

# EPRI Long Term Operations Program, or “Life Beyond 60”

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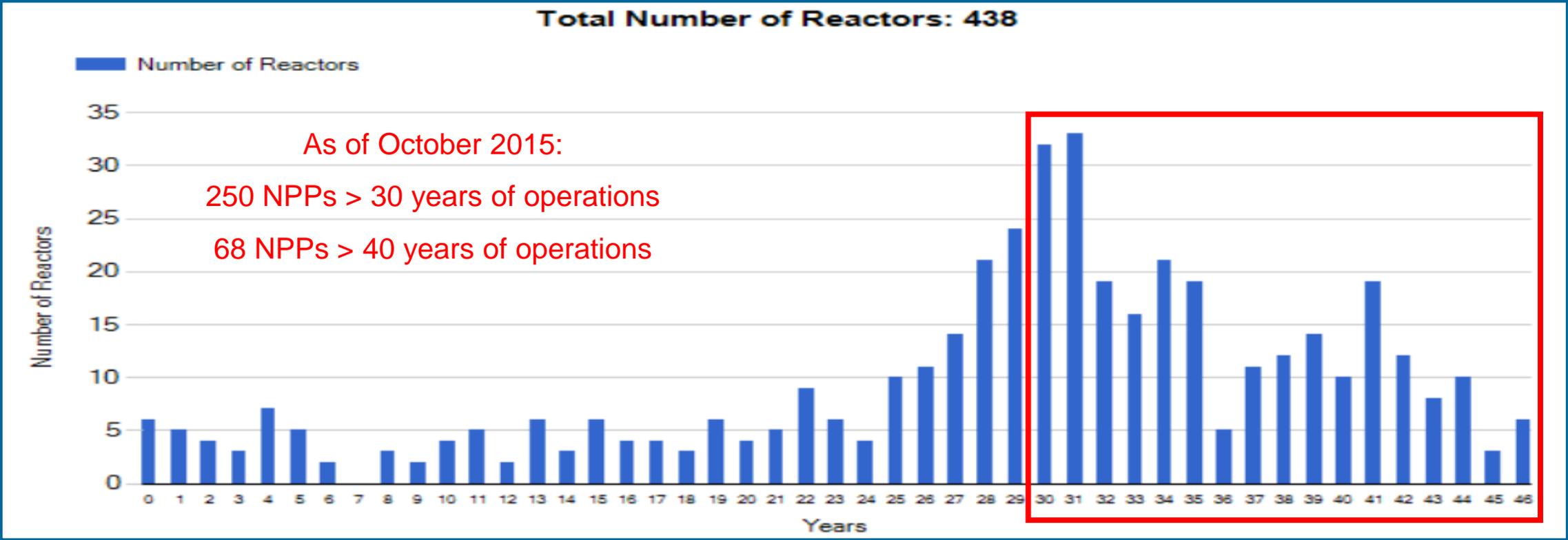
# EPRI LTO Program Goals and Objectives

- Technical basis for **decision** to operate through extended life time
  - Supports business case for life extension and refurbishments
- Technology to **manage** plant assets throughout the lifetime
  - Aging management, asset management and risk management
  - Addresses safety, performance and costs
- Projects for LTO are coordinated and collaborated with US DOE, IAEA, NRC Research and global research partners



On track and providing significant technical information  
to support the first movers by 2019

