Guidance for Transitioning from Operation to Decommissioning for Nuclear Power Plants

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Background / Motivation for Project
Background / Motivation for Project (1/2)

- The cost of decommissioning is highly influenced by overall staffing costs, which is directly related to the overall length of decommissioning ($300,000 total decommissioning cost/day quoted by a site).

- It is anticipated that the guidance developed in this work will help shorten the length of the transition period, and thus shorten the overall length of decommissioning.

Ref. EPRI 1023025
Background / Motivation for Project (2/2)

- A wide range of key activities are necessary after permanent shutdown of a nuclear power plant before active dismantlement of the plant can begin.
- In some cases these transition activities may be prescribed by regulation, while in other cases they may be more practically driven or even optional.
- In either case, it is often unclear what activities are needed and when/how those activities should be conducted to most efficiently transition from operational to decommissioning status.
- The purpose of this project was to develop guidance for transitioning from normal operation to decommissioning.
Project Overview

- Country-specific transition period regulations & experiences compiled for US, Germany, France, Spain, and Switzerland
  - Required transition activities identified
  - Cost-saving transition activities identified
  - Long-lead transition activities identified
  - Transition activities that can be proactively conducted during operation identified

- Guidance developed for the following scenarios:
  - Transitioning to DECON for planned shutdown
  - Transitioning to SAFSTOR for planned shutdown
  - Transitioning to DECON for unplanned shutdown
  - Transitioning to SAFSTOR for unplanned shutdown

- Guidance developed for operating plants to minimize impact of unplanned shutdown
Transition Period Regulations
US Transition Regulations (1/2)

- US plants do not have to apply for a formal decommissioning license after permanent shutdown, unlike some other countries
- Decommissioning process structured around several regulatory submittals

Ref. EPRI 109032
Many regulatory submittals are not strictly required during the transition to decommissioning, but are cost effective

- Permanently Defueled Tech. Specs.
- Security Plan Exemptions
- Rescission of NRC Orders
- Decom. Trust Fund Access Exemption
- Insurance Exemptions
- Certified Fuel Handler Training Program
- Decommissioning QA Plan
- Records Retention Exemption
- Removal of License Renewal Conditions
Typical International Transition Regulations

- Unlike US, after permanent shutdown a specific decommissioning license is needed before major decommissioning activities permitted
  - To obtain license, plants must demonstrate adequate technical and financial capabilities to conduct the decommissioning
  - During transition period, plants may conduct activities covered by the normal operating license (including decontamination, disposal of operational wastes, etc.)

- Review and approval of the license application typically takes 3-5 years
  - Development of decommissioning license application may take >2 years
  - For unplanned shutdowns, transition period durations >5 years common

- In some countries, dismantling activities cannot begin until all fuel is removed from SFP
Transition Period Experiences
US Transition Period Experiences

- 8 US transition period experiences summarized
  - Focus is on Oyster Creek, CR3, Kewaunee, SONGS and VY

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Shutdown Date</th>
<th>Initial Decommissioning Strategy</th>
<th>Months of Decommissioning Preparation</th>
<th>Transition Period Duration</th>
<th>Current Status</th>
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</thead>
<tbody>
<tr>
<td>Connecticut Yankee</td>
<td>Dec-96</td>
<td>DECON</td>
<td>0</td>
<td>2.8 Years</td>
<td>ISFSI Only</td>
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<td>Maine Yankee</td>
<td>Aug-97</td>
<td>DECON</td>
<td>8-20</td>
<td>1.8 Years</td>
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<tr>
<td>Zion 1</td>
<td>Feb-98</td>
<td>SAFSTOR</td>
<td>1</td>
<td>2.4 Years</td>
<td>DECON</td>
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<tr>
<td>Zion 2</td>
<td>Feb-98</td>
<td>SAFSTOR</td>
<td>1</td>
<td>2.4 Years</td>
<td>DECON</td>
</tr>
<tr>
<td>Oyster Creek</td>
<td>Jan-00</td>
<td>DECON</td>
<td>33</td>
<td>N/A</td>
<td>Normal Operation</td>
</tr>
<tr>
<td>Crystal River 3 (CR3)</td>
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<td>SAFSTOR</td>
<td>0</td>
<td>2.4 Years</td>
<td>SAFSTOR</td>
</tr>
<tr>
<td>Kewaunee</td>
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<td>1.6 Years</td>
<td>SAFSTOR</td>
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<td>San Onofre 2 (SONGS 2)</td>
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<td>San Onofre 3 (SONGS 3)</td>
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<td>DECON</td>
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<tr>
<td>Vermont Yankee (VY)</td>
<td>Dec-14</td>
<td>SAFSTOR</td>
<td>16</td>
<td>1.3 Years</td>
<td>SAFSTOR</td>
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</tbody>
</table>

Correlation between transition period duration and months of preparation is evident
US Transition Period Experience

Example – Connecticut Yankee Transition Period Timeline

*Work to support activity possibly begun during transition period
US Transition Period Experience

Example – Exelon Nuclear Mgmt. Model Transition Period Timeline

1. **T – 5 yrs.**
   - Develop Scoping & Screening Process
   - Implement Scoping & Screening Process

2. **T – 4 yrs**
   - Develop Decommissioning Management Model *
   - Identify, Develop & Submit Regulatory Actions

