

WENRA activities on new and existing reactors

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WENRA-RHWG chair

Agenda

- A few words about WENRA
 - Objectives
 - Members & observers
 - Working groups (RHWG, WGWD...)
- WENRA-RHWG activities
 - New reactors
 - Existing reactors
- Outlook

WENRA (1/3)

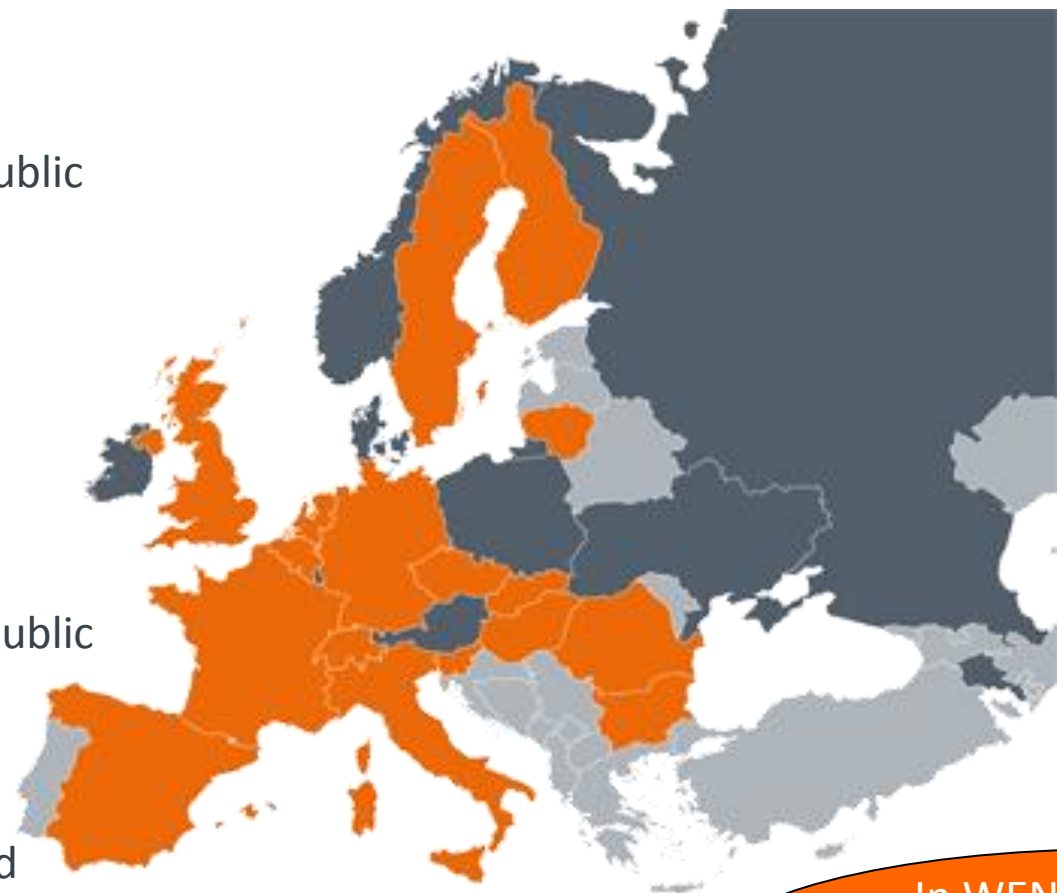
- WENRA is a network of Chief Regulators of EU countries with NPPs and Switzerland as well as of other interested European countries which have been granted observer status.
 - Original Terms of Reference signed on 4 February 1999, updated in 2010
 - In 1999 WENRA comprised of the heads of nuclear regulatory bodies from 10 countries.
 - The main objectives of WENRA at that time were to develop a common approach to nuclear safety and to provide an independent capability to examine nuclear safety in applicant countries.
 - Today (from March 2003) **17 countries** are represented in WENRA.
- The main objectives of WENRA are
 - **to develop a common approach to nuclear safety, with a commitment to continuous improvement of nuclear safety**
 - to provide an independent capability to examine nuclear safety in applicant countries and
 - **to be a network of chief nuclear safety regulators in Europe exchanging experience and discussing significant safety issues.**

