NEA
NUCLEAR ENERGY AGENCY

OECD/NEA

LTO related activities

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The NEA : 34 Countries Seeking Excellence in Nuclear Safety, Technology, and Policy

- **A premier international platform for cooperation in nuclear technology, policy, regulation, research, and education.**
- **34 member countries + strategic partners (e.g., China and India).**
- **8 standing committees and more than 80 working parties and expert groups.**
- **Global relationships with industry, universities, and civil society.**

NEA countries operate about 81% of the world's installed nuclear capacity.

The NEA : Major International Cooperative Frameworks

27 Major Joint Projects

- **Nuclear safety research** and experimental data (e.g., thermal-hydraulics, fuel behaviour, severe accidents).
- **Nuclear safety databases** (e.g., fire, common-cause failures, Operating experience).
- **Nuclear science** (e.g., thermodynamics of advanced fuels).
- **Radioactive waste management** (e.g., thermochemical database).
- **Radiological protection** (e.g., occupational exposure).
- **Nuclear Education, Skills and Technology Framework (NEST)** (promoting the development of a new generation of subject matter experts).

NEA Serviced Bodies

- **Generation IV International Forum (GIF)**
  with the goal to develop new fission technologies with greater sustainability (including effective fuel utilisation and minimisation of waste), economic performance, safety and reliability, proliferation resistance and physical protection.
- **Multinational Design Evaluation Programme (MDEP) -** initiative by national safety authorities to leverage their resources and knowledge for new reactor design reviews.
- **International Framework for Nuclear Energy Cooperation (IFNEC)** 65-country forum for multilateral discussion and analyses of a wide array of nuclear topics involving both developed and emerging economies.

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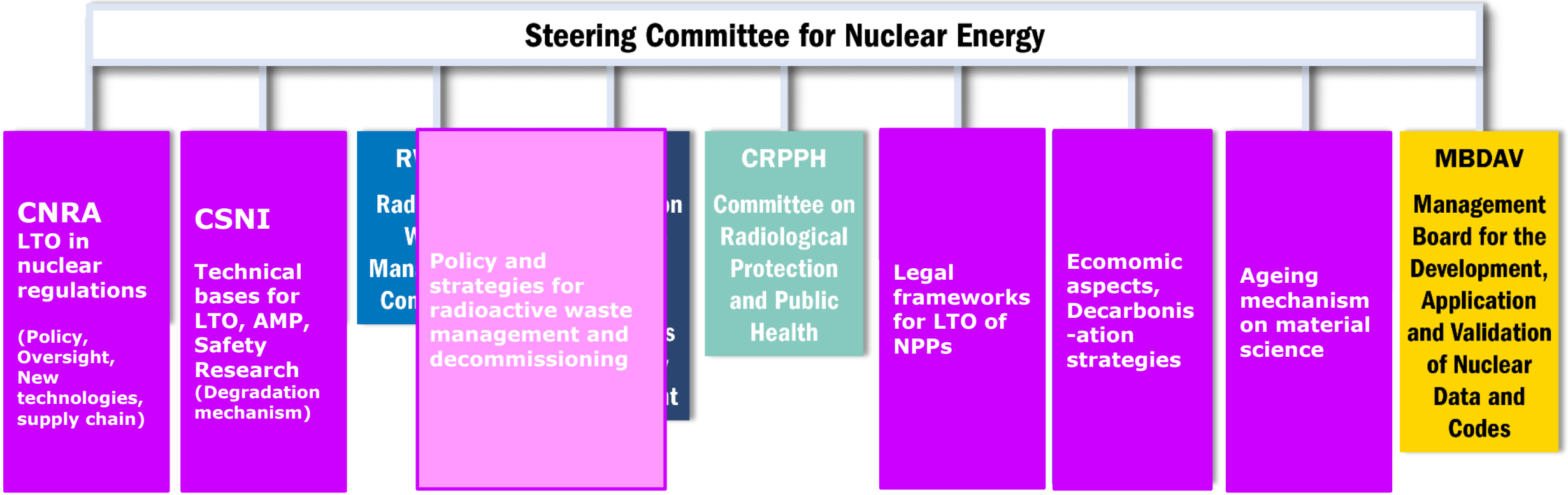
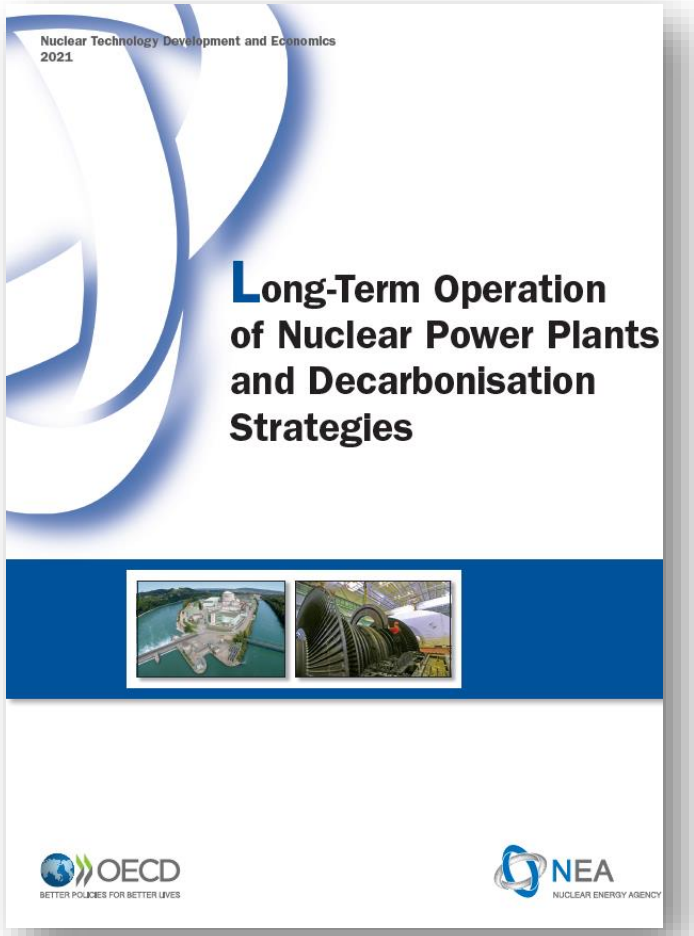
LTO: requiring simultaneous evaluation of multiple factors

