from ex-plant components from operating plants).

RES will develop a data base which identifies and prioritizes the concrete materials, components and operating conditions needed to address the significant issues outlined in SECY 14-0016.

RES will develop a process to evaluate concrete samples harvested from decommissioned plants. RES is in very preliminary discussions with international entities (under the NEA/OECD/CSNI umbrella) to recover materials from a decommissioned plant in Canada affected by ASR. The expected outcome from these discussions can lead to evaluating the suitability and focus of testing that could include removal of core samples from the plant for mechanical and petrographic testing, insitu anchorage and bond testing of the ASR affected concrete and beam structural testing. RES will follow through with implementing the process as concrete materials become available from additional plants. In addition for irradiation effects on concrete materials RES will (fill this on irradiation and other decommissioned plant testing plans).....

.....

.....

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 letter report. The process to evaluate the concrete samples from 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 cooperational cost sharing on the retrieval and testing of samples

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

- **Task 3:** Develop domestic and international partnerships

RES will continue to pursue and develop domestic and international partnerships to share expertise, capabilities and resources related to aging management research for Long-Term operations. 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 has an ongoing collaboration with DOE/EPRI on ASR and irradiation effects on concrete and will continue participating under the international OECD/NEA/CSNI to develop modeling expertise for ASR effected concrete structures. (fill this on other partnerships)

RES will provide NRR management trip reports, summaries, papers, presentations, reports and other information from interactions with domestic and international organizations as a result of this activity. 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/DLR and NRR/DE.

- **Task 4:** Documentation and Compilation of results from Tasks 1,2 and 3 on the status of research results in accordance with SECY 14-0016.

RES will prepare a document annually summarizing the products from the three tasks above and discuss the accomplishments of RES and national and international partners in addressing the four major technical issues (in this case on concrete degradation) in the SRM.

Resources

(To be discussed with others in SGSEB)

Intended Use of RES products

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

Coordination and Schedules

The UNR has been coordinated between RES staff in the Division of Engineering (DE) and DLR staff in NRR. (Need discussion with others in SGSEB)

Priority

High

Points of Contact

NRR: Bennet Brady, Subsequent Renewal, Guidance, and Operations Branch, DLR

RES: Amy Hull, Corrosion and Metallurgy Branch, DE

Note to requester: Attachment to this email is immediately following.

From: Hiser, Matthew
Sent: Wednesday, July 27, 2016 3:12 PM
To: Thompson, Jacqueline
Subject: FW: NRAJ Bilateral Meeting Presentation on Harvesting
Attachments: Harvesting Efforts NRAJ Bilateral 7-20-16.pptx

Or Jacquie ☺

From: Hiser, Matthew
Sent: Wednesday, July 27, 2016 3:04 PM
To: Vera, Graciela <Graciela.Vera@nrc.gov>
Subject: FW: NRAJ Bilateral Meeting Presentation on Harvesting

Hi Gracie,

Can you add this document into non-public ADAMS for me?

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: Hiser, Matthew
Sent: Tuesday, July 26, 2016 10:01 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: FW: NRAJ Bilateral Meeting Presentation on Harvesting

Hi Steve,

I have put together slides on the harvesting for the NRAJ bilateral meeting next month and would like to share them for your review. These have been reviewed by Rob, Pat and Amy (see email chain below).

Thanks!
Matt

From: Hiser, Matthew
Sent: Wednesday, July 20, 2016 1:00 PM
To: Tregoning, Robert <Robert.Tregoning@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: NRAJ Bilateral Meeting Presentation on Harvesting

Thanks Rob! I have added a slide at the end for discussion topics, but kept 5 and 7 in. I can breeze through those fairly quickly.

Amy and Pat, do either of you have any input? If not, I will go ahead and run these by Steve...

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: Tregoning, Robert
Sent: Friday, July 15, 2016 1:19 PM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Hull, Amy <Amy.Hull@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: NRAJ Bilateral Meeting Presentation on Harvesting

Matt:

Just got a chance to look at this. Given that you've only got ½ hour, your 8 slides are probably the max. I would take more than 10 minutes to provide an overview of the activity. If you need to save time, slides 5 and 7 could be eliminated. You could provide them in the slide package but just gloss right over them in the presentation.

Obviously, Japan has a large number of plants that are shut-down. It's still not clear which of these plants will restart. Therefore, there may be a lot of harvesting opportunities there.

The main purpose of this discussion is to see if NRAJ has any activities (or planned activities) to identify harvesting opportunities. If so, it would be good to understand their approach. It would also be good to see if they know which plants are most likely to not restart.

With this in mind it would be good to have a slide or two with a list of questions or discussion topics on this issue to discuss with the Japanese. While we only have ½ hour, we may be flexible to extend the meeting if we need more discussion time on any topic.

Does this make sense?

Ro

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
Two White Flint North, M/S T-10 A36
11545 Rockville Pike
Rockville, MD 20852-2738
ph: 301-415-2324
Blackberry: (b)(6)
fax: 301-415-6671

From: Hiser, Matthew
Sent: Tuesday, July 12, 2016 5:13 PM
To: Hull, Amy <Amy.Hull@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Tregoning, Robert

<Robert.Tregoning@nrc.gov>

Subject: NRAJ Bilateral Meeting Presentation on Harvesting

Hi Amy, Pat, and Rob,

I've pulled together a few slides for discussion of the harvesting program at the NRAJ meeting next month.

Please take a look and provide any comments or edits.

Thanks!

Matt

Strategic Approach for Ex-Plant Materials Harvesting

Matthew Hiser

Amy Hull

Patrick Purtscher

Robert Tregoning

U.S. NRC

NRC-NRAJ Bilateral Technical Information Exchange Meeting
Nuclear Regulatory Commission Headquarters

August 8-9, 2016

Purpose

- Create a framework for a strategic approach to harvesting ex-plant materials to support regulatory needs associated with subsequent license renewal (SLR)
 - Ex-plant materials offer unique environmental exposure that cannot be entirely replicated by laboratory testing with fresh materials
- Align high priority data needs identified in SLR activities with harvesting opportunities from decommissioning plants

Background

- To date, harvesting opportunities have been limited due to few decommissioning plants
 - Zion in U.S., Zorita in Spain
- However, several U.S. plants have already shut down or are planning to do so in the near future
 - Kewaunee, San Onofre, Crystal River, Vermont Yankee, Oyster Creek, Fort Calhoun, Clinton, Quad Cities, Diablo Canyon
- This provides a unique opportunity to plan harvesting to address the highest priority technical and regulatory issues

Harvesting Experience

- Past harvesting efforts have generally involved reactive decision-making
 - Limited opportunities to acquire ex-plant materials
 - Limited strategic planning for harvesting
- Harvesting projects with NRC involvement:
 - Reactors internal materials from Zorita
 - Concrete from Zorita
 - Neutron absorber material from Zion
 - Cables from Zion and Crystal River

Zorita Internals Research Project Timeline

Task	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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										★

Approach: Assessment of Technical Issues and Available Materials for Harvesting

- Utilize various sources of technical information with respect to anticipated degradation in NPPs out to 80 years of operation
 - NRC, DOE, EPRI, IAEA
- Identify high-priority data needs that could be addressed through harvesting ex-plant materials
 - Focus on identifying characteristics of important systems, structures, and components (SSCs) for harvesting
- Gather information on ex-plant material expected to be available based on identified needs
 - May be from both operating and decommissioning reactors

Implementation

- What might the output of this activity look like?
 - For example, the review may show there is value in acquiring CASS material around 15% delta ferrite with various dose ranges (<0.08 dpa, 1–3 dpa, and >5 dpa)
- Once that need is identified, this activity would identify what SSCs might be the best candidates for harvesting
 - For example, perhaps lower support columns would be identified as the ideal SSC to address the CASS data need
- As decommissioning plants announce their plans, there is a clear list of SSCs and their characteristics (metallurgy, temperature, fluence, etc.) that would be desired to address the data need

Current NRC Activities



- NRC is working with Pacific Northwest National Lab (PNNL) to identify technical issues that may be best addressed by ex-plant harvesting
 - Focused on unique value of harvesting to understand material properties in difficult to replicate environments
- NRC also seeking interest from other stakeholders to better understand availability of materials for harvesting
 - Considering a public workshop in fall 2016
 - Stakeholders include EPRI, DOE, U.S. industry, international partners

Discussion Topics

- Japanese approach to ex-plant material harvesting
- Information on available harvesting opportunities from Japanese reactors
 - Is it known which plants will not restart?
- Opportunities for coordination / cooperation on ex-plant harvesting



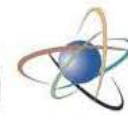
Backup Slides



Neutron Absorbers from Zion

- **Materials Harvested:**
 - Select Boral® NAM panels from Regions 1 and 2 of the Zion SFP
- **Scope:**
 - Visual and microstructural examinations (incl. areal density)
 - Corrosion testing
- **Purpose:**
 - Identify degradation mechanisms and estimate degradation rate
 - Confirm results of in-situ areal density measurements
 - Provide confirmatory data to support regulatory decision-making
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing in 2015-2016
- **Coordination:**
 - EPRI, ZionSolutions, SRNL

Zorita Internals Research Project (ZIRP)

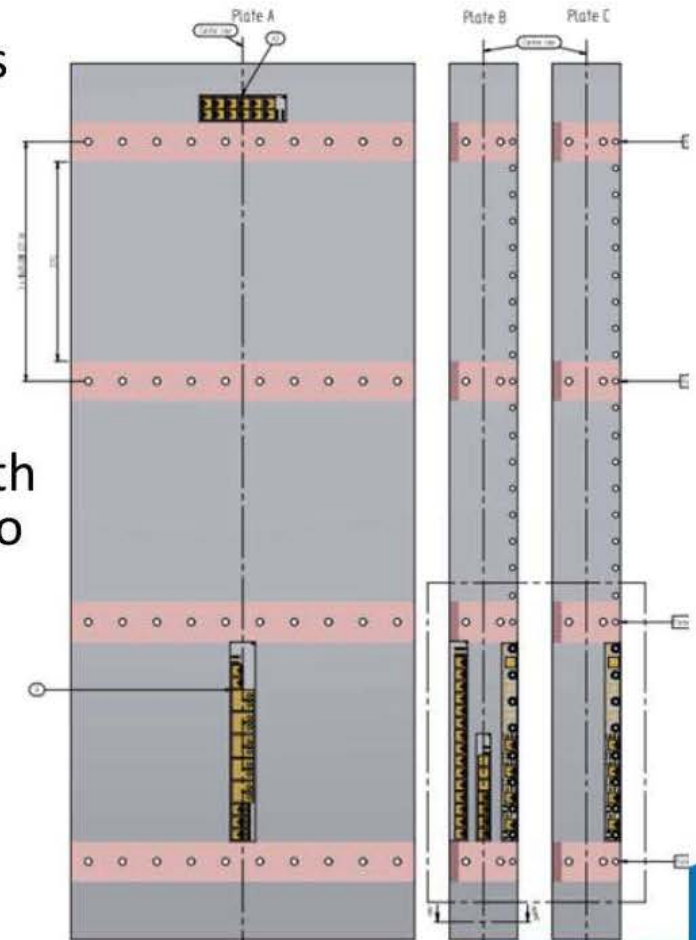


U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

- **Materials Harvested:**
 - Baffle plate and core barrel weld materials
- **Scope:**
 - Mechanical testing (tensile, CGR, FT)
 - Microstructural characterization (void swelling)
- **Purpose:**
 - High-fluence (up to 50 dpa) IAD effects with representative LWR exposure conditions to
 - Support regulatory decision-making associated with SLR
- **Timeline:**
 - Initial discussions in 2006, harvesting in 2013, testing ongoing through 2016
- **Coordination:**
 - EPRI, international consortium, Studsvik, Halden



Concrete from Zorita (Plan)

- **Materials Harvested:**
 - Concrete from structures that are in close proximity to RPV
- **Scope:**
 - Mechanical testing (compressive, tensile, modulus of elasticity)
 - Microstructural characterization
 - Physical change
- **Purpose:**
 - High fluence in combination with temperature and humidity that are representative of LWR environmental effects on structural and shielding performance
 - Supports regulatory decision-making associated with SLR
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing 2016-2018
- **Coordination:**
 - NRC , ENRESA and CSN

Cables: Zion and Crystal River

- **Materials Harvested:**
 - Low and Medium Voltage Cables
- **Scope:**
 - Condition monitoring to assess cable performance under normal operating conditions (accelerated aging) and accident conditions
- **Purpose:**
 - Cable degradation due to normal operating environment and accident conditions
 - Supports regulatory decision-making associated with SLR
- **Timeline:**
 - Initial discussions in 2012; Cable samples harvested from Zion in 2013
 - Plan is to harvest additional samples from Crystal River and Zion in 2015
 - Testing expected to be completed in 2017
- **Coordination:**
 - ORNL, Zion Solutions, NIST, EPRI

Note to requester:
Attachment to this email is
immediately following.

From: [Moyer, Carol](#)
To: [Hull, Amy](#)
Subject: FW: Document for ADAMS, for concurrence
Date: Friday, September 22, 2017 11:20:00 AM
Attachments: [SLR UNR response 09-22-2017.docx](#)

Amy,
FYI, Cassandra said the memo needed a LOT of formatting changes. I am really surprised at this, since we always start from a previous memo for a job like this. Hmm. She did not include a mark-up, only a request to use this one going forward.
Oh, and yes, she will restore the revised concurrence table!
-Carol

From: Cole, Cassandra
Sent: Friday, September 22, 2017 11:08 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: RE: Document for ADAMS, for concurrence

Ok, got it.

I have attached the finalized document for you to use for future memos as there were a lot of edits that needed to be made and I just completed it. Documents presented in this format makes it very difficult to do in a timely manner. Edits included columns, section breaks, page breaks, font and font size. I hope this can be a "template" for you to be able to copy and paste your information into. You may save to your desktop for quick access.

I will replace this version along with the enclosure into ADAMS and bring you the hard copy. Let me know if you need anything else.

From: Moyer, Carol
Sent: Friday, September 22, 2017 9:06 AM
To: Cole, Cassandra <Cassandra.Cole@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: Document for ADAMS, for concurrence

Importance: High

Cassandra,

The document that I forwarded this morning contains a memo and its enclosure. These are revised documents, with a version already in ADAMS at **ML17227A483**.

So, my revised request – Can you please insert this morning's document into the existing ADAMS package, and prepare a concurrence package?

Many thanks,
Carol

From: Moyer, Carol
Sent: Friday, September 22, 2017 8:40 AM
To: Cole, Cassandra <Cassandra.Cole@nrc.gov>
Cc: Hull, Amy <Amy.Hull@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: Document for ADAMS, for concurrence

Hello, Cassandra,

Would you please place the attached memorandum into ADAMS, and prepare a concurrence package?

Feel free to contact me if you have any questions.

Thank you,

Carol

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



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

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

FROM: Michael F. Weber
Director of Nuclear Regulatory Research

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

By memorandum dated May 4, 2017, the Office of Nuclear Reactor Regulation (NRR) requested assistance from the Office of Nuclear Regulatory Research (RES) to provide "specific research products to facilitate the evaluation of future applications for a license to operate during the subsequent license renewal (SLR) period (i.e., 60 to 80 years). These products should build upon analysis methods, tools, and expertise developed as part of ongoing and new research activities, focused specifically on aging effects during the SLR period." This user need request (UNR) supersedes and incorporates work from 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:

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

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

DISTRIBUTION:

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ADAMS Package Accession No.:MLxxxx

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

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NAME	D. Seber	B. Thomas	K. Johnson	M. Weber
DATE	/ /2017	/ /2017	/ /2017	/ /2017

OFFICIAL RECORD COPY

Notes to requester: Attachment to this email is immediately following. This document was how it was provided to the NRC FOIA staff, including the highlighted portions.

From: [Frankl, Istvan](#)
To: [Moyer, Carol](#)
Cc: [Hull, Amy](#); [Hiser, Matthew](#)
Subject: FW: ACTION: RIC posters
Date: Monday, September 25, 2017 2:45:27 PM
Attachments: [AdvMfg poster \(IF\).docx](#)
Importance: High

Carol,
As discussed, we need a proposal for a RIC poster on harvesting **by noon tomorrow**. Matt is on travel, so please work with Amy.
Please use the attached poster for AM as template.
Thanks,
Steve

From: Focht, Eric
Sent: Monday, September 25, 2017 8:33 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Oberson, Greg <Greg.Oberson@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: RE: ACTION: RIC posters
FYI, I created a folder on the G: drive for this RIC: [G:\DF\CMB\RIC\RIC 2017](#)
-Eric

From: Frankl, Istvan
Sent: Friday, September 22, 2017 3:35 PM
To: Rao, Appajosula <Appajosula.Rao@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>; Focht, Eric <Eric.Focht@nrc.gov>
Cc: Oberson, Greg <Greg.Oberson@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>
Subject: ACTION: RIC posters
Importance: High
All,
Additional posters are needed for the RIC. Brian recommended that we prepare posters for IAD and PWSSC (CGR and Initiation).
Please send me a short description as per the enclosed template **by noon Tuesday** (I will be in training on Wednesday).
Thanks,
Steve

From: Thomas, Brian
Sent: Friday, September 22, 2017 2:44 PM
To: Oberson, Greg <Greg.Oberson@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Boyce, Tom <Tom.Boyce@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>; Miller, Kenneth A <KennethA.Miller@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>
Cc: Regan, Christopher <Christopher.Regan@nrc.gov>
Subject: Re: RIC posters

Ok. Let's target the popular stuff:
IAD
PWSSC

CONCRETE, ASR, SCC MODULES;
xLPR

On: 22 September 2017 14:10, "Oberson, Greg" <Greg.Oberson@nrc.gov> wrote:
Hello,
Mike Weber wants RES to propose 4 to 6 more posters for RIC. We have only put forth one idea so far, so we should aim for two more for our division. Please thnk about it and let me know ideas by Wednesday.
Greg

TECHNICAL POSTER/TABLETOP PRESENTATION TOPIC AND DESCRIPTION

Poster/Tabletop Title:

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

Poster/Tabletop Topic and Description:

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 parts. 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 recommendations related to additive manufacturing via DMLM.

Poster/Tabletop Presenter:

- Amy Hull, Senior Materials Engineer, RES/DE/CMB, phone: 301-415-2435, email: amy.hull@nrc.gov
- **NRO?**

Note to requester:
Attachments to this email are
immediately following.

From: [Moyer, Carol](#)
To: [Hull, Amy](#)
Subject: FW: Plim Moyer ABH R0 rlt.docx
Date: Monday, October 16, 2017 6:45:00 PM
Attachments: [Plim Moyer ABH R0 rlt cem.docx](#)
[Plim Moyer ABH 246-143 R1.docx](#)

Sorry – I meant to CC you, as well.

From: Moyer, Carol
Sent: Monday, October 16, 2017 6:43 PM
To: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: RE: Plim Moyer ABH R0 rlt.docx

Rob,

Thanks very much for your detailed review and suggestions for improvement. Please take a look at the revised file (attached) – in both mark-up and clean versions. I will ship the clean version to the other contributors for a quick review.

The files are also in this folder: G:\DE\CMB\2017-006 UNR NRR 2017-006\PLiM paper -Carol

From: Tregoning, Robert
Sent: Monday, October 16, 2017 10:37 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: Plim Moyer ABH R0 rlt.docx

Carol:

Attached is my preliminary mark up of paper. We should talk.....

Rob

REGULATORY RESEARCH ON THE AGING MANAGEMENT OF SLRSTRUCTURES, SYSTEMS AND COMPONENTS IN NUCLEAR POWER PLANTS SUPPORTING LICENSE RENEWAL

C.E. MOYER
U.S. Nuclear Regulatory Commission
Washington, DC, USA
Email: Carol.Moyer@nrc.gov

A.B. HULL, M. SIRCAR, J. PHILIP, J. E. PIRES, D. D. MURDOCK, T. KOSHY
U.S. Nuclear Regulatory Commission
Washington, DC, USA

Abstract

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for commercial power reactors to operate for up to 40 years. These licenses may be renewed for multiple 20-year increments. Now that 48 units of the 99 operating commercial reactors in the U.S. have entered the operating period beyond 40 years, their first period of extended operation (PEO) to operate for up to 60 years, several licensees have indicated that they intend to apply within the next few years for subsequent license renewal (SLR) for an additional 20-year period. Based on existing knowledge, the NRC has created a new set of license renewal guidance documents (LRGDs) for the review of SLR applications and to communicate expectations for the aging management of passive, long-lived plant systems, structures, and components (SSCs). However, in order to ensure the continued adequacy of this guidance, research related to aging of SSCs is being conducted now and will continue beyond the receipt of the initial SLR applications. Research is ongoing in the following four areas: reactor pressure vessel (RPV) neutron embrittlement, irradiation assisted stress corrosion cracking (IASCC) of reactor vessel internals, concrete and containment degradation, and electrical cable qualification and condition assessment. The paper will focus on the research related to concrete degradation, including alkali-silica reaction and irradiation damage to concrete, and condition assessment of electrical cables.

1. INTRODUCTION

The U.S. commercial nuclear power industry intends to submit subsequent license renewal applications (SLRAs), which will allow nuclear power plant (NPP) operation up to 80 years, in accordance with 10 CFR Part 54.31(d) [1] that “a renewed license may be subsequently renewed.” However, an SLR applicant needs to address aging effects on passive long-lived systems, structures, and components (SSCs) within their SLRA. Some licensees are considering submitting applications for a subsequent 20-year (presumably) operating period beyond 60 years. The first of these applications could possibly be submitted as early as 2018.

To ensure readiness for review of possible applications for SLR, the NRC has just completed the development and publishing of new guidance documents, NUREG-2191 and NUREG-2192, [2, 3] for the technical review of SLRAs. An important part of this guidance document development was reviewing NPP operating experience, including worldwide experience with NPP extended operation. The technical bases for SLR guidance are derived from operating experience and from industry and independent confirmatory research.

Aging management programs (AMPs) are developed to anticipate material degradation and to help ensure adequate functionality and safety margins in SSCs. Key technical issues to be addressed in AMPs within subsequent license renewal guidance documents (SLRGDs) include reactor pressure vessel neutron embrittlement at high fluence; irradiation-assisted stress corrosion cracking of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment. [4] The paper describes the status of this ongoing research, and focuses on the areas of concrete and electrical cable aging management.

2. RESEARCH & SLR GUIDANCE DOCUMENTS

The NRC and industry have conducted extensive research over the past several decades to better understand the safety implications and risk associated with aging of SSCs. Recent presentations [5, 6] reviewed the history of NPP license renewal in the U.S and the evolution of the license renewal documents, NUREG-1800 and NUREG-1801 [7, 8] for the initial period of renewal. Being able to extrapolate any observed aging effects from the existing operating experience of less than 50 years for the oldest plant to postulated aging effects at 80 years' operating experience is nontrivial and required much confirmatory research, both of existing studies and AMP effectiveness audits at plants already in extended operation.

Prior to writing the SLRGDs, extensive research efforts were conducted to understand the strengths and shortcomings of the existing guidance documents for the initial period of renewal and to try to identify the 'unknown unknowns' [9]. The 2010 LRGDs were informed by NUREG/CR-6923, [10] the proactive material degradation assessment (PMDA). The PMDA program used expert elicitation to identify and assess various materials degradation mechanisms that could affect plant SSCs for operation up to 40 years. Degradation scenarios were ranked according to the probability of occurrence, level of knowledge concerning that process, and confidence in scores. The expanded material degradation assessment (EMDA, NUREG/CR-7153) [11] evaluated a broader range of SSCs, up to 80 years. The materials and systems addressed in EMDA are generally extended to all of those which fall within the scope of aging management review (AMR) for license renewal. Thus, in addition to piping and core internals, EMDA also includes the reactor pressure vessel (RPV), electrical cables, and concrete structures

NRC staff recently published the 1400 pg. compendium [12] of AMP Effectiveness Audits undertaken to provide a more complete understanding of how AMPs have been implemented by plants during the PEO and the degradation that has been identified by the AMPs. The results from these first-of-a-kind audits provided key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. The knowledge obtained from these audits was a primary source enabling the staff to develop new SLRGDs, to be used following the first PEO.

2.1 GALL-SLR Report (NUREG-2191)

The two-volume 1190 pg. GALL-SLR Report contains the NRC staff's generic evaluation of plant AMPs and establishes the technical bases for their adequacy. The guidance in this document is for the use of future applicants for SLR and encompasses all of the guidance applicable to initial license renewal.

The GALL-SLR Report identifies those material, environment and aging effect combinations that require aging management during the subsequent period of extended operation (PEO), including appropriate AMPs. Applicants are responsible for identifying in their applications any additional items that require aging management. Although the GALL-SLR Report identifies one acceptable approach to manage aging effects, applicants may propose plant-specific alternatives along with sufficient justification that the program will adequately manage the aging effects.

2.2 SRP-SLR (NUREG-2192)

The 509 pg. Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) provides guidance on the content of applications for renewal of the initial renewed operating license. The safety review is based primarily on the information provided by the applicant in a SLR application. Each of the individual SRP-SLR sections addresses: (i) who performs the review, (ii) areas of review, (iii) basis for review, (iv) method of review, and (v) conclusions from the review.