WENRA (2/3)

Members & observers

Members

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



Observers

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

In WENRA countries :
~ 140 reactors in operation
and 5 types of NPP

Working groups

- Two working groups were launched to harmonise safety approaches between countries in Europe
 - Reactor Harmonisation Working Group (**RHWG**) and
 - Working Group on Waste and Decommissioning (**WGWD**).
 - ① The mandate of both working groups was to analyse the current situation and the different safety approaches, compare individual national regulatory approaches with the IAEA Safety Standards, identify any differences and propose a way forward to possibly eliminate the differences. The proposals were expected to be based on the best practices among the most advanced requirements for existing power reactors and nuclear waste facilities.
 - Working group dealing with inspection practices (WIG) was established and its mandate is fulfilled (report published in March 2012)
 - Ad-hoc working groups (as needed)
- The aim is to continuously improve safety and to reduce unnecessary differences between the countries.

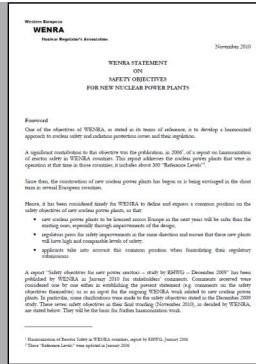
Agenda

- A few words about WENRA
- WENRA-RHWG activities
 - Publications on new reactors
 - Safety objectives for new NPPs
 - WENRA report on safety of new NPP designs
 - WENRA statement on safety of new NPP designs
 - Publications on existing reactors
 - Reference levels
 - Guidance on issue F (design extension)
- Outlook

WENRA & new reactors Publications

www.wenra.org

WENRA statement on safety objectives for new nuclear power plants (Nov 2010)



WENRA Statement on the Safety of New NPP designs (March 2013)



2008

2009

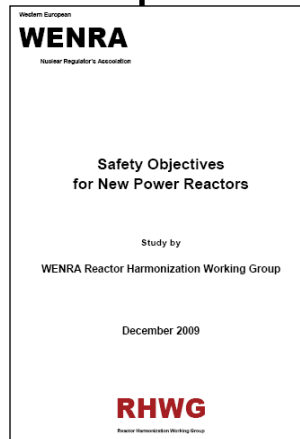
2010

2011

2012

2013

Western European
WENRA RHWG
Nuclear Regulators' Association



Safety Objectives for New Power Reactors: call for stakeholder comments (Sept 2009)

RHWG Booklet on Safety of new NPP designs: call for stakeholder comments (Nov 2012)



WENRA report on the safety of new NPP designs (March 2013)

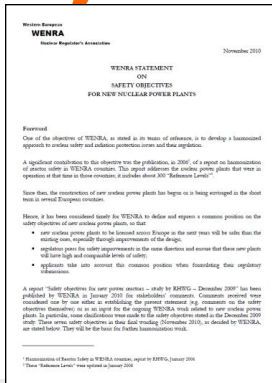
WENRA & new reactors

Safety objectives, published in 2010 (1/4)

- WENRA work on new reactors safety initiated in 2008
- Based on a review of the existing national and international (IAEA) documentation, which showed consistency among the documents on the main lines of expected safety improvements:
 - Reinforce the defence-in-depth (each level and their independence)
 - Extend the design (include severe accidents, as a new level of defence)
 - Reduce the necessity of off-site measures in case of accident
 - Consider safety issues in existing plants
 - Increase components and systems diversity
 - Increase protection against hazards
 - Pay more attention to security and safety/security interface
 - Better consider management of safety
- Development of WENRA safety objectives in 3 steps:
 1. RHWG report (scope, methodology, proposed objectives, areas of improvements, potential quantitative targets...) released in January 2010
 2. Stakeholders consultation through WENRA website
 3. **WENRA statement released in November 2010**

WENRA & new reactors

Safety objectives, published in 2010 (2/4)



- WENRA considers that the design of new NPPs shall take into account the operating experience feedback, lessons learnt from accidents, developments in nuclear technology and improvement in safety assessment.
- These safety objectives are formulated in a qualitative manner to drive design enhancements for new plants with the aim of obtaining a higher safety level compared to existing plants.

