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Long Term Operation Project

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Long Term Operation (LTO) Project Objectives

- Provide technology for continued operation of the current nuclear plants worldwide ***at high performance levels*** through 40 years, 60 years, or beyond

- Investigate technical basis for

  "Life beyond 60"

- Collaborate with other organizations including DOE ***LWR Sustainability (LWRS) Program***

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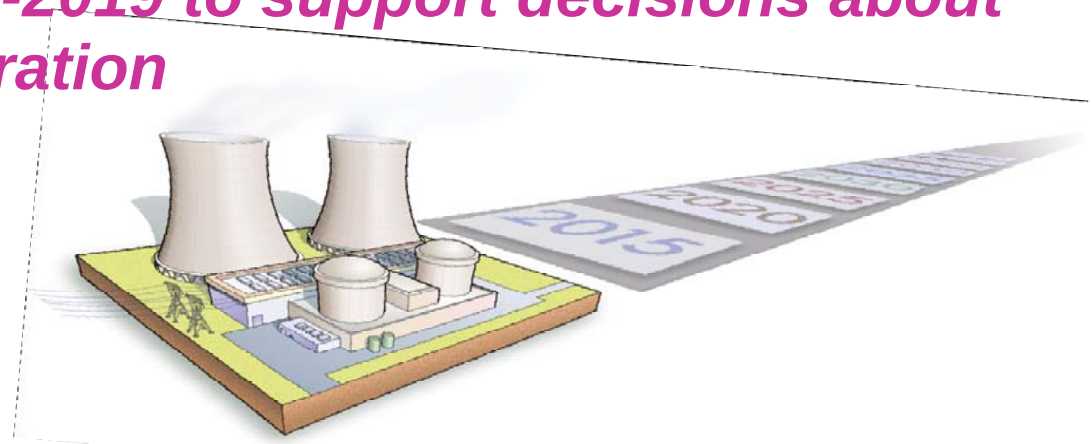
Criteria for LTO Activities

- ***Technical investigation of:***
  - Potential “life limiting” issues
  - Aging management and life-cycle management
  - Opportunities for modernization and uprates
  - Enabling technology (e.g., analysis methods)
- ***Not currently in scope of another program***
- ***Results by 2014-2019 to support decisions about Long Term Operation***



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LTO Approach

The program accomplishes its R&D objectives through several coupled strategies:

1. Maintain an integrated **strategic plan** for R&D
2. Fund **R&D activities** in high-priority technical areas using experts from EPRI programs
3. **Collaborate** with U.S. DOE LWRS program
4. Use **pilot** and **demonstration plants** to obtain data and validate methods of assessment.

18 member companies constitute an LTO Task Force of advisors

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2011 R&D Projects

Primary System Materials Aging

- Primary metals: characterize, model ***IGSCC in Ni-alloys***
- Primary metals: characterize / mitigate ***IASCC of stainless steel***
- Assessing ***RPV embrittlement*** beyond 60 years
- ***Under-water welding*** for reactor internals

Concrete and Containment Aging

- Identification and research on potential life-limiting issues; guidelines and methods for ***concrete and containment*** examinations

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2011 R&D Projects (cont)

Nuclear Fuel

- ***SiC fuel clad*** – SiC joining, in-reactor testing, and benefits assessment

I&C and Information Technology (IT)

- ***Online monitoring*** technology and pilot projects
- Functional and architectural requirements for ***advanced I&C and information systems***

Safety Analysis

- ***Advanced safety analysis methods*:**

  New safety margins method and advanced safety analysis codes (R7)
- ***New PRA tools*** for configuration management, significance determination of plant conditions, and support for design, operational, or regulatory changes.

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2011 R&D Projects (cont)

Cable Aging

- Testing and life management methods for ***medium voltage cables***

Life Cycle Management

- Integrated ***life cycle management*** of key components – database and assessment tools
- Adaptation of ***EDF asset management tools and methods*** to ILCM

LTO Case Studies and Demonstrations

- Ginna and NMP-1 ***demonstration plant*** activities
- Plant refurbishment ***case studies****

** New project for 2011*

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What will be LTO deliverables?

- Automated knowledge bases
- Predictive algorithms or models
- Modeling and simulation tools
- Implementable inspection methods
- Aging management guidelines
- Life cycle management/asset management guidelines
- Plant modernizations with proof of concept

LTO deliverables will be products in 2014-2019 to support license renewal and long term operation decisions.

