Integrated Used Fuel Management

Industry Perspectives

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Nuclear Waste Technical Review Board
Las Vegas, Nevada
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Nuclear Energy

- Driven by strong public and policy-maker support, nuclear energy is poised for significant growth.

**Sources of Emission-Free Electricity 2007**
- Solar, Wind & Geothermal: 4.4%
- Hydro: 22%
- Nuclear: 73.6%

**US Nuclear Electricity Production**
- Billion kilowatt-hours
  - 769 in 2001
  - 807 in 2007

**Potential New Nuclear Plants**
- 17 license applications submitted for 26 reactors, a total of 32 new reactors are under consideration.
Integrated Used Fuel Management

- Three-pronged approach to used fuel management
  - Interim storage at reactor sites and centralized location(s)
  - Recycling
    - consideration of present day reprocessing technologies
    - development of advanced used fuel reprocessing technologies
    - new fuel types and improved waste forms
    - new reactor designs
  - Permanent disposal facility
    - Yucca Mountain site judged suitable by Congress in 2002
    - Yucca Mountain licensing process underway

- Divided into short, medium, and long term goals
  - NRC’s proposed waste confidence rulemaking and DOE contracts for new plant used fuel provide sound foundation on which we can pursue these goals
Current Policy Framework

- **Obama Administration**
  - Yucca not an option
  - Yucca licensing process to continue while alternative plan developed
  - Blue Ribbon Panel to evaluate alternatives
  - R&D should be conducted into advanced recycling technologies

- **Industry Position**
  - Yucca licensing process should continue
  - Nuclear Waste Fee should be reduced to only that needed to cover current expenditures
  - Industry endorses Blue Ribbon Panel
  - Centralized Interim Storage should be pursued by private sector with DOE as a customer
  - Both advanced and present day recycling should be considered, regulatory structure must be developed now
Used Nuclear Fuel Storage

- **12/08 used fuel inventory***
  - Approximately 60,059 MTHM

- **12/08 dry storage inventory**
  - 40,280 assemblies; 12,594 MTHM
  - 1073 casks/canisters loaded
  - At 44 plant sites in 31 states

- **Future dry storage by 2020**
  - Estimating 30,110 MTHM
  - 2,231 casks/canisters loaded (no TADs), or
  - 2,894 casks/canisters loaded (switch to TADs in ‘13)
  - At 73 plant sites in 34 states

*Does not include commercial fuel at Morris, Fort St Vrain, or Idaho Nat’l Lab (313 MTHM)

Also in storage: GTCC – between 10,000 and 30,000 lbs. per decommissioned plant
Commercial Used Fuel Inventory Projections

- The tables that follow represent a simplified model of projected inventories through 2040

- Simplifying Assumptions
  - All current plants operate for 60 years
  - New reactors begin coming on line in 2016 at a rate of 4 per year, 2 per site, and discharge used fuel at 22MTHM/yr on 2 yr cycles. 3 green field new reactor sites are developed, rest are at existing sites
  - New reactors operate 15 years before needing dry storage
  - TAD scenarios assume all fuel loaded into TADs from 2013 on
  - DPC scenarios assume all DPCs loaded at today’s highest capacity from 2013 on
  - No DOE waste acceptance prior to 2040
  - Data through 2008 are based on information from plant owners, beyond 2008 new dry storage is assumed as a percentage of used fuel discharges as follows
    - 50% through 2010, 60% 2011-15, 75% 2016-20, 90% 2021-25, 100% after 2026

- Projections developed by ACI Nuclear Energy Solutions
# Dry Storage System Trends

<table>
<thead>
<tr>
<th>Dry Storage System</th>
<th>Capacity per cask # of assemblies</th>
<th>Capacity per cask MTHM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BWR</td>
<td>PWR</td>
</tr>
<tr>
<td>Typical pre-2000 system</td>
<td>52</td>
<td>24</td>
</tr>
<tr>
<td>Typical present day system</td>
<td>65 (avg)</td>
<td>32</td>
</tr>
<tr>
<td>Future systems (max. currently licensed)</td>
<td>87</td>
<td>37</td>
</tr>
<tr>
<td>TADs</td>
<td>44</td>
<td>21</td>
</tr>
</tbody>
</table>
### Used Fuel Inventory Projections

