EPRI Overview and Nuclear Power Sector Issues

International Nuclear Air Cleaning Conference
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Thomas Turek
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EPRI = Collaborative, Integrated R&D Solutions
Large and Successful R&D Collaboration

- Objective, independent collaborative electricity and environmental research organization
- Science and technology focus—development, integration, demonstration and applications
- Broad technology portfolio ranging from near-term solutions to long-term strategic research
- More than 450 participants in over 40 countries
- Technical programs
  - Energy Efficiency
  - Environment
  - Power Delivery and Markets
  - Generation (Fossil/Hydro)
  - Nuclear
Nuclear Research Portfolio

Existing Fleet: Asset Maximization

- Material Degradation/Aging
  - Corrosion Research
  - Water Chemistry
  - Steam Generator Management
  - BWR Vessels and Internals
  - Materials Reliability

- Fuel Reliability
  - Fuel Reliability Program

- Risk and Asset Management
  - Asset management
  - Safety/risk technology

- Non-Destructive Evaluation
  - NDE Technology
  - Performance Demonstration

- HLW/Spent Fuel
  - High Level Waste Disposal
  - Spent Fuel Storage & Transport

- Equipment Reliability
  - Instrumentation & Control
  - Repair & Replacement Applications
  - Nuclear Maintenance Applications
  - Plant Support Engineering
  - Nuclear Steam Turbines
  - Balance of Plant Corrosion

- LLW & REM
  - Low Level Waste
  - Radiation Exposure Management

New Plant Deployment

- Advanced Nuclear Technology
  - New Nuclear Plant Deployment
  - Advanced Fuel Cycle
  - High Temperature Gas Reactors
EPRI Worldwide Nuclear Utility Participation

**Full Members**
- All 26 U.S. Utilities
- Electricité de France (France)
- British Energy (U.K.)
- CANDU Owners Group (Canada and Romania)
- Eletronuclear (Brazil)
- TEPCO (Japan)
- UNESA (Spain)
- CFE (Mexico)
- Chubu (Japan)
- Rolls Royce (U.K.)
- Eskom (S. Africa)

**Membership and Program Participants Include Over 80% of the World’s 443 Operating Commercial Units.**
EPRI’s Key Interfaces in the Nuclear Industry

- Relationships with DOE, NRC Office of Research, and Idaho National Laboratory
- Cooperation with Vendors, NSSS Owners Groups and Universities
- Global relationships with other research agencies

EPRI has a highly collaborative role in nuclear power

INPO  NEI  EPRI
Operational Regulatory/ Technology
Excellence Public/Government
EPRI Nuclear Power
Mission and Core Industry Drivers

Maximize Carbon Reductions From Nuclear Energy

Inform Operations and Maintenance Decisions

Sustain Nuclear Power as a Safe, Reliable, and Cost Effective Generation Option.

Ensure Continued Nuclear Plant Reliability and Safety
EPRI PRISM (2007)
U.S. CO₂ Reductions … Technical Potential*

* Achieving all targets is very aggressive, but potentially feasible.

EIA Base Case 2007

<table>
<thead>
<tr>
<th>Technology</th>
<th>EIA 2007 Reference</th>
<th>Target</th>
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<tbody>
<tr>
<td>Efficiency</td>
<td>Load Growth ~ +1.5%/yr</td>
<td>Load Growth ~ +1.1%/yr</td>
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<tr>
<td>Renewables</td>
<td>30 GWe by 2030</td>
<td>70 GWe by 2030</td>
</tr>
<tr>
<td>Nuclear Generation</td>
<td>12.5 GWe by 2030</td>
<td>64 GWe by 2030</td>
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<tr>
<td>Advanced Coal Generation</td>
<td>No Existing Plant Upgrades</td>
<td>150 GWe Plant Upgrades</td>
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<tr>
<td></td>
<td>40% New Plant Efficiency by 2020–2030</td>
<td>46% New Plant Efficiency by 2020; 49% in 2030</td>
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<tr>
<td>CCS</td>
<td>None</td>
<td>Widely Deployed After 2020</td>
</tr>
<tr>
<td>PHEV</td>
<td>None</td>
<td>10% of New Vehicles by 2017; +2%/yr Thereafter</td>
</tr>
<tr>
<td>DER</td>
<td>&lt; 0.1% of Base Load in 2030</td>
<td>5% of Base Load in 2030</td>
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EPRI Prism – 2008 EIA with Energy Bill

**Technology** | **EIA 2008 Reference** | **Target**
--- | --- | ---
Efficiency | Load Growth ~ +1.05%/yr | Load Growth ~ +0.75%/yr
Renewables | 55 GWe by 2030 | 100 GWe by 2030
Nuclear Generation | 15 GWe by 2030 | 64 GWe by 2030
Advanced Coal Generation | No Heat Rate Improvement for Existing Plants, 40% New Plant Efficiency by 2020–2030 | 1-3% Heat Rate Improvement for 130 GWe Existing Plants, 46% New Plant Efficiency by 2020; 49% in 2030
CCS | None | Widely Deployed After 2020
PHEV | None | 10% of New Light-Duty Vehicle Sales by 2017; 33% by 2030
DER | < 0.1% of Base Load in 2030 | 5% of Base Load in 2030

Achieving all targets is very aggressive, but potentially feasible.