Relationship with NEA committees



NEA Reports on Long-Term Operation

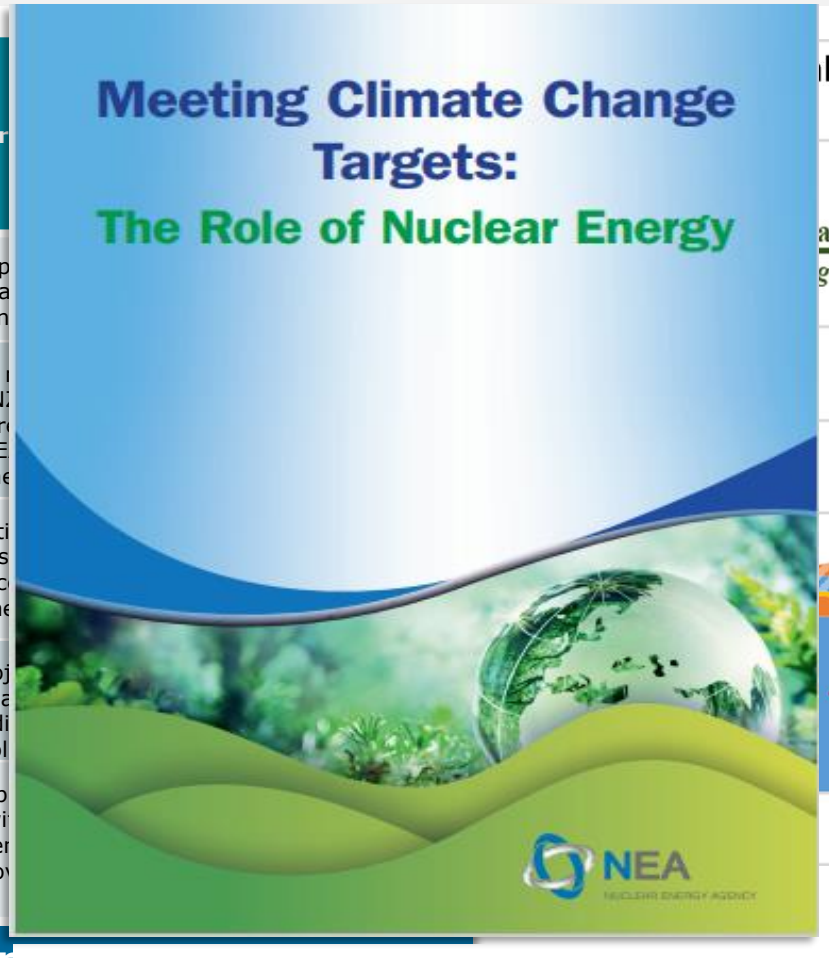
Report: https://www.oecd-nea.org/jcms/pl_15154/legal-frameworks-for-long-term-operation-of-nuclear-power-reactors

