Introduction of Aging Management at BNPP

June 2026

BNPP IAMP Presentation Content

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Regulatory Basis for Aging Management at BNPP

📘 REGULATORY REQUIREMENTS

FANR-REG-16

Operational Safety including Commissioning, Article (16), Ageing Management

- Long-term safe operation through AM programme.
- SSC safety functions maintained over lifetime
- Erosion & corrosion monitoring required
- Cyclic & transient effects managed within design limits

⚙️ GUIDANCE FRAMEWORK

FANR-RG-30
Implementation Guidance

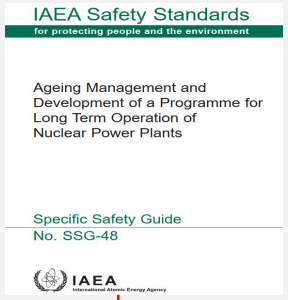
- Reg-16 Provides the reference documents
- IAEA Safety Standard on Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, Specific Safety Guide No. SSG-48

📊 BNPP IMPLEMENTATION

- Integrated Ageing Mgmt. Program (IAMP)
- Plant Programs including ISI, Chemistry, Fire protection, IST etc.
- Erosion & Corrosion Monitoring
- Cyclic & Transient Monitoring

Regulatory requirements are translated into structured plant programs to ensure systematic aging management.

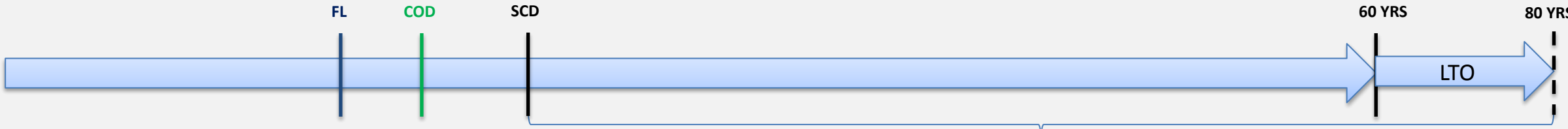
Ageing Management Implementation Timeline



FL: Fuel Load
COD: Commercial Operation Date
SCD: Substantial Completion Date

Programs Required for FL

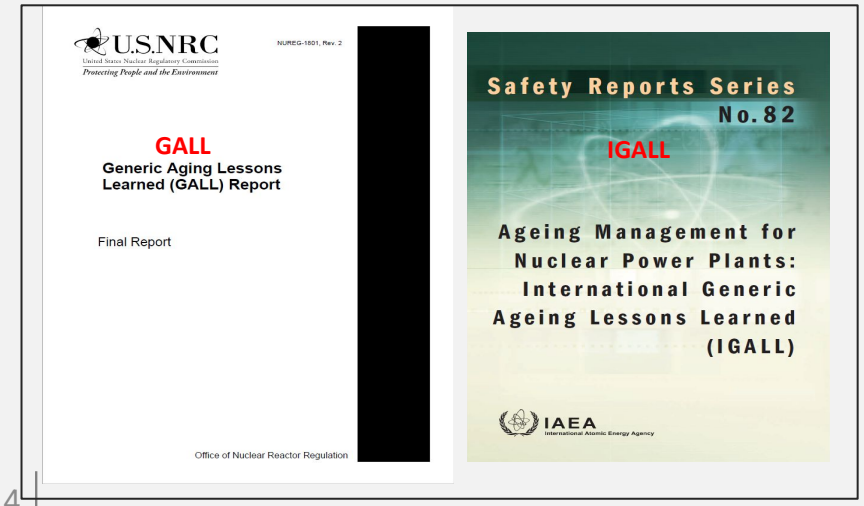
Ageing Management beyond SCD

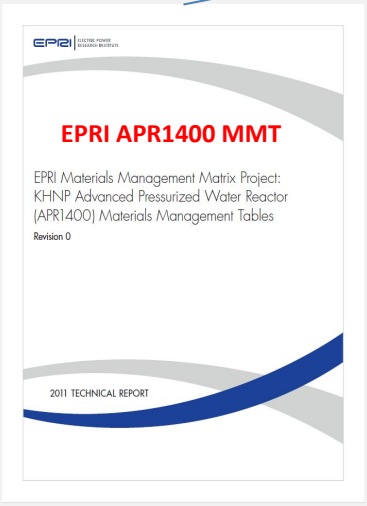


NIMS-REF-0001, Nawah Programs Catalog

BNPP Ageing Management Matrix

OPERATING EXPERIENCE INTERNAL & EXTERNAL





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Operational Timeline Units 1 - 4