For instance, these safety objectives call for an extension of the safety demonstration for new plants, in consistence with the reinforcement of the defence in depth. Some situations that are considered as “beyond design” for existing plants, such as multiple failures conditions and core melt accidents, are considered in the design of new plants.

- Compared to currently operating NPPs, WENRA expects new nuclear power plants to be designed, sited, constructed, commissioned and operated with the objectives of: ▶

It has been considered timely for WENRA to define and express a common position on the safety objectives of new NPP, so that:

- new NPPs to be licensed across Europe in the next years will be safer than the existing ones, especially through improvements of the design;
- regulators press for safety improvements in the same direction and ensure that these new plants will have high and comparable levels of safety;
- applicants take into account this common position when formulating their regulatory submissions.

WENRA & new reactors

Safety objectives, published in 2010 (3/4)

- **O1. Normal operation, abnormal events and prevention of accidents**

- Reducing the frequency of abnormal events
- Better controlling abnormal events

- **O2. Accidents without core melt**

- **No or only minor off-site radiological impact**
- Reducing, as far as reasonably achievable, the core damage frequency
- Reducing, as far as reasonably achievable, the radioactive releases from all sources
- Reducing the impact of external hazards and malevolent acts

- **O3. Accidents with core melt**

- Reduce potential releases, also in the long term
 - **Accidents leading to large or early releases: practically eliminated**
 - **Other core melt accidents: only limited protective measures in area and time**

- **O4. Independence between all levels of defence-in-depth**

- **Enhancing the effectiveness of the independence**

- **O5. Safety and security interfaces**

- Integration, seeking synergies between safety and security

- **O6. Radiation protection and waste management**

- Reducing as far as reasonably achievable
 - Individual and collective doses
 - Radioactive discharges to the environment
 - Quantity and activity of radioactive waste

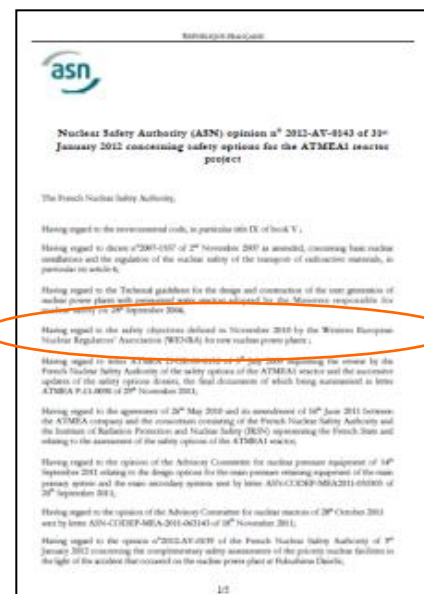
- **O7. Leadership and management for safety**

- The licensee shall have sufficient in house technical and financial resources
- From the design stage, all organisations

WENRA & new reactors

Safety objectives, published in 2010 (4/4)

- Use in **UK GDA process** : ONR Summary of the detailed design assessment of the Electricité de France SA and AREVA NP SAS UK EPR™ nuclear reactor (Step 4 of the GDA process) - 14 December 2011
 - “In 2009, a set of safety objectives for new power reactors (Reference 22), updated in November 2010. ONR was active in the development of these objectives and we consider them to be in line with our own SAPs, and therefore are included within GDA. As a result, we conclude that, once the GDA Issues have been dealt with, and the GDA Assessment Findings adequately addressed, the **UK EPR™ will meet the WENRA safety objectives for new reactors.**”
 - 22 WENRA statement on safety objectives for new nuclear power plants Western European Nuclear Regulators’ Association November 2010 Available via www.wenra.org
- Use in **France for the review of Atmea 1 safety options** (31 January 2012)
 - ASN opinion : “Having regard to the safety objectives defined in November 2010 by the Western European Nuclear Regulators’ Association (WENRA) for new nuclear power plants ; “
 - ASN staff report: **“ASN staff did not, at the safety options stage, identify any incompatibilities between the safety options for the ATMEA1 reactor and the safety objectives as set out by WENRA.** However, this will require confirmation in the event of a possible creation authorisation application as, so far:
 - the location site for the reactor is unknown, which implies that the scale of the external hazards (both natural and human) and the demographic and natural environment (in the context of the possibilities for effective counter-measures) are unknown;
 - the operator and the detailed design of the installation are still unknown.”