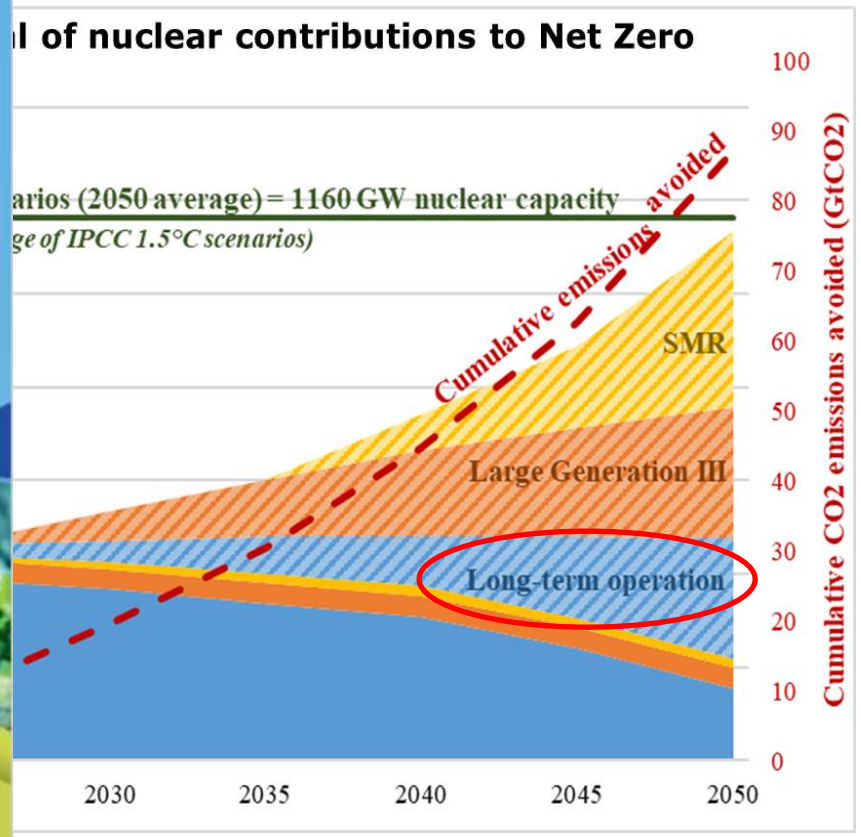


Report: https://www.oecd-nea.org/jcms/pl_60310/long-term-operation-of-nuclear-power-plants-and-decarbonisation-strategies

NEA Reports on Long-Term Operation

Organisation	Scenario	Climate target	Nuclear innovation	Descr
IAEA (2021b)	High Scenario	2°C	Not included	Conservative p on current pla announ
IEA (2021c)	Net Zero Scenario (NZE)	1.5°C	Not included but HTGR and nuclear heat potential are acknowledged.	Conservative estimates. N gigawatts mor than the IE developme
Shell (2021)	Sky 1.5 Scenario	1.5°C	Not specified	Ambitious esti massive inves economic rec resilient ene
IIASA (2021)	Divergent Net Zero Scenario	1.5°C	Not specified	Ambitious proj to compensa actions and di pol
Bloomberg NEF (2021)	New Energy Outlook Red Scenario	1.5°C	Explicit focus on SMRs and nuclear hydrogen	Highly amb pathway wi deployme inno





