

Safety Requirements for Long Term Operation or Ageing Aspects and for Design, Construction and Operation of New Nuclear Power Plants

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01

WENRA Basic Facts

01 WENRA Basic Facts

Origins

- Association of the Heads of nuclear regulatory authorities of the EU countries with nuclear power plants (NPPs) and Switzerland and Ukraine
- Founded in 1999
- Assisted EU Commission in assessing nuclear safety in applicant countries

Mission

- Commitment to **continuous improvement** of nuclear safety in member countries
- Develop a common, **harmonised approach** to nuclear safety
- Develop **common Safety Reference Levels** (SRLs) based on IAEA standards and good practices in member countries

01 WENRA Basic Facts

Members and Observers

18 Members

- Belgium
- Bulgaria
- Czech Republic
- Finland
- France
- Germany
- Hungary
- Italy
- Lithuania
- Romania
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- The Netherlands
- Ukraine
- United Kingdom



9 Observers

- Armenia
- Austria
- Belarus
- Denmark
- Ireland
- Luxemburg
- Norway
- Poland
- Russian Federation

01 WENRA Basic Facts

Working Groups

- Two technical Working Groups established to **harmonise safety approaches** with the aim to continuously improve nuclear safety:

RHWG Reactor Harmonisation Working Group

WGWD Working Group on Waste and Decommissioning

– **Ad-hoc Working Groups**

- Development of Safety Reference Levels (SRLs) for harmonisation of nuclear safety in Europe
- Objectives of Harmonisation:

No substantial differences between countries in national safety requirements and in their implementation in the nuclear installations

02

Vienna Declaration on Nuclear Safety

02 Vienna Declaration on Nuclear Safety

Safety Principles for new and existing NPPs

(1) “**New nuclear power plants** are to be designed, sited, and constructed, consistent with the objective of **preventing accidents** (...) and, should an accident occur (...) avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.”

(2) “Comprehensive and systematic **safety assessments** are to be carried out periodically and regularly **for existing installations** throughout their lifetime in order to identify safety improvements that are oriented **to meet the above objectives**. Reasonably practicable or achievable **safety improvements** are to be implemented in a timely manner.”

03

WENRA Requirements for New Nuclear Power Plants: Design, Construction & Operation

03 WENRA Requirements for new NPPs

Safety objectives for new NPPs

- 7 high level safety objectives (2010)
- WENRA Report on Safety of new NPP designs (March 2013)

Safety Objectives address:

O1. Normal operation and abnormal events

O2. Accidents without core melt

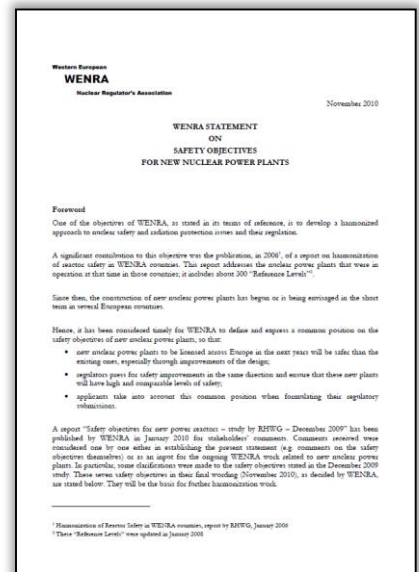
O3. Accidents with core melt

O4. Independence between all levels of defence in depth

O5. Safety and security interfaces

O6. Radiation protection and waste management

O7. Management of safety, from the design stage



03 WENRA Requirements for new NPPs

Safety objectives for new NPPs

New NPPs shall be designed in such a way that

- accidents with core melt which would lead to early or large releases have to be practically eliminated;
- for accidents with core melt that have not been practically eliminated, design provisions have to be taken so that only limited protective measures in area and time are needed for the public (no permanent relocation, no need for emergency evacuation outside the immediate vicinity of the plant, limited sheltering, no long term restrictions in food consumption) and that sufficient time is available to implement these measures.