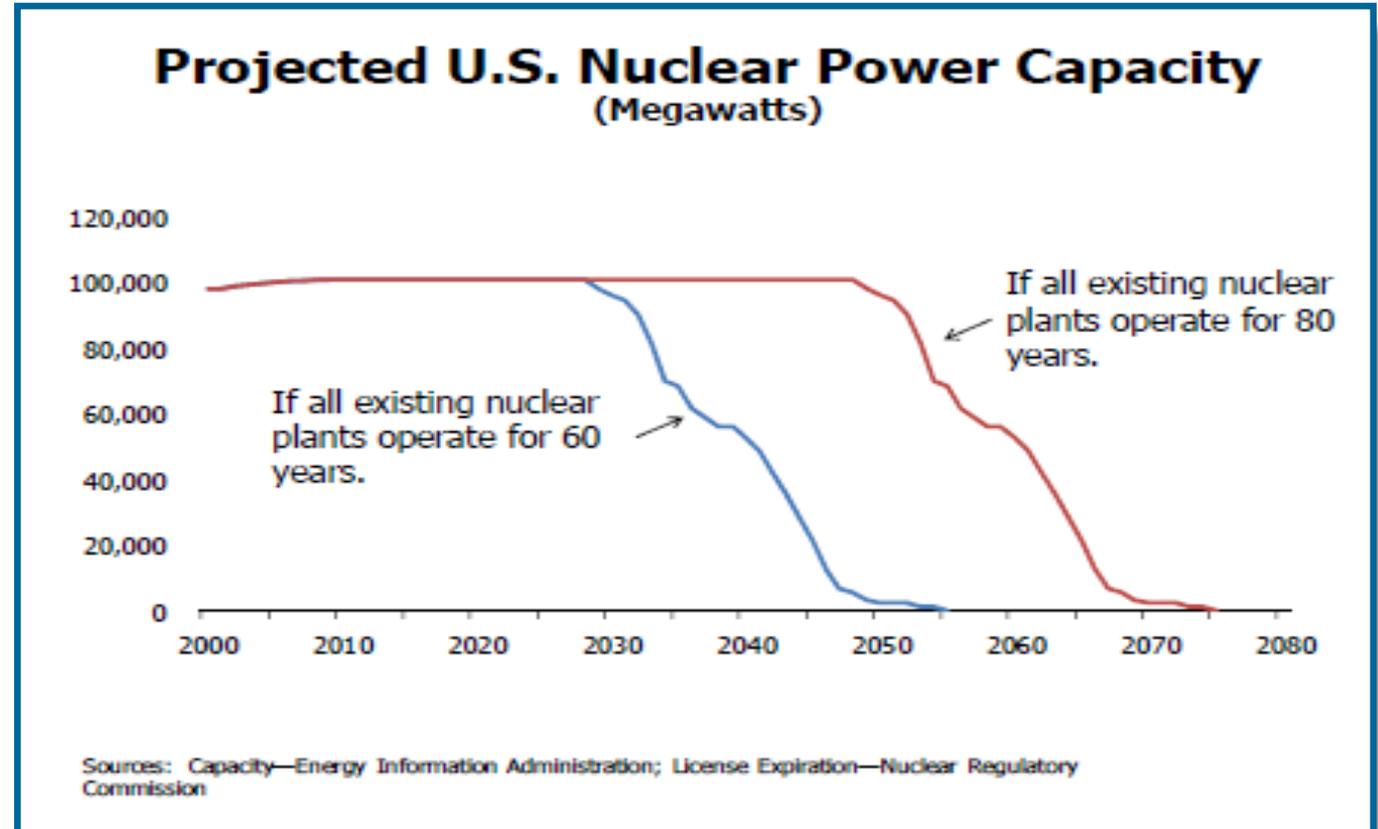
# Long Term Operations – *Global Perspective*



# Long Term Operations – *US Perspective*

License renewal - 40 to 60 years

Second license renewal - 60 to 80

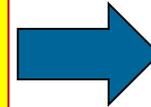


**Without second license renewal the US will lose 30,000 MWs of carbon free generation between 2029 and 2035.**

# Research Focus is on Aging Management

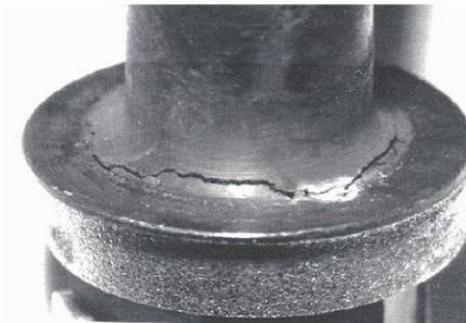
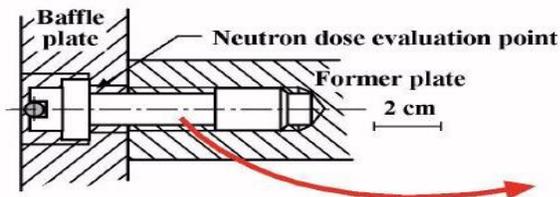
## High Priority:

1. Reactor pressure vessel
2. Primary system metals, welds and piping
3. Electrical cables
4. Concrete and containment structures

