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Development and Application of Modern Safety Requirements as Part of GRS Technical Support for ANVS

Background

- Dutch licensing authority decided to develop a modern set of safety requirements for NPPs und RRs
 - Plans to build NPP in The Netherlands
 - Modification project of a RR
 - New built project of a RR
 - Integrated regulatory framework for NPPs and RRs required
- GRS was contracted to provide enhanced technical support during the pre-licensing activities
 - Development of safety requirements
 - Review process of the safety analysis report (SAR)

Boundary Conditions for the Dutch Safety Requirements for Nuclear Reactors

- Requirements should be **technological neutral**
 - Applicable to both PWR and BWR
 - Not tailored to a specific vendor design
- Requirements should be **goal oriented**
 - Exceptions: prescriptive requirements if a specific technical solution is expected by the regulator
- Most **recent developments in nuclear safety** should be taken into account

Development Steps for Dutch Safety Requirements

- International basis: IAEA, European Council and WENRA
- Implementation of WENRA Defence-in-Depth Concept
- Implementation of a protection concept against internal and external hazards
- Include lessons learned from Fukushima NPP accidents
- IAEA Expert Mission to review the Dutch Safety Requirements
- Develop objectives and goals of
 - Organisational Review Plan
 - Technical Review Plan

Implementation of WENRA Defence-in-Depth Concept

Levels of defence in depth	Associated plant condition categories	Objective	Essential means	Radiological consequences
Level 1	Normal operation	Prevention of abnormal operation and failures	Conservative design and high quality in construction and operation, control of main plant parameters inside defined limits	Regulatory operating limits for discharge
Level 2	Anticipated operational occurrences	Control of abnormal operation and failures	Control and limiting systems and other surveillance features	
Level 3	Level 3.a Postulated single initiating events	Control of accident to limit radiological releases and prevent escalation to core melt conditions	Reactor protection system, safety systems, accident procedures	No off-site radiological impact or only minor radiological impact
	Level 3.b Postulated multiple failure events		Additional safety features, accident procedures	
Level 4	Postulated core melt accidents (short and long term)	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
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

Implementation of a Protection Concept against Internal and External Hazards

- For external hazards: **design basis events** with a exceeding frequency of **10^{-4} 1/a**
- **Combination** of hazards
 - Frequency
 - Possible damage of SSCs
- Loadings shall be derived from a **hazard curve**
- Consideration of hazards **exceeding** the **design basis events**
- **Availability** of **redundant trains**
 - Internal hazards: loss of only redundant train
 - External hazards: no failure of redundant trains

Lessons Learned from Fukushima NPP Accidents

- A **diverse ultimate heat sink** is required
- **Accessibility** and **habitability** of main control room, supplementary control room and emergency control centre
 - Conditions during and after external events
- Enhanced Requirements for **emergency power supply**
 - Alternative emergency power supply
 - Protected connection points for mobile equipment
- **Spent fuel pool** with **gas-tight barrier**

Structure of Dutch Safety Requirements

Dutch Safety Requirements for Nuclear Reactors Technical Part

1. Fundamental objectives
2. Technical safety concept
3. Technical requirements
4. Postulated operating conditions and events
5. Requirements for safety demonstration
6. Requirements for operating rules
7. Requirement for documentation

