

WENRA views on Defence-in-Depth for new reactors

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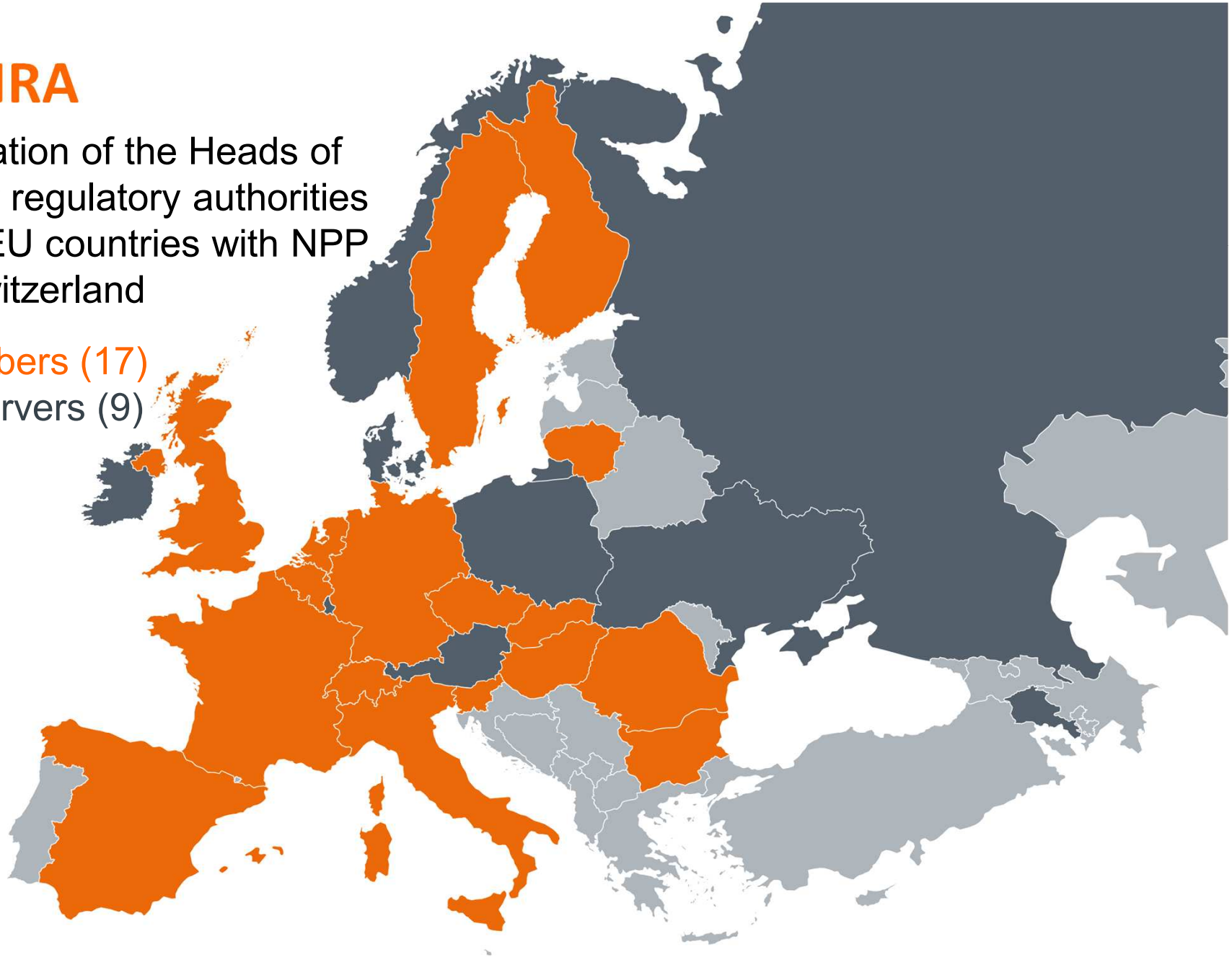
Contents