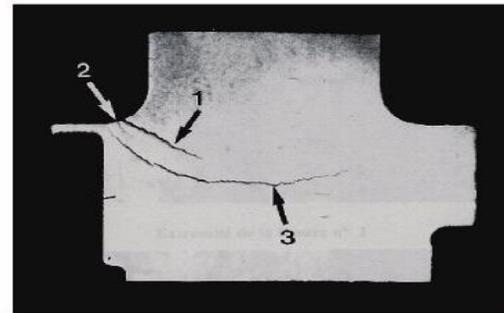
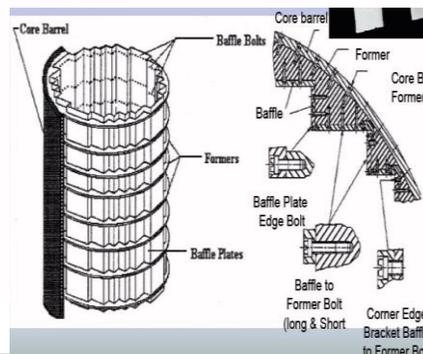
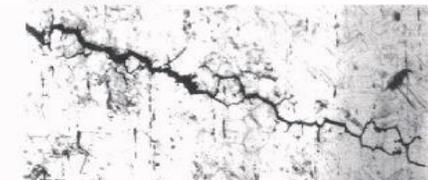


## Aging Impacts from:

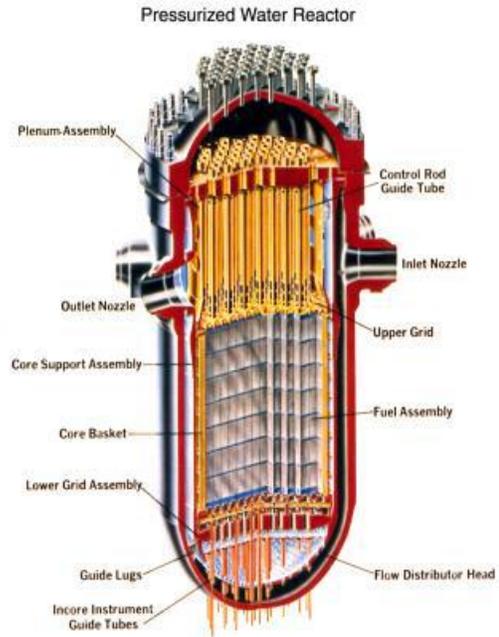
- Increased thermal exposure
- Increased radiation exposure
- Stress corrosion cracking
- Fatigue usage
- Wear



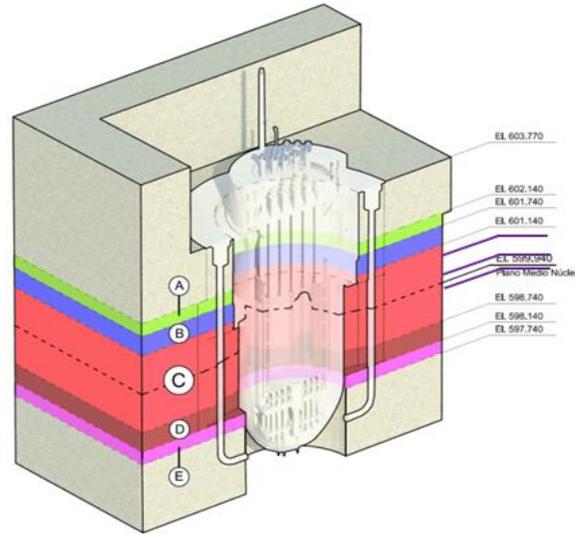
Crack #1



# Research Results in Use For Aging Management

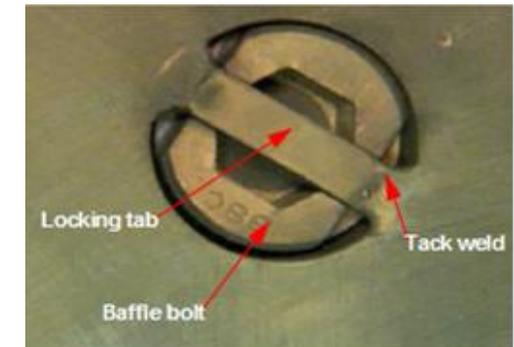


**Reactor vessel surveillance monitoring**



**Concrete irradiation impacts**

**Cable condition monitoring**



**Reactor internals inspections**

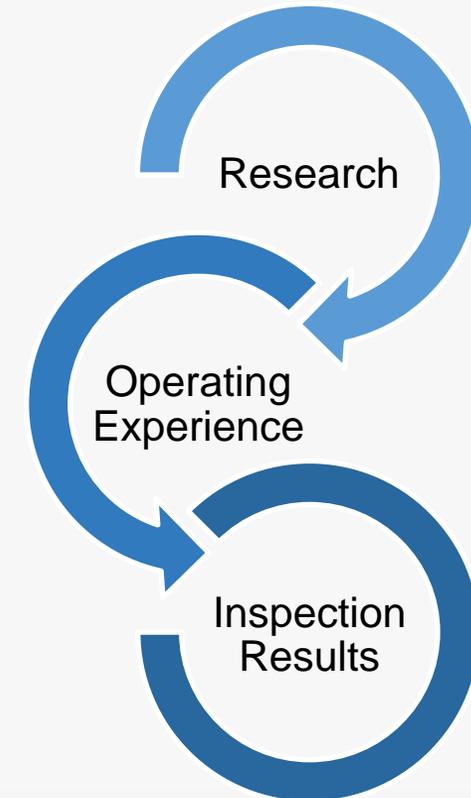
Over 125 EPRI technical reports are referenced in U.S. NRC and IAEA guidance reports.

