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IAEA Safety Standards for Fire Protection

ENSREG (European Nuclear Safety Regulator Group)
European High Level Group on Nuclear Safety and Waste Management
2nd Topical Peer Review – 1st Stakeholder Engagement Event
22 June 2021 13:45-14:00
Virtual Meeting through WEBEX/SCIC platform

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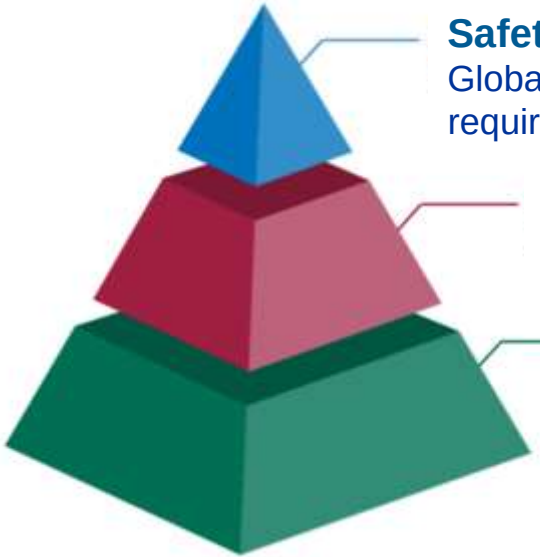
Contents

1. **Structure of IAEA Safety Standards**
2. **IAEA Standard for Fire Safety in Operation of NPPs**
   - Revision of NS-G-2.1 - DS503 “Protection against Internal and External Hazards in the Operation of Nuclear Power Plants”
   - Overview of the provision of fire protection in DS503
   - Reflected operating experiences in Fire Protection to DS503
3. **OSART experiences for Fire Safety**
4. **IAEA Standard for Fire Safety in Design of NPPs**
   - SSG-64 (DS494) “Protection against Internal Hazards in the Design of NPPs”
   - Guides for Safety Analysis (SSG-2 / SSG-3&4)
5. **IAEA TECDOC-1944 “Fire Protection in NPPs” (2021)**

1. Structure of IAEA Safety Standards



Safety Fundamentals
Global reference point for the high level of safety required for use of nuclear energy

Safety Requirements
- Functional conditions that must be met to ensure protection of people and environment

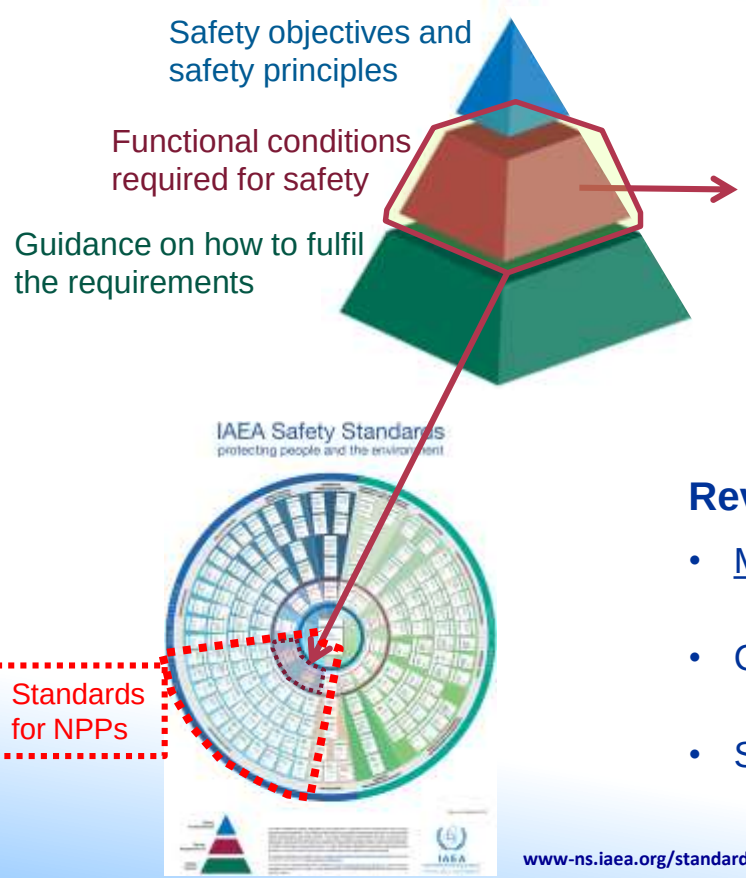
Safety Guides
- Guidance to fulfill the requirements
- User-friendly and up-to-date practical guidance representing good/best practices