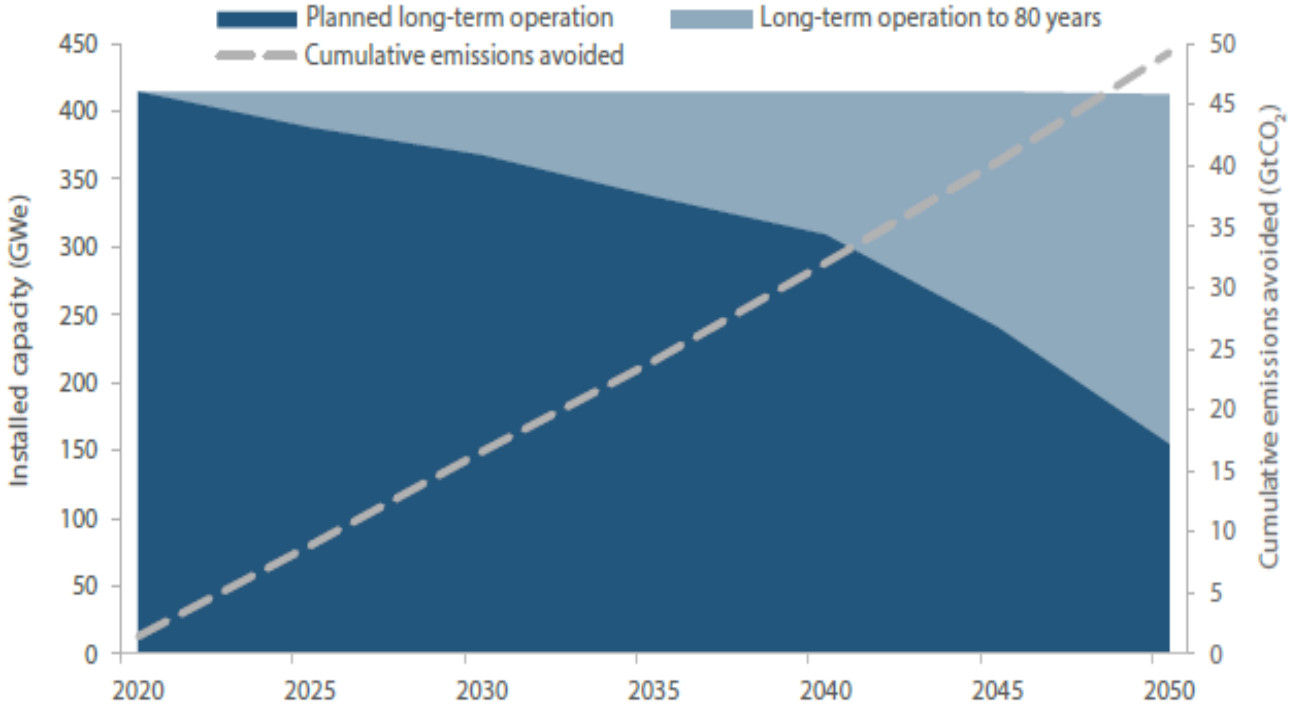
The average IPCC 1.5°C scenario requir reach 1 160 gigawatts of electri

Many pathways require global installed grow significantly

https://www.oecd-nea.org/jcms/pl_69396/meeting-climate-change-targets-the-role-of-nuclear-energy

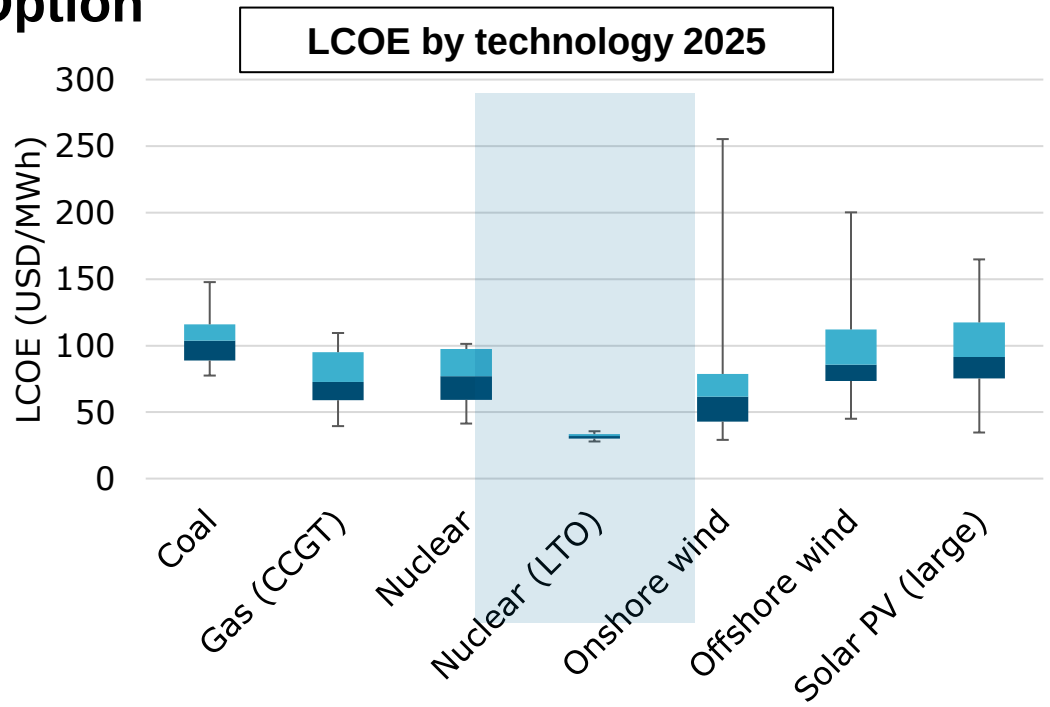
NEA Reports on Long-Term Operation

Long-term operation – installed capacity and cumulative emissions avoided (2020-2050)



Note: Note: It is assumed that nuclear power (12 gCO_2eq/kWh) is displaced by gas with a carbon footprint of 490 gCO_2eq/kWh (Bruckner, 2014). By 2050, 25% of nuclear reactors are used for nuclear heat applications, also displacing gas. By 2050, nuclear reactors operate with a 90% availability factors with 60% of the power used to supply electricity and 30% to supply hydrogen. Hydrogen produced with nuclear power will displace steam methane reforming (10 kg CO_2 per kg of H_2).