While the GALL-SLR Report is geared towards use by applicants to identify acceptable aging management approaches, the SRP-SLR provides guidance to the staff for its review of SLR applications. The SRP-SLR ensures a consistent and transparent review of SLR applications by documenting the acceptance criteria and review procedures that will be used by the staff in its reviews.

3. REGULATORY RESEARCH

The United States' regulations governing the operation of NPPs, Title 10 of the U.S. Code of Federal Regulations, [1] require that licensees demonstrate safety in design and operation of NPPs. Specifically, 10 CFR 54.29(a) requires that licensees manage aging effects so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the PEO. In its mission to ensure protection of the public health and safety, the NRC conducts confirmatory research to better understand and quantify various degradation mechanisms that may impact NPP SSCs. This research enables regulatory confidence regarding aging management of safety-related SSCs. Results from these ongoing research programs reduce uncertainty regarding license renewal and SLR, and help the regulator to maintain appropriate levels of conservatism in NRC regulations and guidance.

Key technical issues to be addressed for LTO [4] include RPV neutron embrittlement at high fluence; IASCC of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment. The paper describes the status of this ongoing research, particularly in the areas of concrete and electrical cable aging management.

4. RESEARCH ON DEGRADATION IN METAL COMPONENTS

4.1 RPV embrittlement

The safe operation of an NPP relies on maintaining the structural integrity of the RPV during routine operations and postulated accident scenarios. Two key capabilities underpin RPV structural integrity: (1) the ability to predict the behaviour of cracked structures under loading, and (2) the ability to predict the effects of irradiation embrittlement on the fracture toughness of RPV steels. Current regulatory procedures depend on empirically based engineering methods that, while generally acknowledged to incorporate large conservatisms, have not necessarily been validated for SLR conditions. Ongoing research is aimed at understanding the adequacy of existing approaches and developing new models and predictive procedures as needed. Issues such as late blooming phases (LBPs), attenuation, and flux effects are being evaluated. Work is also underway to evaluate the continued adequacy of associated regulatory guidance during SLR [13].

4.2 IAD of Reactor Internals

Limited data are available on irradiation effects at fluence levels consistent with SLR for properties such as void swelling and resistance to cracking for reactor internals materials. Preliminary data suggest that the significance of irradiation-assisted degradation (IAD) of LWR vessel internals could increase during long-term operation of NPPs. Particularly, there is interest in understanding the behavior of irradiated stainless steel (SS) weld materials (up to 8 dpa), higher fluence (>10 dpa) SS plate materials, and combined thermal and neutron embrittlement of cast austenitic stainless steel (CASS).

Ongoing research concerning IAD of RPV internals is focused on assessing the significance of void swelling on the structural and functional integrity of PWR internal components. Research is being conducted on harvested ex-plant materials. Work is underway to measure fracture toughness and IASCC for stainless steels & welds. Effects of environment and irradiation may be additive or synergistic; further testing will confirm the combined nature of these effects.

5. RESEARCH ON CONCRETE AND CONTAINMENT DEGRADATION

5.1 ASR

Alkali-Silica Reaction (ASR) is a chemical degradation in concrete that may occur over time as a reaction between the highly alkaline cement paste and reactive non-crystalline (amorphous) silica found in many common aggregates. This reaction causes the expansion of the altered aggregate by the formation of a swelling gel of calcium silicate hydrate (C-S-H). The objective of the research program is to develop the technical basis for generic regulatory guidance to evaluate ASR affected NPP concrete structures through its service life, including SLR). The intended outcome of the research is a methodology to determine for an ASR-affected structure (1) the in-situ structural capacity to resist design-basis static and dynamic loads, (2) its future structural

capacity, and (3) a recommended AMP consistent with the guidance in SRP-SLR for managing the aging effects of ASR in existing structures.

The NRC sponsors experimental research at the National Institute of Standards and Technology (NIST) that involves a combination of testing and modelling to study ASR effects on nuclear concrete structures. This program involves assessing in-situ mechanical properties of ASR-affected concrete, bond and lap splice lengths of reinforcing bars, and the seismic response characteristics of structural members. The NRC is participating in an international cooperative research program to assess structures subjected to concrete pathologies, under the Nuclear Energy Agency. In addition, the NRC is involved in a collaborative program with the technical support organizations for the French regulator.

5.2 Radiation induced degradation of concrete

Irradiated concrete can undergo degradation similar to ASR; swelling aggregate cracks the cement phase. The primary objective of this research is to review, evaluate, and enhance the capability to perform confirmatory analyses and testing of the effects of irradiation of concrete on the integrity of structures in the proximity of the RPV over extended periods of operation. The goal is to provide a technical basis to review plant conditions under AMPs. Over extended periods of operation, concrete structures in the proximity of the RPV, the primary and biological shield walls and the RPV support structures for example, can be subjected to high levels of neutron and gamma radiation together with sustained operating temperatures up to about 150° F. Long-term neutron and gamma irradiation on concrete of the reactor supports and shielding structures can affect dimensions (radiation induced volumetric expansion), micro-cracking of the cement paste, and physical and structural properties of concrete (e.g., reduction of compressive strength, tensile strength, modulus of elasticity, bond strength) that may affect structural performance and shielding capacity. Confirmatory testing depends on availability of suitable cores, possibly from decommissioning US plants. This research assesses the structural and safety significance of concrete irradiation for LTO.

A joint roadmap is being developed by NRC, The US Department of Energy (DOE), and the Electric Power Research Institute (EPRI). While EPRI and DOE have jointly published a report on estimated radiation levels for operation up to 80 years, and EPRI has started developing structural assessments, NRC is pursuing coordination with the Halden Research Program for investigating effects of radiation on bond strength. NRC is performing fluence modeling to assess configuration effects. NRC is also developing test plans to study radiation effects on bond strength and creep, and assessing plant configurations and designs to determine the plant conditions that would indicate a need for aging management.

5.3 Aging management of prestressed concrete containment structures

The objective of this project is to study the effects of aging and modifications of prestressed concrete containment vessels (PCCVs) on their intended safety functions. NUREG/CR-7153 Vol 4, "*Aging of Concrete and Civil Structures*," [11] identified creep and the potential for creep-related fracture as an aging concern applicable to PCCVs because of the sustained, multi-axial loading from the prestressing. This is relevant for aged PCCVs where reinforcement in the radial direction is not present, and when prestressing systems require adjustments, such as modifications for steam generator replacement, other repairs, and loss of prestress. As with other concrete aging mechanisms, creep and the potential for creep-fracture also may interact with other degradation mechanisms, such as ASR, corrosion, and freeze-thaw.

EPRI, DOE and international organizations, such as the Committee for the Safety of Nuclear Installations of the Organization for Economic Development and Cooperation (OECD/CSNI) are cooperating to address shrinkage, creep, drying, and moisture transport. Specifically, this activity focuses on benchmarking aspects of VERCORS, a comprehensive multiyear study of a 1/3 scale PCCV that focuses on aging effects, computational modelling and use of non-destructive evaluation techniques (NDE) and sensors for structural monitoring. Electricité de France (EDF), which started, funds and executes VERCORS, is making information and data from this study available to the OECD/CSNI activity.

6. ELECTRICAL CABLE QUALIFICATION AND CONDITION MONITORING

Electrical cables are often overlooked or ignored in aging analyses and condition monitoring evaluations because they are passive components that are generally considered to require no routine inspection and maintenance. Electrical cables are very important safety components, however, because they provide power to safety-related equipment and are used for instrumentation and control of safety functions. The NRC generic letter, GL 2007-01 [14], showed that a significant number of failures occurred under normal service conditions within the service interval of 20-30 years, which is before the renewed license period and before the end of the expected life span of the cables. The NRC has pursued research on the performance and degradation of both power cables and control cables in NPP environments. In relation to LTO, the NRC is cooperating with DOE and EPRI. A jointly-developed roadmap for cooperative research is being used to keep complementary testing programs on track.

Research in this area is investigating methods used for simulated aging of electrical cables, as well as condition monitoring to confirm that past equipment qualification practices were adequate, and to determine optimum condition monitoring methods to monitor cable aging in periods of extended license renewal. Ongoing research projects have obtained new and naturally aged cable samples that will be subjected to synergistic effects of radiation, temperature, and humidity similar to that seen in operating NPPs. A number of condition-monitoring techniques will be applied during and following aging protocols to determine condition monitoring method predictive capability. Finally, the aged cables will be subject to loss-of coolant accident testing to determine qualification adequacy and margins.

7. CONCLUSION

Extending the operating life of existing NPPs may be, for some utilities, an economically feasible way to meet future energy demands. The responsibility of the NRC is to ensure that plant life extension is safe - that it does not pose additional risk to public health and safety or to the environment. The NRC's process for concluding that a renewed operating license can be issued involves rigorous safety and environmental reviews to verify that regulatory requirements will continue to be met. The NRC has conducted confirmatory research to obtain supporting data and to refine models that predict materials degradation during extended aging. Long-term research to confirm the adequacy of guidance for metallic components is ongoing. The NRC is conducting and planning additional research related to concrete structures and electrical cables, to refine our understanding of degradation that may affect these plant components. The research will continue through the license renewal period (up to 60 years) and into the subsequent license renewal period (up to 80 years). Data analyzed to date suggest that, with appropriate maintenance, light water reactors may be operated through the SLR period safely.

REFERENCES

- [1] Code of Federal Regulations 10 CFR Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, (amended) 1995.
- [2] NUREG-2191, Volumes 1 and 2, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" (ADAMS Accession Nos. ML17187A031 and ML17187A204), 1190 pp, July 2017.
- [3] NUREG-2192, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants" (SRP-SLR) (ADAMS Accession No. ML17188A158) 509pp, July 2017.
- [4] SRM Requirements - SECY-14-0016- "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal," August 29, 2014 (ML14241A578).
- [5] Hull, A. B., and Burke, J, "NPP Subsequent License Renewal: Lessons Learned from Aging Management Program (AMP) Effectiveness Audits," Proceedings from SMiRT-23, Manchester UK, 2015.
- [6] Hull, A., Hiser, A., and Lindo-Talin, S., "NPP License Renewal and Aging Management: Revised Guidance," Proceedings from Third International Conference on Nuclear Power Plant Life Management, Salt Lake City, USA 14–18 May 2012.
- [7] NUREG-1800, Rev. 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," 393pp, Dec. 2010.
- [8] NUREG-1801, Rev. 2, "Generic Aging Lessons Learned (GALL) Report," 861pp, Dec. 2010.
- [9] NUREG-1925, Rev. 3, "Research Activities FY2015-FY 2017," 151pp, February 2016.
- [10] NUREG/CR-6923, "Expert Panel Report on Proactive Materials Degradation Assessment," 2007.
- [11] NUREG/CR-7153, "Expanded Materials Degradation Assessment, Vol. 1-5," 2014
- [12] NRC Technical Letter Report, "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," 1400pp, June 15, 2016 – (ML16167A076).
- [13] Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials." Revision 2. May 31, 1988.
- [14] NRC Generic Letter 2007-01 "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," February 7, 2007.

REGULATORY RESEARCH ON THE AGING MANAGEMENT OF SLRSTRUCTURES, SYSTEMS AND COMPONENTS IN NUCLEAR POWER PLANTS SUPPORTING LICENSE RENEWAL

C.E. MOYER
U.S. Nuclear Regulatory Commission
Washington, DC, USA
Email: Carol.Moyer@nrc.gov

A.B. HULL, M. SIRCAR, J. PHILIP, J. E. PIRES, D. D. MURDOCK, T. KOSHY
U.S. Nuclear Regulatory Commission
Washington, DC, USA

Abstract

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for commercial power reactors to operate for up to 40 years. These licenses may be renewed for multiple 20-year increments. Now that 48 units of the 99 operating commercial reactors in the U.S. have entered the operating period beyond 40 years, their first period of extended operation (PEO) to operate for up to 60 years, several licensees have indicated ~~intention that they intend~~ to apply within the next few years for subsequent license renewal (SLR) for an additional 20-year period. ~~Based on existing knowledge,~~ the NRC has created a new set of license renewal guidance documents (LRGDs) ~~to be ready~~ for the review of SLR applications and to communicate expectations for the aging management of passive, long-lived plant systems, structures, and components (SSCs). ~~However, in order to ensure the continued adequacy of this guidance, Regulatory research related to on the aging management of SSCs is being conducted now and will continue beyond the receipt of the initial SLR applications, to confirm the adequacy of these guidance documents through the SLR period. Should regulatory research identify concerns related to aging management, regulatory guidance may be revised to reflect the new results.~~ Regulatory research is ongoing in the following four areas: reactor pressure vessel (RPV) neutron embrittlement, irradiation assisted stress corrosion cracking (IASCC) of reactor vessel internals, concrete and containment degradation, and electrical cable qualification and condition assessment. The paper will focus on ~~regulatory the~~ research related to concrete degradation, including alkali-silica reaction and irradiation damage to concrete, and condition assessment of electrical cables.

1. INTRODUCTION

The U.S. commercial nuclear power industry intends to submit subsequent license renewal applications (SLRAs), which will allow nuclear power plant (NPP) operation up to 80 years, in accordance with 10 CFR Part 54.31(d) [1] that "a renewed license may be subsequently renewed." However, ~~the an SLR applicant NPPs may need to resolve potential technical challenges from needs to address~~ aging effects on passive long-lived systems, structures, and components (SSCs) ~~before the NRC can approve within their SLRAs. The NRC is aware that~~ some licensees are considering submitting applications for a subsequent 20-year (presumably) operating period beyond 60 years. The first of these applications could possibly be submitted as early as 2018.

To ensure readiness for review of possible applications for SLR, the NRC has just completed the development and publishing of new guidance documents, NUREG-2191 and NUREG-2192, [2, 3] for the technical review of ~~such applications SLRAs that would authorize plant operation beyond 60 years.~~ An important part of this guidance document development ~~activity~~ was reviewing NPP operating experience, including worldwide experience with NPP extended operation. The technical bases for SLR guidance are derived from operating experience and from industry and independent confirmatory research.

Aging management programs (AMPs) are developed to anticipate material degradation and to help ensure adequate functionality and safety margins in SSCs. Key technical issues to be addressed in AMPs within subsequent license renewal guidance documents (SLRGDs) ~~as identified by SRMSECY-14-0016,~~ (ML14241A578) [4] include "reactor pressure vessel neutron embrittlement at high fluence; irradiation-assisted stress corrosion cracking of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment." The paper describes the status of this ongoing research, ~~particularly in and focuses on~~ the areas of concrete and electrical cable aging management.

Commented [RLT1]: Don't think we need to focus on possibility that research may require a change to our guidance in this paper.

Commented [CM2R1]: Can we edit the Abstract at this time? I see nothing wrong with the statement other than the fact that it may be obvious. We are doing confirmatory research, to confirm adequacy of guidance documents that, if implemented, should result in adequate protection of health & safety.

Commented [CM3]: If changes to the abstract are acceptable, I do not object to Rob's proposed edits on this paragraph.

Commented [RLT4]: Do we really want to reference an SRM in an open-literature paper? I would just delete this clause.

Commented [CM5R4]: Agreed, the obscure document type does not need to be mentioned in the text. The reference [4] should be moved to the end of the sentence.

2. RESEARCH & SLR GUIDANCE DOCUMENTS

The NRC and industry have conducted extensive research over the past several decades to better understand the safety implications and risk associated with aging of SSCs. Recent presentations [5, 6] reviewed the history of NPP license renewal in the U.S and the evolution of the license renewal documents, NUREG-1800 and NUREG-1801 [7, 8] for the initial period of renewal. ~~The existing 99-licensed, operating commercial NPPs were granted 40-year licenses on the basis of economic and antitrust considerations—not technical limitations. As global energy needs continue to grow, nuclear power generation will continue to be a critical component in the mix of energy production. There is increasing industry interest in SLR and NPP long-term operation (LTO) beyond the first PEO. Extending the operating life of existing NPPs may be, for some utilities, an economically feasible way to meet future energy demands. The first three plants entered extended operation in 2009; thus they each have 48 years operation. Being able to extrapolate any observed aging effects from the existing operating experience of less than 50 years for the oldest plant to postulated aging effects at 80 years' operating experience is nontrivial and required much confirmatory research, both of existing studies and AMP effectiveness audits at plants already in extended operation.~~

Prior to writing the SLRGDs, extensive research efforts were conducted to understand the strengths and shortcomings of the existing guidance documents for the initial period of renewal and to try to identify the 'unknown unknowns' [9]. The 2010 LRGDs were informed by NUREG/CR-6923, [10] the proactive material degradation assessment (PMDA). The PMDA program used expert elicitation to identify and assess various materials degradation mechanisms that could affect plant SSCs for operation up to 40 years. Degradation scenarios were ranked according to the probability of occurrence, level of knowledge concerning that process, and confidence in scores. The expanded material degradation assessment (EMDA, NUREG/CR-7153) [11] evaluated a broader range of SSCs, up to 80 years. The materials and systems addressed in EMDA are generally extended to all of those which fall within the scope of aging management review (AMR) for license renewal. Thus, in addition to piping and core internals, EMDA also includes the reactor pressure vessel (RPV), electrical cables, and concrete structures

NRC staff recently published the 1400 pg. compendium [12] of AMP Effectiveness Audits undertaken to provide a more complete understanding of how AMPs have been implemented by plants during the PEO and the degradation that has been identified by the AMPs. The results from these first-of-a-kind audits provided key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. The knowledge obtained from these audits was a primary source enabling the staff to develop new SLRGDs, to be used following the first PEO.

2.1 GALL-SLR Report (NUREG-2191)

The two-volume 1190 pg. GALL-SLR Report contains the NRC staff's generic evaluation of plant AMPs and establishes the technical bases for their adequacy. The guidance in this document ~~and the GALL-SLR Report are~~ for the use of future applicants for SLR ~~and. The NRC does not intend to impose the guidance in this document and the GALL-SLR Report on current holders of an initial operating license renewal. However, this document and the GALL-SLR Report encompasses~~ all of the guidance applicable to initial license renewal. ~~The GALL-SLR Report should be treated in the same manner as an approved topical report that is generically applicable. Accordingly, both current holders of initial operating licenses as well as future applicants for initial license renewal may voluntarily choose to reference an AMP in the GALL-SLR Report in their applications. However, such applicants should inform the NRC that they plan to demonstrate consistency with the GALL-SLR Report. The GALL-SLR Report provides a generic evaluation of existing AMPs and an acceptable method to manage aging effects; plant-specific alternatives may be proposed.~~

The GALL-SLR Report identifies those material, environment and aging effect combinations that require aging management during the subsequent period of extended operation (PEO), including appropriate AMPs. Applicants are responsible for identifying in their applications any additional items that require aging management. Although the GALL-SLR Report identifies one acceptable approach to manage aging effects,

Commented [RLT6]: This is covered (or should be covered) in Allen's paper. Shouldn't we just reference his paper here and eliminate the text? If not, we run the risk of stating something that's either contradictory, inconsistent, or results in confusion for someone reading both papers.

Commented [CM7]: This appears redundant.

applicants may propose plant-specific alternatives along with sufficient justification that the program will adequately manage the aging effects.

The content of NUREG-2191 was significantly revised from that of the GALL Report, NUREG-1801, Rev. 2. Some AMPs were retired, others were added. For example, in those designated as mechanical AMPs, in the XLM section, AMPs XLM5, "BWR Feedwater Nozzle," and AMP XLM6, "BWR Control Rod Drive Return Line Nozzles" were retired. A new AMP X.M2, "Neutron Fluence Monitoring" was added that provides a method that may be used to accept neutron irradiation embrittlement time limited aging analyses (TLAAs) for RPV components in accordance with 10 CFR 54.21(c)(1)(iii). This is the TLAA acceptance criterion that states the effects of aging on the intended function or functions of the components will be adequately managed during the PEO. The AMP XLE3 was expanded into three new AMPs to address aspects of industry and NRC guidance related to potentially submerged cables: These are AMP XLE3A "Medium Voltage Power Cables," AMP XLE3B "Instrument and Control Cables," and AMP XLE3C "Low Voltage Power Cables (both alternate and direct current)." To reduce the burden for applicants, AMR line-items were made more specific, the number of AMR line-items citing a plant-specific AMP was significantly reduced, and concomitantly, those that were focused increased. This resulted in the total number of AMR line items increasing from 1521 line items in the GALL Report Rev 2 to 2613 for the GALL-SLR Report.

2.2 SRP-SLR (NUREG-2192)

The 509 pg. Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) provides guidance on the content of applications for renewal of the initial renewed operating license. ~~The principal purposes of the SRP-SLR are to ensure the quality and uniformity of NRC staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent PEO, following the first 20-year PEO (i.e., the initial license renewal period). The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve public and industry understanding of the NRC staff's review process.~~ The safety review is based primarily on the information provided by the applicant in a SLR application. Each of the individual SRP-SLR sections addresses: (i) who performs the review, (ii) areas of review, (iii) basis for review, (iv) method of review, and (v) conclusions from the review.

While the GALL-SLR Report is geared towards use by applicants to identify acceptable aging management approaches, the SRP-SLR provides guidance to the staff for its review of SLR applications. The SRP-SLR ensures a consistent and transparent review of SLR applications by documenting the acceptance criteria and review procedures that will be used by the staff in its reviews. ~~The content of the SRP-SLR is based on that of GALL-SLR Report; thus changes in the GALL-SLR Report are reflected by changes in the SRP-SLR.~~

2.3 Documents Supporting SLRGDs

To clarify the process and the changes, a Technical Bases document [13] and an analysis of public comments [14] will accompany the SLRGDs. Both are knowledge management and knowledge transfer documents associated with NUREG-2191 (GALL-SLR) and NUREG-2192 (SRP-SLR). The first documents the technical changes for the review of SLRAs that were made from the guidance contained in Revision 2 of NUREG-1801 (the GALL Report) and NUREG-1800 (SRP-LR). Consequently, this document provides the underlying rationale that the NRC staff used to develop the SLRGDs. The second document contains the NRC staff's analysis of the public comments received on the drafts of NUREG-2191 and NUREG-2192. Public comment drafts of the GALL-SLR Report and the SRP-SLR were published on December 15, 2015, with the public comment period expiring on February 29, 2016. A supplement to the draft SLRGDs was published on March 29, 2016, with the public comment period expiring on May 31, 2016. The disposition of comments that the NRC staff agreed with and used as the basis for instituting a change to either the GALL-SLR Report or the SRP-SLR are detailed in this document. In addition, the public comments that did not result in a change to either NUREG are also dispositioned, and the staff's technical basis for not agreeing with these comments is presented. Both documents are expected to be officially published at the end of 2017.

Commented [CM8]: This paragraph is not really about research. I think it can be deleted.

Commented [CM9]: These portions could be deleted for brevity.

RG 1.188 [15] will be revised in the process of reviewing and endorsing NEI 17-01 [16] which replaces NEI 95-10, Rev. 6 [17]. The NEI 17-01 industry guideline for implementing the requirements of 10 CFR Part 54 for SLR provides an acceptable approach for implementing the requirements of 10 CFR Part 54, the License Renewal Rule, referred to as the Rule, for SLR. The process outlined in NEI 17-01 is founded on industry experience in implementing the Rule for initial license renewal and on the lessons learned from that industry experience that can be applied to SLR. It is expected that following this guideline will offer a stable and efficient process, resulting in the issuance of a renewed license. However, applicants may elect to use other suitable methods or approaches for satisfying the Rule's requirements and completing an SLRA.

3. REGULATORY RESEARCH

The United States' regulations governing the operation of NPPs, Title 10 of the U.S. Code of Federal Regulations, [1] require that licensees demonstrate safety in design and operation of NPPs. Specifically, 10 CFR 54.29(a) requires that licensees manage aging effects so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the PEO. In its mission to ensure protection of the public health and safety, the NRC conducts confirmatory research to better understand and quantify various degradation mechanisms that may impact NPP SSCs. This research enables regulatory confidence regarding aging management of safety-related SSCs. Results from these ongoing research programs reduce uncertainty regarding license renewal and SLR, and help the regulator to maintain appropriate levels of conservatism in NRC regulations and guidance.

Key technical issues to be addressed for LTO [4] include RPV neutron embrittlement at high fluence; IASCC of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment.²² The paper describes the status of this ongoing research, particularly in the areas of concrete and electrical cable aging management.

