Background on Entergy
Entergy Nuclear
One of the Largest Nuclear Owner/Operators in the U.S.

Utility
- 5 electric utilities (5 regulators)
- 4 contiguous states – Arkansas, Louisiana, Mississippi, Texas
- 22,000 MW of generating capacity
  - 87 generation units
  - 5 nuclear units = 5120 MW
  - 5 coal units = 2233 MW
- 15,000 miles of transmission lines

Operations/Services Business
- 6 non-utility nuclear units at 5 sites (4,998 MW)
- 1 plant managed (800 MW)
Entergy Nuclear
One of the Largest Nuclear Owner/Operators in the U.S.

Entergy Nuclear
7 units with Renewed Licenses
3 units in NRC review for Renewal

ANO
Unit 1 836 MW B&V PWR
Unit 2 858 MW CE PWR

Riverbend
936 MW GE BWR

Grand Gulf
1210 MW GE BWR

Waterford 3
1075 MW CE PWR

Indian Point
Unit 2 974 MW W PWR
Unit 3 965 MW W PWR

Fitzpatrick
820 MW GE BWR

Pilgrim
665 MW GE BWR

Vermont Yankee
506 MW GE BWR

Palisades
798 MW CE PWR

Cooper
764 MW GE BWR
Background on Nuclear Power Plants in U.S.
U.S. Operating Commercial Nuclear Power Reactors

Source: NUREG-1350
Net Electricity Generated in Each State by Nuclear Power

**U.S. Net Electric Generation by Energy Source, 2012**

* Gas includes natural gas, blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuel.
** Hydroelectric includes conventional hydroelectric and hydroelectric pumped storage.
*** Renewable energy includes geothermal, wood and nonwood waste, wind, and solar energy.

U.S. Nuclear Plant Years of Operation
at end of 2013

- 37 reactors (10–19 years)
- 42 reactors (20–29 years)
- 20 reactors (30–39 years and >40 years)

Note: Ages have been rounded up to the end of the year.
Status of License Renewal
NRC License Renewal

- Original License Term - 40 years
- 10 CFR Part 54, License Renewal Rule
- Renewed License Term - +20 years for each renewal (i.e., 40 years, 60 years, 80 years, . . .)
- Application for renewal - after 20 years of operation but at least 5 years before expiration of current license
- Three main review areas by NRC: safety, environmental, and adjudicatory
Status of U.S. License Renewals

Licensed to Operate (100)
- Original License (28)
- License Renewal Granted (72)

Kewaunee's license was renewed before the plant ceased operations on May 7, 2013.
All 6 units seeking license renewal

- 2013–2018: 2 units
- 2019–2022: 4 units
- 2023–2030: 27 units
- 2031–2049: 67 units
Where would the U.S. be without license renewal?

- 26 units would have shutdown by the end of 2013 w/o LR
- 38 units would have shutdown by the end of 2014 w/o LR
Example U.S. License Renewal Project

Project:
License Renewal for Operating Nuclear Power Plants

1. Preliminary or Study Phase
   - 18 to 24 months

2. Engineering & Environmental Work
   - 18 to 24 months

3. License Renewal Application Prep.
   - 6 months

4. NRC Review & Approval
   - 22 to 30 months

5. Commitment Implementation

Typical Schedule = 4 to 5 years*

* Without an ASLB hearing
NRC License Renewal Review Process

START

License Renewal Application**

Safety Review 10 CFR Part 54

Environmental Review 10 CFR Part 51

Site Environment Audit

Safety Evaluation Audit & Review

Safety Evaluation Reports Issued**

Onsite Inspection(s)

Inspection Reports Issued**

Advisory Committee on Reactor Safeguards (ACRS) Review

ACRS Review**

Hearings*

ACRS Letter Issued**

NRC Decision on Application**

Final Supplement to GEIS Issued**

Draft Supplemental Environmental Impact Statement Public Meeting

Draft Supplement to Generic Environmental Impact Statement (GEIS) Issued**

License Renewal Process and Environmental Scoping Meetings

Opportunities for public interaction
* If a request for a hearing is granted
** Available at www.nrc.gov

NUREG-1350
Regulatory & Industry Guidance

Status - on-going revisions of regulatory & industry guidance based on lessons learned and operating experience
U.S. Industry Groups – Supporting LTO

- **NEI LR and SLR Task Force**
  - Regular industry meetings
  - Quarterly industry meetings
  - Quarterly NRC mgmt. meetings
  - SRP & GALL revision recommendations
  - NEI 95-10 industry guidance
  - Industry peer reviews of LRAs

- **NEI License Renewal Working Groups**
  - Mechanical Working Group
    - EPRI Mechanical Tools Doc. Upkeep
  - Electrical Working Group
    - EPRI Electrical Tools Doc. Upkeep
  - Civil/Structural Working Group
    - EPRI Structural Tools Doc. Upkeep
  - Implementation Working Group
    - NRC IP71003, Industry Guidance
  - Subsequent LR Working Group
    - LTO R&D and Licensing Guidance

- **NEI SLR Executive Working Group** [new]

- **ASME Special Working Group – Nuclear Plant Aging Management**

**Goal** - continuous improvement of aging management based on lessons learned and operating experience
Factors Supporting Long Term Operation
U.S. Nuclear Industry Capacity Factors
1980 - 2013

Source: Energy Information Administration
Updated: 4/14

91.8% in 2007
91.1% in 2008
90.3% in 2009
90.9% in 2010
88.9% in 2011
86.4% in 2012
90.9% in 2013
Production Costs = Operations and Maintenance Costs + Fuel Costs. Production costs do not include indirect costs and are based on FERC Form 1 filings submitted by regulated utilities. Production costs are modeled for utilities that are not regulated.