Long-Term Operation is THE Least Cost Option



Note: Coal includes lignite plants. Discount rate of 7% and carbon price of USD30/tCO2 - Source: IEA/NEA (2020)

Long-term operation could save up to 49 gigatonnes of cumulative emissions between 2020 and 2050.

Integrity and Ageing of Components and Structures for LTO

Working group on Integrity and Ageing of Components and Structures (WGIAGE)

Background

The WGIAGE was created in order to collect and analyse the logical basis for the maintenance of the integrity of components, systems and structures, and to propose general principles on the optimal ways of dealing with challenges to integrity, in particular those from ageing. Since its creation, three subgroups were established to gather experts to discuss the **metal components and structures, concrete structures**, and **seismic engineering**.

Nuclear Energy Agency (NEA) - Working Group on Integrity and Ageing of Components and Structures (WGIAGE) (oecd-nea.org)

Integrity and Ageing of Components and Structures for LTO

WGIAGE will:

- constitute a forum to exchange views, information and experience on generic technical aspects of integrity and ageing of components and structures, and review, as necessary, national and international programmes concentrating on research, operational aspects and regulation;
- stimulate, in relevant technical areas, new research and recommend and lead possible international co-operative projects;
- develop technical positions on specific integrity issues of operating, advanced, and innovative nuclear power plants including small modular reactors and research reactors **covering the entire life cycle; and identify areas where further work is needed;** and
- discuss **the potential impact of ageing and other challenges to integrity of SSC on the safety, the regulation, and the operability** of operating, advanced, and innovative nuclear power plants including SMRs as well as of other nuclear facilities.

Integrity and Ageing of Components and Structures for LTO

WGIAGE Programme of Work (1/2)

Item	Status	Outline
Status report on LTO beyond 60 years	Ongoing	Workshop today !!
Status Report on the RPV Integrity Assessment for in-vessel melt retention	Ongoing	Joint activity with WG on Analysis and Management of Accidents. The main objective is to provide relevant mechanical data and recommendations of best-practice for the assessment of mechanical integrity of the ablated vessel in situations of in-vessel melt retention (IVMR).
MECOS - Towards New Approach for Seismic Design of Piping Systems	Complete	**[NEA/CSNI/R(2021)12]**MECOS(Metallic Component margins under high Seismic Loads). 3rd Report in the topics. [NEA/CSNI/R(2015)8]Interim Report on Metallic Component Margins Under High Seismic Loads: Survey of Existing Practices and Status of Benchmark Work [NEA/CSNI/R(2018)3]Integrity of Structures, Systems and Components Under Design and Beyond Design Loads in Nuclear Power Plants/Final Report of the Project on Metallic Component Margins Under High Seismic Loads (MECOS)
OECD/NEA Leak-Before-Break Benchmark Phase 1 Final Report	Complete Phase 2 is ongoing	**[NEA/CSNI/R(2021)13]** Compare the results from different LBB analyses among participating countries. Identify the effects of weld residual stress and crack morphology on LBB analyses, but particularly crack opening displacement (COD), critical bending moment (CBM), and leak rate (LR) calculations.

Integrity and Ageing of Components and Structures for LTO

WGIAGE Programme of Work (2/2)

Item	Status	Outline
IRIS (Improving Robustness Assessment Methodologies for Structures Impacted by Missiles) Phase 3: Tests description and interpretation & Round robin calculations analysis	Complete	**[NEA/CSNI/R(2023)5]** The study of vibration propagation in a civil structure submitted to the impact of a deformable projectile. [NEA/CSNI/R(2011)8] Improving Robustness Assessment Methodologies for Structures Impacted by Missiles (IRIS_2010): Final Report.[NEA/CSNI/R(2014)5] Improving Robustness Assessment Methodologies for Structures Impacted by Missiles (IRIS_2012): Final Report.
OECD-NEA Leak Rate Benchmark Final Report	Complete	**[NEA/CSNI/R(2022)9]** Comparison of leak rate computation practice and the applied tools and software solutions.
Stress Corrosion Cracking: Benchmark of Crack Growth and Leak Flow Rates Models and Comparison with Operating Experience	Ongoing	One group is screening/evaluating operating experience events, curating test cases and providing case descriptions, second group is modelling the selected cases and generating predictions in simulations. Objectives are to provide NPP level validation cases for computations models on integrity and ageing of metal structures, to reinforce the relation between simulation and operating experience databases.**[CODAP Project]**
Ageing management of typical liner structures of containments and spent fuel water pools	Ongoing	Review approval basis from design to inspection of air and watertight steel liners of containment and water pool structures. Comparison of design margins using different codes and standards. Questionnaire to member countries.