4. MATERIALS ISSUES FOR MECHANICAL COMPONENTS RESEARCH ON DEGRADATION IN METAL COMPONENTS

4.1 RPV embrittlement

The safe operation of an NPP relies on maintaining the structural integrity of the RPV during routine operations and postulated accident scenarios. Two key capabilities underpin RPV structural integrity: (1) the ability to predict the behaviour of cracked structures under loading, and (2) the ability to predict the effects of irradiation embrittlement on the fracture toughness of RPV steels. Current regulatory procedures depend on empirically based engineering methods that, while generally acknowledged to incorporate large conservatisms, have not necessarily been validated for SLR conditions. Ongoing research is aimed at understanding the adequacy of existing approaches and developing new models and predictive procedures as needed. ~~Concerns include: Issues such as late blooming phases (LBPs), attenuation, and flux effects are being evaluated. Work is also underway to evaluate the continued adequacy of associated regulatory guidance during SLR RG-1.99, Rev 2-[18] during the period of first and potentially subsequent license renewals. For example, during extended operations the predictions of RG-1.99 tend to under-predict the embrittlement trends observed in operating reactors.~~

4.2 IAD of Reactor Internals

~~There is limited data available on irradiation effects at fluence levels consistent with SLR for properties such as void swelling and resistance to cracking for reactor internals materials. Preliminary data suggest that the significance of irradiation-assisted degradation (IAD) of LWR vessel internals could increase during both the initial license renewal period (i.e., 40 to 60 years) and during even longer-term operation of NPPs. Particularly, there is interest in understanding the behaviour areas of need include: of irradiated stainless steel (SS) weld materials (up to 8 dpa), higher fluence (>10 dpa) SS plate materials, and combined thermal and neutron embrittlement of cast austenitic stainless steel (CASS). Work is addressing the synergistic effects of thermal aging and irradiation damage on CASS.~~

Commented [CM10]: I propose deleting this section. It is very "regulatory," and it does not support the confirmatory research story that we are telling.

Commented [RLT11]: Haven't we already stated the information in Section 3?

Commented [CM12R11]: This expands on the Introduction somewhat. I think it's OK.

~~The objective of this research is to provide confirmatory technical basis for the performance of reactor vessel internal materials during potential extended operation up to 80 years. Ongoing research concerning IAP of RPV internals is focused on assessing the significance of void swelling on the structural and functional integrity of PWR internal components. Research is being conducted on harvested ex-plant materials as well as on representative materials irradiated in test reactors. Work is underway to measure on-fracture toughness and IASCC for stainless steels & welds. Corrosion-fatigue of irradiated materials is being tested at Argonne National Laboratory (ANL). Effects of environment and irradiation may be additive or synergistic; further testing will confirm the combined nature of these effects. Tests are planned for further irradiation of Zircaloy plate material to very high fluence (80 dpa), then characterizing void swelling and mechanical properties.~~

5. RESEARCH ON CONCRETE AND CONTAINMENT DEGRADATION

5.1 ASR

Alkali-Silica Reaction (ASR) is a chemical degradation in concrete that may occur over time as a reaction between the highly alkaline cement paste and reactive non-crystalline (amorphous) silica found in many common aggregates. This reaction causes the expansion of the altered aggregate by the formation of a swelling gel of calcium silicate hydrate (C-S-H). The objective of the research program is to develop the technical basis for generic regulatory guidance to evaluate ASR affected NPP concrete structures through its service life, including SLR. The intended outcome of the research is a methodology to determine for an ASR-affected structure (1) the in-situ structural capacity to resist design-basis static and dynamic loads, (2) its future structural capacity, and (3) a recommended AMP consistent with the guidance in SRP-SLR for managing the aging effects of ASR in existing structures.

The NRC sponsors experimental research at the National Institute of Standards and Technology (NIST) that involves a combination of testing and modelling to study ASR effects on nuclear concrete structures. This program involves assessing in-situ mechanical properties of ASR-affected concrete, bond and lap splice lengths of reinforcing bars, and the seismic response characteristics of structural members. The NRC is participating in an international cooperative research program to assess structures subjected to concrete pathologies, under the Nuclear Energy Agency. In addition, the NRC is involved in a collaborative program with the technical support organizations for the French regulator.

5.2 Radiation induced degradation of concrete

Irradiated concrete can undergo degradation similar to ASR; swelling aggregate cracks the cement phase. The primary objective of this research is to review, evaluate, and enhance the capability to perform confirmatory analyses and testing of the effects of irradiation of concrete on the integrity of structures in the proximity of the RPV over extended periods of operation. The goal is to provide a technical basis to review plant conditions under AMPs. ~~Another goal is to inform development of SLRGD updates for the review of AMPs.~~ Over extended periods of operation, concrete structures in the proximity of the RPV, the primary and biological shield walls and the RPV support structures for example, can be subjected to high levels of neutron and gamma radiation together with sustained operating temperatures up to about 150° F. Long-term neutron and gamma irradiation on concrete of the reactor supports and shielding structures can affect dimensions ~~and change~~ (radiation induced volumetric expansion), micro-cracking of the cement paste, and physical and structural properties of concrete (e.g., reduction of compressive strength, tensile strength, modulus of elasticity, bond strength) that may affect structural performance and shielding capacity. Confirmatory testing depends on availability of suitable cores, possibly from decommissioning US plants. This research assesses the structural and safety significance of concrete irradiation for LTO.

A joint roadmap is being developed by NRC, The US Department of Energy (DOE), and the Electric Power Research Institute (EPRI). While EPRI and DOE have jointly published a report on estimated radiation levels for operation up to 80 years, and EPRI has started developing structural assessments, NRC is pursuing coordination with the Halden Research Program for investigating effects of radiation on bond strength. NRC is performing fluence modeling to assess configuration effects. NRC is also developing test plans to study

Commented [RLT13]: Do we need to state this again?

radiation effects on bond strength and creep, and assessing plant configurations and designs to determine the range of plant conditions that would indicate a need for aging management.

5.3 Aging management of prestressed concrete containment structures

The objective of this project is to study the effects of ageing and modifications of prestressed concrete containment vessels (PCCVs) on their intended safety functions. NUREG/CR-7153 Vol 4, "Aging of Concrete and Civil Structures," [11] identified creep and the potential for creep-related fracture as an aging concern applicable to PCCVs because of the sustained, multi-axial loading from the prestressing. This is relevant for aged PCCVs where reinforcement in the radial direction is not present, and when prestressing systems require adjustments, such as modifications for steam generator replacement, other repairs, and loss of prestress. As with other concrete aging mechanisms, creep and the potential for creep-fracture also may interact with other degradation mechanisms, such as ASR, corrosion, and freeze-thaw.

EPRI, DOE and international organizations, such as the Committee for the Safety of Nuclear Installations of the Organization for Economic Development and Cooperation (OECD/CSNI) are cooperating to address shrinkage, creep, drying, and moisture transport. Specifically, this activity focuses on benchmarking aspects of VERCORS, a comprehensive multiyear study of a 1/3 scale PCCV that focuses on aging effects, computational modelling and use of non-destructive evaluation techniques (NDE) and sensors for structural monitoring. Electricité de France (EDF), which started, funds and executes VERCORS, is making information and data from this study available to the OECD/CSNI activity.

6. ELECTRICAL CABLE QUALIFICATION AND CONDITION MONITORING

Electrical cables are often overlooked or ignored in aging analyses and condition monitoring evaluations because they are passive components that are generally considered to require no routine inspection and maintenance. However, electrical cables are very important safety components, however, because they provide power to safety-related equipment and are used for instrumentation and control of safety functions. The NRC generic letter, GL 2007-01 [19], showed that a significant number of failures occurred under normal service conditions within the service interval of 20-30 years, which is before the renewed license period and before the end of the expected life span of the cables. The NRC has pursued research on the performance and degradation of both power cables and control cables in NPP environments. In relation to LTO, the NRC is cooperating with DOE and EPRI. A jointly-developed roadmap for cooperative research is being used to keep complementary testing programs on track.

Research in this area is investigating methods used for simulated aging of electrical equipment cables, as well as condition monitoring to confirm that past equipment qualification practices were adequate, and to determine optimum condition monitoring methods to monitor cable aging in periods of extended license renewal. Ongoing research projects have obtained new and naturally aged cable samples that will be subjected to synergistic effects of radiation, temperature, and humidity similar to that seen in operating NPPs. A number of condition-monitoring techniques will be applied during and following aging protocols to determine condition-monitoring method predictive capability. Finally, the synergistically-aged cables will be subject to loss-of-coolant accident testing to determine qualification adequacy and margins.

7. CONCLUSION

An assessment of results from currently implemented license renewal AMPs was performed to obtain a better understanding of the phenomena and management of certain materials degradation mechanisms, and informed the development of the SLRGDs, completed in 2017. Extending the operating life of existing NPPs may be, for some utilities, an economically feasible way to meet future energy demands. The responsibility of the NRC is to ensure that plant life extension is safe - that it does not pose additional risk to public health and safety or to the environment. The NRC's process for concluding that a renewed operating license can be issued

Commented [RLT14]: Why don't we restate anything about the research that we're doing, even if it's a sentence or two....

involves rigorous safety and environmental reviews to verify that regulatory requirements will continue to be met. The NRC has conducted confirmatory research to obtain supporting data and to refine models that predict materials degradation during extended aging. Long-term research to confirm the adequacy of guidance for metallic components is ongoing. The NRC is conducting and planning additional research related to concrete structures and electrical cables, to refine our understanding of degradation that may affect these plant components. The research will continue through the license renewal period (up to 60 years) and into the subsequent license renewal period (up to 80 years). Data analyzed to date suggest that, with appropriate maintenance, light water reactors may be operated through the SLR period safely.

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- [4] SRM Requirements - SECY-14-0016- "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal," August 29, 2014 (ML14241A578).
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- [19][14] NRC Generic Letter 2007-01 "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," February 7, 2007.

Note to requester:
Attachment to this email
is immediately following.

From: [Moyer, Carol](#)
To: [Tregoning, Robert](#)
Subject: FW: PLIM paper - draft for review, also 390 form
Date: Monday, October 16, 2017 7:33:00 AM
Attachments: [Plim Moyer ABH R0.docx](#)
[NRC 390 CEM PLIM4.pdf](#)

Rob,
Thanks in advance for your review efforts!
-Carol

From: Hull, Amy
Sent: Friday, October 13, 2017 10:17 AM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: PLIM paper - draft for review, also 390 form
See attached.

REGULATORY RESEARCH ON THE AGING MANAGEMENT OF SLRSTRUCTURES, SYSTEMS AND COMPONENTS IN NUCLEAR POWER PLANTS SUPPORTING LICENSE RENEWAL

Note to requester: This document included the yellow highlighted pages when received by the NRC FOIA staff.

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A.B. HULL, M. SIRCAR, J. PHILIP, J. E. PIRES, D. D. MURDOCK, T. KOSHY
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Abstract

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for commercial power reactors to operate for up to 40 years. These licenses may be renewed for multiple 20-year increments. Now that 48 units of the 99 operating commercial reactors in the U.S. have entered the operating period beyond 40 years, their first period of extended operation (PEO) to operate for up to 60 years, several licensees have indicated intention to apply within the next few years for subsequent license renewal (SLR) for an additional 20-year period. The NRC has created a new set of license renewal guidance documents (LRGDs) to be ready for the review of SLR applications and to communicate expectations for the aging management of passive, long-lived plant systems, structures, and components (SSCs). Regulatory research on the aging management of SSCs is being conducted now and will continue beyond the receipt of the initial SLR applications to confirm the adequacy of these guidance documents through the SLR period. Should regulatory research identify concerns related to aging management, regulatory guidance may be revised to reflect the new results. Regulatory research is ongoing in the following four areas: reactor pressure vessel (RPV) neutron embrittlement, irradiation assisted stress corrosion cracking (IASCC) of reactor vessel internals, concrete and containment degradation, and electrical cable qualification and condition assessment. The paper will focus on regulatory research related to concrete degradation, including alkali-silica reaction and irradiation damage to concrete, and condition assessment of electrical cables.

1. INTRODUCTION

The U.S. commercial nuclear power industry intends to submit subsequent license renewal applications (SLRAs), which will allow nuclear power plant (NPP) operation up to 80 years, in accordance with 10 CFR Part 54.31(d) [1] that "a renewed license may be subsequently renewed." However, the NPPs may need to resolve potential technical challenges from aging effects on passive long-lived systems, structures, and components (SSCs) before the NRC can approve SLRAs. The NRC is aware that some licensees are considering submitting applications for a subsequent 20-year (presumably) operating period beyond 60 years. The first of these applications could possibly be submitted as early as 2018.

To ensure readiness for review of possible applications for SLR, the NRC has just completed the development and publishing of new guidance documents, NUREG-2191 and NUREG-2192, [2, 3] for the technical review of such applications that would authorize plant operation beyond 60 years. An important part of this guidance document development activity was reviewing NPP operating experience, including worldwide experience with NPP extended operation. The technical bases for SLR guidance are derived from operating experience and from industry and independent confirmatory research.

Aging management programs (AMPs) are developed to anticipate material degradation and to help ensure adequate functionality and safety margins in SSCs. Key technical issues to be addressed in AMPs within subsequent license renewal guidance documents (SLRGDs) as identified by SRMSECY-14-0016, (ML14241A578) [4] include "reactor pressure vessel neutron embrittlement at high fluence; irradiation-assisted stress corrosion cracking of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment." The paper describes the status of this ongoing research, particularly in the areas of concrete and electrical cable aging management.

2. RESEARCH & SLR GUIDANCE DOCUMENTS

The NRC and industry have conducted extensive research over the past several decades to better understand the safety implications and risk associated with aging of SSCs. Recent presentations [5, 6] reviewed the history of NPP license renewal in the U.S and the evolution of the license renewal documents, NUREG-1800 and NUREG-1801 [7, 8] for the initial period of renewal. The existing 99 licensed, operating commercial NPPs were granted 40-year licenses on the basis of economic and antitrust considerations -- not technical limitations. As global energy needs continue to grow, nuclear power generation will continue to be a critical component in the mix of energy production. There is increasing industry interest in SLR and NPP long-term operation (LTO) beyond the first PEO. Extending the operating life of existing NPPs may be, for some utilities, an economically feasible way to meet future energy demands. The first three plants entered extended operation in 2009; thus they each have 48 years operation. Being able to extrapolate any observed aging effects from the existing operating experience of less than 50 years for the oldest plant to postulated aging effects at 80 years' operating experience is nontrivial and required much confirmatory research, both of existing studies and AMP effectiveness audits at plants already in extended operation.

Prior to writing the SLRGDs, extensive research efforts were conducted to understand the strengths and shortcomings of the existing guidance documents for the initial period of renewal and to try to identify the 'unknown unknowns' [9]. The 2010 LRGDs were informed by NUREG/CR-6923, [10] the proactive material degradation assessment (PMDA). The PMDA program used expert elicitation to identify and assess various materials degradation mechanisms that could affect plant SSCs for operation up to 40 years. Degradation scenarios were ranked according to the probability of occurrence, level of knowledge concerning that process, and confidence in scores. The expanded material degradation assessment (EMDA, NUREG/CR-7153) [11] evaluated a broader range of SSCs, up to 80 years. The materials and systems addressed in EMDA are generally extended to all of those which fall within the scope of aging management review (AMR) for license renewal. Thus, in addition to piping and core internals, EMDA also includes the reactor pressure vessel (RPV), electrical cables, and concrete structures

NRC staff recently published the 1400pg compendium [12] of AMP Effectiveness Audits undertaken to provide a more complete understanding of how AMPs have been implemented by plants during the PEO and the degradation that has been identified by the AMPs. The results from these first-of-a-kind audits provided key information to aid the NRC in identifying needed changes to existing AMPs and new AMPs that may be needed to provide assurance of safe plant operation during an SLR operating period. The knowledge obtained from these audits was a primary source enabling the staff to develop new SLRGDs, to be used following the first PEO.

2.1 GALL-SLR Report (NUREG-2191)

The two-volume 1190pp GALL-SLR Report contains the NRC staff's generic evaluation of plant AMPs and establishes the technical bases for their adequacy. The guidance in this document and the GALL-SLR Report are for the use of future applicants for SLR. The NRC does not intend to impose the guidance in this document and the GALL-SLR Report on current holders of an initial operating license renewal. However, this document and the GALL-SLR Report encompass all of the guidance applicable to initial license renewal. The GALL-SLR Report should be treated in the same manner as an approved topical report that is generically applicable. Accordingly, both current holders of initial operating licenses as well as future applicants for initial license renewal may voluntarily choose to reference an AMP in the GALL-SLR Report in their applications. However, such applicants should inform the NRC that they plan to demonstrate consistency with the GALL-SLR Report. The GALL-SLR Report provides a generic evaluation of existing AMPs and an acceptable method to manage aging effects, plant-specific alternatives may be proposed.

The GALL-SLR Report identifies those material, environment and aging effect combinations that require aging management during the subsequent period of extended operation (PEO), including appropriate AMPs. Applicants are responsible for identifying in their applications any additional items that require aging management. Although the GALL-SLR Report identifies one acceptable approach to manage aging effects,

applicants may propose plant-specific alternatives along with sufficient justification that the program will adequately manage the aging effects.

The content of NUREG-2191 was significantly revised from that of the GALL Report, NUREG-1801, Rev. 2. Some AMPs were retired, others were added. For example, in those designated as mechanical AMPs, in the XI.M section, AMPs XI.M5, "BWR Feedwater Nozzle," and AMP XI.M6, "BWR Control Rod Drive Return Line Nozzles" were retired. A new AMP X.M2, "Neutron Fluence Monitoring" was added that provides a method that may be used to accept neutron irradiation embrittlement time limited aging analyses (TLAAs) for RPV components in accordance with 10 CFR 54.21(c)(1)(iii). This is the TLAA acceptance criterion that states the effects of aging on the intended function or functions of the components will be adequately managed during the PEO. The AMP XI.E3 was expanded into three new AMPs to address aspects of industry and NRC guidance related to potentially submerged cables: These are AMP XI.E3A "Medium Voltage Power Cables," AMP XI.E3B "Instrument and Control Cables," and AMP XI.E3C "Low Voltage Power Cables (both alternate and direct current)." To reduce the burden for applicants, AMR line-items were made more specific, the number of AMR line-items citing a plant-specific AMP was significantly reduced, and concomitantly, those that were focused increased. This resulted in the total number of AMR line items increasing from 1521 line items in the GALL Report Rev 2 to 2613 for the GALL-SLR Report.

2.2 SRP-SLR (NUREG-2192)

The 509 pg. Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) provides guidance on the content of applications for renewal of the initial renewed operating license. The principal purposes of the SRP-SLR are to ensure the quality and uniformity of NRC staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent PEO, following the first 20-year PEO (i.e., the initial license renewal period). The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve public and industry understanding of the NRC staff's review process. The safety review is based primarily on the information provided by the applicant in a SLR application. Each of the individual SRP-SLR sections addresses: (i) who performs the review, (ii) areas of review, (iii) basis for review, (iv) method of review, and (v) conclusions from the review.

While the GALL-SLR Report is geared towards use by applicants to identify acceptable aging management approaches, the SRP-SLR provides guidance to the staff for its review of SLR applications. The SRP-SLR ensures a consistent and transparent review of SLR applications by documenting the acceptance criteria and review procedures that will be used by the staff in its reviews. The content of the SRP-SLR is based on that of GALL-SLR Report; thus changes in the GALL-SLR Report are reflected by changes in the SRP-SLR.

2.3 Documents Supporting SLRGDs

To clarify the process and the changes, a Technical Bases document [13] and an analysis of public comments [14] will accompany the SLRGDs. Both are knowledge management and knowledge transfer documents associated with NUREG-2191 (GALL-SLR) and NUREG-2192 (SRP-SLR). The first documents the technical changes for the review of SLRAs that were made from the guidance contained in Revision 2 of NUREG-1801 (the GALL Report) and NUREG-1800 (SRP-LR). Consequently, this document provides the underlying rationale that the NRC staff used to develop the SLRGDs. The second document contains the NRC staff's analysis of the public comments received on the drafts of NUREG-2191 and NUREG-2192. Public comment drafts of the GALL-SLR Report and the SRP-SLR were published on December 15, 2015, with the public comment period expiring on February 29, 2016. A supplement to the draft SLRGDs was published on March 29, 2016, with the public comment period expiring on May 31, 2016. The disposition of comments that the NRC staff agreed with and used as the basis for instituting a change to either the GALL-SLR Report or the SRP-SLR are detailed in this document. In addition, the public comments that did not result in a change to either NUREG are also dispositioned, and the staff's technical basis for not agreeing with these comments is presented. Both documents are expected to be officially published at the end of 2017.

RG 1.188 [15] will be revised in the process of reviewing and endorsing NEI 17-01 [16] which replaces NEI 95-10, Rev. 6 [17]. The NEI 17-01 industry guideline for implementing the requirements of 10 CFR Part 54 for SLR provides an acceptable approach for implementing the requirements of 10 CFR Part 54, the License Renewal Rule, referred to as the Rule, for SLR. The process outlined in NEI 17-01 is founded on industry experience in implementing the Rule for initial license renewal and on the lessons learned from that industry experience that can be applied to SLR. It is expected that following this guideline will offer a stable and efficient process, resulting in the issuance of a renewed license. However, applicants may elect to use other suitable methods or approaches for satisfying the Rule's requirements and completing an SLRA.

3. REGULATORY RESEARCH

The United States' regulations governing the operation of NPPs, Title 10 of the U.S. Code of Federal Regulations, [1] require that licensees demonstrate safety in design and operation of NPPs. Specifically, 10 CFR 54.29(a) requires that licensees manage aging effects so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the PEO. In its mission to ensure protection of the public health and safety, the NRC conducts confirmatory research to better understand and quantify various degradation mechanisms that may impact NPP SSCs. This research enables regulatory confidence regarding aging management of safety-related SSCs. Results from these ongoing research programs reduce uncertainty regarding license renewal and SLR, and help the regulator to maintain appropriate levels of conservatism in NRC regulations and guidance.

Key technical issues to be addressed for LTO [4] include RPV neutron embrittlement at high fluence; IASCC of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment." The paper describes the status of this ongoing research, particularly in the areas of concrete and electrical cable aging management.

4. MATERIALS ISSUES FOR MECHANICAL COMPONENTS

4.1 RPV embrittlement

The safe operation of an NPP relies on maintaining the structural integrity of the RPV during routine operations and postulated accident scenarios. Two key capabilities underpin RPV structural integrity: (1) the ability to predict the behaviour of cracked structures under loading, and (2) the ability to predict the effects of irradiation embrittlement on the fracture toughness of RPV steels. Current regulatory procedures depend on empirically based engineering methods that, while generally acknowledged to incorporate large conservatisms, have not necessarily been validated for SLR conditions. Ongoing research is aimed at understanding the adequacy of existing approaches and developing new models and predictive procedures as needed. Concerns include: late blooming phases (LBPs), attenuation, flux effects. Work is underway to evaluate the continued adequacy of RG 1.99, Rev 2 [18] during the period of first and potentially subsequent license renewals. For example, during extended operations the predictions of RG 1.99 tend to under-predict the embrittlement trends observed in operating reactors.

4.2 IAD of Reactor Internals

There is limited data available on irradiation effects at fluence levels consistent with SLR for properties such as void swelling and resistance to cracking for reactor internals materials. Preliminary data suggest that the significance of irradiation-assisted degradation (IAD) of LWR vessel internals could increase during both the initial license renewal period (i.e., 40 to 60 years) and during even longer-term operation of NPPs. Particular areas of need include: irradiated stainless steel (SS) weld materials (up to 8 dpa), higher fluence (>10 dpa) SS plate materials, and combined thermal and neutron embrittlement of cast austenitic stainless steel (CASS). Work is addressing the synergistic effects of thermal aging and irradiation damage on CASS.

The objective of this research is to provide confirmatory technical basis for the performance of reactor vessel internal materials during potential extended operation up to 80 years. Ongoing research concerning IAD of RPV internals is focused on assessing the significance of void swelling on the structural and functional

integrity of PWR internal components. Research is being conducted on harvested ex-plant materials as well as on representative materials irradiated in test reactors. Work is underway on fracture toughness and IASCC for stainless steels & welds. Corrosion fatigue of irradiated materials is being tested at Argonne National Laboratory (ANL). Effects of environment and irradiation may be additive or synergistic; further testing will confirm. Tests are planned for further irradiation of Zorita plate material to very high fluence (80 dpa), then characterizing void swelling and mechanical properties.

5. CONCRETE AND CONTAINMENT DEGRADATION

5.1 ASR

Alkali-Silica Reaction (ASR) is a chemical degradation in concrete that may occur over time as a reaction between the highly alkaline cement paste and reactive non-crystalline (amorphous) silica found in many common aggregates. This reaction causes the expansion of the altered aggregate by the formation of a swelling gel of calcium silicate hydrate (C-S-H). The objective of the research program is to develop the technical basis for generic regulatory guidance to evaluate ASR affected NPP concrete structures through its service life, including SLR). The intended outcome of the research is a methodology to determine for an ASR-affected structure (1) the in-situ structural capacity to resist design-basis static and dynamic loads, (2) its future structural capacity, and (3) a recommended AMP consistent with the guidance in SRP-SLR for managing the aging effects of ASR in existing structures.

The NRC sponsors experimental research at the National Institute of Standards and Technology (NIST) that involves a combination of testing and modelling to study ASR effects on nuclear concrete structures. This program involves assessing in-situ mechanical properties of ASR-affected concrete, bond and lap splice lengths of reinforcing bars and the seismic response characteristics of structural members. The NRC is participating in an international cooperative research program to assess structures subjected to concrete pathologies, under the Nuclear Energy Agency. In addition, the NRC is involved in a collaborative program with the technical support organizations for the French regulator.

