

# INTERNATIONAL SEMINAR ON NUCLEAR SAFETY & SECURITY CHALLENGES OF THE 21st CENTURY

## EU approach to safety of new NPP

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## Introduction

The **fundamental safety objective** for NPP safety is to protect people and the environment from harmful effects of ionizing radiation.

To achieve this objective **specific safety objectives** are defined to:

- **limit the radiation exposure of workers, of public and the release to the environment;**
- **design the NPP against Postulated Events (DBE & DEC)<sup>1</sup>**
- **minimize the likelihood of events that might lead to core damage**
- **mitigate the consequences of such events if they were to occur.**

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<sup>1</sup> DBE = Design Basis Event; DEC = Design Extended Conditions

## Introduction (cont.)

The IAEA Safety Standard NS-R-1: "Design of NPP", making reference to the Safety Fundamentals publication:

- **defines** the general (and specific) Safety Objectives to be considered in the design of NPP
- **gives** *directives* to derive requirements to be implemented in the design of a NPP

This standard NS-R-1 has gone through a review process and is quite ready for being issued by the IAEA (*maybe after reconsidering some aspects due to the post-Fukushima*)

## EU Approach for Safety Objectives for new NPP

- In the European Union (EU) the nuclear safety is a **national responsibility**: each country is responsible to establish the nuclear safety objectives and criteria for nuclear facilities
- To develop a **harmonized approach** to nuclear safety and radiation protection issues and their regulation in EU, in 1999 was created the WENRA
- Jukka Laaksonen, General Director of the Finnish Radiation and Nuclear Safety Authority (STUK) acts at present as WENRA's chairman.

Western European

**WENRA**

Nuclear Regulator's Association

## EU Approach for Safety Objectives for new NPP (cont.)

WENRA has underlined the importance for the **design of new NPPs** to:

- take into account:
  - the operational experience
  - the lessons learned from accidents and
  - the development of technology and safety assessments.
- define a common position in EU Member States (MS) on the Safety Objectives (SO) of new NPPs

## EU Approach for Safety Objectives for new NPP (cont.)

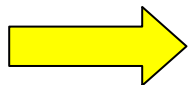
The development of common position aims at:

- having higher levels of safety for new NPPs to be licensed in EU ;
- harmonizing the EU regulator's requ's for safety improvements ensuring so far comparable levels of safety;
- ensuring that **a design** considered suitable in one MS would not be unsuitable in another MS

**Differences related to the siting, site interfaces and later to the quality of construction and operation remain.**

## WENRA Safety Objectives for new NPP

- A short document "**Safety Objectives for new power reactors**" has been issued by WENRA in Nov. '10
- It is based on a study of existing national & international requ's and on a systematic investigation of the IAEA Fundamental Safety Principles
- It formulates 7 SO's in a qualitative manner.
- They reflect the current state of the art in nuclear safety.
- They are not considered static and shall be revised in the future



WENRA is currently elaborating **technical positions** to address the SO's implementation in the design of NPPs.

## **WENRA Safety Objectives for new NPP (cont.)**

The **7 SOs** refer to improvements in the following areas:

**O1. Normal operation, abnormal events & prevention of accidents**

**O2. Accidents without core melt**

**O3. Accidents with core melt**

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

**O5. Safety and security interfaces**

**O6. Radiation protection and waste management**

**O7. Leadership and management for safety**

## WENRA Safety Objectives for new NPP (cont.)

### O1. Normal operation, abnormal events & 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 no off-site radiological impact or only minor radiological impact (no necessity of iodine prophylaxis, sheltering nor evacuation).
- 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 NPP (cont.)

### O3. Accidents with core melt

- reducing potential radioactive releases to the environment from accidents with core melt, also in the long term, by following the qualitative criteria below:
  - 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.

### O4. Independence between all levels of defense-in-depth

- enhancing the effectiveness of the independence between all levels of defense-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 defense-in-depth.

## WENRA Safety Objectives for new NPP (cont.)

### 05. Safety and security interfaces

- ensuring that safety measures and security measures are designed and implemented in an integrated manner. Synergies between safety and security should be sought.

### 06. 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.

### 07 . 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 NPP project and has sufficient in house technical and financial resources to fulfill 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.

## Challenges for regulators

- The WENRA SO's for new NPP are qualitative therefore they need **specific technical positions** for the application. These positions shall be stated by the National Regulators.
- WENRA is developing technical common positions which should harmonize the view of Regulators in EU MSs

## Challenges for regulators

Challenges:

A. Identify the “credible combinations of events” to be considered in the frame of SO n.2 (level three of defense in depth)

- Which credible combinations of independent events are to be considered in the design eliminating the possibility that they lead to CD?
- Which requ’s to be applied to safety analyses of these events?

## Challenges for regulators (cont.)

### B. To be defined the requirements for systems designed to cope with the DEC conditions:

- same requirements as for the systems designed to cope with DBA (safety classification, redundancy, diversity, physical separation,...)?
- accept requirements less stringent for “DEC systems” than for “DBA systems”?
- accept the use in the accident analysis of DEC of systems classified as “non-nuclear safety” DEC ?

## Challenges for regulators (cont.)

### C. Accident Analysis (AA) requirements (models, assumptions, etc.) for DEC accident analysis:

- the same conservative approach as for AA of DBE?
- use of best estimate assumptions & models for DEC ?

### D. For systems designed to provide means for SAM:

- Which requirements shall be requested by the regulator at design stage ?
- What best estimate assumptions and models is expected to be applied in the analyses
- How to consider the uncertainties ?

## Conclusions

1

harmonizing Safety Objectives in EU is a necessary step in order to have common high level safety among MS for new NPP

2

additional harmonization effort is needed from national Regulators (challenges) to develop technical positions to address the implementation of agreed SOs

## Conclusions

3

**the WENRA SOs** address “**in primis**” the improvements of the design conception and the level of implementation of the defense in depth (the first 4 levels)

4

**they** also consider improvements for siting, design against External Events and management for safety since the design phase.

5

**they** will probably receive a **review** following Fukushima lessons (e.g. siting, DEC events, design provisions and preparedness for accident management, etc.)