Strategic Approach for Ex-Plant Materials Harvesting

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Purpose

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- 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

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- 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

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- 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

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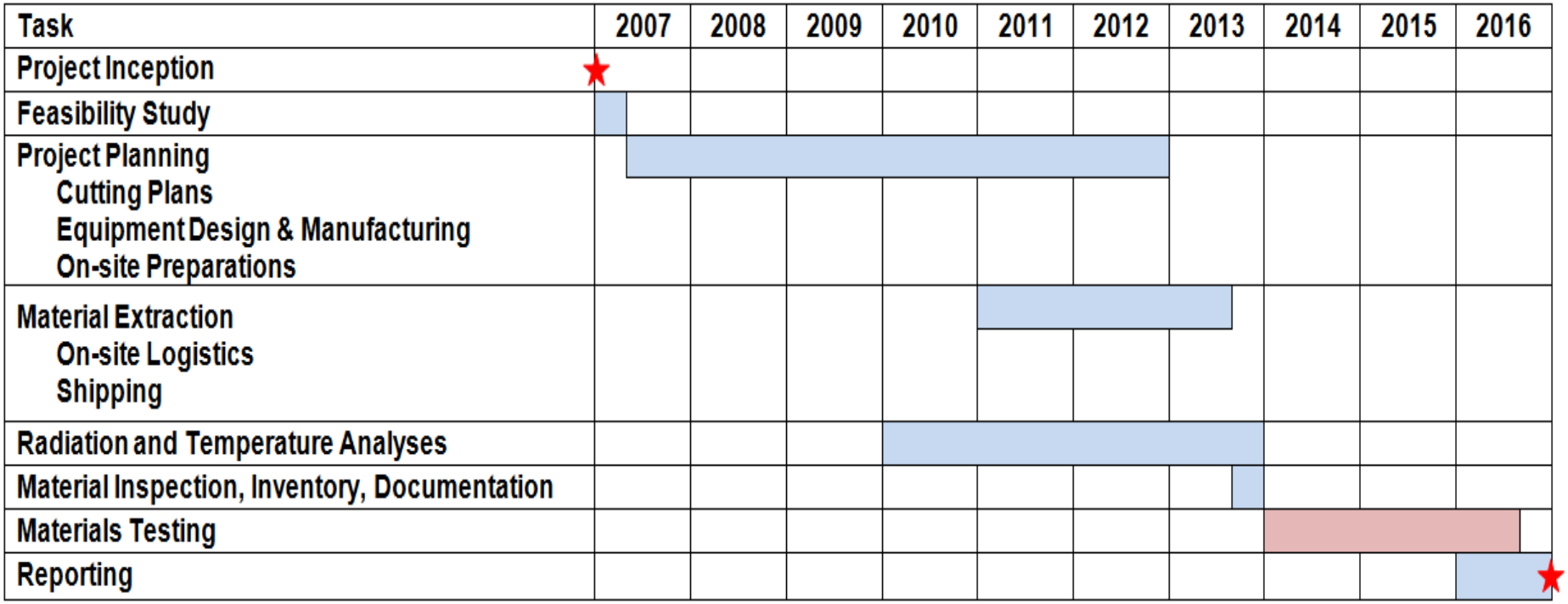

Approach: Assessment of Technical Issues and Available Materials for Harvesting

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- 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

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- 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

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- 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

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- 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

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Backup Slides

Neutron Absorbers from Zion

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- **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)

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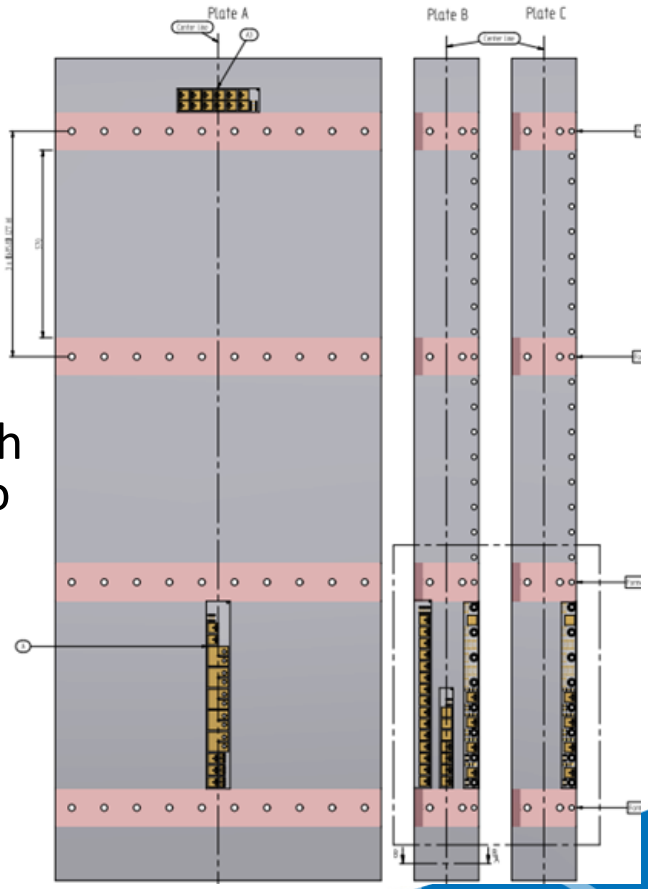
- **Materials Harvested**:
  - Baffle plate and core barrel weld materials
- **Scope**:
  - Mechanical testing (tensile, CGR, FT)
  - Microstructural characterization (void swelling)
- **Purpose**:
  - High-fluence (up to 50 dpa) IAD effects with representative LWR exposure conditions to
  - Support 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)

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- **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

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- **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