5.2 Radiation induced degradation of concrete

Irradiated concrete can undergo degradation similar to ASR; swelling aggregate cracks the cement phase. The primary objective of this research is to review, evaluate, and enhance the capability to perform confirmatory analyses and testing of the effects of irradiation of concrete on the integrity of structures in the proximity of the RPV over extended periods of operation. The goal is to provide a technical basis to review plant conditions under AMPs. Another goal is to inform development of SLRGD updates for the review of AMPs. Over extended periods of operation, concrete structures in the proximity of the RPV, the primary and biological shield walls and the RPV support structures for example, can be subjected to high levels of neutron and gamma radiation together with sustained operating temperatures up to about 150° F. Long-term neutron and gamma irradiation on concrete of the reactor supports and shielding structures can affect dimensional change (radiation induced volumetric expansion), micro-cracking of the cement paste, physical and structural properties of concrete (e.g., reduction of compressive strength, tensile strength, modulus of elasticity, bond strength) that may affect structural performance and shielding capacity. Confirmatory testing depends on availability of suitable cores, possibly from decommissioning US plants. This research assesses the structural and safety significance of concrete irradiation for LTO.

A joint roadmap is being developed by NRC, The US Department of Energy (DOE), and the Electric Power Research Institute (EPRI). While EPRI and DOE have jointly published a report on estimated radiation levels for operation up to 80 years, and EPRI has started developing structural assessments, NRC is pursuing coordination with the Halden Research Program for investigating effects of radiation on bond strength. NRC is performing fluence modeling to assess configuration effects. NRC is also developing test plans to study radiation effects on bond strength and creep, and assessing plant configurations and designs to determine the range of plant conditions that would indicate a need for aging management.

5.3 Aging management of prestressed concrete containment structures

The objective of this project is to study the effects of ageing and modifications of Prestressed Concrete Containment Vessel (PCCV) on their intended safety functions. NUREG/CR-7153 Vol 4, "*Aging of Concrete and Civil Structures*," [11] identified creep and potential for creep-related fracture as an aging concern applicable to PCCVs because of the sustained, multi-axial loading from the prestressing. This is relevant for aged PCCVs where reinforcement in the radial direction is not present and when prestressing systems require adjustments such as modifications for steam generator replacement, other repairs, and loss of prestress. As with other concrete aging mechanisms, creep and potential for creep-fracture also may interact with other degradation mechanisms such as ASR, corrosion, and freeze-thaw.

EPRI, DOE and international organizations, such as the Committee for the Safety of Nuclear Installations of the Organization for Economic Development and Cooperation (OECD/CSNI) are cooperating to address shrinkage, creep, drying, and moisture transport. Specifically, this activity focuses on benchmarking aspects of VERCORS, a comprehensive multiyear study of a 1/3 scale PCCV that focuses on aging effects, computational modelling and use of non-destructive evaluation techniques (NDE) and sensors for structural monitoring. Electricité de France (EDF), which started, funds and executes VERCORS, is making information and data from this study available to the OECD/CSNI activity.

6. ELECTRICAL CABLE QUALIFICATION AND CONDITION MONITORING

Electrical cables are often overlooked or ignored in aging analyses and condition monitoring evaluations because they are passive components that are generally considered to require no routine inspection and maintenance. However, electrical cables are very important safety components because they provide power to safety-related equipment and are used for instrumentation and control of safety functions. The NRC generic letter, GL 2007-01 [19], showed that a significant number of failures occurred under normal service conditions within the service interval of 20-30 years, which is before the renewed license period and before the end of the expected life span of the cables. The NRC has pursued research on the performance and degradation of both power cables and control cables in NPP environments. In relation to LTO, the NRC is cooperating with DOE and EPRI. A jointly-developed roadmap for cooperative research is being used to keep complementary testing programs on track.

Research in this area is investigating methods used for simulated aging of electrical equipment as well as condition monitoring to confirm that past equipment qualification practices were adequate and to determine optimum condition monitoring methods to monitor cable aging in periods of extended license renewal. Ongoing research projects have obtained new and naturally aged cable samples that will be subjected to synergistic effects of radiation temperature and humidity similar to that seen in operating NPPs. A number of condition-monitoring techniques will be applied during and following aging protocols to determine condition-monitoring method predictive capability. Finally, the synergistically aged cables will be subject to loss-of coolant accident testing to determine qualification adequacy and margins.

7. CONCLUSION

An assessment of results from currently implemented license renewal AMPs was performed to obtain a better understanding of the phenomena and management of certain materials degradation mechanisms, and informed the development of the SLRGDs, completed in 2017. Extending the operating life of existing NPPs may be, for some utilities, an economically feasible way to meet future energy demands. The responsibility of the NRC is to ensure that plant life extension is safe - that it does not pose additional risk to public health and safety or to the environment. The NRC's process for concluding that a renewed operating license can be issued involves rigorous safety and environmental reviews to verify that regulatory requirements will continue to be met.

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- [2] NUREG-2191, Volumes 1 and 2, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" (ADAMS Accession Nos. ML17187A031 and ML17187A204), 1190 pp, July 2017.
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AND COMPONENTS IN NUCLEAR POWER PLANTS SUPPORTING LICENSE RENEWAL

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From: [Hiser, Matthew](#)
To: [Hiser, Allen](#)
Subject: FW: Harvesting Workshop Agenda Brainstorming
Date: Monday, November 21, 2016 10:49:36 AM
Attachments: [Workshop Agenda 11-4-16.docx](#)
[NRC Harvesting Workshop Announcement.docx](#)

If you get a chance, please take a look at the draft agenda and provide any comments or feedback.

From: Hiser, Matthew
Sent: Friday, November 04, 2016 12:48 PM
To: Hiser, Allen <Allen.Hiser@nrc.gov>
Cc: Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: FW: Harvesting Workshop Agenda Brainstorming

Tying you into this discussion on the harvesting workshop per Rob's suggestion. Any input much appreciated ☺

From: Hiser, Matthew
Sent: Friday, November 04, 2016 12:46 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Poehler, Jeffrey <Jeffrey.Poehler@nrc.gov>
Subject: RE: Harvesting Workshop Agenda Brainstorming

Hi Rob, Pat, and Jeff,

Please find attached my updates to the agenda based on our discussion yesterday. It may be somewhat premature, but I went ahead and tried to put times to the agenda, just to see how it might schedule out. Session 5 is probably the main area of uncertainty along with international presenters in general.

Please take a look and provide any comments or feedback by next Wednesday, so we can hopefully finalize this and share with DOE/EPRI very soon.

I also attached the latest version of the workshop announcement, which we plan to use to publicize to other attendees and presenters.

Thanks!

Matt

Original Appointment-----

From: Hiser, Matthew

Sent: Wednesday, November 02, 2016 2:34 PM

To: Hiser, Matthew; Purtscher, Patrick; Tregoning, Robert; Poehler, Jeffrey

Subject: Harvesting Workshop Agenda Brainstorming

When: Thursday, November 03, 2016 1:00 PM-2:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: HQ-TWFN-08C01-10p

Hi Rob, Jeff, Pat,

I've put together an outline of an agenda for this workshop on harvesting that we are planning for March. My first cut at it is attached. I'd like to use this meeting to brainstorm how to structure the workshop and, if possible, who to ask to present and on what topics.

Rob and I were discussing trying to selectively target participants and presentations to cover the topics we'd like, rather than simply asking DOE and EPRI and others for their take on "harvesting." I think if we plan this well, we can get an interesting and substantive discussion. If not, we may just get a rehash of SLR-type talks...

Thanks!

Matt

<< File: Agenda Outline.docx >>

Ex-Plant Materials Harvesting Workshop

Location: NRC HQ in Rockville, MD

Dates: March 7-8, 2017

Motivation:

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

Purpose and Objective:

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

Workshop Topics:

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

Draft Agenda – March 7-8, 2017 Harvesting Workshop

Tuesday, March 7, 2017

Introduction

- NRC overview of workshop purpose and objectives 8:00 – 8:10

Session 1: Lessons learned from harvesting experience

- EPRI Perspective on Harvesting Lessons Learned 8:10 – 8:45
 - Zorita, Baffle Bolts, Barsebeck, etc.
- DOE Perspective on Harvesting Lessons Learned 8:45 – 9:20
 - Zion, etc.
- NRC Perspective on Harvesting Lessons Learned 9:20 – 9:50
 - Shoreham, St. Lucie, Zorita, Zion, etc.

BREAK 9:50 – 10:05

- Japan – JNES / JNRA 10:05 – 10:40
 - International Perspective on Harvesting Lessons Learned

DISCUSSION 10:40 – 11:30

LUNCH 11:30 – 12:30

Session 2: Technical data needs best addressed by harvesting

- PNNL/NRC 12:30 – 12:55
 - Overview of data needs best addressed by harvesting
- Belgium - Tractebel 12:55 – 1:20
 - Perspective on harvesting data needs, particularly RPV
- Korea – KAERI? 1:20 – 1:45
 - Perspective on harvesting data needs, Kori plant
- Switzerland – ENSI or PSI? 1:45 – 2:10
 - Perspective on harvesting data needs, Muhleberg

DISCUSSION 2:10 – 2:45

BREAK 2:45 – 3:00

Session 3: Sources of Materials

- NRC 3:00 – 3:15
 - Available materials from decommissioning plants and past harvesting programs
- EPRI / NEI 3:15 – 3:45
 - Available materials from operating reactors and past harvesting programs
- DOE (ORNL?) 3:45 – 4:15
 - Available materials at DOE labs from past harvesting programs
- IAEA ? 4:15 – 4:45
 - International harvesting opportunities

DISCUSSION 4:45 – 5:30

Wednesday, March 8, 2017

Session 4: Practical aspects of Harvesting

- US decommissioning company 8:00 – 8:40
 - Decommissioning process vs. harvesting: schedule, site-specific, timing for different components
- International decommissioning company – Germany? 8:40 – 9:20
 - Decommissioning and harvesting plans and experience
- US utility 9:20 – 10:00
 - Decommissioning process and plans
 - Owner perspective on harvesting and decommissioning

BREAK 10:00 – 10:15

- Researcher perspective – EPRI or DOE or international 10:15 – 10:45
 - Practical challenges to plan for and carry out harvesting

DISCUSSION 10:45 – 11:45

LUNCH 11:45 – 12:45

Session 5: Harvesting Decision-making

- PNNL / NRC 12:45 – 1:15
 - Technical information needed for informed harvesting decisions
- EPRI/NEI 1:15 – 1:45
 - Balancing costs and benefits to ensure value from harvesting
- DOE 1:45 – 2:15
 - Applying past experience to future harvesting decisions
- International - ? 2:15 – 2:45
 - Harvesting decision-making
- DISCUSSION 2:45 – 4:00
 - Potential harvesting partnerships
 - RPV, internals, piping, concrete, cables
 - US, international opportunities

Discussion Topics

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

Note to requester:
Attachments to this email
are immediately following.

From: [Hiser, Matthew](#)
To: [Poehler, Jeffrey](#)
Subject: FW: Harvesting Workshop Agenda Brainstorming
Date: Monday, November 21, 2016 10:28:17 AM
Attachments: [Workshop Agenda 11-4-16.docx](#)
[NRC Harvesting Workshop Announcement.docx](#)

Hi Jeff,

Just wanted to check if you had any input to provide on the harvesting workshop agenda (attached).

Thanks!

Matt

From: Hiser, Matthew
Sent: Wednesday, November 09, 2016 10:37 AM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Poehler, Jeffrey <Jeffrey.Poehler@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Hiser, Allen <Allen.Hiser@nrc.gov>
Subject: FW: Harvesting Workshop Agenda Brainstorming

Just wanted to send a reminder for feedback / input on the workshop agenda.

Thanks!

Matt

From: Hiser, Matthew
Sent: Friday, November 04, 2016 12:46 PM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Poehler, Jeffrey <Jeffrey.Poehler@nrc.gov>
Subject: RE: Harvesting Workshop Agenda Brainstorming

Hi Rob, Pat, and Jeff,

Please find attached my updates to the agenda based on our discussion yesterday. It may be somewhat premature, but I went ahead and tried to put times to the agenda, just to see how it might schedule out. Session 5 is probably the main area of uncertainty along with

international presenters in general.

Please take a look and provide any comments or feedback by next Wednesday, so we can hopefully finalize this and share with DOE/EPRI very soon.

I also attached the latest version of the workshop announcement, which we plan to use to publicize to other attendees and presenters.

Thanks!

Matt

Original Appointment-----

From: Hiser, Matthew

Sent: Wednesday, November 02, 2016 2:34 PM

To: Hiser, Matthew; Purtscher, Patrick; Tregoning, Robert; Poehler, Jeffrey

Subject: Harvesting Workshop Agenda Brainstorming

When: Thursday, November 03, 2016 1:00 PM-2:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: HQ-TWFFN-08C01-10p

Hi Rob, Jeff, Pat,

I've put together an outline of an agenda for this workshop on harvesting that we are planning for March. My first cut at it is attached. I'd like to use this meeting to brainstorm how to structure the workshop and, if possible, who to ask to present and on what topics.

Rob and I were discussing trying to selectively target participants and presentations to cover the topics we'd like, rather than simply asking DOE and EPRI and others for their take on "harvesting." I think if we plan this well, we can get an interesting and substantive discussion. If not, we may just get a rehash of SLR-type talks...

Thanks!

Matt

<< File: Agenda Outline.docx >>

Ex-Plant Materials Harvesting Workshop

Location: NRC HQ in Rockville, MD

Dates: March 7-8, 2017

Motivation:

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

Purpose and Objective:

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

Workshop Topics:

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

Draft Agenda – March 7-8, 2017 Harvesting Workshop

Tuesday, March 7, 2017

Introduction

- NRC overview of workshop purpose and objectives 8:00 – 8:10

Session 1: Lessons learned from harvesting experience

- EPRI Perspective on Harvesting Lessons Learned 8:10 – 8:45
 - Zorita, Baffle Bolts, Barsebeck, etc.
- DOE Perspective on Harvesting Lessons Learned 8:45 – 9:20
 - Zion, etc.
- NRC Perspective on Harvesting Lessons Learned 9:20 – 9:50
 - Shoreham, St. Lucie, Zorita, Zion, etc.

BREAK 9:50 – 10:05

- Japan – JNES / JNRA 10:05 – 10:40
 - International Perspective on Harvesting Lessons Learned

DISCUSSION 10:40 – 11:30

LUNCH 11:30 – 12:30

Session 2: Technical data needs best addressed by harvesting

- PNNL/NRC 12:30 – 12:55
 - Overview of data needs best addressed by harvesting
- Belgium - Tractebel 12:55 – 1:20
 - Perspective on harvesting data needs, particularly RPV
- Korea – KAERI? 1:20 – 1:45
 - Perspective on harvesting data needs, Kori plant
- Switzerland – ENSI or PSI? 1:45 – 2:10
 - Perspective on harvesting data needs, Muhleberg

DISCUSSION 2:10 – 2:45

BREAK 2:45 – 3:00

Session 3: Sources of Materials

- NRC 3:00 – 3:15
 - Available materials from decommissioning plants and past harvesting programs
- EPRI / NEI 3:15 – 3:45
 - Available materials from operating reactors and past harvesting programs
- DOE (ORNL?) 3:45 – 4:15
 - Available materials at DOE labs from past harvesting programs
- IAEA ? 4:15 – 4:45
 - International harvesting opportunities

DISCUSSION 4:45 – 5:30

Wednesday, March 8, 2017

Session 4: Practical aspects of Harvesting

- US decommissioning company 8:00 – 8:40
 - Decommissioning process vs. harvesting: schedule, site-specific, timing for different components
- International decommissioning company – Germany? 8:40 – 9:20
 - Decommissioning and harvesting plans and experience
- US utility 9:20 – 10:00
 - Decommissioning process and plans
 - Owner perspective on harvesting and decommissioning

BREAK 10:00 – 10:15

- Researcher perspective – EPRI or DOE or international 10:15 – 10:45
 - Practical challenges to plan for and carry out harvesting

DISCUSSION 10:45 – 11:45

LUNCH 11:45 – 12:45

Session 5: Harvesting Decision-making

- PNNL / NRC 12:45 – 1:15
 - Technical information needed for informed harvesting decisions
- EPRI/NEI 1:15 – 1:45
 - Balancing costs and benefits to ensure value from harvesting
- DOE 1:45 – 2:15
 - Applying past experience to future harvesting decisions
- International - ? 2:15 – 2:45
 - Harvesting decision-making
- DISCUSSION 2:45 – 4:00
 - Potential harvesting partnerships
 - RPV, internals, piping, concrete, cables
 - US, international opportunities

Discussion Topics

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

Note to requester:
Attachment to this
email is immediately
following.

From: [Moyer, Carol](#)
To: [Brock, Kathryn](#)
Cc: [Freeman, Eric](#)
Subject: FW: Harvesting Workshop
Date: Wednesday, November 23, 2016 11:11:00 AM
Attachments: [NRC Harvesting Workshop Announcement.docx](#)

Kathryn,
Here is another item for your Ed Bradley meeting, just in case there is interest in cooperation on ex-plant materials.
Carol

From: Hiser, Matthew
Sent: Wednesday, November 23, 2016 8:29 AM
To: Moyer, Carol <Carol.Moyer@nrc.gov>
Subject: Harvesting Workshop

Hi Carol,
Here's the announcement we've been using to publicize the workshop.
Please let me know if you'd like more info ☺
Thanks and happy Thanksgiving!
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

Ex-Plant Materials Harvesting Workshop

Location: NRC HQ in Rockville, MD

Dates: March 7-8, 2017

Motivation:

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

Purpose and Objective:

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

Workshop Topics:

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

Note to requester:
Attachment to this
email is immediately
following.

From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#)
Subject: FW: DE Briefing on Harvesting
Date: Wednesday, December 06, 2017 11:36:00 AM
Attachments: [Harvesting One Pager 12-1-17 \(IF\).docx](#)
Importance: High

Hi Rob,

If we rescheduled this for next Friday, Dec. 15, any chance you could attend or call in?

Thanks!

Matt

From: Frankl, Istvan
Sent: Wednesday, December 06, 2017 9:24 AM
To: Hiser, Matthew <Matthew.Hiser@nrc.gov>
Cc: Audrain, Margaret <Margaret.Audrain@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: DE Briefing on Harvesting
Importance: High

Matt,

I have attached my revisions and comments.

Are you planning to draft slides as well? Please see my comment on this in the attachment.

Also, Chris declined the briefing scheduled for Monday. Usually, briefings like this cannot be completed in less than an hour. I would have liked the briefing to take place before the ANL trip but please try to reschedule to address Chris' request.

Thanks,

Steve

From: Hiser, Matthew
Sent: Friday, December 01, 2017 3:33 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: DE Briefing on Harvesting

Hi Steve,

I have attached a draft one-pager that could be used to brief Brian and Chris on the harvesting efforts in the context of their questions regarding the ANL travel. Do you mind if I go ahead and schedule something with them for next week?

Meg, Pat, and Rob, please feel free to edit / comment on this draft one-pager as necessary.

Thanks!

Matt

Ex-Plant Materials Harvesting ~~UpdateOne-Pager~~

Motivation and Objective:

- Ex-plant materials are valuable for confirmatory testing because they have been exposed to actual in-service plant operating conditions (temperature, irradiation, coolant, etc.)
 - Generally, research involves accelerated, simulated aging conditions in a lab which may not be as representative of actual in-service aging
 - Highly representative materials (actual plant components) and aging conditions reduces the uncertainty associated with the applicability of research findings.
- With plants shutting down both in the U.S. and Europe, there are increasing opportunities to harvest components from decommissioning plants.
- Insights from ex-plant harvesting would support regulatory decisions for subsequent license renewal (SLR), and could have implications for the current license period
 - There is a task in the new UNR for SLR from NRR/DLR requesting RES to investigate opportunities for harvesting where appropriate.

Commented [F11]: Please summarize full scope of this task including related database.

Past Activities:

- Workshop in March 2017
 - NRC staff hosted a 2-day workshop with interested stakeholders, including domestic and international utilities and research organizations, to discuss benefits and challenges associated with ex-plant harvesting.
 - Sessions covered motivation for harvesting, data needs, sources of materials, lessons learned, the practical aspects of harvesting, and harvesting decision-making and planning
 - The discussion focused on the importance of clearly identifying the need and purpose for performing a harvesting project. All participants agreed harvesting is a complex and expensive proposition, but one that can be worthwhile if the need is clearly defined and addressed.
- PNNL Report on Harvesting Criteria
 - PNNL has produced a draft final report for NRC on criteria for harvesting decision-making and planning
 - Provides overview of past harvesting efforts and lessons learned as well as suggestions for approach to prioritize data needs for harvesting
- PLiM
 - NRC staff provided a presentation, poster, and paper for the recent PLiM conference in October 2017.

Path Forward:

- Focused on two parallel efforts:
 - Developing alignment within NRC on prioritization of harvesting data needs
 - Use criteria identified in PNNL report to establish effective prioritization scheme for relevant areas: RPV, RPV internals and other metals, electrical components, concrete
 - Developing a database identifying sources of materials for harvesting
 - Start with lab-based "boneyards" of prior harvested materials
 - Visits to ANL, PNNL, and ORNL (leveraged with already planned travel) support this activity
 - Coordinate with DOE NSUF Nuclear Fuel and Materials Library (NFML) run by INL as appropriate and beneficial

Commented [F12]: Please mention above that this is supported by the SLR UNR.

Commented [F13]: This needs to be expanded in this one-pager or on separate slides to address DE management comments/questions on the ANL and follow-on trips (please see my prior email on this).

Commented [F14]: There is no approved travel to ORNL in 2018.

From: [Frankl, Istvan](#)
To: [Moyer, Carol](#)
Cc: [Hiser, Matthew](#)
Subject: FW: ACTION: Input for quarterly EPRI MOU call
Date: Thursday, September 21, 2017 12:03:45 PM
Attachments: [image004.jpg](#)
[image006.jpg](#)
[image007.jpg](#)
[image008.jpg](#)

Note to requester: The two images above Thomas Koshy's name repeated throughout this document did not save when uploaded into NRC's redaction software. The images are a photo of Thomas Koshy and the NRC seal.

Carol,

Please review the enclosed request from Greg, align with Matt and if elevation to EPRI and NRC management is necessary, please draft talking points to support the upcoming call.

Thanks,

Steve

From: Oberson, Greg
Sent: Wednesday, September 20, 2017 4:49 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Cc: Koshy, Thomas <Thomas.Koshy@nrc.gov>
Subject: FW: ACTION: Input for quarterly EPRI MOU call

Steve,

There is an action item to: "Review the availability of cables that could be harvested from plants in decommissioning to support research on cable aging and performance under realistic conditions. Elevate as needed to EPRI and NRC management to facilitate successful availability."

Tom suggests that this falls under the scope of the harvesting activity in your branch. Can you take responsibility for this action item?

Thanks,

greg

From: Koshy, Thomas
Sent: Wednesday, September 20, 2017 3:03 PM
To: Oberson, Greg <Greg.Oberson@nrc.gov>
Cc: Miller, Kenneth A <KennethA.Miller@nrc.gov>
Subject: RE: ACTION: Input for quarterly EPRI MOU call

Greg

Cable harvesting for the project that is currently progressing is completed. I have consulted Kenn Miller on this already

We have another big project on harvesting separately to cover many items electrical equipment, cables, concrete, radiated RX components etc., That is progressing separately.

It is done from Istavan's branch

I do not see any other inputs from ICEEB



Thomas Koshy, Acting Branch Chief
Instrumentation, Controls & Electrical Engineering Branch
Division of Engineering, Office Of Research, USNRC
Email: Thomas.Koshy@nrc.gov
Tel: Number: 301-415-2154

Room no: TWFN-10B48
MS TWFN-10A36

From: Oberson, Greg

Sent: Wednesday, September 20, 2017 1:47 PM

To: Koshy, Thomas <Thomas.Koshy@nrc.gov>

Subject: RE: ACTION: Input for quarterly EPRI MOU call

This is the actions list. Yours is the cable harvesting. I have that on the SharePoint spreadsheet already.

Greg

From: Koshy, Thomas

Sent: Wednesday, September 20, 2017 1:43 PM

To: Oberson, Greg <Greg.Oberson@nrc.gov>

Subject: RE: ACTION: Input for quarterly EPRI MOU call

Can you get me the old agenda to see if I&C/ Electrical had any



Thomas Koshy, Acting Branch Chief
Instrumentation, Controls & Electrical Engineering Branch
Division of Engineering, Office Of Research, USNRC
Email: Thomas.Koshy@nrc.gov
Tel: Number: 301-415-2154
Room no: TWFN-10B48
MS TWFN-10A36

From: Oberson, Greg

Sent: Wednesday, September 20, 2017 11:43 AM

To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Miller, Kenneth A <KennethA.Miller@nrc.gov>; Boyce, Tom <Tom.Boyce@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>

Cc: Regan, Christopher <Christopher.Regan@nrc.gov>

Subject: ACTION: Input for quarterly EPRI MOU call

BCs,

The quarterly EPRI MOU management update call will be held in mid-October. You are responsible for providing updates on action items from the June meeting, as well as to identify challenges/issues that would benefit from management attention. I have placed a spreadsheet file on SharePoint with the action items and I assigned them to a branch to provide an input. Please provide a few sentences to a paragraph update and identify any challenges/issues. It is ok to have no challenges/issues. If you believe that I assigned the wrong branch the action, please let me know. Input is requested by COB October 2.