WENRA statement on Safety Objectives (O3) for New Nuclear Power Plants (2010)

03 WENRA Requirements for new NPPs

Defense in Depth (DiD) for new NPPs

Levels of defence in depth	Objective	Essential means	Radiological consequences	Associated plant condition categories
Level 1	Prevention of abnormal operation and failures	Conservative design and high quality in construction and operation, control of main plant parameters inside defined limits	No off-site radiological impact (bounded by regulatory operating limits for discharge)	Normal operation
Level 2	Control of abnormal operation and failures	Control and limiting systems and other surveillance features		Anticipated operational occurrences
Level 3 ⁽¹⁾	Control of accident to limit radiological releases and prevent escalation to core melt conditions ⁽²⁾	Reactor protection system, safety systems, accident procedures	No off-site radiological impact or only minor radiological impact ⁽⁴⁾	Postulated single initiating events
		Additional safety features ⁽³⁾ , accident procedures		Postulated multiple failure events
Level 4	Control of accidents with core melt to limit off-site releases	Complementary safety features ⁽³⁾ to mitigate core melt, Management of accidents with core melt (severe accidents)	Off-site radiological impact may imply limited protective measures in area and time	Postulated core melt accidents (short and long term)
Level 5	Mitigation of radiological consequences of significant releases of radioactive material	Off-site emergency response Intervention levels	Off site radiological impact necessitating protective measures ⁽⁵⁾	-

04

WENRA Requirements for Existing Nuclear Power Plants: Periodic Safety Reviews (PSRs)

04 WENRA Requirements for Existing NPPs: PSRs

Updated WENRA Safety Reference Levels (SRLs)

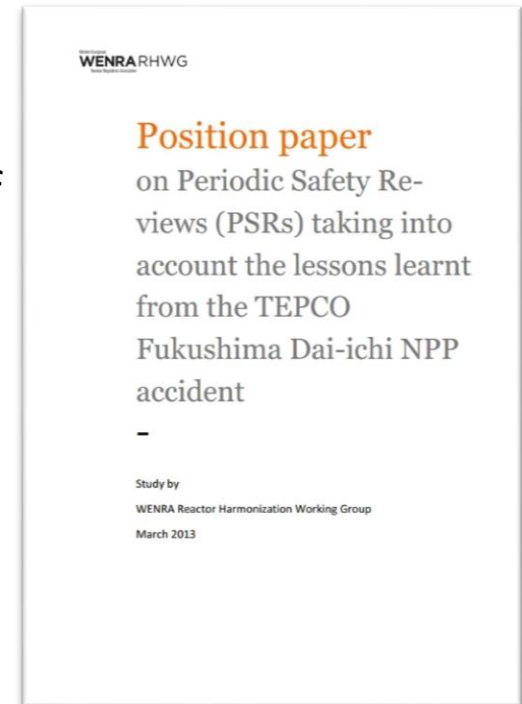
Safety area	Issue	Number of RLs
Safety Management	A – Safety Policy	9
	B – Operating organisation	15
	C – Management system	26
	D – Training and authorization of NPP staff	15
Design	E - Design basis envelope for existing reactors	46
	F – Design extension of existing reactors	25
	G – Safety classification of structures, systems and components	7
	T – Natural hazards	19
Operation	H – Operational limits and conditions	19
	I – Ageing management	8
	J – System for investigation of events and operational experience feedback	16
	K – Maintenance, in-service inspection and functional tests	20
	LM – Emergency operating procedures and severe accident management guidelines	20
Safety verification	N – Contents and updating of safety analysis report	17
	O – Probabilistic safety analysis	16
	P – Periodic safety review	9
	Q – Plant modifications	15
Emergency preparedness	R – On-site emergency preparedness	20
	S – Protection against internal fire	20

**overall,
342 SRL**

04 WENRA Requirements for Existing NPPs: PSRs

WENRA Position Paper on PSRs (2013)

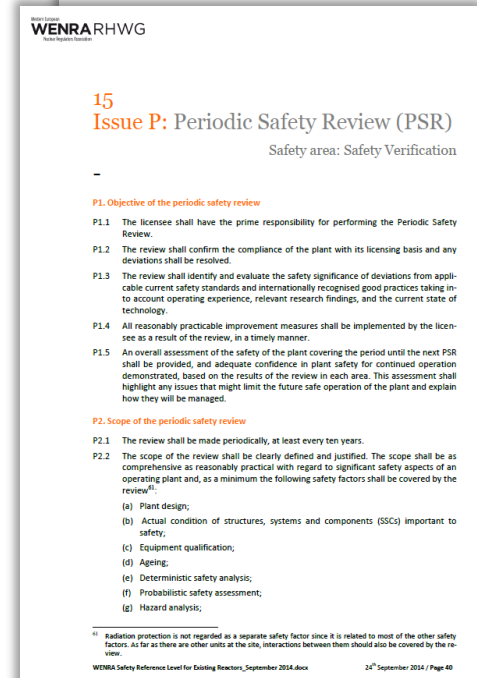
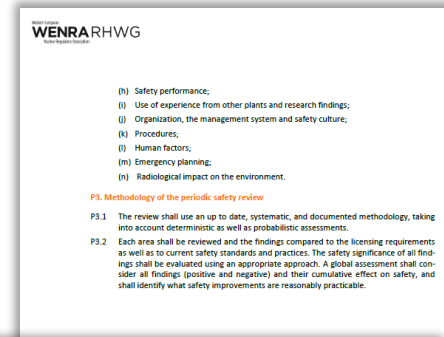
- PSRs required in all WENRA countries at least every ten years
- An opportunity to review not only the conformity of the plant, but also **identify possible safety improvements**