WENRA & new reactors

Report on safety of new NPP designs, published in 2013 (1/5)

- The WENRA safety objectives are by nature high level \Rightarrow When the WENRA statement was published in November 2010, it was already recognized that supplementing them with some more detailed common positions on selected issues would help to clarify the meaning.
 - “These 7 safety objectives ... will be the basis for further harmonization work... Based on these safety objectives, WENRA is currently developing positions on selected key issues for the design of new NPPs.”
- The 2013 WENRA report (“booklet”) was established as a result of the following steps:
 - **First phase : initial list of topics to be addressed**
 - Intentional crash of a commercial airplane
 - Defence-in-Depth approach for new NPPs
 - Independence of Defence-in-Depth levels
 - Practical elimination
 - Provisions to mitigate accidents with core melt and their radiological consequences
 - **Second phase : additions to this list**
 - Multiple failure conditions
 - External hazards
 - **Third phase : consistency check with lessons learned from Fukushima accident**
 - **Stakeholder consultation through WENRA website (late 2012)**
 - **Final version endorsed by WENRA (March 2013)**

WENRA & new reactors

Report on safety of new NPP designs, published in 2013 (2/5)

- The “booklet” sets out the common positions established by the RHWG on the selected key safety issues.
 - The safety issues were chosen on the basis that they were particularly relevant to the expectations for new reactors in comparison with existing reactors.
 - The topics were selected so that they would be relevant for the design of new reactors, constitute an entity and also to make it possible to complete the work by the end of 2012, taking into account the resources of the RHWG.
- The “booklet” presents WENRA safety expectations for the design of new NPPs.
 - These expectations are defined in addition to recent design requirements presented in international texts such as the ones presented in IAEA SSR-2/1 (2011).
 - The work was initiated and also a major part of the work was carried out before the TEPCO Fukushima Daiichi accident ⇒ the report discusses also some considerations based on the major lessons from this accident, especially concerning the design of new NPPs, and how they are covered in the new reactor safety objectives and the common positions.

WENRA & new reactors

Report on safety of new NPP designs, published in 2013 (3/5)



01 Introduction

02 WENRA safety objectives for new nuclear power plants

03 Selected key safety issues

- 03.1 Position 1: Defence-in-depth approach for new nuclear power plants
- 03.2 Position 2: Independence of the levels of Defence-in-depth
- 03.3 Position 3: Multiple failure events
- 03.4 Position 4: Provisions to mitigate core melt and radio-logical consequences
- 03.5 Position 5: Practical elimination
- 03.6 Position 6: External hazards
- 03.7 Position 7: Intentional crash of a commercial airplane

04 Lessons Learnt from the Fukushima Dai-ichi accident

- 04.1 External hazards
- 04.2 Reliability of safety functions
- 04.3 Accidents with core melt
- 04.4 Spent Fuel Pools
- 04.5 Safety assessment
- 04.6 Emergency preparedness in design

Annex 1 WENRA Statement on Safety Objectives for New Nuclear Power Plants, November 2012

WENRA & new reactors

Report on safety of new NPP designs, published in 2013 (4/5)

