Methodology for conclusions development, identification of gaps and proposals for solutions (sections 6 and 7)

Workshop on ‘LTO Beyond 60 Years’
Organized by NRG in cooperation with OECD/NEA
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Objectives of the methodology

- Provide common rules for development of section 6, ‘Conclusions for NPP operation beyond 60 years’ and section 7, ‘Proposed dispositioning of identified areas for enhancement’ of the report
- Describe development process, roles and responsibilities
- Provide uniform template for section 6 and 7 inputs
- Provide examples of section 6 and 7 inputs
- Agree upon work plan for 2024 and assign action items

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Project report structure

1. Introduction
2. LTO perspective and regulatory background
3. Non-technical challenges for safe LTO of NPPs
4. Technical challenges important for LTO beyond 60
5. Safety requirements important for LTO beyond 60

6. Conclusions for NPP operation beyond 60 years
   6.1. Areas properly addressed
   6.2. Identified areas for enhancement

7. Proposed dispositioning of identified areas for enhancement

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Development process

Step 1 – Development of the draft of areas for enhancement (section 6.2)
Responsible: NRG, selected TT members Deadline: June 2024

Step 2 – Review and comments on areas for enhancement (section 6.2)
Responsible: TT members Deadline: July 2024

Step 3 – Development of the draft of areas properly addressed (section 6.1)
Responsible: NRG, selected TT members Deadline: July 2024

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Development process

Step 4 – Review and comments of areas properly addressed (section 6.1)
Responsible: TT members Deadline: August 2024

Step 5 – Finalization of section 6
Responsible: NRG Deadline: September 2024

Step 6 – Development of proposals for dispositioning of areas for enhancement (section 7)
Responsible: TT members Deadline: September 2024

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Development process

Step 7 – Compilation of proposals of areas for enhancement (section 7)
Responsible: NRG Deadline: October 2024

Step 8 – Review and comments on proposals for dispositioning of areas for enhancement (section 7)
Responsible: TT members Deadline: November 2024

Step 9 – Finalization of section 7
Responsible: NRG Deadline: December 2024

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Reporting results of section 6 and 7

- Conclusion number
- Relevant sub-section of the report
- Description of conclusion

Conclusion number format example:

- ‘A2.1-03’ for the third conclusion of type ‘area properly addressed’ primarily based on sub-section 2.1

- ‘E4.6-01’ for the first conclusion of type ‘area for enhancement’ primarily based on sub-section 4.6

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Example 1 of section 6 results

Relevant sub-section of the report: 2.4. Applicability of IAEA safety standards for LTO beyond 60

Conclusion number: A2.4-01

Conclusion title: Guidance for LTO beyond 60

Description of conclusion: As discussed in sections 2.3, 2.4 and 2.5, the IAEA has developed based on US NRC and other member states experience a set of safety standards and other publications which is applicable also for safe LTO beyond 60 years. The IAEA guidance is being regularly updated and represents member states consensus on recommended approach to ageing management and preparation for safe LTO, including LTO beyond 60 years.

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Example 2 of section 6 results (tbc)

Relevant sub-section of the report: 2.4. Applicability of IAEA safety standards for LTO beyond 60

Conclusion number: A2.4-02

Conclusion title: Sharing proven AMPs, TLAAs and other programmes to manage ageing

Description of conclusion: The IAEA International Ageing Lessons Learned (IGALL) programme has an essential role in monitoring and sharing the latest proven practices in ageing management (AMPs, TLAAs etc.) The IGALL maintains the continuously updated database of known ageing effects and degradation mechanisms and proven AMPs and TLAAs to manage them. US NRC GALL [8] as well as GALL SLR [7] (supporting LTO from 60 to 80 years for US plants) have been also incorporated into IGALL documents and database.

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Example 2 of section 6 results

Based on the increasing number of NPPs going through comprehensive safety assessments to demonstrate safe operation during LTO beyond the original design life time (30 or 40 years), the current experience is continuously collected, analyzed and shared in the the IGALL Safety Report [13], supported by the publicly available, consolidated IGALL programme database:

https://gnssn.iaea.org/NSNI/PoS/IGALL/SitePages/Home.aspx

This ensures incorporating latest operating experience and knowledge, keeping the IGALL a living programme and an efficient tool to maintain the ageing management in NPPs effective and on the state-of-the-art level.