04 WENRA Requirements for Existing NPPs: PSRs

Safety Reference Levels: Issue P

- Key objectives of PSR are:
 - Confirmation of **compliance of NPPs with licensing basis (P1.2)**
 - Identification and timely implementation of **reasonably practicable improvement measures (P1.4)**
 - Identification of issues that might limit the lifetime of the facility (P1.5)
 - Use of an up to date, systematic, and documented methodology (deterministic and probabilistic) (P3.1)



04 WENRA Requirements for Existing NPPs: PSRs

Reference for PSR

SRL P1.3: The review shall identify and evaluate the safety significance of deviations from applicable **current safety standards and internationally recognised good practices** taking into account operating experience, relevant research findings, and the current state of technology.

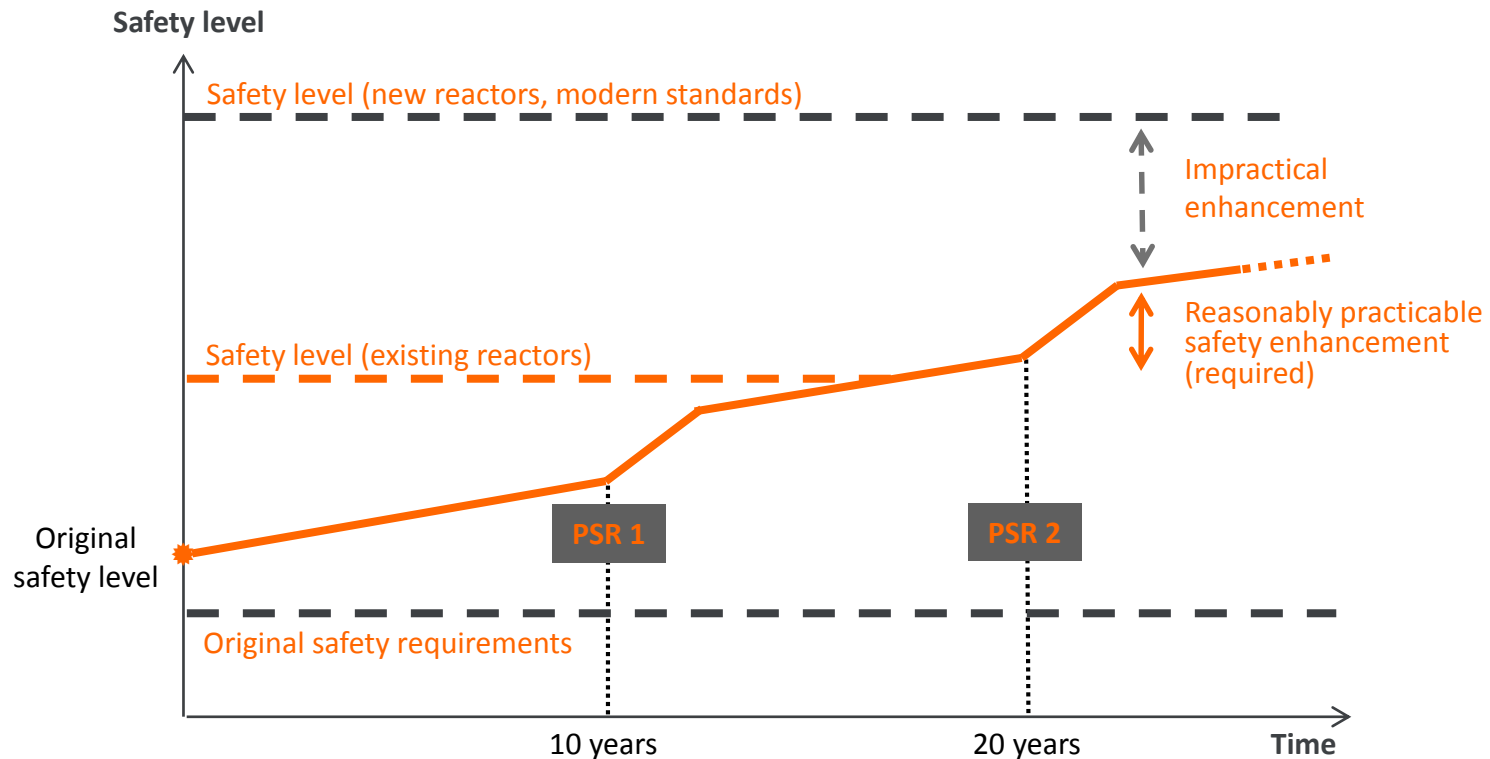
“The safety objectives address new civil NPP projects. However, these objectives should be used as a reference for identifying reasonably practicable safety improvements for “deferred plants” and existing plants during periodic safety reviews.”