	O1 Normal operation, abnormal events & prevention of accidents	O2 Accidents without core melt	O3 Accidents with core melt	O4 Independence between all levels of DiD	O5 Safety & security interfaces	O6 Radiation protection & waste management	O7 Leadership & management for safety
Position 1: Defence-in-depth (DiD) approach for new NPPs	✓	✓	✓	✓			
Position 2: Independence of the levels of DiD				✓			
Position 3: Multiple failure events				✓			
Position 4: Provisions to mitigate core melt and radiological consequences			✓				
Position 5: Practical elimination			✓				
Position 6: External hazards		✓					
Position 7: Intentional crash of a commercial airplane		✓			✓		

WENRA & new reactors

Report on safety of new NPP designs, published in 2013 (5/5)

Common position on selected key safety issues



Lessons from the TEPCO Fukushima Daiichi accident



Defence-in-depth (DiD) Approach (Position 1)

Independence of the levels of DiD (Position 2)

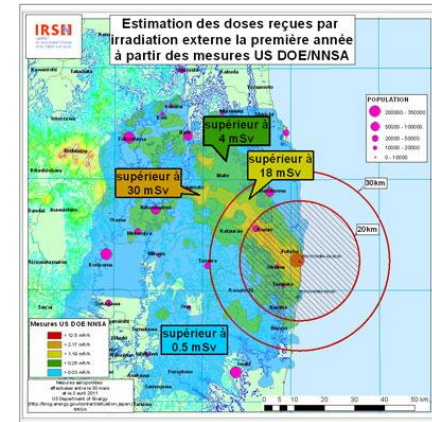
Provisions to mitigate core melt and radiological consequences (Position 4)

External hazards (Position 6)

Intentional crash of a commercial airplane (Position 7)

Practical elimination (Position 5)

Multiple failure events (Position 3)



WENRA & Existing reactors Publications (1/2)

www.wenra.org

Western European
WENRA
Nuclear Regulators Association

Western European
WENRA RHWG
Nuclear Regulators Association

2006

2008

2010

2011

2012

2013

The proposal by the WENRA Task Force about "Stress tests" specifications (April 2011)

Revised WENRA Terms of Reference (March 2010)

WENRA Conclusions arising from the Consideration of the Lessons from the TEPCO Fukushima Dai-ichi Nuclear Accident (May 2012)

Harmonisation of Reactor Safety in WENRA countries (Main Report, January 2006)

Western European Nuclear Regulators' Association
REACTOR HARMONIZATION WORKING GROUP

WENRA Reactor Safety Reference Levels
January 2008

Issue	Page
A. Safety Policy	5
B. Operating Organisations	3
C. Management System	5
D. Training and Authorisations of NPP staff	8
E. Design Basis Evaluation for Existing Reactors	10
F. Design Evaluation of Existing Reactors	19
G. Safety Classification of Systems, Structures and Components	20
H. Operational Limits and Conditions	21
I. Agency Management	25
J. System for Investigations of Events and Operational Experience Feedback	24
K. Maintenance, In-service inspection and Functional Testing	26
L.M. Emergency Operating Procedures and Severe Accident Management Guidelines	29
N. Contents and updating of Safety Analysis Report	31
O. Probabilistic Safety Analysis	33
P. Periodic Safety Reviews	35
Q. Plant Modifications	36
R. On-site Emergency Preparedness	38
S. Protection against Internal Flows	41

RLs for operating reactors (Jan 2008)

Progress towards harmonisation of safety for existing reactors in WENRA countries (Jan. 2011)

Pilot study on Long term operation (LTO) of nuclear power plants (March 2011)



WENRA Position Paper on Periodic Safety Reviews (April 2013)

WENRA & Existing reactors Publications (2/2)

www.wenra.org

WENRA Recommendation on
flaw indications (August 2013)

WENRA Conclusions arising from
the Consideration of the Lessons
from the TEPCO Fukushima Dai-ichi
Nuclear Accident (May 2012)

WENRA Statement regarding the revision of the
RLs for existing reactors taking into account the
lessons learned from the TEPCO Fukushima Dai-ichi Nuclear Accident (Oct 2014)



Western European
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Nuclear Regulators Association