Structured QA process

- Science-based and high technical quality
- Expert consensus – Peer and Member-state review
- Transparent and open process

1. Structure of IAEA Safety Standards -

Safety Standards for Design, Commissioning and Operation of NPPs



Revised after the Fukushima Daiichi accident Main changes

- Margins to withstand external events and to avoid cliff-edge effects
- Considerations for Multiple facilities / activities at one site
- Strengthened considerations of Defense in Depth

www-ns.iaea.org/standards/

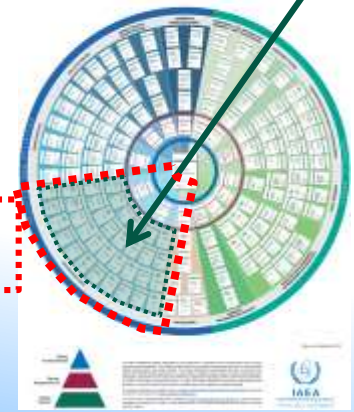
1. Structure of IAEA Safety Standards -

Safety Standards for Design, Commissioning and Operation of NPPs

Safety objectives and safety principles

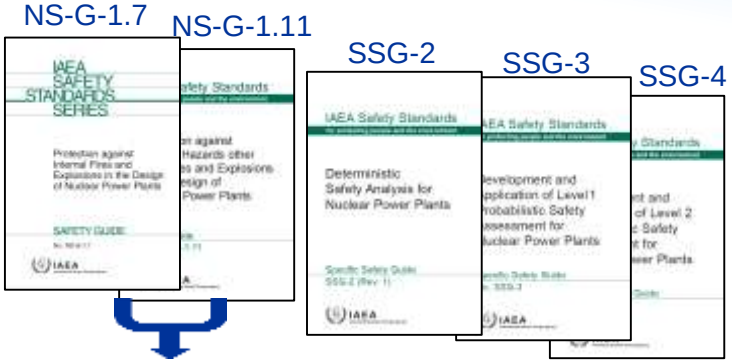
Functional conditions required for safety

Guidance on how to fulfil the requirements



Standards for NPPs

Guides include Fire Safety in Design / Safety Assessment



SSG-64 (DS494)

Protection against Internal Hazards in the Design of NPPs

Guides include Fire Safety in Operation

SSG-XX (DS503)

Protection against Internal and External Hazards in the Operation of NPPs

www-ns.iaea.org/standards/

2. Revision of NS-G-2.1 "Fire Safety in the Operation of Nuclear Power Plants" – DS503

Specific Draft Standard DS503 "Protection against Internal and External Hazards in the Operation of Nuclear Power Plants"

- Revision work for NS-G-2.1 (2000) approved in 2017
  - Wider range of hazards and their combination must be addressed in operational safety, according to IAEA Vienna Declaration on Nuclear Safety
  - Segregation of Design & Operation, Consideration for combination of internal & external hazards are recommended in TM of IAEA&EC JRC (2015 in Brussels)

- Draft Review by Member States and Internal Review Committees are Done (Step 11)

- Waiting for Final Review by Committee on Safety Standard (Publication : 2022 or 2023)

Scope of DS503

- Facilities to be applied: Operation of Water-cooled Nuclear Power Plant
- Topics

Hazard Management for Prevention, Protection & Mitigation by Operating measures against:
- Internal fires
- Internal explosions
- Internal flooding
- Electromagnetic interference
- Release of hazardous substances, etc

Hazard Management for Protection & Mitigation by Operating measures against:
- Seismic hazards
- External floods
- Extreme winds
- External fires
- Other extreme meteorological conditions
- Volcanism
- Aircraft crash
- Biological phenomena, etc

Overview of the provision of fire protection in DS503

- Draft DS503 para. 1.6. states:

  "Operating experience gained from incidents and accidents in nuclear power plants around the world has continued to demonstrate that fire continues to be an important risk contributor in many Member States. […]"

- Recommendation in original NS-G-2.1 is sustained or enhanced in main text & **Appendix I**

  Internal Fire: (approx. 10 pages) >> Other hazards (1-2 pages)

- Recommendations for internal fire are referred from recommendations on other hazards

- More clear interface/segregation with Design guide: SSG-64(DS494) "Protection against Internal Hazards in the Design of Nuclear Power Plants"