Integrity and Ageing of Components and Structures for LTO

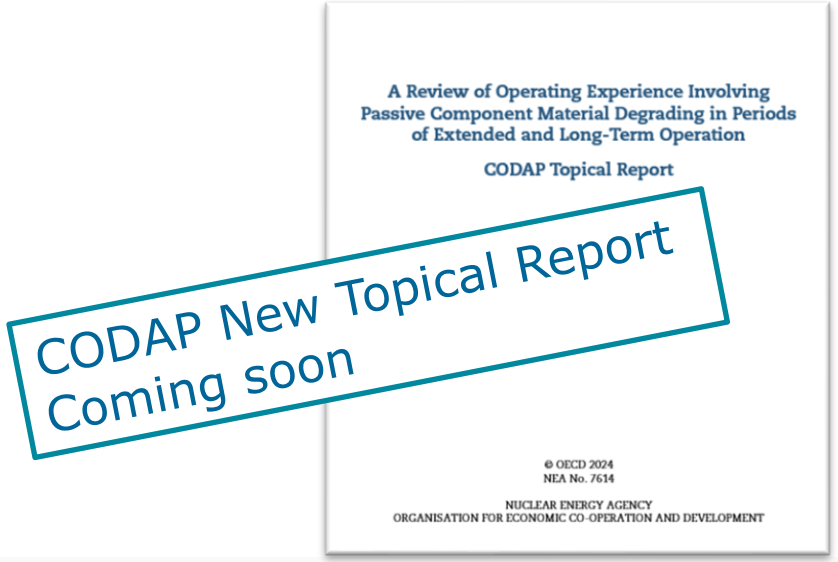
CODAP Project (Phase 5)

1. Project period

- January 2024-December 2026

2. Participants

- Canada, Czechia, Finland, France, Germany, Japan, Korea, Netherlands, Slovak Republic, Spain, Switzerland, Chinese Taipei, United Arab Emirates and United States.



CODAP New Topical Report
Coming soon

CNRA/CSNI publications on LTO/Ageing Management

Technical Aspects of Ageing for Long-term Operation [NEA/CSNI/R(2002)26]

- Technical aspects of the basis for long-term operation. Its objective is the characterisation of technical key items. Regulatory aspects are being discussed within CNRA. The report referenced NEA/CNRA/R(1999)1 on "Regulatory Aspects of Ageing Reactors"

Ageing Management of Thick-Walled Concrete Structures, Including ISI, Maintenance and Repair, Instrumentation Methods and Safety Assessment in View of LTO: Workshop Proceedings[NEA/CSNI/R(2009)9]

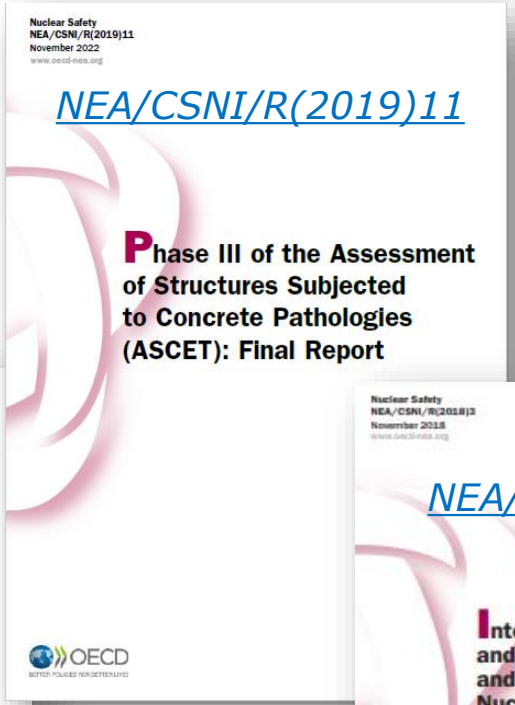
- Workshop held in Prague, October 2008. There was a need to review the state-of-the-art techniques for the integrity assessment of concrete structures, and to recommend areas where further research is warranted.