SharePoint file is here:

<http://fusion.nrc.gov/res/team/de/Divison%20Meeting%20Docs/EPRI%20MOU%20meeting>

Please let me know if you have questions.

Thanks,

Greg

From: [Iyengar, Raj](#)
To: [Mehta, Shivani](#)
Cc: [Nove, Carol](#); [Tregoning, Robert](#); [Hiser, Matthew](#)
Subject: FW: ACTION: IRSN meeting summary
Date: Thursday, March 23, 2017 2:59:36 PM

Shivani,

DE input to IPT is highlighted below. Please let me know if you have changes.

Raj

(Folks in Cc: - If you have any changes, please let Shivani know by OCB today.)

Action Items :

- IRSN will re-connect NRC (Carol Nove) with Gerard Cattiaux.
- IRSN will send ODOBA agreement to NRC for collaboration.
- NRC to follow up on NDE testing work with IRSN, CEA, and PNNL. (NRC Update: While the agreement included a task for PNNL to collect data with CEA's flexible phased-array ultrasonic probe, this task has been on-hold due to funding limitations. NRC confirmed that PNNL did not receive the flexible array probe from CEA.)
- NRC to renew IRSN/RES information exchange on NDE testing. (NRC Update: In light of the expiration date for the current NDE Implementing Agreement (December 31, 2017), NRC proposes to meet with IRSN during the summer 2017 to discuss and plan the scope of the next Agreement.)
- NRC will share the actions and results from the Harvesting workshop. (NRC Update: Action items from the workshop provided. An update on NRC initiative on developing a systematic approach to harvesting reactor materials and components is also provided. Please contact Rob Tregoning if IRSN is interested in developing a harvesting wish list or in participating in the group to develop sources of material.)

From: Iyengar, Raj
Sent: Wednesday, March 22, 2017 10:28 AM
To: Nove, Carol <Carol.Nove@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>
Subject: FW: ACTION: IRSN meeting summary

Carol/Rob,

I have suggested some edits (see highlighted portion below). Please revise, as needed.

Raj

1. Integrity of Plant and Structures

a. Research on Material Ageing (including CASS/DMW collaborative research and Materials Harvesting planning for LTO research)

For IRSN: Francois Barré

For NRC : Raj Iyengar, Carol Nove and Rob Tregoning

IRSN: No update

NRC: Update on CASS (dissimilar metal welds)

Brief summary of Harvesting workshop held at the NRC during the week of March 6, 2017. Resulted in two actions: 1) Create a list of important data needs from harvesting, and 2) develop a database of available harvesting opportunities.

b. Research on Concrete Pathologies (ODOBA)

For IRSN: Francois Barré

For NRC : Jacob Philip

IRSN: Update on ODOBA

NRC: Summary of ASR Research to Date

Action Items :

- IRSN will re-connect NRC (Carol Nove) with Gerard Cattiaux.
- IRSN will send ODOBA agreement to NRC for collaboration.
- NRC to follow up on NDE testing work with IRSN, CEA, and PNNL. (NRC: Upon follow up, NRC found that PNNL had not received any information from CEA. NRC requests IRSN to ensure information is transmitted to PNNL to enable continued activity in this area.)
- NRC to renew IRSN/RES information exchange on NDE testing. (Due:)
- NRC will share the actions and results from the Harvesting workshop. (Due:)

From: Mehta, Shivani

Sent: Friday, March 17, 2017 3:20 PM

To: Hoxie, Chris <Chris.Hoxie@nrc.gov>; Hudson, Nathanael <Nathanael.Hudson@nrc.gov>; Santiago, Patricia <Patricia.Santiago@nrc.gov>; Lee, Richard <Richard.Lee@nrc.gov>; Bales, Michelle <Michelle.Bales@nrc.gov>; Nove, Carol <Carol.Nove@nrc.gov>; Iyengar, Raj <Raj.Iyengar@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Philip, Jacob <Jacob.Philip@nrc.gov>; Salley, MarkHenry <MarkHenry.Salley@nrc.gov>; Hamburger, Kenneth <Kenneth.Hamburger@nrc.gov>; Kanney, Joseph <Joseph.Kanney@nrc.gov>; Kowalczyk, Jeff <Jeff.Kowalczyk@nrc.gov>; Grant, Jeffery <Jeffery.Grant@nrc.gov>

Cc: Herrity, Thomas <Thomas.Herrity@nrc.gov>; Berrios, Ilka <Ilka.Berrios@nrc.gov>; Armstrong, Kenneth <Kenneth.Armstrong@nrc.gov>; Rolf, Joan <Joan.Rolf@nrc.gov>; Sangimino, Donna-Marie <Donna-Marie.Sangimino@nrc.gov>

Subject: ACTION: IRSN meeting summary

Good Afternoon

The draft meeting summary for the IRSN meeting held on Monday, March 13th is attached. For you topic area: please summarize **both** IRSN's and your presentations. I have them at a very high level now but please feel free to add as much information as you think would be beneficial for the record of the meeting.

Also, please check the Participant list for anyone I may have missed.

Comments/edits are due by **COB March 23rd**

Feel free to reach out if there are any questions

Thanks,

Shivani

Shivani N Mehta, P.E.
International Relations Specialist (Rotation)
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Mail Stop T-10A24
Shivani.Mehta@NRC.gov
301.415.0860 (Desk)
301.415.6671 (FAX)

From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#)
Subject: FW: Action: Rewrite in response to Feedback on UNR Response Task 2
Date: Wednesday, September 06, 2017 9:39:33 AM

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.
- \$175 K 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: [Hiser, Matthew](#)
To: [Hull, Amy](#); [Frankl, Istvan](#); [Tregoning, Robert](#); [Purtscher, Patrick](#)
Subject: FW: Ex-Plant Harvesting

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

From: Hiser, Matthew

Sent: Monday, August 15, 2016 4:56 PM

To: Hiser, Matthew; Frankl, Istvan; Tregoning, Robert; Purtscher, Patrick

Subject: Ex-Plant Harvesting

When: Thursday, August 18, 2016 11:00 AM-11:30 AM (UTC-05:00) Eastern Time (US & Canada).

Where: 10th floor huddle room

I think it would be good to get everyone on same page regarding next steps for the harvesting program.

We have an early draft of the PNNL deliverable, with the final version expected in early 2017. I'd like to discuss that work as well as the workshop that was discussed with NRAJ last week and been discussed previously.

Thanks!

Matt

From: [Hiser, Matthew](#) on behalf of [RES_DE_Cal Resource](#)
To: [Purtscher, Patrick](#); [Thomas, Brian](#); [Tregoning, Robert](#); [Frankl, Istvan](#); [Hiser, Matthew](#); [Vera, Graciela](#)
Subject: FW: Harvesting Workshop

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

From: RES_DE_Cal Resource
Sent: Thursday, February 23, 2017 9:20 AM
To: RES_DE_Cal Resource; Thomas, Brian; Tregoning, Robert; Frankl, Istvan; Hiser, Matthew; Vera, Graciela
Subject: Harvesting Workshop
When: Thursday, March 02, 2017 9:15 AM-9:30 AM (UTC-05:00) Eastern Time (US & Canada).
Where: T10-E16

From: Hiser, Matthew
Sent: Thursday, February 23, 2017 9:09 AM
To: Snail, Malika <Malika.Snail@nrc.gov <mailto:Malika.Snail@nrc.gov> >
Subject: Quick Brief for Brian Thomas

Hi Malika,

Could you schedule a 15-minute briefing with Brian Thomas on the topic of "Harvesting Workshop" for some time next week?

Attendees should be myself, Rob Tregoning, Steve Frankl, and Brian. It looks like we might all be free on Thursday, March 2 between 9:30 and 10:00.

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

From: [Hiser, Matthew](#)
To: [Nove, Carol](#)
Cc: [Purtscher, Patrick](#); [Audrain, Margaret](#)
Subject: FW: inventory of ex-plant materials at PNNL
Date: Friday, August 03, 2018 8:55:19 AM

Hi Carol,

I will be heading to PNNL next week for a trip focused on NMSS dry storage work there with Bruce and Darrell. However, while I'm there I'm planning to spend a little time meeting with Pradeep on the harvesting contract we have with them (Pat Purtscher is the COR; I am alt. COR).

One topic will be a report they're finalizing and addressing NRC comments on, while another will be their efforts to identify previously harvested materials at PNNL. I think they're already doing a large portion of that for you, which probably meets our needs as well. I just wanted to touch base with you on what they are doing under your contract and let you know I'll be there next week and might discuss that some with Pradeep (not give direction of course, just try to be clear on what they're doing for your contract and whether that covers everything we're looking at for harvesting).

Let me know if you have any questions or concerns with that and we can catch up the week of August 13...

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: Purtscher, Patrick

Sent: Thursday, August 02, 2018 11:26 AM

To: Hiser, Matthew <Matthew.Hiser@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>

Subject: FW: inventory of ex-plant materials at PNNL

FYI

From: Nove, Carol

Sent: Thursday, August 02, 2018 10:17 AM

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

Subject: RE: inventory of ex-plant materials at PNNL

Pat,

I think it will be done before the end of the summer. I'll send it to you when I get it.

Carol

From: Purtscher, Patrick

Sent: Monday, July 30, 2018 9:31 AM

To: Nove, Carol <Carol.Nove@nrc.gov>

Subject: inventory of ex-plant materials at PNNL

Good morning,

Pradeep told me that PNNL is doing an inventory of ex-plant materials for you. Do you know when they will complete that task?

Pat

Materials Engineer

US Nuclear Regulatory Commission | Office of Nuclear Regulatory Research
Division of Engineering | Corrosion and Metallurgy Branch
11545 Rockville Pike | Rockville, MD 20852-2738
Phone: 301-415-3942 | Office: TWFN 10A49
ptp1@nrc.gov

From: [Hull, Amy](#)
To: [Hiser, Matthew](#)
Subject: FW: Joe, you are a TM on this: STAQS action for "Strategic Approach for Obtaining Material and Component Aging Information" w/ PNNL
Date: Monday, July 13, 2015 11:06:19 AM
Attachments: [image001.jpg](#)

FYI.

From: Kanney, Joseph
Sent: Monday, July 13, 2015 10:19 AM
To: Hull, Amy
Subject: RE: Joe, you are a TM on this: STAQS action for "Strategic Approach for Obtaining Material and Component Aging Information" w/ PNNL
OK. Thanks!

From: Hull, Amy
Sent: Friday, July 10, 2015 3:26 PM
To: Kanney, Joseph
Subject: Joe, you are a TM on this: STAQS action for "Strategic Approach for Obtaining Material and Component Aging Information" w/ PNNL
All approved by RES. As discussed before, you are a TM on this. When we begin the negotiations with PNNL, we will let you know and get you more actively involved.
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.

From: Frankl, Istvan
Sent: Tuesday, July 07, 2015 9:25 PM
To: West, Steven
Cc: Brock, Kathryn; Bamford, Lisa; Stout, Kathleen; Hull, Amy; Hiser, Matthew; Focht, Eric
Subject: STAQS action for "Strategic Approach for Obtaining Material and Component Aging Information" w/ PNNL
Steve,
PMDA has notified me today that subject request for proposal and funding action to initiate new work with PNNL had not been routed to you for approval.
This work has three inter-related objectives:

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

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

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

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

ABH SOW Fig 3



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

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

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

Thanks,

Istvan (Steve) Frankl

Branch Chief

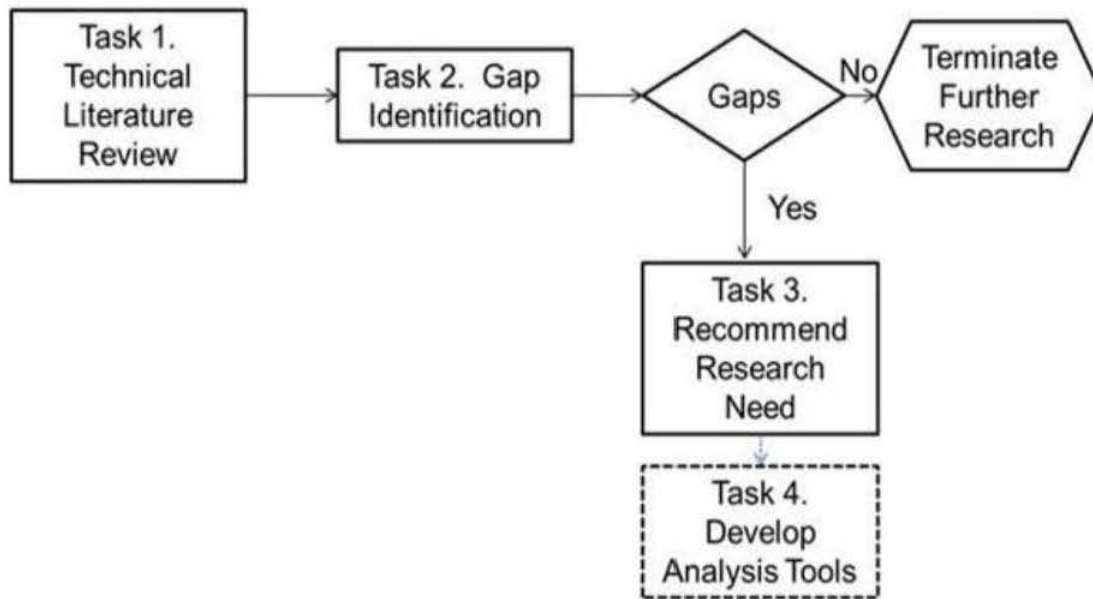
RES/DE/CMB

U.S. Nuclear Regulatory Commission

Phone: (301) 415-2227 (after 6/22/2015)

E-mail: Istvan.Frankl@nrc.gov

Note to requester: The figure image did not copy when upload into the NRC redaction software. The image has been included on the next page.



From: [Moyer, Carol](#)
To: [Hiser, Matthew](#)
Cc: [Tregoning, Robert](#)
Subject: FW: Join us in Nashville!
Date: Wednesday, September 27, 2017 9:12:00 AM
Attachments: [image001.png](#)

Matt,

This might be of interest to you, for harvesting-related opportunities. The cost looks pretty high, though, so I would want to see who the speakers and exhibitors are going to be.

Carol

From: Decommissioning Strategy Forum [mailto:events@email.exchangemonitor.com]

Sent: Wednesday, September 27, 2017 9:04 AM

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

Subject: [External_Sender] Join us in Nashville!

June 7-8, 2018
Gaylord Opryland Resort
Nashville, TN

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This message was sent to carol.moyer@nrc.gov

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From: [Hiser, Matthew](#)
To: [Poehler, Jeffrey](#)
Subject: FW: Materials Harvesting Workshop

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

From: Hiser, Matthew

Sent: Monday, December 12, 2016 4:41 PM

To: Hiser, Matthew

Subject: Materials Harvesting Workshop

When: Wednesday, March 08, 2017 8:00 AM-5:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: HQ-3WFN-1C03-32p

From: [Hiser, Matthew](#)
To: [Poehler, Jeffrey](#)
Subject: FW: Materials Harvesting Workshop

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

From: Hiser, Matthew
Sent: Friday, December 09, 2016 9:03 AM
To: Hiser, Matthew
Subject: Materials Harvesting Workshop
When: Tuesday, March 07, 2017 8:00 AM-5:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: HQ-3WFN-1C03-32p

From: [Frankl, Istvan](#)
To: [Oberson, Greg](#); [Focht, Eric](#); [Rao, Appajosula](#); [Hiser, Matthew](#); [Rossi, Matthew](#); [Purtscher, Patrick](#)
Subject: FW: meeting with JNRA on August 7 and 8
Date: Tuesday, May 10, 2016 3:29:24 PM

All,
Rob has requested topics/ sub-topics supporting subject meeting with JNRA. Please review his enclosed email and send me your suggestions **by COB Monday (5/16)**.
Thanks,
Steve

From: Tregoning, Robert

Sent: Tuesday, May 10, 2016 9:11 AM

To: Rudland, David <David.Rudland@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>; Alley, David <David.Alley@nrc.gov>; McHale, John <John.McHale@nrc.gov>; Mitchell, Matthew <Matthew.Mitchell@nrc.gov>; Morey, Dennis <Dennis.Morey@nrc.gov>; Burke, John <John.Burke@nrc.gov>

Cc: Hiser, Allen <Allen.Hiser@nrc.gov>; Manoly, Kamal <Kamal.Manoly@nrc.gov>; Hardies, Robert <Robert.Hardies@nrc.gov>; Karwoski, Kenneth <Kenneth.Karwoski@nrc.gov>; Benson, Michael <Michael.Benson@nrc.gov>

Subject: meeting with JNRA on August 7 and 8

All:

Just some advanced notice that the **Japanese (JNRA) are coming on August 7 and 8 to the NRC** for a 2-day meeting to discuss **material's research and issues**. We meet about every 18 months with them and the last meeting was in January 2015 at JNRA. All the slides and the meeting summary from that meeting are available and I can provide that information if you are interested. The biggest follow-on areas after that meeting were related to cable aging and concrete aging and we had productive discussions with the Japanese in those areas after the January 2015 meeting. I've started to work with JNRA on putting together an agenda for the meeting. Here are a few topics that I think might be appropriate/of interest to us:

- PWSCC crack growth and crack initiation
- RPV embrittlement studies
- cable aging
- concrete aging
- EAF
- irradiated assisted degradation
- probabilistic fracture mechanics of pressure boundary components
- NDE issues (not quite materials but related)
- aging of cast austenitic steels
- peening
- degradation of spent fuel pool neutron absorbers
- material harvesting opportunities

Please canvas your staff and respond to me by **COB next Tuesday (5/17)** with your topics of interest for the meeting (either from this initial list or not). It would also be helpful if you indicate any specific subtopics (say for instance NDE of CASS components) within these broader topics that are of most interest. After I get our list together, I'll send it to JNRA and work with them to get consensus on the agenda.

Please let me know if you have any questions. Thanks for your help.
Rob

From: [Hull, Amy](#)
To: [Hiser, Matthew](#)
Subject: FW: need to talk to you...: NRC/Industry June Materials Meeting
Date: Wednesday, May 13, 2015 10:06:45 AM

From: Hull, Amy
Sent: Wednesday, May 13, 2015 9:33 AM
To: Frankl, Istvan (Istvan.Frankl@nrc.gov)
Subject: need to talk to you...: NRC/Industry June Materials Meeting
What we are envisioning goes way beyond this. I need to talk to you about this before agreeing. Really, now it would be Zion, Zorita, etc.

From: Tregoning, Robert
Sent: Wednesday, May 13, 2015 8:49 AM
To: Focht, Eric; Benson, Michael; Oberson, Greg; Hull, Amy
Subject: NRC/Industry June Materials Meeting
All:

We're planning on covering the following topics during the June meeting (6/2 – 6/4)

1. WRS round robin– Benson/?
2. Expert Panel CGR disposition curves – Oberson/Crooker
3. PWSCC initiation research – Focht/Crooker
4. Ex-plant material database development – Hull

The first three topics are meant to be joint talks with us and industry, while Amy's topic will just be an NRC talk. Can you please provide me with the following information by the end of this week (if possible)?

- a. Title of talk
- b. Presenters – both NRC presenter (or contractor) and industry if joint
- c. Time needed for talk (we've nominally allocated 30 minutes per talk but it can be more or less as needed).

Let me know if you have any questions. Thanks for your help.

Rob

Robert Tregoning
Technical Advisor for Materials
US Nuclear Regulatory Commission
21 Church Street, M/S CS-5A24
Rockville, MD 20850
ph: 301-251-7662
Blackberry: (b)(6)
fax: 301-251-7425

From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#); [Purtscher, Patrick](#)
Subject: FW: Planning/Setup for Harvesting Workshop

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

From: Hiser, Matthew
Sent: Monday, January 30, 2017 8:24 AM
To: Hiser, Matthew
Subject: Planning/Setup for Harvesting Workshop
When: Monday, March 06, 2017 2:00 PM-4:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: HQ-3WFN-1C03-32p

From: [Hiser, Matthew](#)
To: [Purtscher, Patrick](#)
Subject: FW: Pls send us link to the Sept 2017 TLR --- Action: Rewrite in response to Feedback on UNR Response Task 2
Date: Thursday, September 14, 2017 9:36:00 AM

Hi Pat,
Can you send Amy the latest version of the TLR with comments? I think Amy is just interested for her info in crafting the UNR response...

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: Wednesday, September 13, 2017 2:06 PM

To: Hiser, Matthew ; Purtscher, Patrick

Cc: Moyer, Carol

Subject: Pls send us link to the Sept 2017 TLR --- Action: Rewrite in response to Feedback on UNR Response Task 2

Hi Matt and Pat,

Please can you provide us a link to the Sept 2017 TLR?

Thanks,

Amy

From: Hiser, Matthew

Sent: Tuesday, September 05, 2017 2:23 PM

To: Hull, Amy <Amy.Hull@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>

Subject: RE: Action: Rewrite in response to Feedback on UNR Response Task 2

Hi Amy,

My initial thoughts on how to respond to some of these questions are in red below. I only think maybe 1 or 2 of the bullets need changes to the text of the response (in my opinion). Do you know who in NRR reviewed Task 2 and provided these comments? It might be just as easy to have a quick meeting with them to explain things more clearly.

I'd suggest you take the lead on editing the response as much (or little) as appropriate, since you and Carol took the lead in compiling the input initially. My feedback is in red below and Pat can certainly add anything from his perspective.

Thanks!

Matt

Matthew Hiser

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.**
- \$175 K 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: [Frankl, Istvan](#)
To: [Cherson, Greg](#)
Cc: [Hiser, Matthew](#)
Subject: PW: PNNL Emergent Travel for CMB
Date: Thursday, June 28, 2018 2:25:09 PM
Importance: High

Greg,

We have a new emergent travel request. Details are below and in the enclosed email:

Hiser	Matthew	CMB	Domestic	Dry Cask Storage and Harvesting Research Visit	Mission	Priority 2 - License and Regulation Related	Richland, WA	08/05/2018	08/09/2018	\$1,500	Visit PNNL to observe and discuss dry cask storage research, including CISC testing and an EPRI inspection demonstration on a canister mockup. In addition, meet with PNNL staff working on harvesting and observe PWSCC and NDE testing capabilities. This activity directly supports UNR NMSS-2017-001.
-------	---------	-----	----------	--	---------	---	--------------	------------	------------	---------	---

Thanks,
Steve

From: Hiser, Matthew
Sent: Thursday, June 28, 2018 2:04 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>
Subject: PNNL Emergent Travel

Hi Steve,

I submitted the emergent travel request to our branch spreadsheet ([\nrc.gov\nrc\HQ\Office\RES\RES\DE\CMB\Travel\FY18\RES-DE\travel - CMB.xlsx](#)) for this trip. Darrell Dunn and Bruce Lin (CIB) will also be attending this inspection demonstration by EPRI. I want to emphasize that this travel has value for the harvesting program as well.

Also, a reminder Raj discussed this with Chris last Thursday and got buy-in from Chris and the NMSS BC Hipolito Gonzalez.

Please let me know if there's anything else I need to do to help support this request.

Thanks!

Matt

From: [Oberson, Greg](#)
To: [Hull, Amy](#); [Moyer, Carol](#)
Cc: [Hiser, Matthew](#); [Boyce \(RES\), Tom](#)
Subject: FW: QUERY - CLARIFICATION ON ePOSTERS
Date: Wednesday, February 14, 2018 9:42:38 AM
Attachments: [image002.png](#)
[image003.png](#)

This poster seems to be causing never-ending confusion. Can you confirm which of these is the correct title and who the presenters are?

Thanks,
Greg

From: Weber, Michael

Sent: Wednesday, February 14, 2018 9:09 AM

To: Oberson, Greg <Greg.Oberson@nrc.gov>

Cc: Boyce (RES), Tom <Tom.Boyce@nrc.gov>; Peters, Sean <Sean.Peters@nrc.gov>; DiFrancesco, Nicholas <Nicholas.DiFrancesco@nrc.gov>

Subject: QUERY - CLARIFICATION ON ePOSTERS

Good morning, Greg. The info that I have from the RIC planners shows you co-authoring presenting two very similar sounding ePosters. Are you doing both? Or is there duplication here in the titles? Please advise.

- **Harvesting of Aged Materials from Nuclear Power Plants** by **Greg Oberson and Amy Hull**
- **Harvesting of Aged Materials from** Operating and Decommissioning **Nuclear Power Plants** by **Greg Oberson and Matt Hiser**

Thanks,

Mike

Michael Weber
Director of Nuclear Regulatory Research
US Nuclear Regulatory Commission
301-415-1902
Mail Stop T-10B16

Dnl



Note to requester: The image did not copy over when this document was uploaded to NRC's FOIA redaction software. Image included on next page.

*Intentionally, deliberately, and
proactively including employees to
accomplish our nuclear
safety and security mission*

Note to requester: The attachments to this email are immediately following.