Reflected operating experiences in Fire Protection to DS503

- Linkage to SSG-64 and SSG-30 (Safety Classification)
- Nuclear Security Aspect : Communication with Security Staff in Manual Firefighting, etc.
- Enhanced items to be trained (Risk of hot work, Importance of ventilation, status of fire dampers, etc.)
- More realistic assumption in case of relying on external firefighting service
  - Possible delay of their arrival should be taken into account
  - A well-balanced notification protocol for reliability and rapidness should be established
- Using latest terminology
  - “Fire area” → “Fire component”
  - The term “combustible liquids” is deleted, & united to “flammable liquids”, according to “Globally Harmonized System of Classification and Labelling of Chemicals (GHS)” UNECE
- Consideration for flooding hazards by fire water, and combination with other hazards
- External Fire

3. OSART experiences for fire safety

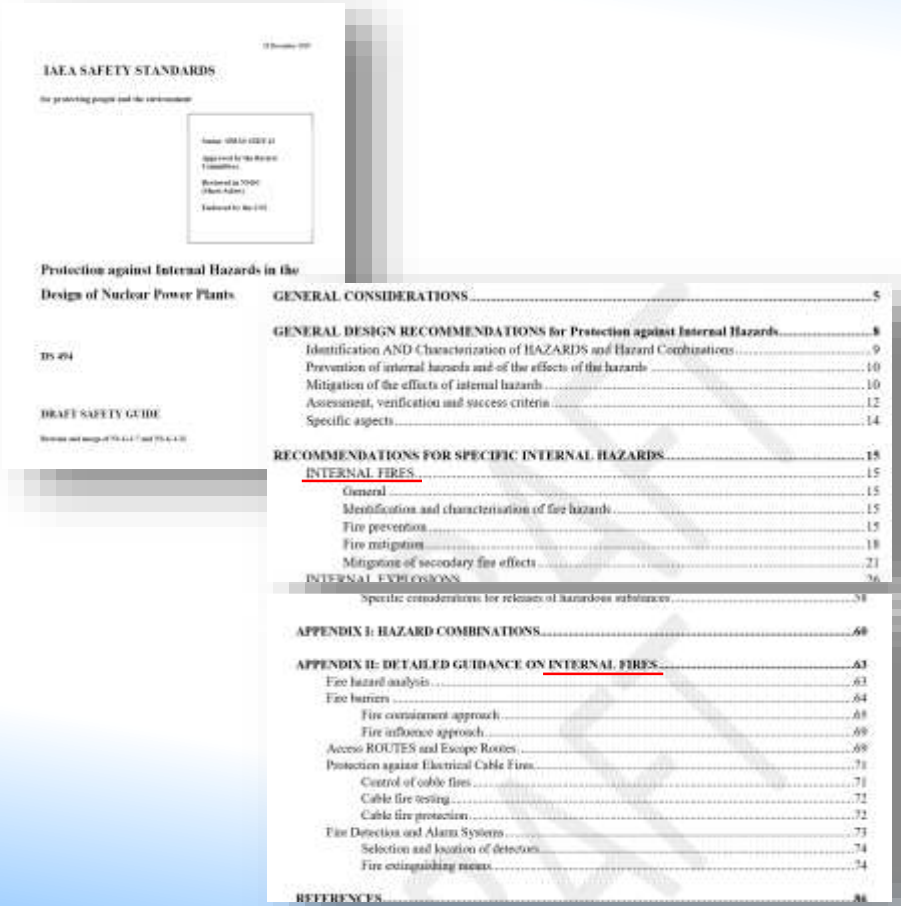
- **Established in 1982**
- **210 Missions for 37 Member States' NPPs and their Corporate functions to provide:**
  - **Independent assessment of the Status of NPP Operational Safety**
  - **Recommendations in areas where alignment with IAEA Safety Standards needs to be improved**
  - **Suggestions that would enable the host organizations to improve or expand policies or programmes in order to make the performance more effective**
- **To identify Good Practices and share these with the international industry**

Frequent Recommendations or Suggestions on Fire Safety identified based on NS-G-2.1

1) **Control of Combustible Materials** : (4 cases / 15 missions conducted in 2016-2018)
2) **Integrity of Fire Components / Barriers** : (2 cases / 15 missions conducted in 2016-2018)
3) **Arrangements For Hot Works** : (2 cases / 15 missions conducted in 2016-2018)

Visit **"OSART Highlights"** https://www.iaea.org/services/review-missions/operational-safety-review-team-osart

4. Protection Against Fire in the Design of NPPs
SSG-64 (DS494) “Protection against Internal Hazards in the Design of NPPs”