Challenges in Long-term Operation of Nuclear Power Plants

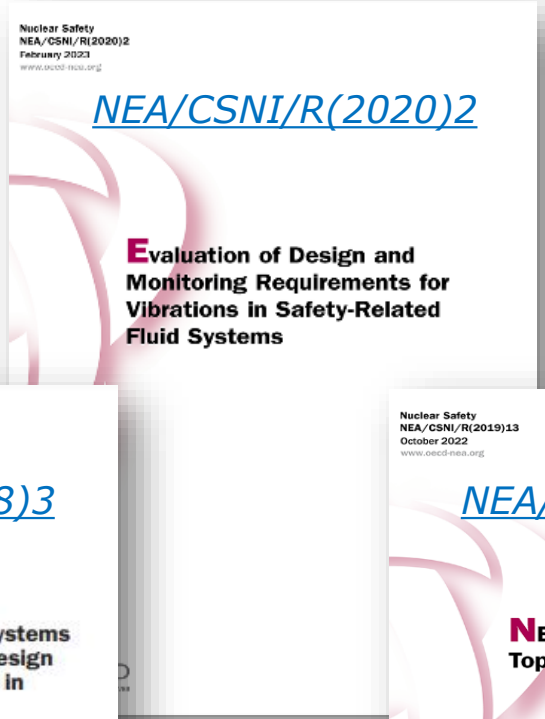
Implications for Regulatory Bodies [NEA/CNRA/R(2012)5]