From: [Hiser, Matthew](#)
To: [Hiser, Allen](#)
Subject: FW: PLiM Slides Submission
Date: Monday, October 16, 2017 4:58:00 PM
Attachments: [NRC PLiM slides on Harvesting final.pdf](#)
[NRC PLiM slides on Harvesting final.pptx](#)

PP slides as well in case you need them...

From: Hiser, Matthew
Sent: Monday, October 16, 2017 4:58 PM
To: 'PLiM2@iaea.org' <PLiM2@iaea.org>
Cc: Hiser, Allen <Allen.Hiser@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>; Moyer, Carol <Carol.Moyer@nrc.gov>; 'KRIVANEK, Robert' <R.Krivanek@iaea.org>; KANG, Ki-Sig <K.S.Kang@iaea.org>
Subject: PLiM Slides Submission

Dear PLiM Organizers,

I have attached the slides for the presentation entitled: "Harvesting of Aged Materials from Operating and Decommissioning Nuclear Power Plants." An accompanying paper should be sent on a slight delay by this Friday.

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

Harvesting of Aged Materials from Operating and Decommissioning Nuclear Power Plants

M. Hiser^a, P. Purtscher^a, P. Ramuhalli^b, A. B. Hull^a, R. Tregoning^a
^aU.S. Nuclear Regulatory Commission (NRC), Washington, D.C., USA
^bPacific Northwest National Laboratory (PNNL), Richland, WA, USA

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Outline

- Background and Motivation
- NRC Harvesting Experience
- Recent NRC Activities
 - Criteria for Prioritizing Data Needs
 - Database for Sources of Materials
- Path Forward

Background and Motivation

- Recent trends in global nuclear industry:
 - Interest in extending nuclear power plant (NPP) lifespans
 - Numerous NPPs, both in U.S. and internationally, have announced plans to or already have shut down
- Limited budgets have restricted the resources available to support new research, including harvesting programs
 - Aligning interests and leveraging with other organizations is important to maximize value

NRC Harvesting Experience

- NRC has participated in numerous harvesting programs over the years:
 - RPV, CRDM penetrations, RCS piping, RPV internals, neutron absorbers, and cables
 - From unfinished, operating ,and decommissioning plants in U.S. and internationally
- Significant value in using harvested components to confirm data from other research programs

Technical Lessons Learned

- Harvesting can provide highly representative aged materials for research
 - May be only practical source of representative aged materials
 - May be able to use limited harvested materials to validate larger accelerated aging data set
- Important to gain as much information as possible in advance before committing to specific harvesting project

Logistical Lessons Learned

- Harvesting is an expensive, time-consuming effort
- Leveraging resources with other research organizations helps mitigate cost challenges
- Transporting irradiated materials, particularly internationally, is cumbersome and time-consuming



Lifting operation for irradiated materials transport cask

Recent NRC Activities

- Strategic approach to materials harvesting
 - Due to limited opportunities, past harvesting efforts have generally been reactive to individual plants shutting down
- Prioritize the data needs best addressed by harvesting
- Workshop held in March 2017 at NRC HQ to discuss all aspects of harvesting with other interested stakeholders

Potential Criteria for Harvesting Prioritization

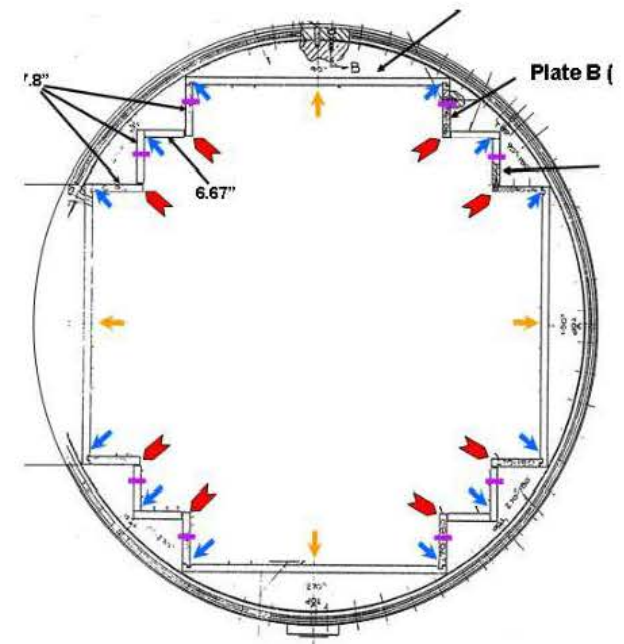
- Applicability of harvested material for addressing critical gaps
- Ease of laboratory replication of the degradation scenario
- Unique field aspects of degradation
- Fleet-wide vs. plant-specific applicability of data

Potential Criteria for Harvesting Prioritization

- Harvesting cost and complexity
- Availability of reliable in-service inspection (ISI) techniques for the material / component
- Availability of materials for harvesting
- Timeliness of the expected research results relative to the objective

Database for Sources of Materials

- NRC is pursuing the development of a database for sources of materials for harvesting
- Allow for aligning of high-priority data needs to the available sources of materials
- NRC is interested in engaging with other organizations in developing the database



Example of reactor
internals harvesting plan

Conclusion and Path Forward

- Harvesting can yield highly representative and valuable data on materials aging
- Data Needs Prioritization and Sources of Materials Database
- As specific harvesting opportunities are identified, NRC welcomes opportunities for cooperation and leveraging with other interested research organizations

Harvesting of Aged Materials from Operating and Decommissioning Nuclear Power Plants

M. Hiser^a, P. Purtscher^a, P. Ramuhalli^b, A. B. Hull^a, R. Tregoning^a
^aU.S. Nuclear Regulatory Commission (NRC), Washington, D.C., USA
^bPacific Northwest National Laboratory (PNNL), Richland, WA, USA

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Outline

- Background and MotivationNRC Harvesting
Experience Recent NRC ActivitiesCriteria for
Prioritizing Data NeedsDatabase for Sources
of MaterialsPath Forward

Background and Motivation

- Recent trends in global nuclear industry: Interest in extending nuclear power plant (NPP) lifespans Numerous NPPs, both in U.S. and internationally, have announced plans to or already have shut down Limited budgets have restricted the resources available to support new research, including harvesting programs Aligning interests and leveraging with other organizations is important to maximize value

Note to requester: Presenter notes from this PowerPoint presentation did not copy over when uploaded into NRC's redaction software. Notes from this slide are: "Recent trends in global nuclear industry: Interest in extending nuclear power plant (NPP) lifespans; Technical basis for managing aging of systems, structures, and components for longer time; Numerous NPPs, both in U.S. and internationally, have announced plans to or already have shut down; New opportunities for harvesting components that were aged in representative light water reactor (LWR) environments; Limited budgets have restricted the resources available to support new research, including harvesting programs; Aligning interests and leveraging with other organizations is important to maximize value."

NRC Harvesting Experience

- NRC has participated in numerous harvesting programs over the years:RPV, CRDM penetrations, RCS piping, RPV internals, neutron absorbers, and cablesFrom unfinished, operating ,and decommissioning plants in U.S. and internationallySignificant value in using harvested components to confirm data from other research programs

Note to requester: Presenter notes for this slide exceed the character limit to insert on this page. Notes included as a seperate page after this slide presentation.

Technical Lessons Learned

- Harvesting can provide highly representative aged materials for research
May be only practical source of representative aged materials
May be able to use limited harvested materials to validate larger accelerated aging data set
Important to gain as much information as possible in advance before committing to specific harvesting project

Note to requester: Presenter notes for this slide are: "Harvesting can provide highly representative aged materials for research. May be only practical source of representative aged materials, particularly if irradiation and temperature are important factors. Achieving high fluence levels with representative irradiation conditions through other means is very challenging. May be able to use limited harvested materials to validate larger accelerated aging data set. Important to gain as much information as possible in advance before committing to specific harvesting project
Ideally a bounding, yet realistic, material/environment. Understand material information (CMTRs if available) and plant operating conditions."

Logistical Lessons Learned

- Harvesting is an expensive, time-consuming effortLeveraging resources with other research organizations helps mitigate cost challengesTransporting irradiated materials, particularly internationally, is cumbersome and time-consuming

Note to requester: Presenter notes for this slide are: "Harvesting is an expensive, time-consuming effort. Must balance cost with potential benefits carefully. High technical relevance of materials is needed to ensure value. Leveraging resources with other research organizations helps mitigate cost challenges. Can introduce challenges for testing when aligning research priorities and interests of multiple organizations. May be needed, particularly for expensive testing of irradiated materials. Transporting irradiated materials, particularly internationally, is cumbersome and time-consuming. Avoiding extra transport, especially between countries, is highly recommended."



Lifting operation for irradiated materials transport cask

Recent NRC Activities

- Strategic approach to materials harvestingDue to limited opportunities, past harvesting efforts have generally been reactive to individual plants shutting downPrioritize the data needs best addressed by harvestingWorkshop held in March 2017 at NRC HQ to discuss all aspects of harvesting with other interested stakeholders

Note to requester: Presenter notes for this slide are: "Strategic approach to materials harvesting. Due to limited opportunities, past harvesting efforts have generally been reactive to individual plants shutting down. Prioritize the data needs best addressed by harvesting. Criteria for harvesting prioritization developed by PNNL. Workshop held in March 2017 at NRC HQ to discuss all aspects of harvesting with other interested stakeholders. Good discussion of experience, including challenges and pitfalls, from those with firsthand knowledge."

Potential Criteria for Harvesting Prioritization

- Applicability of harvested material for addressing critical gaps
Ease of laboratory replication of the degradation scenario
Unique field aspects of degradation
Fleet-wide vs. plant-specific applicability of data

Note to requester: Presenter notes for this slide are: "Applicability of harvested material for addressing critical gaps. Harvesting for critical gaps prioritized over less essential technical gaps. Ease of laboratory replication of the degradation scenario. For example, simultaneous thermal and irradiation conditions are difficult to replicate. Unique field aspects of degradation. For example, unusual operating experience or legacy materials (fabrication methods, etc.) no longer available. Fleet-wide vs. plant-specific applicability of data."

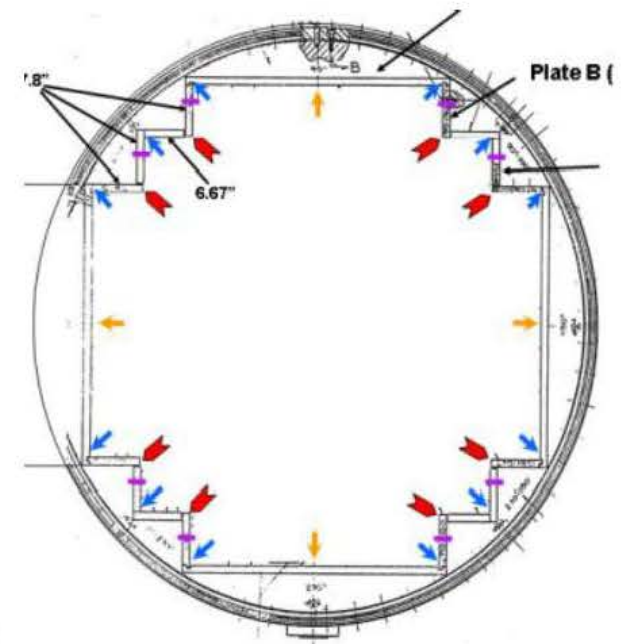
Potential Criteria for Harvesting Prioritization

- Harvesting cost and complexityAvailability of reliable in-service inspection (ISI) techniques for the material / componentAvailability of materials for harvestingTimeliness of the expected research results relative to the objective

Note to requester: Presenter notes for this slide are: "Harvesting cost and complexity. For example, harvesting unirradiated concrete or electrical cables less expensive and less complex than harvesting from the reactor internals. Availability of reliable in-service inspection (ISI) techniques for the material / component. If mature inspection methods exist and are easy to apply, harvesting may be less valuable. Availability of materials for harvesting. Timeliness of the expected research results relative to the objective."

Database for Sources of Materials

- NRC is pursuing the development of a database for sources of materials for harvesting. Allow for aligning of high-priority data needs to the available sources of materials. NRC is interested in engaging with other organizations in developing the database.



Example of reactor
internals harvesting plan

Note to requester: Presenter notes for this slide are: "NRC is pursuing the development of a database for sources of materials for harvesting. Includes both previously harvested materials and those available for future harvesting. Allow for aligning of high-priority data needs to the available sources of materials. The level of detail should be appropriate for the factors influencing decision-making. NRC is interested in engaging with other organizations in developing the database."

Conclusion and Path Forward

- Harvesting can yield highly representative and valuable data on materials aging
Data Needs Prioritization and Sources of Materials Database
As specific harvesting opportunities are identified, NRC welcomes opportunities for cooperation and leveraging with other interested research organizations

Note to requester: Presenter notes for this slide are: "Harvesting can yield highly representative and valuable data on materials aging. Having a clearly defined objective and early engagement with other stakeholders are keys to success. Data Needs Prioritization and Sources of Materials Database. NRC is interested in working with other organizations to identify high-priority data needs of common interest. As specific harvesting opportunities are identified, NRC welcomes opportunities for cooperation and leveraging with other interested research organizations."

Presenter notes on “NRC Harvesting Experience” slide:

NRC has participated in numerous harvesting programs over the years:

RPV, CRDM penetrations, RCS piping, RPV internals, neutron absorbers, and cables

From unfinished, operating, and decommissioning plants in U.S. and internationally

Significant value in using harvested components to confirm data from other research programs

Harvesting materials from highly representative long-term aging environments increases confidence in safety margins

Example Projects

RPV materials

Shoreham, Midland

Reactor vessel head CRDM penetrations

North Anna, Davis-Besse

Pressurizer from St. Lucie

Piping from VC Summer, NMP, Oconee

Reactor internals from Zorita

Joint harvesting and testing project with EPRI and international

Neutron absorbers from Zion

Harvesting coordinated with DOE and EPRI; Independent NRC testing

Concrete from Zorita

Cables from Zion and Crystal River

Previous Benefits of Harvesting

Reduce unnecessary conservatism

Flaw distributions and Master Curve information came from harvested materials to support PTS rule

Understand in-service flaws

Mockups for NDE qualification

Leak rate methodology from studying in-service flaws

Identify and better understand safety issues

High-energy arc fault tests on aluminum electrical components

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

From: [Hiser, Matthew](#)
To: [Frankl, Istvan](#)
Subject: FW: Ex-Plant Materials Harvesting meeting
Date: Thursday, October 06, 2016 2:40:13 PM
Attachments: [Harvesting Workshop Plan 9-27-16.docx](#)

Hi Steve,

I just wanted to check if this ever percolated back up to Brian following our briefing of him last week.

Thanks!

Matt

From: Hiser, Matthew
Sent: Tuesday, September 27, 2016 1:03 PM
To: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>
Subject: RE: Ex-Plant Materials Harvesting meeting

Hi Steve,

I have attached my updates to the one-pager per the feedback from the meeting this morning.

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

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

From: Vera, Graciela
Sent: Friday, September 16, 2016 12:14 PM

To: Vera, Graciela; Brock, Kathryn; RES_DE_Cal Resource; Thomas, Brian; Frankl, Istvan; Tregoning, Robert; Purtscher, Patrick; Hiser, Matthew

Subject: Ex-Plant Materials Harvesting meeting

When: Tuesday, September 27, 2016 10:00 AM-11:00 AM (UTC-05:00) Eastern Time (US & Canada).

Where: TWFN-07B01

Ex-Plant Materials Harvesting Workshop

Motivation:

- With the wave of plants shutting down both in the U.S. and Europe, there are increasing opportunities to harvest components from decommissioning 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, which reduces the uncertainty associated with the applicability of the aging conditions.
- Insights from ex-plant harvesting research would support regulatory decisions for subsequent license renewal (SLR), and could have implications for the current license period depending on the findings.
- There is a task in the new draft UNR for SLR from NRR/DLR requesting RES to investigate opportunities for harvesting where appropriate.

Purpose and Objective:

- For NRC staff and interested stakeholders to have greater awareness and knowledge of the benefits and challenges associated with ex-plant harvesting.
- Facilitate contacts and communication to enable specific cooperative ex-plant harvesting programs to be initiated, leveraging limited NRC resources to produce highly representative technical data of materials degradation for extended plant operation.

Approach:

- NRC staff host a 2-day workshop with interested stakeholders, including domestic and international utilities and research organizations, to discuss benefits and challenges associated with ex-plant harvesting.
- Format will include sessions with time for presentations and open discussion of different aspects of ex-plant materials harvesting.
- Views and insights from domestic and international regulators (JNRA), researchers (DOE, SCK-CEN in Belgium), industry (EPRI, utilities), and decommissioning companies' experience will be encouraged.
- Single talk given at relevant RIC session to disseminate ex-plant harvesting effort and encourage participation in workshop.

Intended Outcome:

- NRC staff and stakeholders are better informed of the benefits and challenges associated with ex-plant harvesting.
- Contacts are made with domestic and international utilities and researchers to allow for further discussion of specific cooperative research projects that may address technical data gaps associated with materials degradation that can be best addressed through ex-plant harvesting.

Potential Dates:

- March 9-10, 2017 – Thursday/Friday before RIC
- March 16-17, 2017 – Thursday/Friday of RIC week
- March 20-21, 2017 – Monday/Tuesday after RIC

Discussion Topics:

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

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

From: [Hiser, Matthew](#)
To: [Miller, Kenneth A](#); [Sircar, Madhumita](#)
Cc: [Purtscher, Patrick](#); [Audrain, Margaret](#)
Subject: FW: Materials Harvesting
Date: Friday, August 03, 2018 3:55:25 PM
Attachments: [Harvesting Needs Prioritization 8-3-18.xlsx](#)

Hi Kenn and Mita,

I just wanted to follow up from this meeting/email back in May on harvesting priorities. I have attached a template of the prioritization of harvesting needs in the metals area. Can you follow that template to provide input for the electrical and concrete technical areas?

Please let me (or Meg or Pat on cc) know if you have any questions.

Thanks!
Matt

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

From: Hiser, Matthew
Sent: Wednesday, May 16, 2018 10:36 AM
To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Philip, Jacob <Jacob.Philip@nrc.gov>
Cc: Miller, Kenneth A <KennethA.Miller@nrc.gov>; Christensen, Jason <Jason.Christensen@nrc.gov>
Subject: RE: Materials Harvesting

Thanks everyone for attending the meeting this morning. I appreciate the update on activities for electrical and concrete and have attached the documents that were printed out this morning.

Action Items for Metals, Concrete, and Electrical

1. Use prioritization criteria to prioritize data needs for harvesting in each area.
2. Catalog any previously harvested materials that may be available at labs.
3. Identify relevant information from license renewal documents for decommissioning plants

Thanks!
Matt

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

From: Hiser, Matthew
Sent: Monday, May 07, 2018 3:56 PM
To: Hiser, Matthew; Purtscher, Patrick; Tregoning, Robert; Audrain, Margaret; Sircar, Madhumita; Pires, Jose; Koshy, Thomas; Murdock, Darrell; Philip, Jacob
Cc: Miller, Kenneth A; Christensen, Jason
Subject: Materials Harvesting
When: Wednesday, May 16, 2018 9:00 AM-10:00 AM (UTC-05:00) Eastern Time (US & Canada).
Where: T10D40

Rescheduling for hopefully a better time for everyone.

We'd like to meet with electrical and concrete research staff to discuss the latest status of the materials harvesting

activities under Task 2 of UNR NRR-2017-006.

The four topics we'd like to update you on / discuss in this meeting are:

- 1.CMB staff development of prioritization criteria for harvesting needs and lessons learned from exercising them for metals
- 2.CMB staff effort to development inventory of previously harvested materials already available at lab facilities
- 3.Latest status of harvesting plans for electrical and concrete components
- 4.Pulling relevant information from license renewal documents for decommissioning plants

Criteria Title	Description	Scoring Guidance
Criticalness of Technical Gap Addressed	Harvesting to address critical gaps should be prioritized over less essential technical gaps	<p>H = high risk significance / little to no available data MH = Medium-high risk significance / limited data available M = Moderate risk significance / some data available ML = low to moderate risk significance / sufficient data available for regulatory decisions L = Low risk significance / large amount of data available</p> <p>H = High MH = Medium-high M = Medium ML = Medium-low L = Low</p>
Importance of Harvested Materials over Laboratory Aging	Key considerations are the ease of laboratory replication of aging mechanism and unique field aspects of the aging mechanism. Degradation mechanisms that are harder to replicate with simulated aging conditions would be of higher priority for harvesting. For example, simultaneous thermal and irradiation conditions are difficult to replicate outside of the plant environment. Alternatively, accelerated aging may not be feasible for a mechanism sensitive to dose rate. These two degradation mechanisms may be best evaluated using harvested materials. For unique field aspects, legacy materials (e.g., fabrication methods, composition) that are no longer available, but may play an important role in a potential degradation mechanism, would have a higher priority than harvesting materials that can be obtained from other sources with representative properties.	<p>H = Nearly impossible to replicate service environment / critically important to use harvested materials MH = Challenging to replicate service environment / important to use harvested materials M = Possible with some limitations to replicate service environment / moderately important to use harvested materials ML = Not challenging to replicate service environment / less important to use harvested materials L = Very easy to replicate service environment / not important to use harvested materials</p>
Applicability to US Operating Fleet	There is greater value in developing knowledge to address an issue that may be applicable to a larger number of plants compared to one that may only affect a relatively small number of plants.	<p>H = All plants MH = All PWRs M = All BWRs or most PWRs ML = ~10-15 plants L = <5 plants</p> <p>H = No or very limited inspection methods available / low confidence in AMPs MH = Limited inspection methods available / low-to-moderate confidence in AMPs M = Some inspection methods available / moderate confidence in AMPs ML = Good inspection methods available / medium-high confidence in AMPs L = Effective, well-accepted inspection methods</p>
Regulatory Considerations Related to Inspections and AMPs	If mature inspection methods exist and are easy to apply to monitor degradation, harvesting may be less valuable. If inspection methods do not exist, harvesting may be essential to ensure confidence in the assessment of age-related degradation in that particular component. The less confidence that NRC staff has in the effectiveness of the relevant AMP, the higher priority for harvesting.	<p>H = Highly irradiated (>5 dpa) MH = Lightly irradiated / contaminated M = Minimal contamination or high effort unirradiated ML = Unirradiated, moderate effort expected L = Unirradiated, low effort expected</p>
Harvesting cost and complexity	Activities with higher costs and complexity are less attractive than similar activities with lower costs and that are simpler to execute. For example, harvesting unirradiated concrete or electrical cables is less expensive and less complex than harvesting from the RPV internals or the RPV.	
Timeliness of results	The ability of a potential harvesting program to provide timely results to support either a technical or regulatory need is important. Having high confidence that results will be timely increases the priority.	
Availability of materials for harvesting	The availability of materials to harvest for a particular data need is clearly essential and increases the priority.	

Need Description	Basic Info		Technical Criteria										Cost / Complexity		Project Specific	
	Purpose / Testing Planned	Technical Knowledge Gained	Criticalness of Technical Gap Addressed		Importance of Harvested Materials over Laboratory Aging		Applicability to US Operating Fleet		Regulatory Considerations Related to Inspections and AMPs		Score Average	Basis for Technical Priority			Timeliness of results	Availability of materials for harvesting
METALS			Score	Comment	Score	Comment	Score	Comment	Score	Comment			Score	Comment		
High fluence reactor internals	Void swelling, mechanical properties, IASCC	Likely extent of void swelling in PWRs during extended operation and impact on cracking	M	Fills data gap for extended plant operation	MH	Laboratory replication very difficult to impossible to achieve fluences with representative irradiation conditions	MH	Applicable to high-fluence components in most PWRs	MH	EPRI performing R&D on NDE for void swelling; MRP-227 uses primarily visual testing, which could detect void swelling once fairly significant	3.75	Significance of void swelling at higher fluences is uncertain, and inspections may detect onset of significant degradation	VH	Very high cost for highly irradiated internals		TBD
Thermally aged unirradiated CASS	Fracture toughness and microstructure	Fracture toughness data in real conditions to compare to accelerated aging data	MH	Validate accelerated aging data	H	Purpose of work would be to provide real-world validation of accelerated aging in lab testing	M	Most applicable to a subset of PWRs	H	No ISI method available to measure loss of FT	4.25	Would greatly increase confidence in large set of accelerated aging data with testing of unirradiated materials	M	Moderate cost for contaminated, but not irradiated, primary stem components		
Moderate fluence (1-2 dpa) CASS	Fracture toughness and microstructure	Fracture toughness data near limit requiring further evaluation	ML	Confirm regulatory position	MH	May be possible, but difficult to replicate long-term aging and irradiation effects	M	Most applicable to a subset of PWRs	H	No ISI method available to measure loss of FT	3.5	Would increase confidence in regulatory position	H	High cost for irradiated components		
Metallic components with known flaws	NDE and destructive examination	Determine whether SCC mitigation methods are effective at preventing SCC; effectiveness of NDE at detection and sizing	MH	Validate NDE and mitigation method effectiveness	MH	Purpose of work would be to provide real-world validation of lab testing	H	Applicable to all plants	ML	Purpose of this work is to assess inspection and mitigation method effectiveness	3.75	Increase confidence in NDE and mitigation methods	M	Moderate cost for contaminated, but not irradiated, primary stem components		
Metallic components with limiting fatigue life	NDE and destructive examination	Determine whether fatigue flaws are present in high usage locations	MH	Validate fatigue life methodologies	ML	Purpose of work would be to provide real-world validation of lab testing	H	Applicable to all plants	ML	Fatigue calculations inform sampling inspections of limiting fatigue locations	3.25	Increase confidence in fatigue life calculations	M	Moderate cost for contaminated, but not irradiated, primary stem components		

[illegible]

[illegible]

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

From: [Sircar, Madhumita](#)
To: [Hiser, Matthew](#)
Cc: [Pires, Jose](#); [Seber, Dogan](#)
Subject: FW: Materials Harvesting
Date: Thursday, September 13, 2018 3:39:28 PM
Attachments: [Copy of Harvesting Needs Prioritization MS JP.xlsx](#)

Matt,
Please find attached our input on harvesting needs prioritization.
Thanks,
Mita

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

From: Pires, Jose
Sent: Wednesday, September 12, 2018 5:17 PM
To: Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>
Subject: RE: Materials Harvesting

Mita,

Sorry for the delay. I entered a line for ASR and added something on the first column of the irradiation.