3. **T – 3 yrs.**
   - Develop Decision Making Framework
   - Identify key Decisions

4. **T – 2 yrs.**
   - Gather Information & Implement Decision Making Framework
   - Review & Approve Strategic Plan

5. **T – 1 yrs.**
   - Develop & Submit PSDAR & DCE **
   - Implement Governance Changes *

- **Shutdown Date**

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- **T – 5 yrs.**
  - Staff Corporate Decommissioning Transition Manager Position
  - Identify Site Decommissioning Lead

- **T – 4 yrs**
  - Identify Corporate Team Leads
  - Identify Scoping & Screening Team

- **T – 3 yrs.**
  - Identify Mod Resources
  - Assemble Site DC Transition Team

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*Initial Plant Only – Management Model Addition

** PSDAR Submission Tied to Strategy Approvals; PSDAR Does Not Require NRC Approval, DCE (Decommissioning Cost Estimate) for PSDAR plan will be submitted with or shortly after PSDAR submittal. No approval required for DCE.

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Major US Transition Period Activities (1/2)

- Preparation of Regulatory Submittals
- Historical Site Assessment (Rad & Non-Rad)
- Initial Site Characterization
- Disposal of Operational Wastes
- Cool and Dim / Cold and Dark Program
- Develop Communications Plan
- Transition to Decommissioning Organization and Staffing
- Spent Fuel Management
  - Fuel Building Modifications / Spent Fuel Pool Islanding
  - ISFSI Design / Permitting / Construction
Major US Transition Period Activities (2/2)

- Full System Chemical Decontamination
- Hot Spot Removal
- Hazardous Material Removal (Asbestos, flammable material, etc.)
- Dismantling of Non-Nuclear Facilities
- Planning for Major Decommissioning Engineering Challenges
  - Major Component Removal
  - Reactor Vessel and Internals Segmentation
Transition Period Guidance
General Transition Period Guidance

- Begin planning for decommissioning at least 3 years prior to the date of permanent shutdown
- Create decommissioning planning team during operation
  - Relieve planning team members of operational duties
  - Start with smaller team → expand team after last refueling outage
- Decommissioning planning resources:
  - Review applicable regulations
  - Review decommissioning experiences and available guidance
  - (US Only) Review past regulatory submittals on NRC ADAMS
  - Visit decommissioning sites
  - Work with industry experts
Transition Period Guidance Summary

- Specific guidance is provided for each major transition period activity in the report
- Example transition plans provided for transitioning to DECON and SAFSTOR for both planned and unplanned shutdown
- Decommissioning guidance for operating plants is provided to help minimize impact of unplanned shutdown
- NRC ADAMS accession numbers summarized for regulatory submittals (including RAIs) from SONGS, VY, Kewaunee, & CR3
Example US Transition Plan (Unplanned Shutdown to DECON)
Example US Transition Plan (Planned Shutdown to DECON)
Example US Transition Plan (Planned Shutdown to DECON)

Zoom View

-3 -2 -1 0 1 2 3

Years from Permanent Shutdown

- Requests for NRC Orders
- Rescission
- Emergency/Severe Weather Security Exemption
- CFH Training Program
- Site-Specific Cost Est.
- Permanently Shutdown EP
- Decommissioning QA Plan
- Initial Site Characterization (Inc. Non-Rad)
- EP Exemption / Permanently Defueled EP
- Post-Shutdown Decom. Activities Report
- Irradiated Fuel Management Plan
- DTF Access Exemption

~1.3 Year Transition Period

- Plant Transition Activity
- Interaction with NRC
- NRC Acceptance

Implement Permanently Defueled EP

Spent Fuel Decay Milestone
Example US Transition Plan (Planned Shutdown to DECON)
Zoom View: Non-Regulatory Activities Only

-3 -2 -1 0 1 2 3
Years from Permanent Shutdown

-3 -2 -1 0 1 2 3
Power Operations
Decom. Planning
Historical Site Assessment
Initial Site Char (Inc. Non-Rad)
ISFSI Planning/Permitting
Implement Exemptions, etc.
Full System Chem Decon
Implement Spent Fuel Pool Island
Establish Cool and Dim
Asbestos Removal
Conventional Bldg. Dismantling
Hot Spot Reduction
Dismantling Activities
Spent Fuel Decay Milestone
Implement PDEP
ISFSI Construction

Plant Transition Activity
Interaction with NRC
NRC Acceptance

~1.3 Year Transition Period

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Guidance for Currently Operating Plants

- Pre-plan for decommissioning
  - Develop high level plans that address critical decommissioning issues/questions

- Consider preparing decommissioning-related regulatory submittals
  - Many regulatory submittals will not be significantly affected by short term plant operations or changes to decommissioning plans

- Get involved in decommissioning regulation development / revision process

- Maintain comprehensive historical site assessment during normal operation (pursuant to 10 CRF 50.75 (g)
EPRI Transition Period Guidance Report Summary

- Status:
  - Reviewed by NEI/Utility Decommissioning Transition Working Group and international EPRI Decommissioning Program members:
    - Recent experiences added to the report
    - Utility comments have been incorporated
  - Report to be published in near future as *Guidance for Transition from an Operational to Decommissioning Status*, Report # 3002007551
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