NEA CSNI publications on LTO/Ageing Management

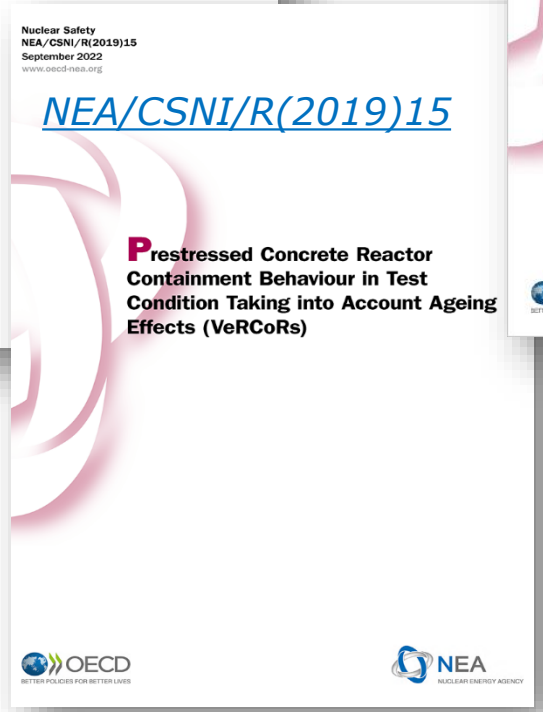
NEA/CSNI/R(2015)13



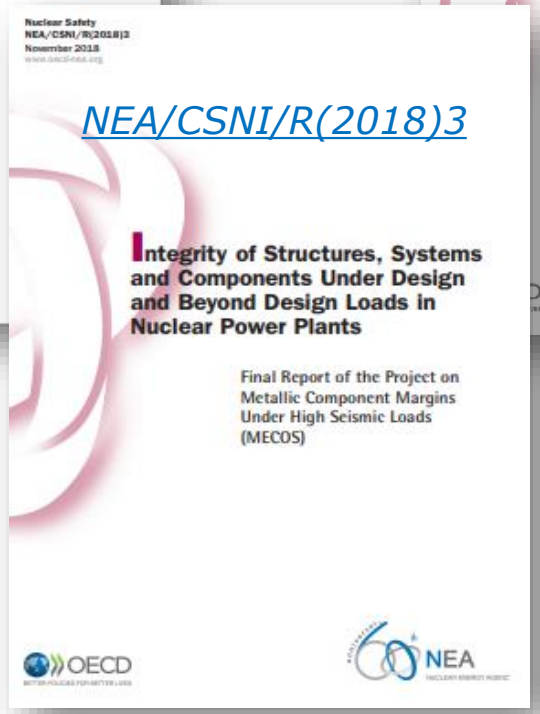
NEA/CSNI/R(2019)11



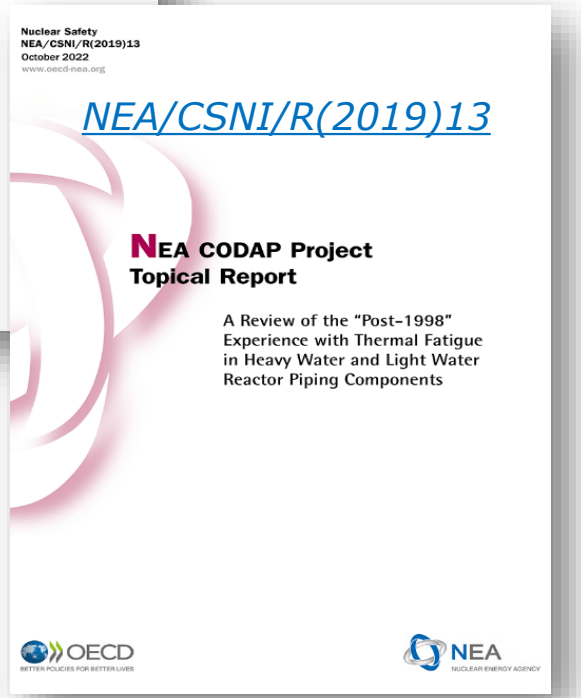
NEA/CSNI/R(2020)2



NEA/CSNI/R(2019)15



NEA/CSNI/R(2018)3



NEA/CSNI/R(2019)13

NEA's Workshops for ageing management

Workshop : Ageing management considerations in mechanical codes and standards

28-29 June 2023, Tokyo (Japan) - Hitotsubashi Hall
Participants Approx. 100 (in-person)

High-level national and international experts from a wide range of stakeholders shared their experiences and views during the four sessions of the workshop:

1. National regulatory requirements related to ageing phenomena on reactor coolant pressure boundary
2. Code requirements on RCPB to address/prevent ageing
3. Operation experiences related to ageing phenomena on RCPB
4. Challenges of ageing phenomena in C&S applied to SMRs/AMRs

All presentation materials are available on our website

Upcoming Workshop for ageing management and LTO

The workshop's objectives are to establish a common understanding of asset management, holistic and probabilistic approaches for safe, reliable and sustainable operation of NPPs. Participants will have opportunities to share experiences, brainstorm innovative ideas, establish best practices and identify gaps for management of NPP assets that could leverage non-deterministic and probabilistic methodologies when practicable.

Upcoming Workshop for ageing management and LTO

Welcome Address & Introduction

Training session 1: Risk
Training session 2: Asset Management
Training session 3: LTO and Asset Management of passive components

Day One: 26 Tuesday

Panel Sessions & Brainstorm

Panel 1: Regulatory Perspective
Panel 2: Application of Risk Information
Panel 3: Examples of Current Asset and Aging Management
Panel 4: Non-Deterministic Approaches to Asset Management and New Projects

Day Two: 27 Wednesday

Recap, Brainstorm and Wrap-up

Use of Risk and other Non-deterministic approaches to Asset/Ageing Management
Breakout sessions (Application, Methods, Challenges and Gaps)

Day Tree (half day): 28 Thursday

Panel 1
Michelle Kichline
NRC

- Michelle Kichline (NRC): Risk-informed programs used at the U.S. NRC
- Naoto Sekimura (University of Tokyo): Long Term Operation and Ageing Management: Challenge and Perspective
- Torsten Häntzka (ENSI): Ageing Management Approach on Swiss NPP: Scope, methodology, boundary conditions
- Jean-Karim Intissar (ASN): Regulatory Perspective for Long Term Operation

Panel 2
John Nakoski
NEA

- Pat O'Regan (EPRI): Risk-Informed Applications in the United States
- Yasuhiro Sakurai (CRIEPI): Risk-Informed Applications in Japan
- Gabriel Georgescu (IRSN): Use of PSA in France for Periodic Safety Reviews

Panel 3
Brett Titus
NEI

- Brett Titus (NEI): LTO: A Bridge to a Nuclear Future
- Toshimasa Takao (TEPCO): Aging Management at TEPCO
- Gary Adkins (Enercon): Asset and Aging Management Experience in the U.S.
- TBD

Panel 4
Ben Salisbury
EPRI

- US Utility (TBD)
- Davide Mercurio (Jensen Hughes): Use of Non-Deterministic Approaches to Asset Management
- Lauren Gibson (NRC): TBD
- David Bouhjiti (IRSN): Probabilistic Analyses for the Advanced PTS Analysis for LTO: APAL Project – Outline, Results and Conclusions

Registration Link (by 8th March) https://www.oecd-nea.org/confdb/confdb/conf?id=791

Conclusions

- NEA helps to maintain the competence in member countries to ensure the safety of existing nuclear facilities

- Priority topics are Long-term operation and Ageing management, Risk-informed regulation and graded approaches, etc.

- LTO beyond 60 years is one of the prioritized research topics for the WGIAGE and seeks for the opportunity on the collaborative activities on LTO

- NEA published several reports and organized workshops to discuss challenges and innovative, hybrid approach for future improvements

Thank you for your attention

Please contact keiko.chitose@oecd-nea.org if you have any questions

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