José

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

From: Sircar, Madhumita
Sent: Monday, September 10, 2018 4:05 PM
To: Seber, Dogan <Dogan.Seber@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>
Subject: FW: Materials Harvesting

Jose,

As we discussed last week, I have provided input on harvesting needs prioritization for (i) Structures Exposed to High Radiation and (ii) Post-tensioned Structures. Could you please provide input on AAR and review the input I provided on the two topics.

I propose to delete the other topics and keep these 3 topics only. As I understand this form will be used to communicate with NRR and tee-up the discussion with NRR. CMB has a UNR from NRR.

Dogan,

Once Jose and I complete our input, I will send it to you for review.

Matt requested to get it by 9/14.

Thanks,
Mita

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

From: Hiser, Matthew
Sent: Friday, August 03, 2018 3:55 PM
To: Miller, Kenneth A <KennethA.Miller@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>
Cc: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>
Subject: FW: Materials Harvesting

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Please let me (or Meg or Pat on cc) know if you have any questions.

Thanks!

Matt

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Sent: Wednesday, May 16, 2018 10:36 AM

To: Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Tregoning, Robert <Robert.Tregoning@nrc.gov>; Audrain, Margaret <Margaret.Audrain@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>; Koshy, Thomas <Thomas.Koshy@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Philip, Jacob <Jacob.Phip@nrc.gov>

Cc: Miller, Kenneth A <KennethA.Miller@nrc.gov>; Christensen, Jason <Jason.Christensen@nrc.gov>

Subject: RE: Materials Harvesting

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Thanks!

Matt

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From: Hiser, Matthew

Sent: Monday, May 07, 2018 3:56 PM

To: Hiser, Matthew; Purtscher, Patrick; Tregoning, Robert; Audrain, Margaret; Sircar, Madhumita; Pires, Jose; Koshy, Thomas; Murdock, Darrell; Philip, Jacob

Cc: Miller, Kenneth A; Christensen, Jason

Subject: Materials Harvesting

When: Wednesday, May 16, 2018 9:00 AM-10:00 AM (UTC-05:00) Eastern Time (US & Canada).

Where: T10D40

Rescheduling for hopefully a better time for everyone.

We'd like to meet with electrical and concrete research staff to discuss the latest status of the materials harvesting activities under Task 2 of UNR NRR-2017-006.

The four topics we'd like to update you on / discuss in this meeting are:

1. CMB staff development of prioritization criteria for harvesting needs and lessons learned from exercising them for metals
2. CMB staff effort to development inventory of previously harvested materials already available at lab facilities
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Harvesting cost and complexity	Activities with higher costs and complexity are less attractive than similar activities with lower costs and that are simpler to execute. For example, harvesting unirradiated concrete or electrical cables is less expensive and less complex than harvesting from the RPV internals or the RPV.	
Timeliness of results	The ability of a potential harvesting program to provide timely results to support either a technical or regulatory need is important. Having high confidence that results will be timely increases the priority.	
Availability of materials for harvesting	The availability of materials to harvest for a particular data need is clearly essential and increases the priority.	

	Basic Info		Technical Criteria										Cost / Complexity		Project Specific	
Need Description	Purpose / Testing Planned	Technical Knowledge Gained	Criticalness of Technical Gap Addressed		Importance of Harvested Materials over Laboratory Aging		Applicability to US Operating Fleet		Regulatory Considerations Related to Inspections and AMPs		Score Average	Basis for Technical Priority			Timeliness of results	Availability of materials for harvesting
METALS			Score	Comment	Score	Comment	Score	Comment	Score	Comment			Score	Comment		
High fluence reactor internals	Void swelling, mechanical properties, IASCC	Likely extent of void swelling in PWRs during extended operation and impact on cracking	M	Fills data gap for extended plant operation	MH	Laboratory replication very difficult to impossible to achieve fluences with representative irradiation conditions	MH	Applicable to high-fluence components in most PWRs	MH	EPRI performing R&D on NDE for void swelling; MRP-227 uses primarily visual testing, which could detect void swelling once fairly significant	3.75	Significance of void swelling at higher fluences is uncertain, and inspections may detect onset of significant degradation	VH	Very high cost for highly irradiated internals		TBD
Thermally aged unirradiated CASS	Fracture toughness and microstructure	Fracture toughness data in real conditions to compare to accelerated aging data	MH	Validate accelerated aging data	H	Purpose of work would be to provide real-world validation of accelerated aging in lab testing	M	Most applicable to a subset of PWRs	H	No ISI method available to measure loss of FT	4.25	Would greatly increase confidence in large set of accelerated aging data with testing of unirradiated materials	M	Moderate cost for contaminated, but not irradiated, primary stem components		
Moderate fluence (1-2 dpa) CASS	Fracture toughness and microstructure	Fracture toughness data near limit requiring further evaluation	ML	Confirm regulatory position	MH	May be possible, but difficult to replicate long-term aging and irradiation effects	M	Most applicable to a subset of PWRs	H	No ISI method available to measure loss of FT	3.5	Would increase confidence in regulatory position	H	High cost for irradiated components		
Metallic components with known flaws	NDE and destructive examination	Determine whether SCC mitigation methods are effective at preventing SCC; effectiveness of NDE at detection and sizing	MH	Validate NDE and mitigation method effectiveness	MH	Purpose of work would be to provide real-world validation of lab testing	H	Applicable to all plants	ML	Purpose of this work is to assess inspection and mitigation method effectiveness	3.75	Increase confidence in NDE and mitigation methods	M	Moderate cost for contaminated, but not irradiated, primary stem components		
Metallic components with limiting fatigue life	NDE and destructive examination	Determine whether fatigue flaws are present in high usage locations	MH	Validate fatigue life methodologies	ML	Purpose of work would be to provide real-world validation of lab testing	H	Applicable to all plants	ML	Fatigue calculations inform sampling inspections of limiting fatigue locations	3.25	Increase confidence in fatigue life calculations	M	Moderate cost for contaminated, but not irradiated, primary stem components		

[illegible]

	Basic Info		Technical Criteria										Cost / Complexity		Project Specific	
Need Description	Purpose / Testing Planned	Technical Knowledge Gained	Criticalness of Technical Gap Addressed		Importance of Harvested Materials over Laboratory Aging		Applicability to US Operating Fleet		Regulatory Considerations Related to Inspections and AMPs		Score Average	Basis for Priority	Cost / Complexity		Timeliness of results	Availability of materials for harvesting
CONCRETE			Score	Comment	Score	Comment	Score	Comment	Score	Comment			Score	Comment		
Structures exposed to high radiation	Degradation of concrete due to irradiation, attenuation of radiation through concrete.	Physical and mechanical degradation data under service environment. Level of irradiation (neutron, gamma, temperature) through the concrete and depth of irradiation damage. Aggregate expansion, cracking of concrete, differential response of components of concrete, i.e. aggregate, mortar, and rebar/steel embeds and degradation under thermo-hydro-radio-mechanical environment due to radiation. Conduct NDEs.	H	Confirm regulatory position. Data available from 1970's are not representative of light water reactor (LWR) environments. Recent limited number of data available from NRAJ are representative of LWR environment. Validate accelerated aging data. Currently no data available from service irradiated concrete. Real world validation of test data and benchmarking of degradation models. Conduct NDEs.	H	Harvesting is of high importance because no data available from service irradiated concrete, inaccessible for inspection, limited lab test data, small scale lab test specimen.	M	Most PWRs	H	New aging mechanism added for further evaluation in SLR-GALL and SLR-SRP. No inspection method and data available.	4.5	Very limited data, new aging mechanism added in SLR-GALL, SLR-SRP. No inspection method and OE not available because location inaccessible. Safety significance for RPV support structures are critical.	M	Moderate cost for moderate level of irradiation on concrete.		TBD
Post-tensioned structures	Degradation of post-tensioning (PT) system.	In-situ internal degradation, delamination, adjustment of prestress force and interaction with insitu degradation.	MH	Investigate and verify knowledge related to degradation modes under sustained multi axial prestressing force without radial rebar, internal degradation, degradation of prestressing system including anchorage, NDE methods.	MH	Real world validation of lab testing, bench marking of numerical modelling, potential failure modes, applicable NDEs. Critical information from failed post-tensioned containment.	MH	About 37% US NPPs containment is post-tensioned. Also there are a few post-tensioned/prestressed SFP.	H	Concrete internal condition is not part of ISI. Limited condition monitoring for tendon. Detensioning and retensioning of tendons of aged containment. Effective NDE for PT containment structure not available.	4.25	Improve confidence on numerical modelling, potential failure modes, degradations, and NDEs. Collect critical information from failed post-tensioned containment.	L	Unirradiated		TBD
Corrosion of reinforcing steel, tendon, liner, embedment	Degradation of concrete from Alkali-Silica-Reaction (ASR)	Ongoing research is providing understanding of the concrete material damage mechanisms and the characterization of that damage as well as of its implications to structural performance. The knowledge gained is primarily derived from laboratory testing together with visual observations of field structures.	MH	To study in-situ effects of ASR concrete degradation and comparison with understanding developed from laboratory testing. To investigate possibility of combined aging effects such as ASR and reinforcement corrosion.	M	The knowledge gained from the current research is primarily derived from controlled laboratory testing involving controlled aging environments at constant environments, homogeneous aging and single aging mechanism.	H	One plant severely affected by ASR in the US. Because ASR is a slow evolving chemical mechanism of the concrete itself and all plants have safety-related concrete structures, monitoring for ASR is part of concrete management programs for all concrete structures for long term operations.	M	Monitoring for manifestation of ASR is part of aging management programs for concrete structures. For structures with ASR more complex aging management plans would monitor the progression of ASR, concrete cracking, structural deformations and, if needed, involve coring and testing of samples. Study of in-situ conditions would support implementation of more effective aging management plans.	3.75	Inform adjustments to aging management programs. Enhanced understanding of the possibility of combined degradation effects in the field. Assess homogeneity of damage in real structures.	L	Unirradiated		An international cooperative research program is being initiated under the auspices of the CSNI. The program will test concrete samples harvested from a decommissioned nuclear power plant in Canada extensively affected by ASR. The NRC plans to participate in this program, which is likely to provide timely results.

Spent fuel pool and transfer canal-boric acid attack on concrete in PWRs
Alkali Aggregate Reaction
Large structural sections for testing

[illegible]

Note to requester: The "RES-DE bilateral meetings RIC 2017" hyperlink in this document is included on the next page.

From: [Frankl, Istvan](#)
To: [Tregoning, Robert](#)
Cc: [Hiser, Matthew](#); [Purtscher, Patrick](#); [Hull, Amy](#)
Subject: FW: Bilateral meetings during the RIC
Date: Monday, February 06, 2017 3:50:00 PM
Attachments: [image001.gif](#)

Rob,

The only meeting we are planning around the RIC is the Harvesting Workshop. Please provide the latest information as requested by our TA below

Thanks,

Steve

From: Berrios, Ilka
Sent: Monday, February 06, 2017 2:56 PM
To: Iyengar, Raj <Raj.Iyengar@nrc.gov>; Frankl, Istvan <Istvan.Frankl@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>; Boyce, Tom <Tom.Boyce@nrc.gov>; Seber, Dogan <Dogan.Seber@nrc.gov>
Cc: Thomas, Brian <Brian.Thomas@nrc.gov>; Nakoski, John <John.Nakoski@nrc.gov>
Subject: Bilateral meetings during the RIC

All,

Please let me know if you are planning to have any bilateral meetings during the RIC. You can either send me the info or update the file in [SharePoint](#).

[RES-DE bilateral meetings RIC 2017](#)

This is the info that we need:

Country/ Organization	Date	Time	Attendees	RES/DE management needed?	Topic of discussion
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Thanks,

Ilka
415-2404

RES/DE Bilateral Meetings during the 2017 RIC

Branch	Country/ Organization	Date	Time	Attendees	RES/DE management needed?	Topic of discussion
SGSEB	IAEA	03/16/2017	1-5pm	Mr. Shin Morita, Section Head of External Events Safety Section and Technical staff from RES and NRO	A welcome by RES/DE management would be beneficial	IAEA's external hazards safety section head, Morita Shin will be meeting with RES/NRO technical staff to discuss IAEA's ongoing technical activities including progress of IAEA programs, future collaboration opportunities between IAEA/EESS and NRC in seismic/structural areas
ICEEB	Halden Reactor Project, DI&C Safety Demonstration Project group (Norway)	Thursday 16 Friday 17	1-5pm 9am - 5pm	Peter Karpati, Jon Kvaalem, and Christian Raspotnig from Halden. Bruce Hallbert, INL RES/DE: Sushil, Ian and Derekf	no	DI&C safety assurance <i>with special focus on experiences with assurance cases</i>
CMB	EPRI, DOE, PNNL, ORNL, Energy Solutions, Dominion, CRIEPI, JNRA, JAEA, GRS, SCK-CEN, Studsvik, Westinghouse, Tejano AEC	3/7 – 3/8	8-5pm, each day	30 attendees representing the NRC and the organizations listed	No, this is a working level meeting	Discussing better ways to proactively plan for harvesting materials from decommissioning nuclear power plants

Danoff, Karen

From: Hiser, Matthew
Sent: Wednesday, May 27, 2015 4:01 PM
To: Frankl, Istvan
Subject: FW: slides for next week

FYI – Rob's feedback

From: Tregoning, Robert
Sent: Wednesday, May 27, 2015 3:45 PM
To: Hiser, Matthew
Cc: Hull, Amy
Subject: RE: slides for next week

Matt/Amy:

I took a quick look at this and think it's generally okay. You have ½ hour and there may be more material here than you can fit into the allotted time. If you were to cut information, I'd consider cutting the slides on our current harvesting programs. While these are interesting, they are not germane to developing an information tool to help select future plant SSCs for evaluation.

I also think it would be good to stress that we want to identify the characteristics of important SSC for harvesting up front so that when plants announce their plans, we can move quickly to identify SSCs of interest. It would really be nice if you provided a concrete example (bad pun) on how this tool would be used. For example, there could be value in getting CASS material with 15% delta ferrite that has received various amount of irradiation (< 0.08 dpa, 1 – 3 dpa, and > 5 dpa). It might be possible to identify a single component (e.g., lower support columns) that might possess the requisite properties for such an evaluation. In my mind at least, the information tool would ideally identify the material characteristics of interest to study and also components that would possibly satisfy these requirements.

This is just my idea and it may be premature at this point to have in the presentation, but we should be thinking about this now so the information tool is structured appropriately.

Thanks,

Rob

PS – let me know when the presentation is final so that I can put it with the rest.

Robert Tregoning

Technical Advisor for Materials

US Nuclear Regulatory Commission

21 Church Street, M/S CS-5A24

Rockville, MD 20850

ph: 301-251-7662

Blackberry: (b)(6)

fax: 301-251-7425

From: Hiser, Matthew
Sent: Wednesday, May 27, 2015 2:54 PM
To: Tregoning, Robert
Cc: Frankl, Istvan; Hull, Amy
Subject: FW: slides for next week

Hi Rob,

Please feel free to review and provide comments/edits on these slides on Strategic Harvesting for the meeting next week.

Thanks!

Matt

Matthew Hiser

Materials Engineer

Corrosion and Metallurgy Branch

From: Hull, Amy

Sent: Wednesday, May 27, 2015 2:52 PM

To: Frankl, Istvan

Cc: Hiser, Matthew

Subject: slides for next week

Hi Steve,

These are ready for you to review. I will complete 390 form now.

From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#)
Cc: [Frankl, Istvan](#); [Hull, Amy](#)
Subject: FW: slides for next week
Date: Wednesday, May 27, 2015 2:54:00 PM
Attachments: [harvesting - status.pptx](#)

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

Hi Rob,
Please feel free to review and provide comments/edits on these slides on Strategic Harvesting for the meeting next week.
Thanks!
Matt

Matthew Hiser

*Materials Engineer
Corrosion and Metallurgy Branch
Division of Engineering
Office of Nuclear Regulatory Research
301-251-7601*

From: Hull, Amy
Sent: Wednesday, May 27, 2015 2:52 PM
To: Frankl, Istvan
Cc: Hiser, Matthew
Subject: slides for next week

Hi Steve,
These are ready for you to review. I will complete 390 form now.

Strategic Approach for Obtaining Material and Component Aging Information

Matthew Hiser

Amy Hull

U.S. NRC RES/DE/CMB

Industry/NRC Materials Programs Technical Information Exchange Meeting
Nuclear Regulatory Commission Headquarters

June 2 - 4, 2015

Outline

- Purpose
- Background
- Harvesting Experience
- Approach to Strategic Harvesting
- Engagement with Other Stakeholders

Purpose

- Create a framework for a strategic approach to harvesting ex-plant materials
 - Ex-plant materials offer unique environmental exposure that cannot be entirely replicated by laboratory testing with fresh materials
- Combine high priority data needs identified in SLR/LTO activities with harvesting opportunities from decommissioning plants

Background

- To date, harvesting opportunities have been limited due to few decommissioning plants
 - Zion in U.S., Zorita in Spain
- However, several U.S. plants have already shut down or are planning to do so in the near future
 - Kewaunee, SONGS, Crystal River, Vermont Yankee, Oyster Creek
- This provides a unique opportunity to plan harvesting for the maximum utility to address the highest priority technical issues

Harvesting Experience

- Past harvesting efforts have generally involved a reactive decision-making process
 - Limited opportunities to acquire ex-plant materials
 - Limited strategic planning for harvesting
- Harvesting projects with NRC involvement:
 - Reactors internal materials from Zorita
 - Concrete from Zorita
 - Neutron absorber material from Zion
 - Cables from Zion and Crystal River

Zorita Internals Research Project (ZIRP)

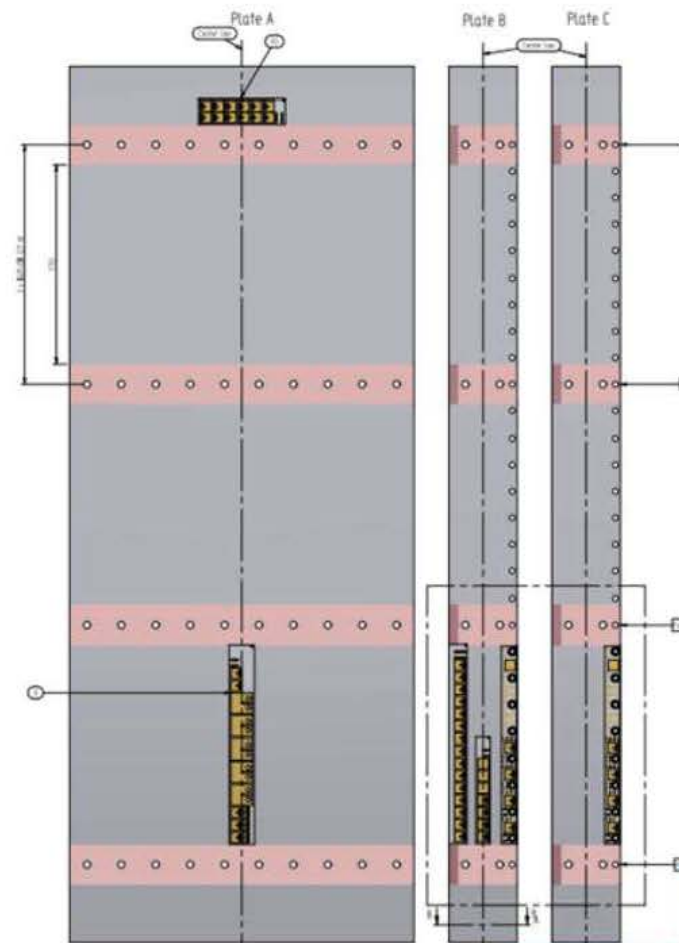


U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

- **Materials Harvested:**
 - Baffle plate and core barrel weld materials
- **Scope:**
 - Mechanical testing (tensile, CGR, FT)
 - Microstructural characterization (void swelling)
- **Purpose:**
 - High-fluence (up to 50 dpa) IAD effects with representative LWR exposure conditions
- **Timeline:**
 - Initial discussions in 2006, harvesting in 2013, testing ongoing through 2016
- **Coordination:**
 - EPRI, international consortium, Studsvik, Halden



ZIRP Timeline

Task	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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										★

Neutron Absorbers from Zion

- **Materials Harvested:**
 - Select Boral® NAM panels from Regions 1 and 2 of the Zion SFP
- **Scope:**
 - Visual and microstructural examinations (incl. areal density)
 - Corrosion testing
- **Purpose:**
 - Identify degradation mechanisms
 - Estimate degradation rate
 - Confirm results of in-situ areal density measurements
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing in 2015-2016
- **Coordination:**
 - EPRI, ZionSolutions, SRNL

Concrete from Zorita (Plan)

- **Materials Harvested:**
 - Concrete from structures that are in close proximity to RPV
- **Scope:**
 - Mechanical testing (compressive, tensile, modulus of elasticity)
 - Microstructural characterization
 - Physical change
- **Purpose:**
 - High fluence in combination with temperature and humidity that are representative of LWR environment effects on structural and shielding performance
- **Timeline:**
 - Initial discussions in 2014, harvesting in 2015, testing 2016-2018
- **Coordination:**
 - NRC , ENRESA and CSN

Cables: Zion and Crystal River

- **Materials Harvested:**
 - Low and Medium Voltage Cables
- **Scope:**
 - Condition monitoring to assess cable performance under normal operating conditions (accelerated aging) and accident conditions
- **Purpose:**
 - Cable degradation due to normal operating environment and accident conditions
- **Timeline:**
 - Initial discussions in 2012
 - Cable samples harvested from Zion in 2013
 - Plan is to harvest additional samples from Crystal River and Zion in 2015
 - Testing expected to be completed in 2017
- **Coordination:**
 - ORNL, Zion Solutions, NIST, EPRI

Challenge: NPP Safety Beyond 60 Years



NPPs allowed 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. The staff currently believe (SECY-14-0016, NUREG-1925) the most significant technical issues challenging power reactor operation beyond 60 years are:

- 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.

As stated in SRM-SECY-14-006, “the staff should continue to emphasize in communications with industry the need to strive for satisfactory resolution of these issues prior to the NRC beginning a review of any SLR application.”



Approach: Integrated Aging Degradation Need/Resource Interrogatory Tool

- Various domestic and international sources of technical information of generic nature with respect to anticipated degradation in NPPs during LTO, extrapolating to 80 years of operation.
- Evaluate what relevant ex-plant material from decommissioned reactors is projected to be available for potential harvesting.
- Replace current piecemeal approach that obtains isolated and fragmented degradation information as targets of opportunity arise at a few plants with a strategic plan that is more comprehensive, broader in scope, and more risk-informed.