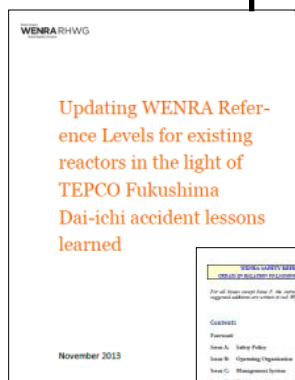
2012

2013

2014

2015

Western European
WENRA RHWG
Nuclear Regulators Association

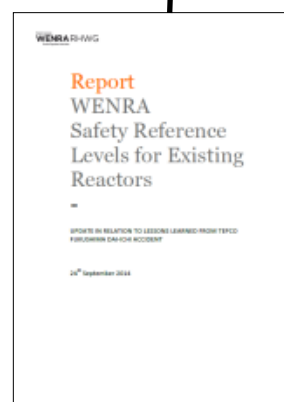


Public consultation on draft
updated RLs (Nov. 2013)

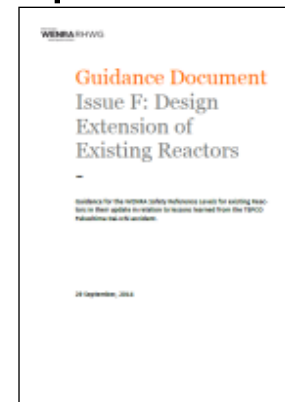
WENRA SAFETY REFERENCE LEVELS FOR EXISTING REACTORS
WENRA PUBLICATION TO SUPPORT THE WENRA STATEMENT ON FLAW INDICATIONS

For all States except those of the member states of the IAEA, all members shall be invited to study and sign the publication and to inform the secretariat, whenever appropriate, of any comments.

CONTENTS:	
Foreword	2
State A - Safety Policy	3
State B - Operating Organization	4
State C - Management System	6
State D - Training and Accreditation of Staff (also with Safety Engineers)	9
State E - Design Basis Evaluation for Existing Reactors	10
State F - Design Fundamentals of Existing Reactors	27
State G - Safety Classification of Structures, Systems and Components	35
State H - Operational Loads and Constraints	35
State I - Aging Management	39
State J - Review and Investigation of Events and Operational Experience Feedback	40
State K - Maintenance, Technical Inspection and Functional Testing	47
State L - Emergency Operating Procedures and Event Analysis Management Guidelines	49
State M - Causes and Typology of Safety Analysis Report (SAR)	50
State N - Probabilistic Safety Analysis (PSA)	55
State O - Periodic Safety Review (PSR)	56
State P - Risk Mitigation	60
State Q - Generic Emergency Preparedness	60
State R - Phenomena Ignored General Plans	60
State S - General Conclusions	61



RLs for existing reactors
(Sept 2014)



Guidance on
Issue F
(Oct 2014)

WENRA & Existing reactors

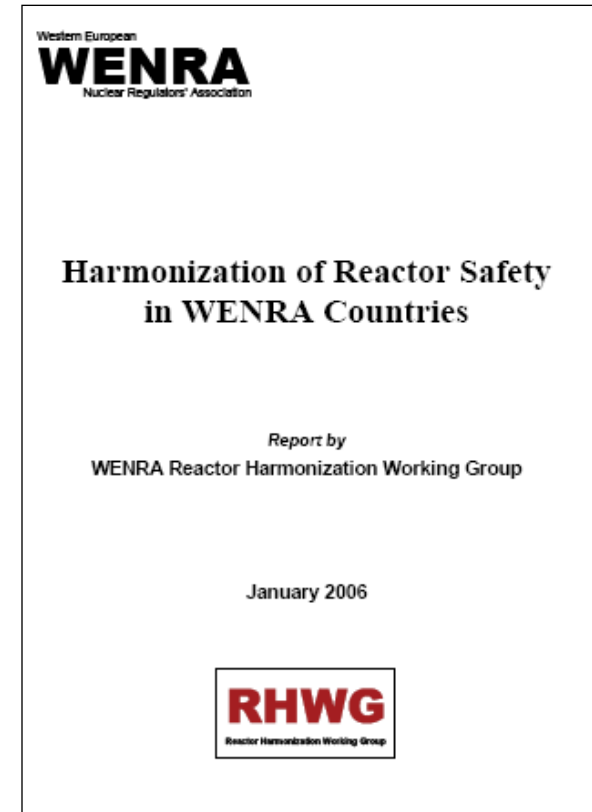
Learning from the Fukushima Dai-ichi accident