Unit 4:
- Fuel Load: 17 Dec 2023
- COD: 07 Sep 2024
- U4RF01: 11 Jul 2025

Unit 3:
- Fuel Load: 29 June 2022
- COD: 24 Feb 2023
- U3RF01: 22 Mar 2024
- U3RF02: Sep 2025

Unit 2:
- Fuel Load: 22 March 2021
- COD: 24 March 2022
- U2RF01: 3 March 2023
- U2RF02: 20 Sep 2024
- U2RF03: 06 April 2026

Unit 1:
- Fuel Load: 29 February 2020
- COD: 1 April 2021
- U1RF01: 7 April 2022
- U1RF02: 29 Sept 2023
- U1RF03: 07 Mar 2025

COD: Commercial Operation Date

Aging Programs Implemented at Fuel Load

GALL AMP ID	AMP Title
XI.M1	ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD
XI.M2	Water Chemistry
XI.M3	Reactor Head Closure Stud Bolting
XI.M10	Boric Acid Corrosion
XI.M17	Flow-Accelerated Corrosion
XI.M19	Steam Generators
XI.M26	Fire Protection
XI.M31	Reactor Vessel Surveillance
XI.S8	Protective Coating Monitoring and Maintenance Program
X.M1	Fatigue Monitoring (TLAA)
XI.S1	ASME Section XI, Subsection IWE, Steel containments and steel liners for concrete containments
XI.S2	ASME Section XI, Subsection IWL, Examination requirements for reinforced and prestressed concrete containments

ENEC official AMPs

#	GALL #	IGALL #	AMP Title	NIMS TITLE
1	XI.M1	AMP102	ASME Section XI Inservice Inspection, Subsections IWB, IWC,and IWD	In-Service Inspection
2	XI.M2	AMP103	Water Chemistry	Chemistry
3	XI.M10	AMP110	Boric Acid Corrosion	Boric Acid Corrosion
4	XI.M17	AMP114	Flow-Accelerated Corrosion	Erosion and Corrosion Monitoring
5	XI.M19	AMP116	Steam Generators	Steam Generator Management
6	XI.M26	AMP130	Fire Protection	Fire Protection
7	XI.M31	AMP118	Reactor Vessel Surveillance	Reactor Coolant Pressure Boundary Material Surveillance
8	XI.S1	AMP301	ASME Section XI, Subsection IWE, Steel containments and steel liners for concrete containments	In-Service Inspection
9	XI.S2	AMP302	ASME Section XI, Subsection IWL, Examination requirements for reinforced and prestressed concrete containments	In-Service Inspection
10	XI.S3	AMP303	ASME Section XI, Subsection IWF, Inservice inspection requirements for Class 1, 2, 3, and metal containment (MC) piping and components and their associated supports.	In-Service Inspection
11	XI.S4	AMP304	10 CFR 50, Appendix J, Containment building leak rate tests	Containment Leak Rate Testing
12	X.E1	AMP207	Environmental Qualification (EQ) of Electric Components (TLAA)	Equipment Qualification
13	X.M1	AMP101	Fatigue Monitoring (TLAA)	Cyclic and Transient Monitoring
14	X.S1	AMP313	Concrete Containment Tendon Prestress (TLAA)	In-Service Inspection

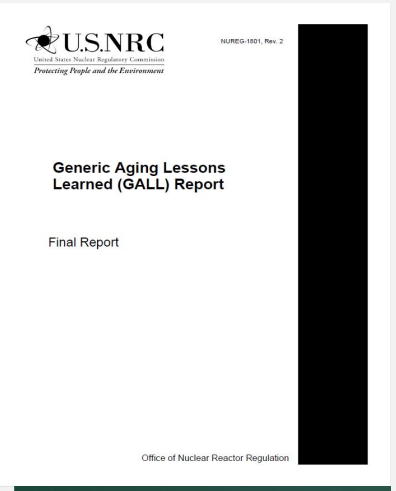
BNPP Aging Management Strategy: Integration of GALL and IGALL