Annex 1
Postulated
Events

Annex 2
Hazards


Annex 3
Single
Failure
Concept

Annex 4
Safety
Demonstration

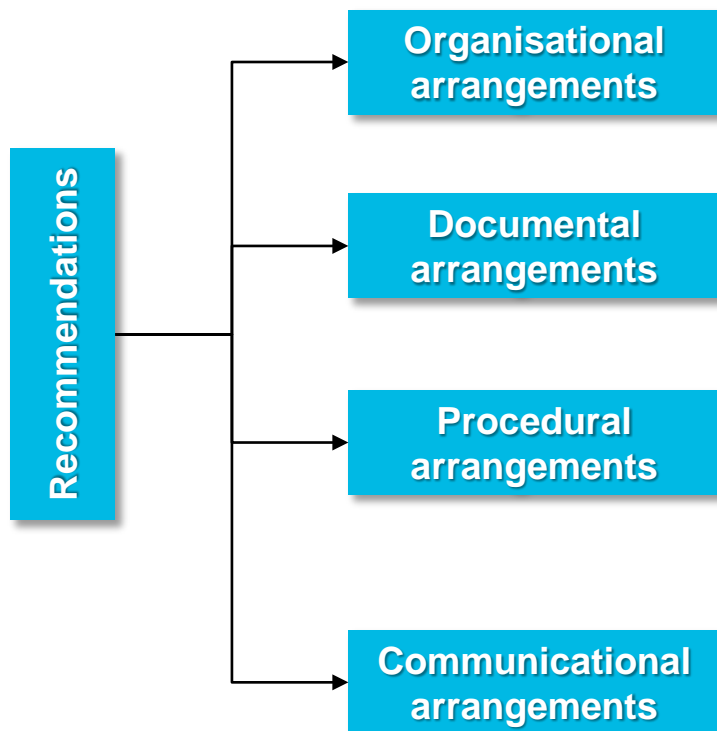
Annex 5
Definitions

Annex 6
Research
Reactors

Objective and Goals of Organisational Review Plan

Goals	<ul style="list-style-type: none">● Efficient and effective review● Guidance for the organisation / preparation of the review phase
Objectives	<ul style="list-style-type: none">● Establishing organisational and communicational means before SAR submittal
	<ul style="list-style-type: none">● Enhancing common understanding of review process<ul style="list-style-type: none">– Description of key success factor
	<ul style="list-style-type: none">● Communication of ANVS expectations to all stakeholders
	<ul style="list-style-type: none">● Responsibilities clearly communicate
	<ul style="list-style-type: none">● Efficient use of resources

Structure of Organisational Review Plan



- Recommendations for the pre-review phase
- Selection of examples of arrangements
- List of action items
 - Checklist with specific actions to be performed

Communicational Arrangements

- Communication only to adjacent organisations



Objective and Goals of Technical Review Plan

Goals	<ul style="list-style-type: none">● Efficient and effective review● Guidance for the technical review of a SAR
Objectives	<ul style="list-style-type: none">● Contributing to a high quality review (particularly, all safety aspects covered)
	<ul style="list-style-type: none">● Promoting a strictly safety-oriented review approach
	<ul style="list-style-type: none">● Uniformity of the review<ul style="list-style-type: none">– Harmonized review approach among the reviewers– all applicants shall be treated equally → transparency
	<ul style="list-style-type: none">● Communication of expectations concerning<ul style="list-style-type: none">– Scope,– Structure and– level of detail in the SAR

Common Review Steps for Technical Areas



- From **high-level** safety considerations to more **detailed** (technical) **issues**
 - see multi step process of ONR’s GDA process
- **Stepwise process**
 - to improve traceability and predictability of the reviewers evaluation
 - to support applicant drafting SAR
- **Primarily for design related issues**
 - but approach also applicable for non-design related issues

Content of the Technical Review Plan

- **Description of the general review approach**
- For each **review area**¹⁾ generic description of the expected **content relevant for nuclear safety**
- Addresses **interfaces between review areas**
 - SAR chapters reviewed by different experts
 - Example 1: I&C is a own review area, but has interfaces to nearly all technical review areas
 - Example 2: Internal hazards addressed in several review areas

¹⁾ Ideally, a review area represents a chapter of the SAR

Summary

- Dutch Safety Requirements for NPPs and RRs represent the most recent state of the art in science and technology
- A Review plan was developed for a efficient and effective review process, including
 - Organisational Review Plan
 - Technical Review Plan
- Currently, both documents are applied in SAR review processes