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Integration with License Renewal and Life Extension Processes

- **EPRI LTO Task Force** reviews portfolio and results regularly.
- **Periodic coordination meetings** with all R&D stakeholders and utilities in license renewal.
- EPRI maintains **LTO Issue Tracking Table (ITT)** on behalf of all stakeholders.
- Application to **License Renewal** is coordinated through NEI and NRC

Do we know all the issues?

Are we working on the right stuff?

ISSUE TRACKING TABLE (ITT)

Issue ID	Primary Issue Description	Detailed Sub-issue Description	LTO Status	EPRI Program Status	NEI LRWG ID	Category	Priority
1.1	Primary System Metals Aging	Environmental SCC of Ni Alloy base material and weld materials (600, 690, 82/182, 52/152)	LTO		1.1	1-Life Limiting	1-High
1.1	Primary System Metals Aging	Environmental SCC of stainless steel	LTO		1.1	1-Life Limiting	1-High
1.2	Primary System Metals Aging	IASCC of austenitic stainless steel internals (shrouds, baffle bolts, ...) and cast stainless steel	LTO	Materials Program	1.2	1-Life Limiting	1-High
1.3	Primary System Metals Aging	Environmental effects on fracture resistance of Ni Alloy and stainless steel	LTO	Materials Program	1.3	2- Life Cycle Mgmt	3-Low
1.5	Primary System Metals Aging	Isolated issues of FAC and wasting of Low alloy steels in SGs			1.4	6-Not LTO	
1.5	Primary System Metals Aging	Isolated issues of FAC and wasting of internals near control rods			1.4	6-Not LTO	
1.5	Primary System Metals Aging	Isolated issues of FAC and wasting of BWR bottom head drain		Materials/NDE Pgms	1.4	6-Not LTO	
1.5	Primary System Metals Aging	NDE methods (irreg. welds, vol. exam of CASS and J-grooves, eddy current of SGs)		Materials/NDE Pgms	1.5	6-Not LTO	
4.3	Digital I&C Modernization and Enhanced Functionality	7300 Systems (I&C)			2	6-Not LTO	
10.1	Underground and BOP Equipment Aging	Integrated monitoring and assessment of degradation for RUL determinations	LTO	ER Program	3	2- Life Cycle Mgmt	1-High
9.1	Cable Aging	Submerged/ wetted cables & EQ and non-EQ	LTO	ER Program	4	1-Life Limiting	2-Medium
2.1	Concrete and Connections Aging	Building in-leakage (below grade Cat I structures) & Intake Structure	LTO		5.1	5-Unknown	3-Low
2.1	Concrete and Connections Aging	Prolonged concrete radiation and temperature exposure	LTO		5.2	5-Unknown	3-Low
2.1	Concrete and Connections Aging	Pre-tensioned concrete structures with post-tensioning system (grouted/non-grouted)	LTO	NDE Program	5.3	5-Unknown	3-Low
2.1	Concrete and Connections Aging	Concrete liner corrosion	LTO		6	5-Unknown	3-Low
1.9	Primary System Metals Aging	RPV embrittlement from fluence (Expected for 80 yrs)	LTO		7	1-Life Limiting	1-High
10.1	Underground and BOP Equipment Aging	CASS NDE – PRACTICAL leakage detection study		NDE Program	8	6-Not LTO	
1.2	Primary System Metals Aging	Reactor internals repair	LTO	Materials Program	9	2- Life Cycle Mgmt	3-Low
7.1	Environmental Interface	Water Availability and Quality	LTO		10	1-Life Limiting	3-Low
14.1	Coatings	Suppression pool repair & coating			11	6-Not LTO	
1.2	Primary System Metals Aging	Construction methods for shroud replacement			12	6-Not LTO	
1.4	Primary System Metals Aging	Environmental effects on fatigue life of Ni Alloy and stainless steel ("Corrosion Fatigue"), GSI-190	LTO		13	2- Life Cycle Mgmt	3-Low
1.9	Primary System Metals Aging	Examination of surveillance capsules	LTO (DOE)		14	1-Life Limiting	1-High
4.2	Digital I&C Modernization and Enhanced Functionality	I&C Compatibility Equivalency Database			15	6-Not LTO	
2.1	Concrete and Connections Aging	Cooling Tower structural issues	LTO		16	5-Unknown	3-Low
18.1	Personnel knowledge Capture	No LTO issues		ER Program	17	6-Not LTO	