- Higher fuel prices
- Lower GDP/Load Growth Rate
- More Renewables, Nuclear
EPRI Nuclear Power Sector Goals and Strategic Focus

Develop Cost-Effective Technology

to

Maximize the Utilization of Existing Nuclear Assets

Support the Deployment of New Nuclear Technology

Long Term Operation

Advanced Plants & Fuel Cycle
Drivers and Challenges
Top Issues are Technical

- Technical challenges trump other business challenges
- Plant reliability issues dominated by materials and equipment reliability
Materials Aging Institute

- The Materials Aging Institute (MAI) is an EdF led initiative to preserve and promote the nuclear option
  - Extend the life of existing plants
  - Design and build the next generation of nuclear plants
  - Initial Engagement by EPRI and TEPCO
  - Collaborate on broad materials issues

Opportunity for Access to Global R&D for EPRI Members
Issues and Opportunities Require Future R&D

- Long Term Asset Management
- Concrete aging especially containment
- Water availability
- Skilled workforce
- NDE testing and analysis
- Digital I&C
- OLM and prognostics
- Risk-informing processes
- Buried pipe
- High performance fuel
- Aging of metals
- Cable aging
- Water availability
Building for the Future

- Existing nuclear plant licenses extended to 80 years.
- ALWR deployment.
- All existing nuclear plant licenses extended to 60 years.
- First new nuclear plants deployed.
Importance of Current Plant Life After 60
From DOE Asst Sec. Spurgeon at Feb 2008 DOE/NRC Workshop

Nuclear’s potential expansion

To significantly reduce carbon emissions, the United States will need 300 Gigawatts of nuclear power by 2050.
Importance of Current Plant Life After 60
From DOE Asst Sec. Spurgeon at Feb 2008 DOE/NRC Workshop

Nuclear without 80 year extensions

In total, 15 Trillion Kilowatt Hours and 12 Billion Metric tons of avoided CO2 emissions would be lost without license extensions.

That total electricity output could provide power to over 70 million households for 20 years.
EPRI Advanced Nuclear Technology Program…
Leveraging the Industry
U.S. Integrated Spent Fuel Management

• Large-scale nuclear expansion will require integrated spent fuel management:
  – Central Interim Storage
  – Geologic Repository
  – Transportation Systems
  – Eventual Fuel Recycling
  – Advanced Reactors
Nuclear Energy for $H_2$ and Process Heat

• Potential future market for high-temperature heat is 5% to 15% of the total U.S. energy market

• High Temperature Gas Reactor (HTGR) can fill industrial and transportation sector needs:
  – Displace >5% of petrochemical natural gas needs
  – Process heat for enhanced oil recovery, oil refining, oil shale and coal to liquids
  – Longer term: Hydrogen for zero-emissions transportation

• HTGRs can also co-generate electricity

NGNP (Next Generation Nuclear Plant) is key first step
EPRI = Collaborative, Integrated R&D Solutions
EPRI.com Past Contributions

• Use of EPRI/NRC-RES Fire Probabilistic Risk Assessment (PRA) Methodology in Estimating Risk Impact of Plant Changes (1013489)

• Support System Initiating Events: Identification and Quantification Guideline (1013490)

• Methodology for Fire Configuration Risk Management (10129488)

• Heat Exchanger Thermal Performance Margin Guideline (1012129)

• A Framework for the Treatment of External Events in Configuration Risk Management: 2004 Configuration of Risk Management Forum Research Task (1009675)
EPRI.com Past Contributions

• ANT Margins and Monitoring (1015388)

• HVAC Testing, Adjusting, and Balancing Guideline (1003092)

• Chiller Performance Monitoring and Troubleshooting Guide (1007361)

• HVAC Fans and Dampers Maintenance Guide (TR-112170)

• Hydramotor (R) Actuator Application and Maintenance Guide:
  ASCO NH90 Series Hydramotors (R) for Nuclear Applications (TR-112181)
Together…Shaping the Future of Electricity