**Scenario 1 – Current Plants/TADs in ‘13**

<table>
<thead>
<tr>
<th>Year</th>
<th>MTHM Total</th>
<th>MTHM Pools</th>
<th>MTHM Dry Storage</th>
<th>Dry Cask Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>2008</td>
<td>60,059</td>
<td>47,465</td>
<td>12,594</td>
<td>1,073</td>
</tr>
<tr>
<td>2009</td>
<td>62,432</td>
<td>48,651</td>
<td>13,781</td>
<td>1,164</td>
</tr>
<tr>
<td>2010</td>
<td>64,461</td>
<td>49,666</td>
<td>14,795</td>
<td>1,242</td>
</tr>
<tr>
<td>2020</td>
<td>87,193</td>
<td>57,083</td>
<td>30,110</td>
<td>2,894</td>
</tr>
<tr>
<td>2030</td>
<td>110,383</td>
<td>58,207</td>
<td>52,176</td>
<td>5,431</td>
</tr>
<tr>
<td>2040</td>
<td>130,013</td>
<td>58,207</td>
<td>71,806</td>
<td>7,687</td>
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</table>
## Used Fuel Inventory Projections
### Scenario 2 – Current + New Plants/ TADs in ‘13

<table>
<thead>
<tr>
<th>Year</th>
<th>MTHM Total</th>
<th>MTHM Pools</th>
<th>MTHM Dry Storage</th>
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<tr>
<td>2020</td>
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<tr>
<td>2030</td>
<td>117,071</td>
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<td>5,431</td>
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<tr>
<td>2040</td>
<td>143,741</td>
<td>65,599</td>
<td>78,142</td>
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# Used Fuel Inventory Projections

**Scenario 3 – Current + New Plants w/o TADs**

<table>
<thead>
<tr>
<th>Year</th>
<th>MTHM Total</th>
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<th>MTHM Dry Storage</th>
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<tr>
<td></td>
<td>Total</td>
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<td>78,142</td>
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<td></td>
<td>5,196</td>
<td>29</td>
<td>356</td>
<td></td>
</tr>
</tbody>
</table>

- **Non-trans, bare fuel**: Non-transferred, bare fuel storage.
- **Non-trans, canister**: Non-transferred, canister storage.
- **Trans bare fuel**: Transferred bare fuel storage.
- **Trans bare fuel, trans license pending**: Transferred bare fuel with pending transfer license.
- **DPCs**: Directly Packed Casks.
- **DPCs trans license pending**: Directly Packed Casks with pending transfer license.
## Used Fuel Locations

<table>
<thead>
<tr>
<th>Year</th>
<th>Shutdown Plants*</th>
<th>Operating Plants</th>
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<tbody>
<tr>
<td></td>
<td>Pool Storage</td>
<td>Dry Cask Storage</td>
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<tr>
<td></td>
<td>Sites</td>
<td>States</td>
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<td>1980</td>
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<tr>
<td>1990</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>2040</td>
<td>22</td>
<td>17</td>
</tr>
</tbody>
</table>

* Assumes all plants operate for 60 years
Ramifications of significant repository delay

- Delay in DOE acceptance of used fuel is a commercial issue – albeit an important one
- Delay in DOE acceptance is also an enormous liability for the US taxpayers – we must get it right this time
- Outcome of Blue Ribbon Commission will be key to future success – we need an implementable and sustainable plan
- Industry is confident that existing dry cask storage technology, coupled with aging management programs already in place, is sufficient to sustain safe dry cask storage for at least 100 years in support of both existing and new nuclear plants
Blue Ribbon Panel – Industry Vision

- Needed to produce roadmap for sustainable long-term federal program to meet legal and contractual obligation to remove used fuel from reactor sites
- Independent, credible, and unbiased, with technical, organizational, and policy expertise
- Lay out a well defined path with firm milestones for recycling decisions
- Address eventual geologic disposal
  - Learn from the Yucca Process
- Provide actionable recommendations for DOE Energy Innovation Hubs
  - Extreme Materials
  - Modeling & Simulation
Centralized Interim Storage

- Efforts to move forward should not wait for Blue Ribbon Commission deliberations to be complete
- Near-term consolidation of used fuel (Interim Storage)
  - Volunteer sites
  - Private sector initiative with DOE as a customer
  - NRC Licensed
Conclusion

- The nuclear industry is pursuing an integrated approach to used fuel management
- Used fuel inventories in storage will continue to grow
- Dry Cask storage can safely accommodate this growth for a century or more
- The nation wants and needs more nuclear energy
- An implementable and sustainable federal used nuclear fuel management plan must be developed
  - Plan must address all elements of integrated approach – centralized interim storage, recycling, and disposal