2.1	Concrete and Connections Aging	High strength bolts embedded in concrete	LTO		18	5-Unknown	3-Low
8.2	Integrated, Phased Refurbsihments and Uprates	Generic Study for large component replacement including costs (ref. NEI financial model from 1st round of LR)	LTO	ER Program	19	2- Life Cycle Mgmt	3-Low
3.1	SSC Monitoring, Diagnostics, and Prognostics	On-line monitoring, diagnostics, and prognostics for active components	LTO		20	2- Life Cycle Mgmt	1-High
3.2	SSC Monitoring, Diagnostics, and Prognostics	On-line monitoring, diagnostics, and prognostic for passive components	LTO		21	2- Life Cycle Mgmt	2-Medium
13.1	Equipment Qualification Improvements	Containment temperature monitoring, source term	LTO		22	5-Unknown	3-Low
15.1	Fuel Pool Internals Aging	Fuel pool liner cracking		NDE Program	23	6-Not LTO	
3.1	SSC Monitoring, Diagnostics, and Prognostics	On-line monitoring, diagnostics, and prognostic for transformers and generators	LTO		24	2- Life Cycle Mgmt	1-High
8.3	Integrated, Phased Refurbsihments and Uprates	Manufacturing capabilities (large components, etc)			25	6-Not LTO	
10.1	Underground and BOP Equipment Aging	Selective leaching		NDE Program	26	6-Not LTO	
5.3	Nuclear Fuel Design and Performance	ISFSI license including hydrogen embrittlement	LTO		27	1-Life Limiting	3-Low
14.1	Coatings	Identify issues for LTO	LTO		28	5-Unknown	3-Low
17.1	Emergency Preparedness	No LTO issues			29	6-Not LTO	
7.3	Environmental Interface	Hydrodams – relicensing (FERC)			30	6-Not LTO	
19.1	Public Education about Current Fleet vs.New Plants	No LTO issues			31	6-Not LTO	
5.4	Nuclear Fuel Design and Performance	Water chemistry (including fuel behavior)		Fuels Program	32	6-Not LTO	
2.1	Concrete and Connections Aging	Concrete issues database and resolution guidelines	LTO			1-Life Limiting	1-High
2.2	Concrete and Connections Aging	Pilot study of concrete cracking of fuel pools at liner connections	LTO			2- Life Cycle Mgmt	1-High
4.1	Digital I&C Modernization and Enhanced Functionality	Define architecture and functionality	LTO			3-Modernization	1-High
6.1	Risk-informed Safety Margins Characterization	Identifying technology gaps and developing enhanced analysis capabilities	LTO			4-Infrastructure	1-High
5.1	Nuclear Fuel Design and Performance	SiC Cladding for Improved Operations	LTO			3-Modernization	2-Medium
5.2	Nuclear Fuel Design and Performance	Advanced fuel analysis capability	LTO			4-Infrastructure	2-Medium
8.1	Integrated, Phased Refurbsihments and Uprates	Benchmark of decision and planning process	LTO			4-Infrastructure	2-Medium
10.2	Underground and BOP Equipment Aging	New materials and methods for system replacement/refurbishment	LTO	ER Program		3-Modernization	2-Medium
11.1	NDE Technology Advancements	Life Cycle Management of NDE information on SSCs	LTO			2- Life Cycle Mgmt	2-Medium
12.1	Upgrading Design, Licensing, and Operating Bases	Identify issues for LTO	LTO			4-Infrastructure	2-Medium
1.8	Primary System Metals Aging	Irradiation induced creep in reactor internals (From NRC PMMD)	LTO			2- Life Cycle Mgmt	3-Low
1.9	Primary System Metals Aging	RPV cold over-pressurization life limits (Expected for 80 yrs)	LTO			1-Life Limiting	3-Low
7.2	Environmental Interface	Coping with increased room temperatures	LTO			5-Unknown	3-Low
1.6	Primary System Metals Aging	Extremely low prob. of failure (xLPR – risk informed analysis for hidden welds, etc.)		Materials/NDE Pgms		6-Not LTO	
1.7	Primary System Metals Aging	Low allow steel corrosion from boric acid (From NRC PMMD)				6-Not LTO	
11.2	NDE Technology Advancements	ISI inspectability (risk informed sampling where access issues exist)		NDE Program		6-Not LTO	
20.1	Plant Security	No LTO issues				6-Not LTO	

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