WENRA statement on Safety Objectives for new Nuclear Power Plants (2010)

04 WENRA Requirements for Existing NPPs: PSRs

Continuous improvement

- PSR are
 - Key process for nuclear safety and continuous improvement
 - Used for identification of reasonably practicable improvement measures



05

WENRA Safety Reference Levels (SRLs) and Recommendations for Long Term Operation (LTO) and Ageing Management

05 SRLs and Recommendations on LTO and Ageing

Updated WENRA SRLs

Safety area	Issue	Number of RLs
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05 SRLs and Recommendations on LTO and Ageing

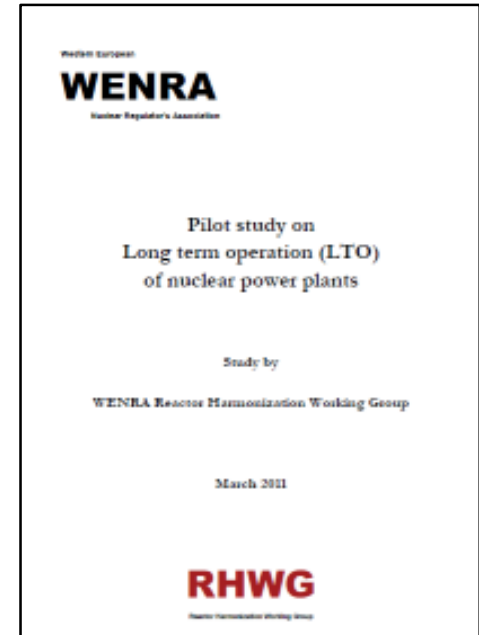
LTO

- Ageing of key structures, systems and components (SSCs) such as reactor vessel or reactor containment, is a common limiting factor for LTO
- Address safety level of the NPP and **possibilities for safety improvements**
- SRL I2.2: The licensee shall provide monitoring, testing, sampling and inspection activities to assess ageing effects to **identify unexpected behaviour** or degradation during service.
- SRL I3.1: Ageing management of the reactor pressure vessel and its welds shall take all relevant factors including **embrittlement, thermal ageing, and fatigue** into account to compare their performance with prediction, throughout plant life.
- SRL I3.2: Surveillance of major structures and components shall be carried out to **timely detect the inception of ageing effects** and to allow for preventive and remedial actions.

05 SRLs and Recommendations on LTO and Ageing

WENRA Pilot study on LTO (2011)

- There are **no real cliff edge effects** in the level of safety or technical degradation due to ageing when reaching the original design lifetime.
- The licensee may be able to justify operation beyond the original design lifetime.
- Key issues for LTO
 - Demonstrating and maintaining plant conformity to its currently applicable regulatory requirements
 - Enhancing plant safety as far as reasonably practicable



A relevant element in evaluating “reasonable” safety enhancements is the remaining time for which the considered plant will be operated before final shutdown.

06

Summary and Outlook

06 Summary and Outlook

- Requirements published by WENRA relevant for LTO and ageing
 - Issue P and I of the Safety Reference Levels
 - Pilot Study on LTO
- WENRA issued 7 high level safety objective for new NPPs
 - 7 positions of selected key safety issues were published to give further clarification of the safety objectives.
- Outlook
 - Implementation of Vienna Declaration
 - Development of WENRA views on new topics, having safety implications on both existing and new reactors (e.g. passive systems, practical elimination)
 - Overall review of the SRLs, including Issue I, to take account of new IAEA publications and safety development

Thank you.

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