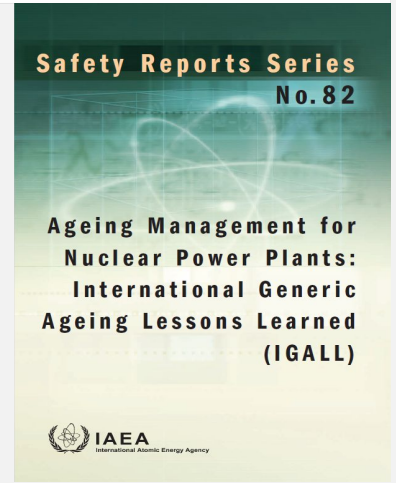
Framework

- US aging management largely follows guidance from Generic Aging Lessons Learned (GALL) report for license renewal (LR) and subsequent license renewals (SLRs)
- Other Utilities typically following IAEA's International GALL (IGALL)
- *ENEC, same as reference plant, Aging Management considers both GALL and IGALL*
- Alignment with GALL by managing Active components through ENEC Maintenance Rule program

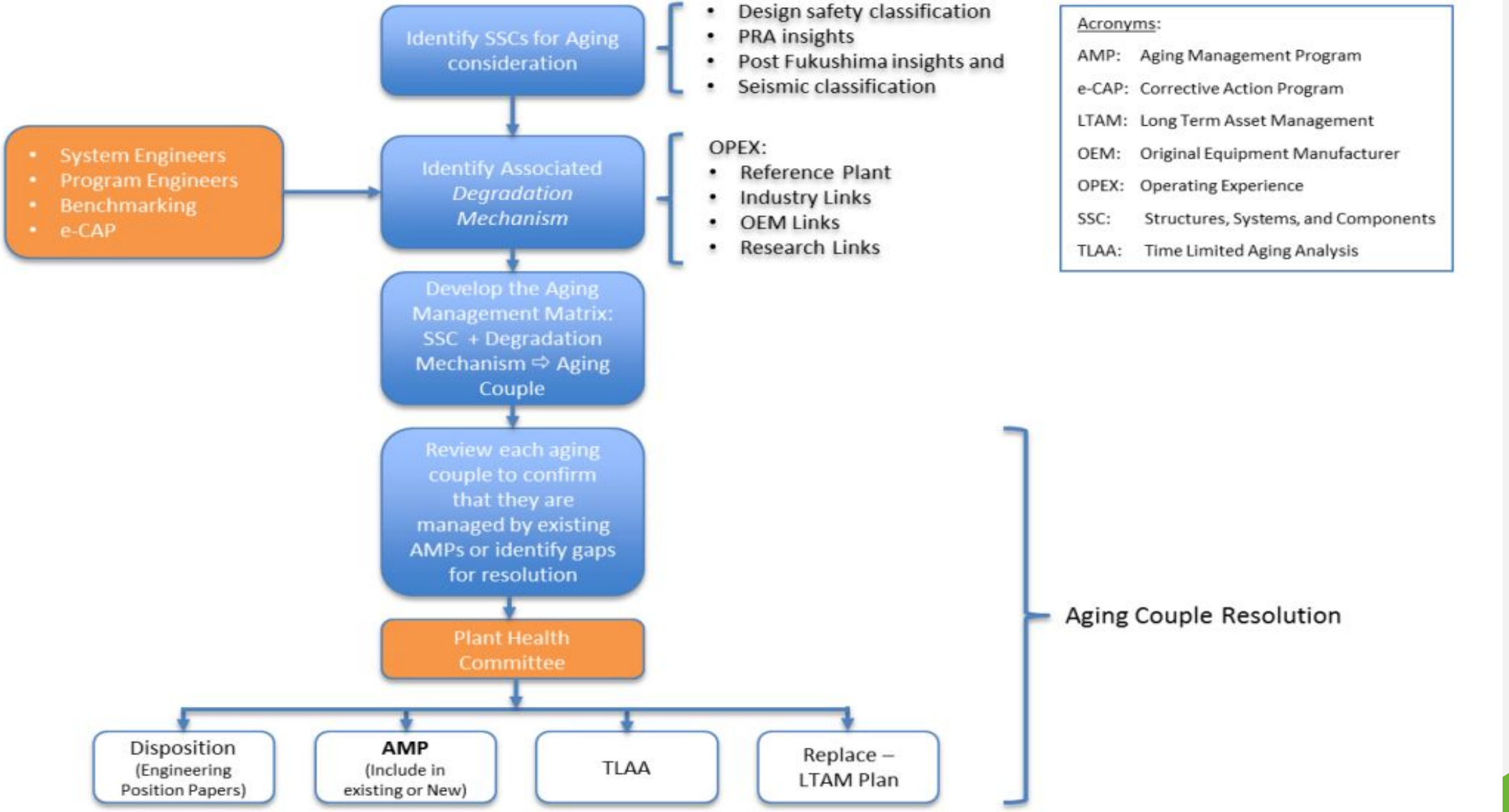
SSC Aging Management

- Passive SSCs are those that do not move to function (such as structures, heat exchangers, valves, pumps, piping etc.). Their age-related degradation can only be monitored and trended by performing periodic condition assessments (such as inspections, testing, and measurements).
- Aging of active components is managed in accordance with US-NRC rule 10 CFR 50.65, Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants - Maintenance Rule Program.





