



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

NRC Commissioner Briefing

DOE Light Water Reactor Sustainability (LWRS) Program

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LWRS Program

Objective:

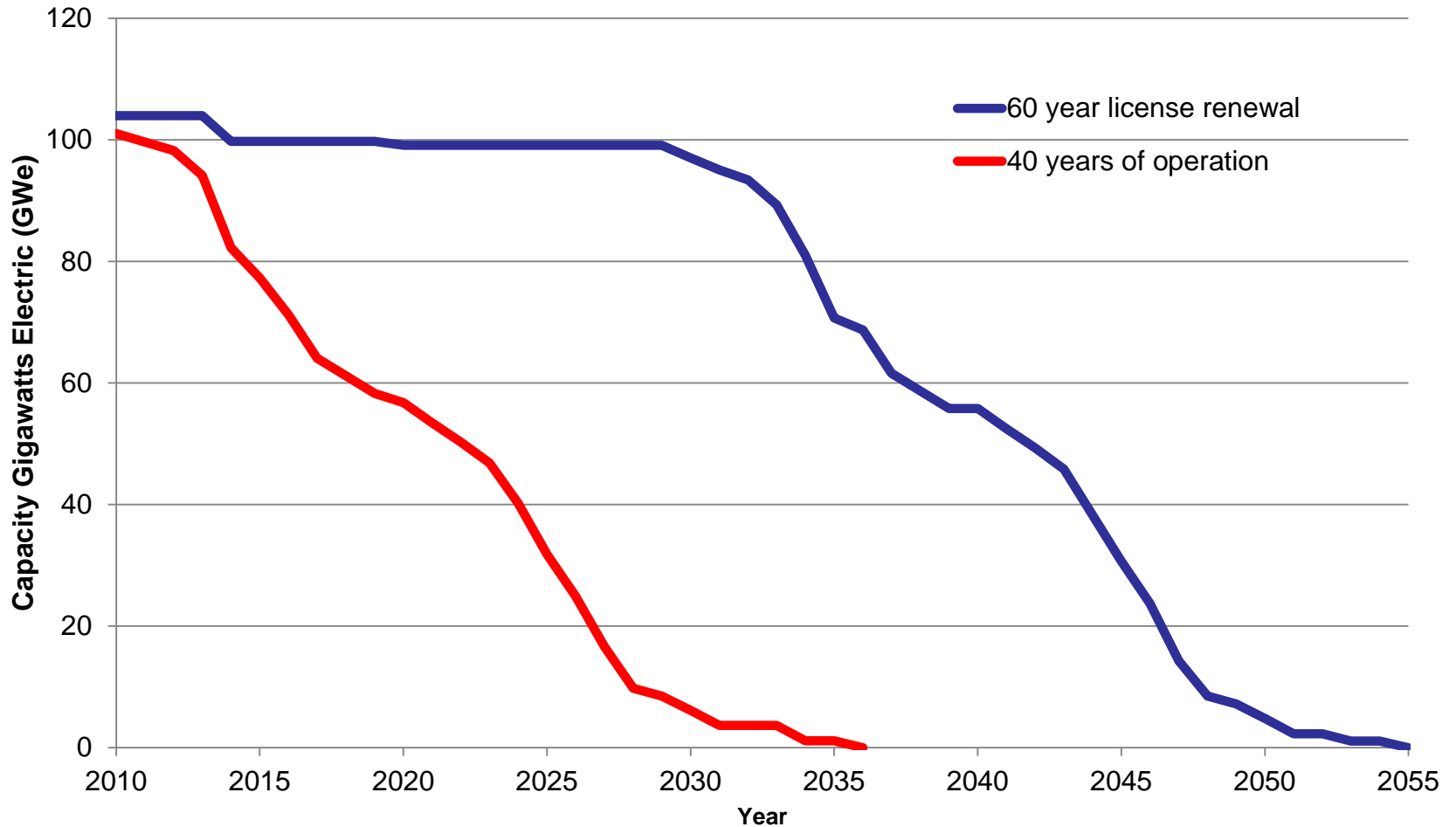
- **Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors**

Goals:

- **Develop the scientific basis to understand, predict, and measure changes in materials and apply this knowledge to solutions**
- **Research and develop new technologies to address enhanced plant performance, economics, and safety**



Projected Fleet Capacity



LWRS Program

Three areas of research:

- **Materials Aging and Degradation**
- **Advanced Instrumentation, Information, and Control Systems Technologies**
- **Risk-Informed Safety Margin Characterization**

Materials Aging and Degradation

- **Increased lifetime leads to increased exposures**
 - Time at temperature; Stress; Coolant Chemistry; Neutrons
- **Extending reactor life to 60, 80 years or beyond may increase susceptibility and severity of known forms of degradation**
- **Our Materials Aging and Degradation research:**
 - Develops the scientific basis for understanding and predicting long-term environmental degradation behavior of materials in nuclear power plants
 - Investigates the potential for new mechanisms of materials degradation

Materials Aging and Degradation

- ***Measurements of degradation:*** High quality data
- ***Mechanisms of degradation:*** Understand the underlying mechanisms for better prediction and mitigation
- ***Modeling and simulation:*** Use mechanistic models to explore data trends for extended life
- ***Monitoring:*** Non-destructive monitoring must be used to validate predicted degradation
- ***Mitigation strategies:*** Develop technologies to reduce the rate of degradation, facilitate economic repair, and potentially replace with advanced materials that are less susceptible

Materials Aging and Degradation

- **Metals: including Reactor Pressure Vessels, core internals, steam generators, and balance of plant**
 - Irradiation-Assisted Stress Corrosion Cracking
 - High-fluence phase transformations and swelling of core internals
 - High-fluence effects on RPV steel
 - Crack initiation in Nickel based alloys
 - Thermal Aging of Cast Austenitic Stainless Steels
 - Environmentally Assisted Fatigue
- **Concrete: Joint research plan with EPRI focused on radiation effects (supports and biological shield) and monitoring tools**
- **Cables: Joint research plan with EPRI and NRC to better predict and monitor cable aging**
- **Mitigation, repair, and replacement technologies: Weld repair techniques; Post irradiation annealing; Advanced replacement alloys; and Advanced Non-Destructive Examination techniques**

Advanced Instrumentation, Information, and Control (II&C) Systems Technologies

- **Address long-term aging and reliability concerns of existing II&C technologies and develop and test new technologies**
- **Establish a strategy to implement long-term modernization of II&C systems.**
- **Develop the scientific and technical bases to support safe and efficient plant II&C modernization.**



Risk-Informed Safety Margin Characterization (RISMC)

■ Margins Analysis Techniques

- Develop techniques to conduct margins analysis, including methodology for carrying out simulation-based studies of margin

■ Simulation components of the RISMC Toolkit

- RELAP-7
 - Systems code that will simulate behavior at the plant level
 - Advanced computational tools and techniques to allow faster and more accurate analysis
- Simulation Controller (RAVEN – Risk Analysis Virtual ENvironment)
 - Provides input on plant state to RELAP-7 (including operator actions, component states, etc.)
 - Integrates output from RELAP-7 with other considerations (e.g., probabilistic and procedures information) to determine component states
- Aging Simulation (Grizzly)
 - Component aging and damage evolution will be modeled in separate modules that will couple to RELAP-7 and RAVEN

Summary

- **Research supports continued operation**
- **Proactive research to address issues early**
- **No generic technical show stoppers to long-term operation have been identified**
- **Supporting the development of improved monitoring techniques**
- **Inform industry Aging Management Programs**