Source: Ventyx Velocity Suite - Updated: 5/13
U.S. Nuclear Industrial Safety Accident Rate

1997-2013

ISAR = Number of accidents resulting in lost work, restricted work, or fatalities per 200,000 worker hours.
Note: Starting in 2008, data includes supplemental personnel
Source: World Association of Nuclear Operators
Updated: 4/14
Environmental - Awareness

Life-Cycle Emissions
Nuclear energy’s life-cycle carbon emissions are comparable to those of renewable energy sources.

Comparison of Life-Cycle Emissions
Tons of Carbon Dioxide Equivalent per Gigawatt-Hour

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Emissions (Tons CO₂)</th>
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<tbody>
<tr>
<td>Coal</td>
<td>1,041</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>622</td>
</tr>
<tr>
<td>Biomass</td>
<td>46</td>
</tr>
<tr>
<td>Solar</td>
<td>39</td>
</tr>
<tr>
<td>Hydro</td>
<td>18</td>
</tr>
<tr>
<td>Nuclear</td>
<td>17</td>
</tr>
<tr>
<td>Geothermal</td>
<td>15</td>
</tr>
<tr>
<td>Wind</td>
<td>14</td>
</tr>
</tbody>
</table>

A report to members of the Nuclear Energy Institute

Independent studies show that nuclear energy’s “life-cycle” emissions of carbon dioxide are about the same as wind and geothermal power and significantly less than other electricity sources. A life-cycle measurement takes into account the facility’s construction, the mining and processing of fuel, routine operation, disposal of used fuel and the ultimate dismantling of the facility—in other words, its entire life cycle.
Subsequent License Renewal
LTO and “Life beyond 60”
NRC/DOE Workshops in 2008 & 2011; NEI LTO/SLR Forums in 2013 & 2014

Nuclear Electricity Generating Capacity

- Current Reactors, 40 Years
- New Capacity Being Considered
- 8 Builds Per Year Starting 2049
- Current Reactors, 60 Years
- 4 Builds Per Year Starting 2021
- Generating Capacity with 80-Year Life

Source: NRC/DOE Life Beyond 60 Workshop February 2008

2nd NRC/DOE/NEI Workshop
February 22-24, 2011
Washington, D.C.

NEI Long Term Operation/
Subsequent License Renewal
Washington, D.C.
Status of License Renewal Rule
Source: NRC Presentation on Subsequent License Renewal, 8-8-12 (updated)

1982
Nuclear Plant Aging Research Program

1995
License Renewal Rule Revised

2001
GALL Report Issued

2009
First Unit Enters the Period of Extended Operation

Industry Informs NRC of Its Intent to Submit Subsequent Renewal Applications

1991
License Renewal Rule Promulgated

2000
First Renewed Licenses Issued

2005
GALL Report, Rev. 1 Issued

2010
GALL Report, Rev. 2 Issued

2015?

2018?
First Subsequent Renewal Application Submitted
Anticipate SLR Milestone Schedule

2009  
1st LR Plants Enter the Period of Extended Operation

2016  
Begin SLR Submittal Preparations
  - MDM and EMDA Updated
  - Revise GALL and SRP, NEI 95-10
  - NRC Prepares SECY Paper on SLR

2018  
1st SLR License Application Submitted
  - 2 Years for SLR Application Preparation

2020  
1st SLR License Approved by the NRC
  - 2 Years for NRC Review of SLR Application

2024  
5 Year Minimum to Submit SLR for Continued Operation Per Timely Renewal
  - SLR License Approved 9 Years Before Expiration of Original License

2029  
License Expires for 1st LR Plants
LTO Research Activities (DOE and EPRI)

- Materials Aging and Degradation
- Instrumentation, Information and Control System Technologies
- Risk Informed Safety Margin Characterization
- Advanced Light Water Reactor Nuclear Fuels
Investing in Long Term Operation

2008-2012 Nuclear Capital Spending
(2012 Billions of $)

Total = $8.5 Billion in 2012
Investing in the future to increase output and enhance safety

Distribution of Capex in 2012

Source: Electric Utility Cost Group
Challenges to LTO

Oyster Creek Nuclear Power Plant, Oldest In U.S., Closing 10 Years Early  
12/8/10

Dominion says Kewaunee nuclear plant will shut down for good  
Oct. 22, 2012

Progress Turns Out Lights on Crystal River Nuclear Plant  
February 6, 2013

Southern California Edison Announces Plans to Retire San Onofre Nuclear Generating Station  
6/7/2013

Entergy announces plans to close Vermont Yankee  
Aug 27, 2013
Summary

- Safety, performance, cost, environmental, and public opinion factors are favorable for operation of U.S. nuclear power plants for more than 60 years.

- Continued investment in refurbishments and upgrades required to maintain the trend of safety, reliability, and performance improvements.

- Existing NRC regulatory structure for LR and SLR ensures safe and environmentally responsible long term operation of U.S. nuclear power plants.

- Continuous improvement of aging management activities must be maintained based on lessons learned and operating experience – effective corrective action programs.

- Research and development efforts by EPRI, DOE, NRC, and others are essential to support and maintain the option of long term operation and SLR.
Thank You!