Sources: PMDA & EMDA

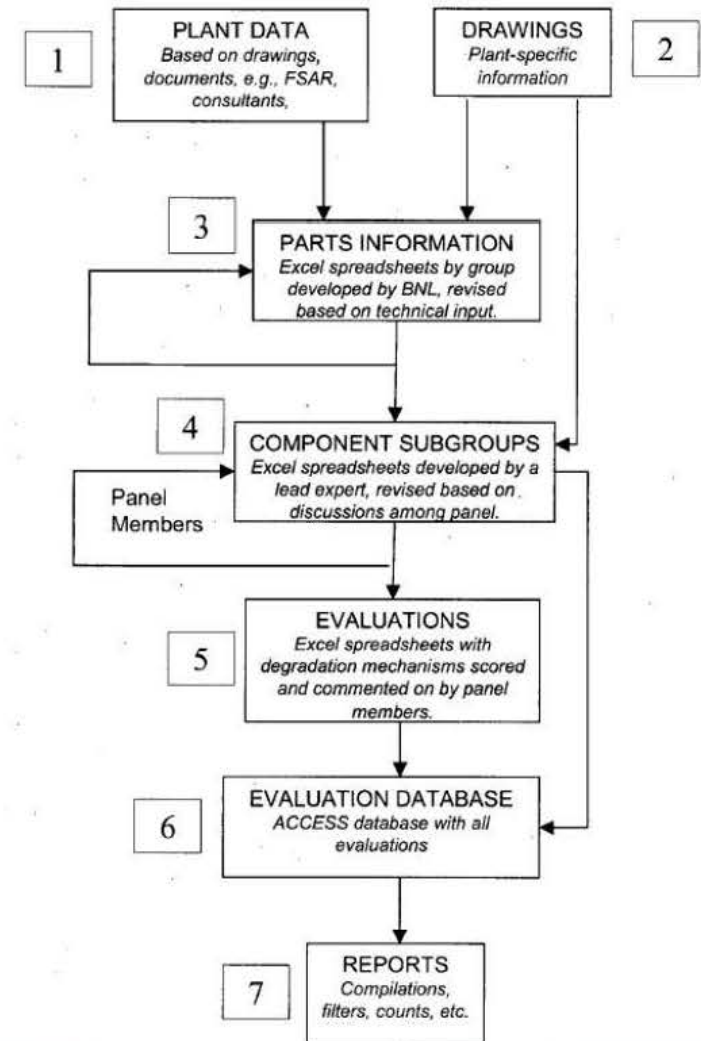
How does one try to predict the future?

Experts were tasked with

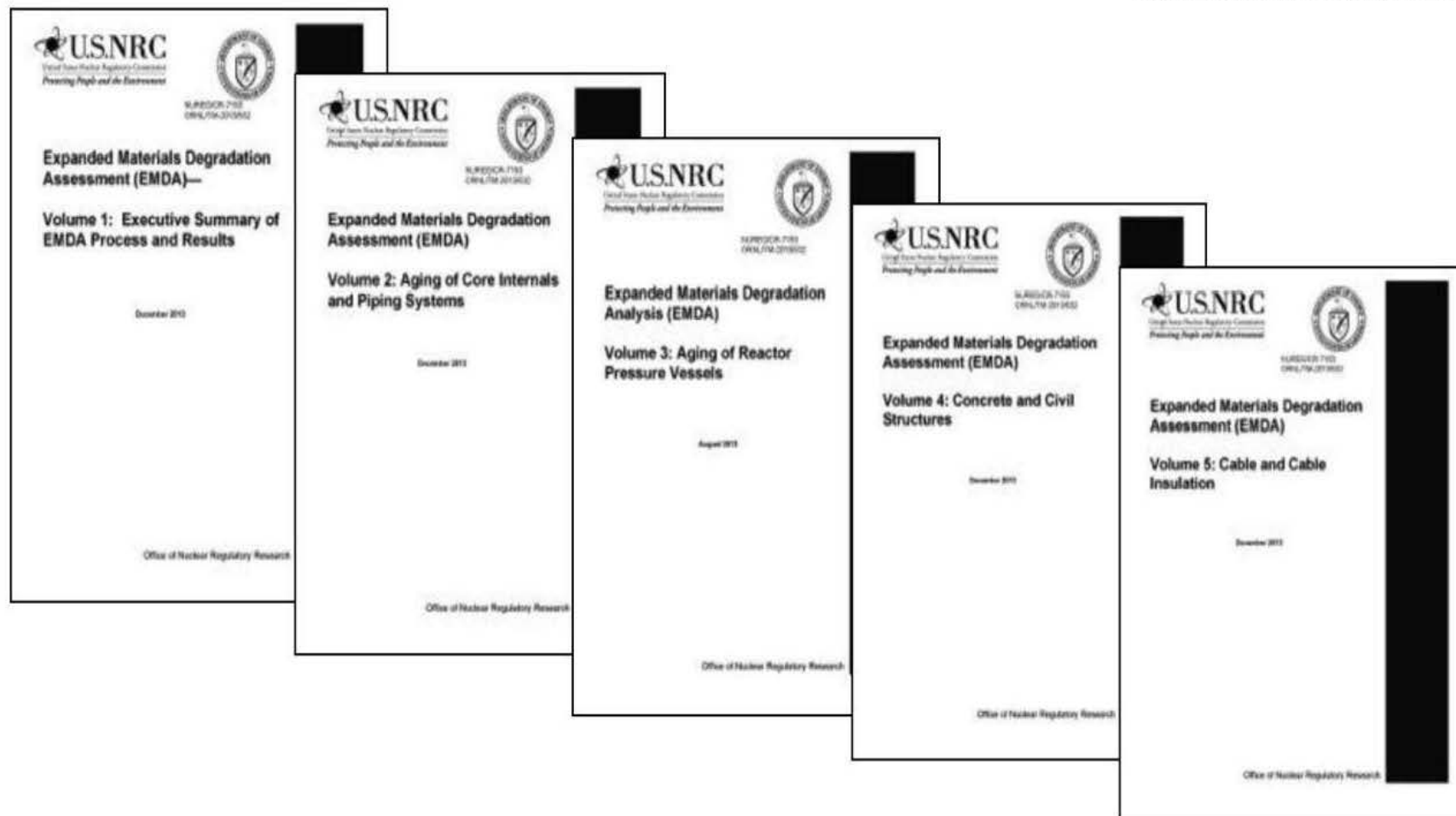
- Listing vulnerable reactor components
- Reviewing relevant degradation mechanisms
- Determining the degree to which the components were vulnerable to these mechanisms
- Determining confidence level in their predictions

The PMDA panel evaluated 3863 components (2203 for PWRs, 1603 for BWRs) for their susceptibility to 16 degradation mechanisms. NUREG/CR-6923 is nearly 4000 pages long. The electronic version is 121 MB and consists of 16 files

The EMDA panels investigated issues of reactor aging beyond 60 years to identify possible knowledge gaps, and provided an expansion of scope and time

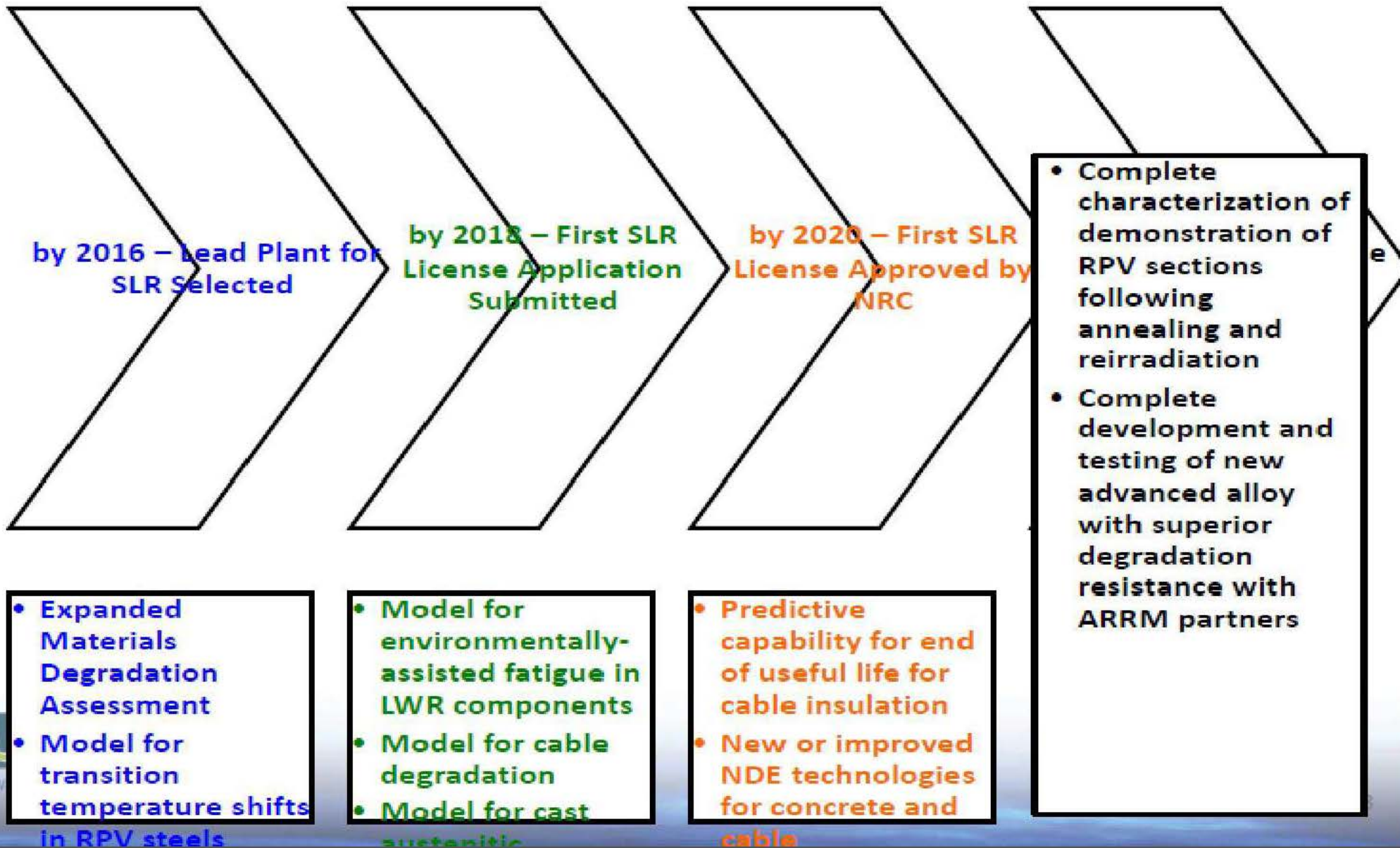


EMDA (NUREG/CR-7153)



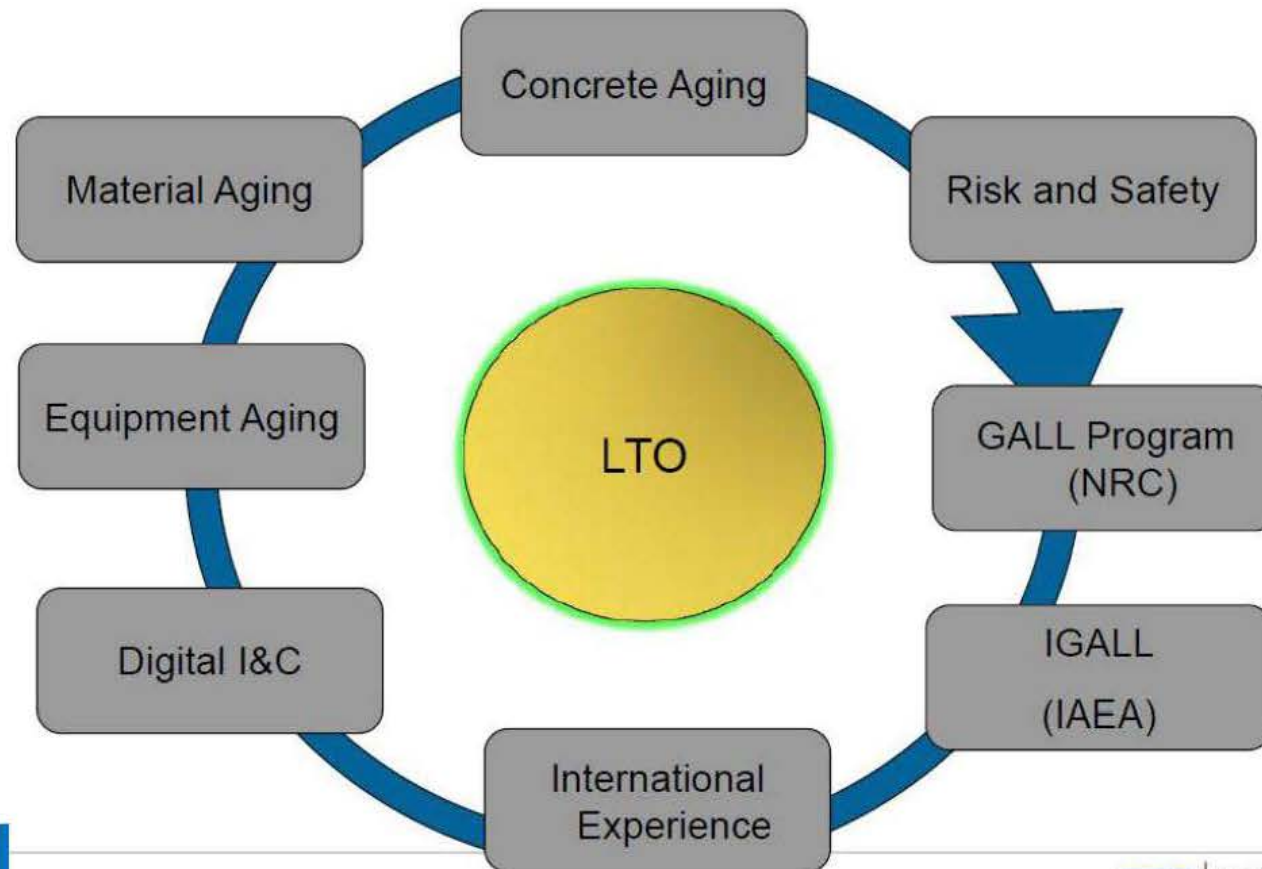
Source: DOE LWRS Program

(J. Busby, Overview Presentation to NESCC May 12, 2015)

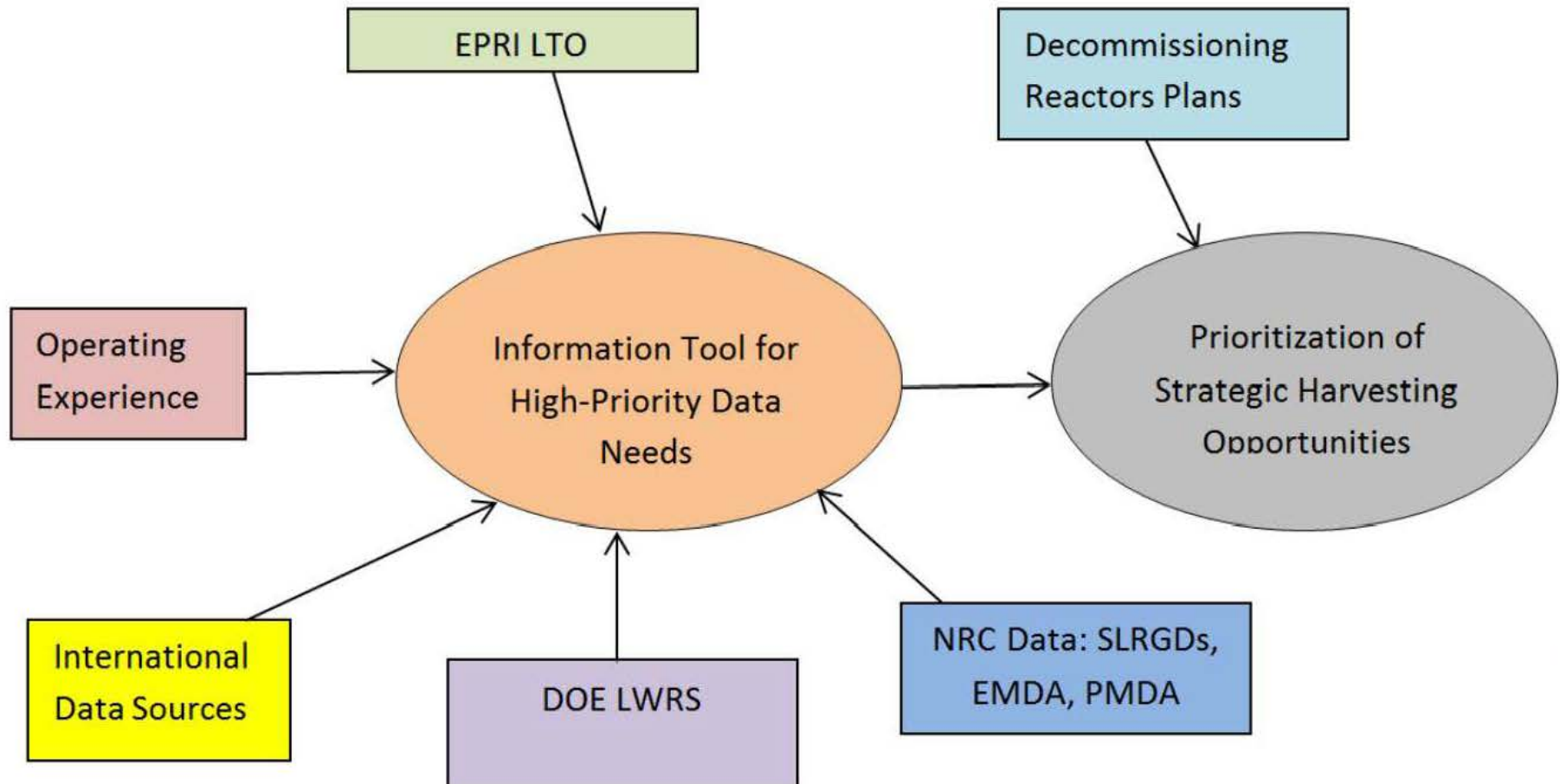


Coordination with EPRI and DOE

- The cooperative program with EPRI LTO ensures the timely exchange of information on planned and ongoing aging management research activities. (MOU until 9/30/2016)
- With the DOE LWRS program, materials related gaps in relation to SLR were identified and documented in NUREG/CR-7153, "Expanded Materials Degradation Assessment, Vol. 1-5," 2014. This research ranked the significance of aging-related degradation phenomena that could affect reactor system and components during SLR. (MOU until 8/22/2019)



The Vision: Integrated Aging Degradation Need/Resource Interrogatory Tool



Stakeholder Engagement

- IAEA CRP: Evaluation of Structures and Components Material Properties Utilizing Actual Aged Materials Removed from Decommissioned Reactors for Safe LTO.
- Conduct public workshops to further refine the concept of useful database of research objectives for ex-plant materials
- NRC invites collaboration under current EPRI/LTO and DOE/LWRS MOUs.



Acknowledgements

- Robert Tregoning, RES/DE
- Eric Focht, RES/DE
- Darrell Murdock, RES/DE
- Mita Sircar, RES/DE

Acronyms

- ARRM – advanced radiation resistant materials
- CGR- crack growth rate
- CRP – coordinated research project (IAEA)
- CSN – Spanish regulator
- EMDA- expanded materials degradation assessment
- ENRESA – Spanish decommissioning authority
- FT – fracture toughness
- GALL – Generic Aging Lessons Learned
- IAD – irradiation-assisted degradation
- IGALL – international GALL
- LTO – long-term sustainability
- LWRS – LWR Sustainability
- MOU – Memorandum of Understanding
- NAM – neutron absorbing material
- NIST – National Institute of Standards & Technology
- NPAR – nuclear plant aging research
- PMDA – Proactive Materials Degradation Assessment
- PTS – pressurized thermal shock
- RPV – reactor pressure vessel
- SFP- spent fuel pool
- SLR – subsequent license renewal
- SLRGDs – subsequent license renewal guidance documents
- SRP-LR standard review plan for license renewal

From: [Hiser, Matthew](#)
To: [Tregoning, Robert](#)
Subject: FW: Revised NRC-NRAJ 2016 Materials Meeting Agenda
Date: Thursday, June 23, 2016 12:57:00 PM

From: Rao, Appajosula

Sent: Thursday, June 23, 2016 12:53 PM

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

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

Subject: RE: Revised NRC-NRAJ 2016 Materials Meeting Agenda

Matt:

You unilaterally decide on actions. If you are the lead and want to present all topics I have no objection. Please do not expect any help in the preparation of the slides or any technical discussion.

Sri

From: Hiser, Matthew

Sent: Thursday, June 23, 2016 12:28 PM

To: Rao, Appajosula <Appajosula.Rao@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>

Subject: FW: Revised NRC-NRAJ 2016 Materials Meeting Agenda

Hi Guys,

Do either of you have a preference on one of these options? I am fine with either...

- IAD: Sri or Matt
- CASS: Pat or Sri
- Harvesting: Matt or Pat

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: Tregoning, Robert

Sent: Thursday, June 23, 2016 7:13 AM

To: Kirk, Mark <Mark.Kirk@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Gordon,

Matthew <Matthew.Gordon@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>; Hiser,

Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Sircar,

Madhumita <Madhumita.Sircar@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>

Cc: Frankl, Istvan <Istvan.Frankl@nrc.gov>; Rudland, David <David.Rudland@nrc.gov>; Burke, John

<John.Burke@nrc.gov>; Jung, Ian <Ian.Jung@nrc.gov>

Subject: Revised NRC-NRAJ 2016 Materials Meeting Agenda

All:

Attached is the revised agenda for the NRC/NRAJ meeting in August. The only change is that the concrete aging and the metals aging portions of the agenda have been swapped so that the first technical topic is concrete. The concrete folks will have additional, more in-depth discussions after the morning of the 8th as a side-bar. Please let me know if there are any issues with this revised agenda. I'm still awaiting the following:

1. CMB identification of leads for their topics on the agenda.

2. NRAJ to identify their speakers for the various topics.

I'll send out a final agenda once 1 and 2 have been completed.

Thanks for your help,

Rob

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

From: [Hiser, Matthew](#)
To: [Rao, Appajosula](#); [Purtscher, Patrick](#)
Subject: FW: Revised NRC-NRAJ 2016 Materials Meeting Agenda
Date: Thursday, June 23, 2016 12:28:00 PM
Attachments: [NRC-NRAJ 2016 Materials Meeting Agenda.docx](#)

Hi Guys,

Do either of you have a preference on one of these options? I am fine with either...

- IAD: [Sri](#) or [Matt](#)
- CASS: [Pat](#) or [Sri](#)
- Harvesting: [Matt](#) or [Pat](#)

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: Tregoning, Robert

Sent: Thursday, June 23, 2016 7:13 AM

To: Kirk, Mark <Mark.Kirk@nrc.gov>; Murdock, Darrell <Darrell.Murdock@nrc.gov>; Gordon, Matthew <Matthew.Gordon@nrc.gov>; Rao, Appajosula <Appajosula.Rao@nrc.gov>; Hiser, Matthew <Matthew.Hiser@nrc.gov>; Purtscher, Patrick <Patrick.Purtscher@nrc.gov>; Sircar, Madhumita <Madhumita.Sircar@nrc.gov>; Pires, Jose <Jose.Pires@nrc.gov>

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

Subject: Revised NRC-NRAJ 2016 Materials Meeting Agenda

All:

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1. CMB identification of leads for their topics on the agenda.
2. NRAJ to identify their speakers for the various topics.

I'll send out a final agenda once 1 and 2 have been completed.

Thanks for your help,

Rob

AGENDA

NRC/NRAJ Bilateral Meeting on Materials Issues

NRC Headquarters, Rockville, MD, USA
August 8 - 9, 2016

Monday, August 8th, 2016
Location: Room O7-B4

<u>Time</u>	<u>Topic</u>	<u>Speaker</u>
8:00 am	Introductions	All
8:05 am	Welcome	B. Thomas, NRC
8:15 am	Opening Remarks	R. Tregoning, NRC K. Sakamoto, NRAJ
	<u>Concrete Aging</u>	
8:30 am	Radiation Effects on Concrete Structures	M. Sircar, NRC M. Nakano, NRAJ
9:15 am	NDE for Thick Concrete Sections	M. Sircar, NRC M. Nakano, NRAJ
10:00 am	Break	
10:15 am	Monitoring and Aging Management of ASR Affected Concrete Structures	M. Sircar, NRC M. Nakano, NRAJ
11:00 am	Technical and Regulatory Concerns	All
12:00 pm	Lunch	
	<u>Cable Aging</u>	
1:30 pm	NRC Research Activities	D. Murdock, NRC
2:30 pm	NRAJ Research Activities	NRAJ
3:30 pm	Break	
3:45 pm	Technical and Regulatory Concerns	All
4:30 pm	Adjourn	

AGENDA

NRC/NRAJ Bilateral Meeting on Materials Issues

NRC Headquarters, Rockville, MD, USA

August 8 - 9, 2016

Tuesday, August 9th, 2016

Location: Room O7-B4

<u>Time</u>	<u>Topic</u>	<u>Speaker</u>
	<u>Metals Aging</u>	
8:00 am	RPV embrittlement studies	M. Kirk, NRC NRAJ
9:30 am	Irradiated Assisted Degradation	S. Rao/M. Hiser, NRC NRAJ
10:15 am	Break	
10:30 am	Irradiated Assisted Degradation, cont.	S. Rao/M. Hiser, NRC NRAJ
11:00 am	Technical and Regulatory Concerns	All
12:00 pm	Lunch	
	<u>Possible Future Collaboration Areas</u>	
1:30 pm	Environmentally Assisted Fatigue	R. Tregoning, NRC NRAJ
2:00 pm	Aging of CASS	Rao/Purtscher, NRC NRAJ
2:30 pm	Peening	J. Collins, NRC NRAJ
3:00 pm	Break	
3:15 pm	Material Harvesting	P. Purtscher, NRC NRAJ
3:45 pm	Actions and Next Meeting	R. Tregoning, NRC K. Sakamoto, NRAJ
4:15 pm	Closing Remarks	R. Tregoning, NRC K. Sakamoto, NRAJ
4:30 pm	Adjourn	