Western European
WENRA
Nuclear Regulators' Association

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Reactor Harmonization Working Group

# WENRA safety objectives for new nuclear power plants

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# Background

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- **WENRA work on new reactors safety initiated in 2008**
  - RHWG report released in January 2010
  - Stakeholders consultation through WENRA website
  - WENRA statement released in November 2010

- **What are "new NPPs"**
  - **projects that are under way or planned in the short term**
  - **not address Generation 4**

- **Work on new NPPs safety can also be useful to further enhance the safety of existing NPPs**

# Safety objectives for new NPPs
# Review of the documentation

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- **a review of the existing national and international documentation showed consistency on the main lines of expected safety improvements compared to existing reactors:**
  - **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 issues**
  - **Better consider management of safety**

# Safety objectives for new NPPs Structure

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***7 safety objectives calling for improvements on the following issues, compared to existing reactors***

**O1. Normal operation and abnormal events**

**O2. Accidents without core melt**

**O3. Accidents with core melt**

- ***This implies that new reactors are designed to cope with core melt situations: a major step in safety compared to existing reactors***

**O4. Independence between all levels of defence**

**O5. Safety and security interfaces**

**O6. Radiation protection and waste management**

**O7. Management of safety, from the design stage**

# Safety objectives for new NPPs
# Link with IAEA safety principles

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**These 7 safety objectives are derived from the IAEA Safety Fundamentals document (SF-1) which establishes ten safety principles (SP)**

| IAEA SF-1 safety principles | | WENRA safety objectives | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | O1 | O2 | O3 | O4 | O5 | O6 | O7 |
| SP 3 | Leadership and management for safety | | | | | ✓ | | ✓ |
| SP 5 | Optimization of protection | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| SP 6 | Limitation of risks to individuals | | ✓ | ✓ | | | ✓ | |
| SP 7 | Protection of present and future generations | | | | | | | |
| SP 8 | Prevention of accidents | ✓ | ✓ | ✓ | ✓ | ✓ | | |

# WENRA safety objectives for new reactors (1/4)

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- **O1. Normal operation, abnormal events and prevention of accidents**
  - reducing the frequencies of abnormal events by enhancing plant capability to stay within normal operation.
  - reducing the potential for escalation to accident situations by enhancing plant capability to control abnormal events.

- **O2. Accidents without core melt**
  - ensuring that accidents without core melt induce[1] no off-site radiological impact or only minor radiological impact (in particular, no necessity of iodine prophylaxis, sheltering nor evacuation[2]).
  - reducing, as far as reasonably achievable,
    - the core damage frequency taking into account all types of credible hazards and failures and credible combinations of events;
    - the releases of radioactive material from all sources.
  - providing due consideration to siting and design to reduce the impact of external hazards and malevolent acts.

# WENRA safety objectives for new reactors (2/4)

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## ➢O3. Accidents with core melt

- ❑**reducing potential radioactive releases to the environment from accidents with core melt[1], also in the long term[2], by following the qualitative criteria below:**
  - accidents with core melt which would lead to early[3] or large[4] releases have to be practically eliminated[5] ;
  - 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 safety objectives for new reactors (3/4)

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- **O4. Independence between all levels of defence-in-depth**
  - **enhancing the effectiveness of the independence between all levels of defence-in-depth, in particular through diversity provisions (in addition to the strengthening of each of these levels separately as addressed in the previous three objectives), to provide as far as reasonably achievable an overall reinforcement of defence-in-depth.**
- **O5. Safety and security interfaces**
  - **ensuring that safety measures and security measures are designed and implemented in an integrated manner. Synergies between safety and security enhancements should be sought.**
- **O6. Radiation protection and waste management**
  - **reducing as far as reasonably achievable by design provisions, for all operating states, decommissioning and dismantling activities :**
    - **individual and collective doses for workers;**
    - **radioactive discharges to the environment;**
    - **quantity and activity of radioactive waste.**

# WENRA safety objectives for new reactors (4/4)

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- **O7. Leadership and management for safety**
  - **ensuring effective management for safety from the design stage. This implies that the licensee:**
    - establishes effective leadership and management for safety over the entire new plant project and has sufficient in house technical and financial resources to fulfil its prime responsibility in safety;
    - ensures that all other organizations involved in siting, design, construction, commissioning, operation and decommissioning of new plants demonstrate awareness among the staff of the nuclear safety issues associated with their work and their role in ensuring safety.

# Safety objectives for new NPPs
# Why no quantitative safety target

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- **Safety objectives should be understandable by the public**
  - **For this purpose, numerical values may not be more informative**
  - **These qualitative safety objectives point out clear expectations (e.g. O3)**

- **However, more specific (including quantitative) targets could help in the dialogue between regulators and the industry**
  - **If quantitative values are used, they should be targets and not acceptance criteria (compliance may noy be enough)**

# Conclusion: Main messages conveyed by these safety objectives

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- **Taking into account the operating experience feedback, lessons learnt from accidents, developments in nuclear technology and improvement in safety assessment, WENRA considers that new reactors shall benefit from design enhancements compared to existing reactors.**

- **WENRA considers that these safety objectives reflect the current state of the art in nuclear safety and can be implemented at the design stage using the latest available industrial technology of power reactors.**

- **The WENRA safety objectives should be used as a reference when identifying any reasonably practicable safety improvement in periodic safety review of existing NPPs**

# Outlook

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- **Based on these safety objectives, WENRA is currently developing position papers on selected key issues for the design of new NPPs, such as**
  - **Air plane crash**
  - **Defence-in-depth approach, independence between levels of defence**
  - **Core melt management**
  - **Practical elimination**

- **Objective: issue a booklet by the end of 2012**