- WENRA
 - RHWG
 - Safety objectives
 - Key safety issues for new NPPs
- Defence-in-Depth for new reactors
- Independence between different levels of DiD
- Conclusion

WENRA

Association of the Heads of nuclear regulatory authorities of the EU countries with NPP and Switzerland

- Members (17)
- Observers (9)



WENRA RHWG task

Harmonization is one of the WENRA objectives

→ Reactor Harmonization Working Group (RHWG)

- Reports to WENRA
- Development of **Reference Levels for existing reactors**
 - 2006, updated 2008, new revision under preparation
- Work on new reactors started in 2008
- Development of **WENRA Safety Objectives for new NPP**
 - WENRA Statement (November 2010)
- Selection of key safety issues for new reactors
 - WENRA Statement and **WENRA Report on Safety of new NPP designs** (March 2013)
 - Includes lessons learnt from the Fukushima accident

WENRA Safety objectives

- O1. Normal operation, abnormal events and prevention of accidents
- O2. Accidents without core melt
- O3. Accidents with core melt
- O4. Independence between all levels of DiD
 - enhancing the effectiveness of the independence between all levels of DiD, in particular through diversity provisions to provide as far as reasonably achievable an overall reinforcement of DiD.
- O5. Safety and security interfaces
- O6. Radiation protection and waste management
- O7. Leadership and management for safety

Selected key safety issues for new NPPs

Position 1: DiD approach for new nuclear power plants

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

Defence-in-Depth for new reactors

A clear expectation to address in the original design what was often “beyond design” for the previous generation of reactors, such as multiple failure events and core melt accidents.

Provisions against single initiating events and multiple failure events:

- two complementary approaches
- share the same objective: controlling accidents to **prevent their escalation to core melt conditions**
- prefer to treat the multiple failure events as part of the 3rd level of DiD (sub-levels 3.a and 3.b)

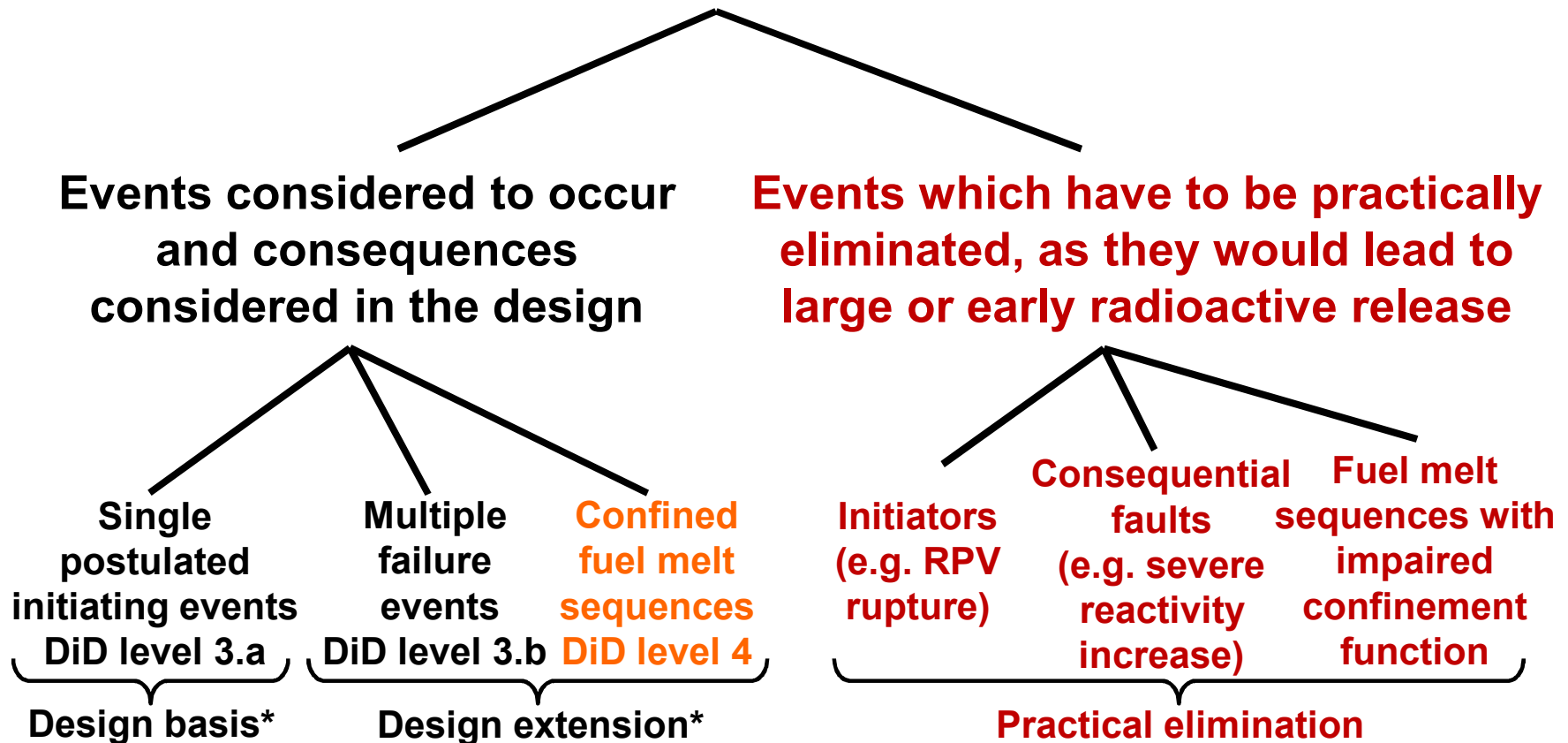
WENRA’s view is also that clear distinction should be made between accidents without core melt (O2) and those with core melt (O3). Thus, **core melt accidents** should be treated **on a separate level of DiD**.