Aging Management Administrative Procedure



Aging Management Administrative Procedure

SSC Scoping

- ENEC FSAR provides specific component classifications in terms of safety class, quality group/class, electrical class, and seismic category.
- IAMP considers only passive equipment (such as structures), and degradation that is not remediated by typical maintenance programs.
- Only SSCs with credible Degradation modes considered. Degradation Modes identified in EPRI 1024568.

BNPP Aging Management Matrix (BAMM)

- Process described in Integrated Aging Management Administrative Procedure.
- Helpful documents - EPRI 1024568, EPRI Materials Management Matrix Project: KHNP Advanced Pressurized Water Reactor (APR1400) Materials Management Tables.
- The BAMM is maintained as a living document, to be updated continuously through the life of the plant based on the operation life and OEs.
- It lists down the identified SSCs with Aging couple and provide couple resolution.

BNPP Aging Management Strategy: Reflection in Program Description & Procedural documentations

IAMP Program Description

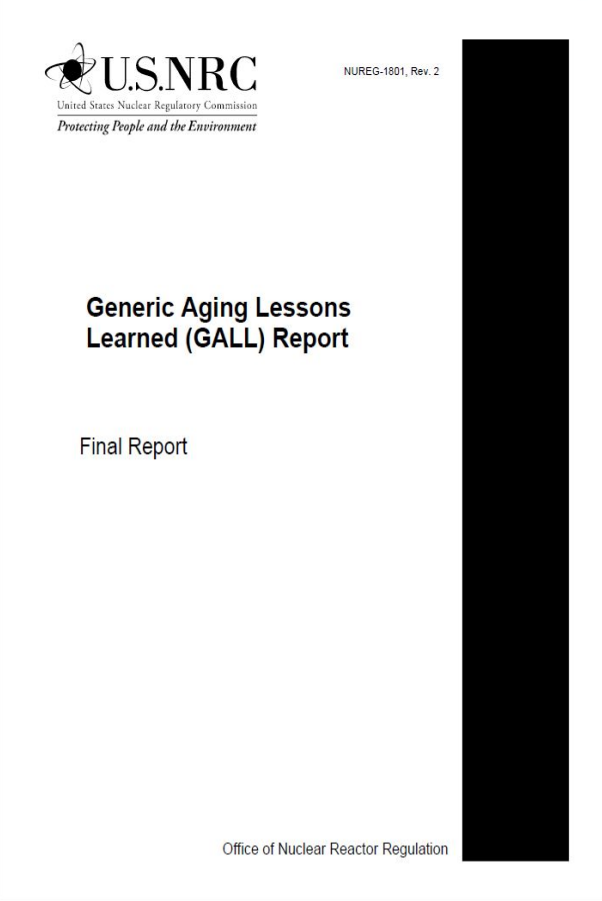
- Incorporates aging management principles from the design and construction phases and embeds them into early plant operations.
- Various programs (AMPs) are established to identify and mitigate early ageing effects through routine, systematic processes
- Physical aging and obsolescence of structures, systems, and components (SSCs) are proactively managed in an integrated manner
- Aging-related conditions are captured through the Corrective Action Program (CAP), with supporting programs in place for key Time-Limited Aging Analyses (TLAAs)
- The IAMP organizational framework defines clear roles and responsibilities, including dedicated program ownership and cross-functional involvement

