Current U.S. Fleet Performance

U.S. Commercial Nuclear Power Reactors—Years of Operation by the End of 2010

<table>
<thead>
<tr>
<th>Years of Commercial Operation</th>
<th>Number of Reactors</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–9</td>
<td>0</td>
</tr>
<tr>
<td>10–19</td>
<td>3</td>
</tr>
<tr>
<td>20–29</td>
<td>48</td>
</tr>
<tr>
<td>30–39</td>
<td>46</td>
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<tr>
<td>40 plus</td>
<td>7</td>
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</tbody>
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Note: Ages have been rounded up to the end of the year.
Current Status of License Renewal

License Renewal Granted for Operating Nuclear Power Reactors

Licensed to Operate (104)
- License Renewal Granted (59)
- Original License (45)
Selected Technical Issues in License Renewal

- Metal fatigue
- Submerged electrical cables
- Steel containment and liner plate degradation
- Neutron absorber degradation
- Refueling cavity/spent fuel pool leakage
- Buried piping
Metal Fatigue

- Analysis methodology could yield non-conservative results
- Potential delay in implementation of planned corrective actions to address aging
- Requiring license renewal applicants to demonstrate that their analysis results are conservative
Submerged Electrical Cables

• Cables not designed for continuous submerged service in electrical manholes
• Cable failure can disable safety systems
• Revised inspection procedures and program guidance to increase and expand inspection and test frequencies
Steel Containment and Liner Plate Degradation

• Corrosion due to water leakage or contact with wood or foreign objects
• Potential impacts on structural integrity and leak tightness
• Obtained applicant commitments for additional inspections and increased maintenance; issuing advisory to other licensees
Neutron Absorber Degradation

- Long-term use of neutron absorbers in spent fuel pools leads to deformation and degradation of the materials
- Potentially reduce safety margins and violate subcriticality requirement
- Developed new aging management program for neutron absorbing materials degradation
Refueling Cavity/Spent Fuel Pool Leakage

- Concerns regarding the impacts of historical water leakage from concrete walls and floors
- Potential effect on structural integrity and leak tightness
- Obtained commitments from license renewal applicants
Buried Piping

- Corrosion on soil side of piping
- Potential effects on system safety, releases of hazardous material
- Enhanced agency guidance to increase inspections and focus on key preventive measures
Life Beyond 60

• 2008 NRC/US Department of Energy (DOE) “life beyond 60” workshop
• Developing domestic and international partnerships to share expertise, capabilities, and resources related to aging management research
  – US DOE
  – Electric Power Research Institute (EPRI)
  – International Forum for Reactor Aging Management (IFRAM)
Integrated Aging Management
Long-Term Research Plan

- Electric cable insulation
- Prolonged concrete exposure to high temperature and radiation
- Reactor vessel and internals
Electric Cable Insulation

• Cable failures worldwide increasing with plant age
• Cables provide power needed to operate equipment and transmit signals to and from the various controllers
• Research to confirm whether requirements for electrical equipment are being met through an extended period
Prolonged Concrete Exposure to HighTemperature and Radiation

• Prolonged exposure to elevated temperatures and radiation facilitates chemical interactions and induces strains
• Compromise concrete performance
• Research on sufficiency of current methods to evaluate effects and the effects themselves
Reactor Vessel and Internals

• Irradiation embrittlement of vessels and internal components
• Life-limiting factor for the reactor vessel and internals
• Compiling a comprehensive database of worldwide embrittlement information and conducting research on conditions to which reactor vessel internals are exposed
Summary

- We must effectively utilize operating experience to identify technical issues
- Training and knowledge management are critical
- Significant research required to address potential operation beyond 60 years