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Example 3 of section 6 results

Relevant sub-section of the report: 4.3. Reactor vessel internals

Conclusion number: E4.3-05

Conclusion title: IASCC growth rates for highly irradiated austenitic stainless steels

Description of conclusion: IASCC growth rates for highly irradiated (>20 dpa) austenitic stainless steels (wrought and welds), as detailed in Section 4.3.2 above. This issue is applicable to PWRs since BWR internals do not experience these fluence levels. This issue affects analysis of found flaws but does not affect existing aging management programs for detection of degradation.

Proposals for dispositioning: TBD

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Example 4 of section 6 results (tbc)

Relevant sub-section of the report: 4.3. Reactor vessel internals

Conclusion number: E4.3-06

Conclusion title: IASCC of WWERs

Description of conclusion: A general understanding of IASCC development is not sufficient for LTO 80. A comprehensive forecast methodology needs to be developed. The evaluation of the degradation of WWER RPV internals by IASCC is based on experimental data obtained for steels other than Ti-stabilized austenitic stainless steel 08CH18N10T, the main structural material of WWER internals.

It is necessary to establish reliable ISI method to determine any possible IASCC crack specifically in baffle – former bolts. These may have different designs for different WWERs and consequently different requirements for NDT inspection methods.

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Example 4 of section 6 results

The input data for the development of the mechanical modelling and for the development of the assessment methodology should be based on neutron irradiation with similar parameters (neutron spectrum, temperature, environment) as in operating NPPs and the level of neutron irradiation should be equivalent to the level of neutron irradiation of the internals components of operating RPVs at the end of life. It is therefore necessary to use material from harvesting activities during decommissioning of NPPs

Proposals for dispositioning: TBD

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Example 5 of section 6 results (tbc)

Relevant sub-section of the report: 5.1 Availability of original design basis documentation

Conclusion number: E5.1-01

Conclusion title: Design basis documentation

Description of conclusion: As discussed in section 5.1, availability of up-to-date DBD is important precondition for safe LTO, both for modification/ configuration management and identification of TLAAs. As we can see from results of IAEA SALTO peer review service which are analyzed in SALTO Highlights 2005-2015 [182], SALTO Highlights 2015-2018 [33] and SALTO Highlights 2018-2022 [34], 'DBD is frequently not adequately managed to ensure its availability for the plant'.

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Example 5 of section 6 results

From this perspective, many NPPs decided to retrieve or reconstitute DBD which is a complex, expensive and long-term task. Examples of design basis documentation reconstitution projects can be Ringhals NPP in Sweden, Dukovany and Temelin NPPs in the Czech Republic, Paks NPP in Hungary and Kozloduy NPP in Bulgaria. Many other NPPs are currently facing to this challenge, e.g. Armenian NPP in Armenia, Atucha NPP in Argentina, Angra NPP in Brazil, Koeberg NPP in South Africa.

Proposals for dispositioning: TBD

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Any questions?

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Work plan for 2024 - action items

Step 1 – Development of the draft of areas for enhancement (section 6.2)

Responsible: NRG, selected TT members Deadline: June 2024

Step 3 – Development of the draft of areas properly addressed (section 6.1)

Responsible: NRG, selected TT members Deadline: July 2024

2. LTO perspective and regulatory background

~~2.1. Benefits of safe LTO of existing fleet NPPs~~

~~2.2. Current LTO perspectives~~

~~2.3. US NRC regulatory framework for LTO beyond 60~~

2.4. Applicability of IAEA safety standards for LTO beyond 60

Examples developed

~~2.5. Typical national regulatory frameworks~~

~~2.6. CNSC regulatory framework for LTO beyond 60~~

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3. Non-technical challenges for safe LTO of NPPs

~~3.1. Economic reasons~~

~~3.2. Political decisions~~

~~3.3. Environmental reasons~~

3.4. Supply chain issues

3.5. Human resources, knowledge and competence management

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4. Technical challenges important for LTO beyond 60

~~4.1. General considerations~~

4.2. Reactor pressure vessel (RPV)

4.3. Reactor vessel internals

4.4. Steam generators

4.5. Safety class 1 piping

Examples developed

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4. Technical challenges important for LTO beyond 60

4.6. Buried and underground piping
4.7. Concrete containment and civil structures
4.8. Electrical cable systems
4.9. I&C safety systems

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5. Safety requirements important for LTO beyond 60

5.1. Availability of original design basis documentation

5.2. Development of codes, standards and regulations

5.3. Technological obsolescence

Examples developed

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Important milestones in 2024

WGIAGE Meeting – 18-22 March 2024
Sections 2, 3, 4.1 – March 2024
Sections 4.2 - 4.9, 5 – May 2024
Section 6 - September 2024
Section 7 - December 2024

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Any questions?

Show current section 6 draft

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