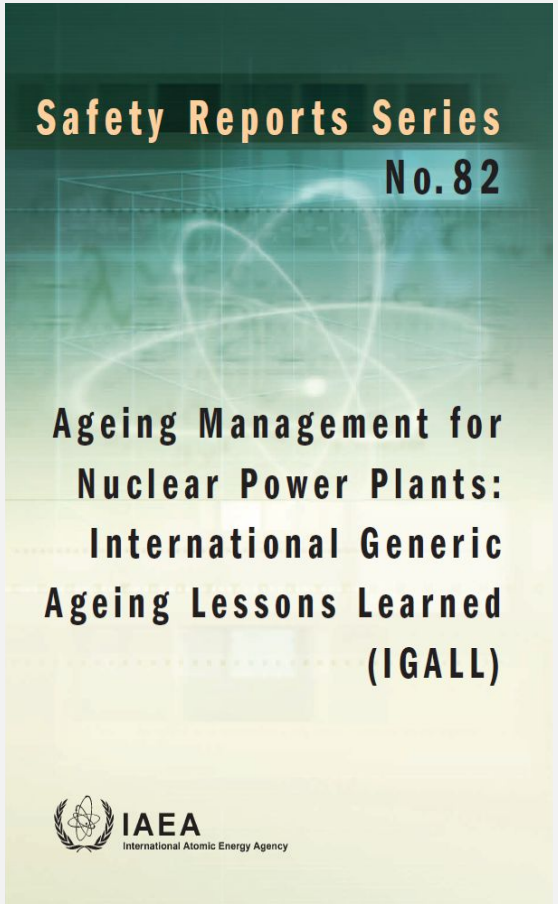
Program Effectiveness

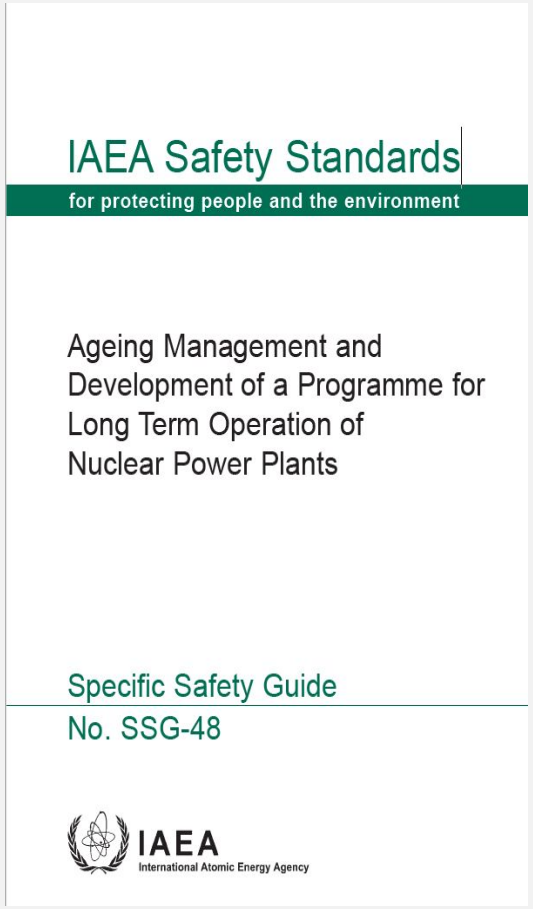
- Program health indicators report and review process with dedicated program document
- Established processes for training, documentation retention, and knowledge transfer thru back up engineers
- IAMP oversight through program health reports, Corrective Action Program (CAP) trending, and periodic self assessments.

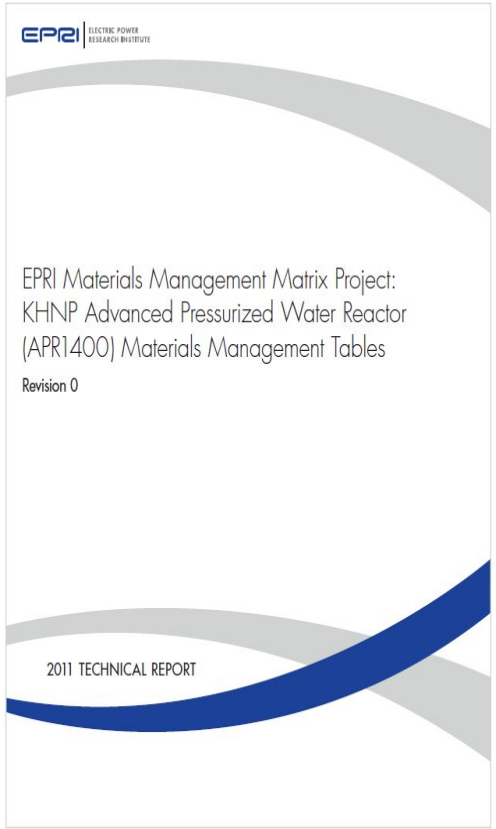
- BNPP IAMP Strengths
  - Proactive Lifecycle Integration
  - Comprehensive Programmatic Framework
  - Robust Organizational Governance
  - Effective Corrective Action Integration
  - Forward-Looking Design and Planning

Aging Management throughout the NPP lifetime









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Q&A / Discussion