| Levels of DiD | Associated plant condition categories | Objective |
|----------------------|---|---|
| Level 1 | Normal operation | Prevention of abnormal operation and failures |
| Level 2 | Anticipated operational occurrences | Control of abnormal operation and failures |
| Level 3 | DiD Level 3.a Postulated single initiating events | Control of accident to limit radiological releases and prevent escalation to core melt conditions |
| | DiD Level 3.b Postulated multiple failure events | |
| Level 4 | Postulated core melt accidents | Control of accidents with core melt to limit off-site releases |
| Level 5 | - | Mitigation of radiological consequences of significant releases of radioactive material |

| Levels of DiD | Associated plant condition categories | Objective | Essential means | Radiological consequences |
|----------------------|---|--|---|--|
| Level 3 | DiD Level 3.a Postulated single initiating events | Control of accident to limit radiological releases and prevent escalation to core melt conditions | Reactor protection system (RPS), safety systems, accident procedures | No off-site radiological impact or only minor radiological impact |
| | DiD Level 3.b Postulated multiple failure events | | Additional safety features, accident procedures | |
| Level 4 | Postulated core melt accidents | Control of accidents with core melt to limit off-site releases | Complementary safety features to mitigate core melt, management of accidents with core melt (severe accidents) | Limited protective measures in area and time |

Practical elimination

SAFETY DEMONSTRATION



* Comparable to IAEA SSR-2/1

Independence between different levels of DiD

Basic safety expectations

Independence to the extent reasonably practicable between different levels of DiD

- Failure of one level of DiD does not impair other levels of DiD involved in the protection against or mitigation of the event.

This requires adequate application of:

- physical separation, structural or by distance;
- functional isolation;
- diversity.

Independence between different levels of DiD Implementation

In particular, and to the extent reasonably practicable,

- 1) DiD **level 3** should be independent from levels 1 and 2,
- 2) DiD **sub-levels 3.a and 3.b** should be independent from each other,
- 3) DiD **level 4** should be independent from all the other levels.

Specific considerations on emergency AC power supply, cable separation, RPS and other I&C, and containment.

Conclusion

Defence-in-Depth is a key concept of the safety objectives established by WENRA for new nuclear power plants.

The DiD concept should be strengthened in all its relevant principles.

Thank you