# Summary of Operating Experience for > 40 Years

- Over 40 plants in the U.S. have entered the first period of extended operation
- Work on second license renewal (SLR) is well underway
  - Lead plants identified
  - Draft GALL for SLR
  - Technical discussions with NRC and Industry
- EPRI is supporting the lead plants

**First application for SLR expected in 2018-2019**

Living research programs – technical reports are updated based on:

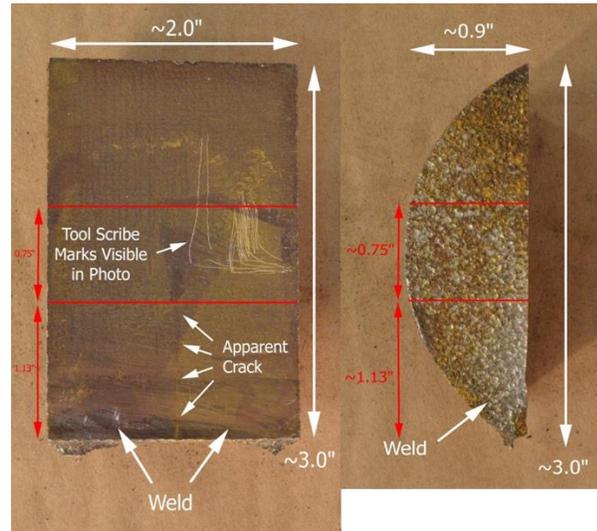


# R&D Continues for Metals and Reactor Pressure Vessel

Testing materials harvested from reactors to confirm laboratory research findings

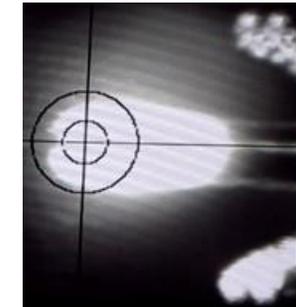
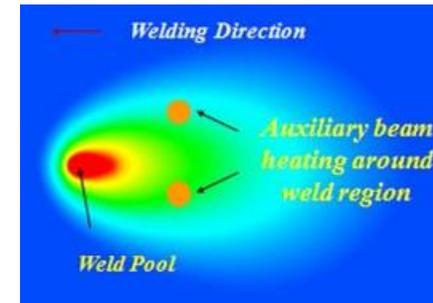