- **Spring 2011** : development of a specification for the EU Stress Tests
- **Spring 2012** : WENRA Conclusions arising from the Consideration of the Lessons from the TEPCO Fukushima Dai-ichi Nuclear Accident
 - WENRA is ready to tackle further issues as necessary on the basis of the lessons learned from the Fukushima accident. WENRA's commitment is to proceed along the path of **defining or revising existing RLs** as well as developing guidance documents for practical use by regulators.
 - Creation of new working groups in the RHWG:
 - **T1 Natural Hazards**
 - WENRA will produce updated harmonised guidance for the identification of natural hazards, their assessment and the corresponding assessment for “cliff-edge” (margins) effects. **RLs will be updated accordingly.**
 - **T2 Containment in Severe Accident**
 - WENRA will **review RLs** in light of the various measures identified to prevent containment overpressurisation, including those relevant for hydrogen mitigation and containment venting, **and modify them if necessary.**
 - **T3 Accident Management**
 - WENRA will **review RLs** in light of the various measures identified in relation to organisational and material arrangements for preventing or mitigating a significant radiological release, **and modify them if necessary.**
 - **I.4 Mutual assistance**
 - WENRA will put in place arrangements for mutual assistance amongst regulatory bodies in responding to nuclear accidents in one of its members' states.
 - The results from the stress tests and conclusions from the CNS 2012 will be incorporated as soon as they become available.

WENRA & Existing reactors

RLs for existing NPPs: 2006-2011

- Established in 2006, updated in 2007 and 2008
- Set of **about 300 consensual reference levels (RLs)** throughout WENRA countries
 - Safety management
 - safety policy, operator's organization,
 - quality management, training and certification
 - Design
 - design check and improvement, safety classification, design envelope of light-water reactors
 - Operation
 - operating limits and conditions, ageing management
 - experience feedback, maintenance, accident procedures, accidents beyond the design basis
 - Safety verification
 - contents of the safety report, PSA, re-examinations, changes
 - Emergency situations
 - on-site emergency preparedness, internal fires
- Status report published by WENRA in March 2011



WENRA & Existing reactors

RLs update in the light of Fukushima Dai-ichi accident

Area where
most
changes
occurred

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

New issue



11 February 2015

OECD/NEA Workshop on Innovations in Water Cooled Reactor Technologies

WENRA & Existing reactors

RLs for existing NPPs: 2014 version

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 RLS**

WENRA & Existing reactors

Guidance on issue F (design extension)

- Published in October 2014 to
 - provide explanations of the intent of the RLs of Issue F,
 - contribute to a consistent interpretation
 - permit insights into the considerations which have led to their formulation.
- Goes through each RL of issue F and, where necessary also provides background information (for easy reference)
- It also includes:
 - a listing for **design extension conditions** which are needed to be taken into account in the safety analyses.
 - a listing of initiating and consequential events for design basis accidents although it is relevant for Issue E (Design Basis Envelope for Existing Reactors).
 - This contributes to an overall picture of the foundation for both design basis accidents and design extension conditions

Guidance Document

Issue F: Design Extension of Existing Reactors

-

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Outlook

- Post Fukushima Dai-ichi actions :
 - Developing guidance on natural hazards (earthquake, floods, extreme weather)
 - Finalize the database DEEPER (giving general background information about European reactor designs, useful in an emergency)
- Other ongoing tasks
 - Follow-up on implementation of new RLs, also in the context of the new EU Directive on Nuclear Safety
 - Overall review of the RLs, to take account of new IAEA publications and safety development
 - Develop WENRA views on new topics, having safety implications both on existing and new reactors:
 - Passive systems
 - Practical elimination
 - ...

Thank you.