Core internals and weld materials from a PWR



Boat sample from a BWR core shroud

Developing advanced welding techniques to repair highly irradiated materials



Advanced laser welding

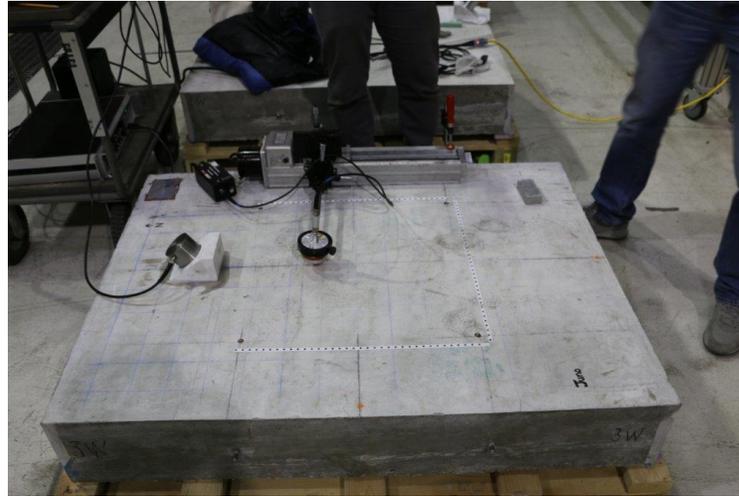
Friction stir welding



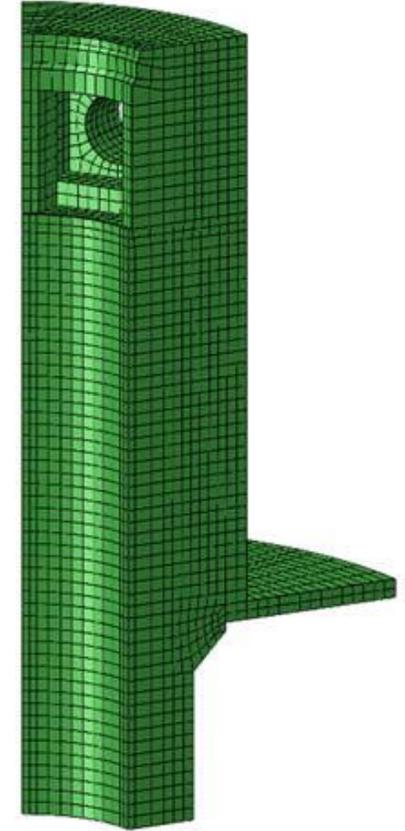
# R&D Continues for Concrete and Civil Structures



Developing management and evaluation programs for reactive aggregates



Developing techniques for nondestructive concrete inspection



Modeling concrete structures exposed to high levels of radiation to determine remaining margins of safety

# R&D Continues for Electrical Cables



Harvesting field aged cables for additional temperature and radiation testing

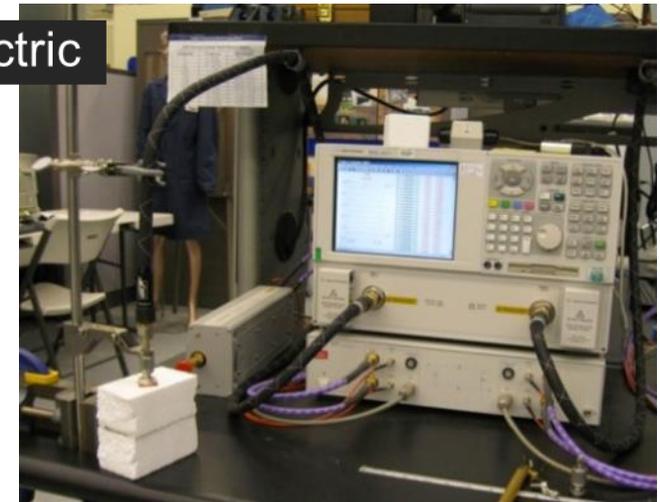
Using forensic and laboratory data, with advances in condition monitoring determine cable *remaining useful life*

Acoustic

Developing advances in condition monitoring of cable insulating materials

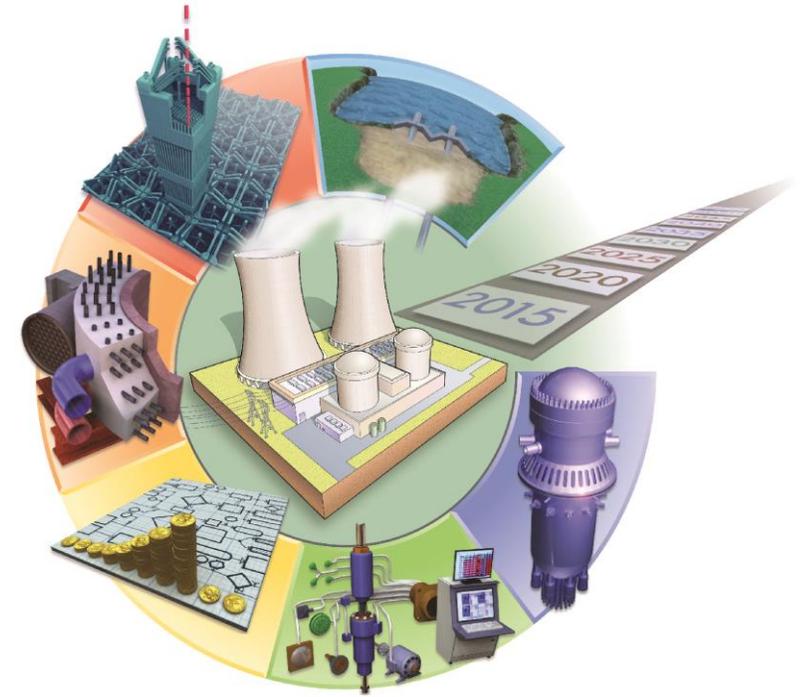


Dielectric



# Conclusion from the Research

- Technical bases are established and in use for aging management
- Continuous improvements based on research results, inspections and operating experience
- Coordination and collaboration with global research partners



**No show stoppers have been identified based on R&D to date.**



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