IAEA SAFETY STANDARDS

Protection against Internal Hazards in the Design of Nuclear Power Plants

DS 494

DRAFT SAFETY GUIDE

GENERAL CONSIDERATIONS 5

GENERAL DESIGN RECOMMENDATIONS for Protection against Internal Hazards 9
Identification AND Characterization of HAZARDS and Hazard Combinations 9
Prevention of internal hazards and of the effects of the hazards 10
Mitigation of the effects of internal hazards 10
Assessment, verification and success criteria 12
Specific aspects 14

RECOMMENDATIONS FOR SPECIFIC INTERNAL HAZARDS 15
INTERNAL FIRES 15
General 15
Identification and characterization of fire hazards 15
Fire prevention 15
Fire mitigation 18
Mitigation of secondary fire effects 21
INTERNAL EXPLOSIONS 26
Specific considerations for releases of hazardous substances 58

APPENDIX I: HAZARD COMBINATIONS 60

APPENDIX II: DETAILED GUIDANCE ON INTERNAL FIRES 63
Fire hazard analysis 63
Fire barriers 64
Fire containment approach 68
Fire influence approach 69
Access ROUTES and Escape Routes 69
Protection against Electrical Cable Fires 71
Control of cable fires 71
Cable fire testing 72
Cable fire protection 72
Fire Detection and Alarm Systems 73
Selection and location of detectors 74
Fire extinguishing means 74

REFERENCES 81

Draft safety guide DS494 under publication

Revision and merge of the NS-G-1.7 (fires and explosion) and NS-G-1.11 (other internal hazards)

- Publication expected June/July 2021 as SSG-64

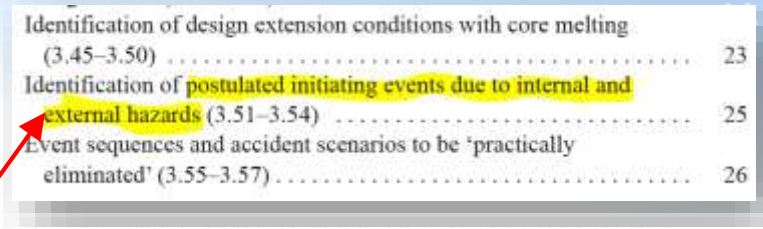
Main changes

- Unified and revised approach for all internal hazards in the design and safety assessment
- Fire hazard extensively covered in the main body and dedicated Appendix
- Defence in Depth used as an underlying principle when considering protection against internal hazards in the design of NPPs

Safety Analysis (Deterministic and Probabilistic)

SSG-2 (Rev.1) – Deterministic Safety Analysis

- Fire hazard analysis itself is not covered, but
- Effects and loads resulting from the fire (induced SSC failures) are PIEs



SSG-3 & SSG-4 – Probabilistic Safety Assessment (PSA)

- Detailed recommendations on fire PSA modelling
- Includes also recommendation to consider induced fires (e.g. Seismically)
- Main changes expected:
  - Fire in Multi-unit context
  - Fire for Spent Fuel Pool PSA

5. IAEA TECDOC-1944 “Fire Protection in NPPs” (2021)

Section 3: (Passive/Active) Protection Systems

Section 4: Prevention Activities

Section 5: Fire Risk Analysis

Section 6: Emergency Response

Input from ‘OSART Good Practices database’

Online Work Approval System by the combination of area control and fire load control of combustible material in temporary modification

Training or Arrangements to ensure firefighting capabilities with Pre-plan, exercise with Mock-up, Smoke simulation, etc.

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Thank you!
Questions?

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DS503 Proposed Structure (Step 11)

Sec. 1	Introduction
Sec. 2	General considerations for the management of internal and external hazards in nuclear power plants
Sec. 3	Application of the management system to hazard management
Sec. 4	Ensuring safety against internal hazards in the operation of nuclear power plants
Sec. 5	Ensuring safety against external hazards in the operation of nuclear power plants
Sec. 6	Combination of hazards
Sec. 7	Periodic updating of hazard management
Sec. 8	Control of materials and housekeeping in hazard management
Sec. 9	Inspection, maintenance and testing of hazard prevention, protection and mitigation measures
Sec. 10	Training of personnel on hazard management

Appendix I – technical aspects to be considered in hazard management for protection against internal hazards

- Internal fires
- Internal explosions
- Internal flooding
- Electromagnetic interference
- Release of hazardous substances, etc

Appendix II – technical aspects to be considered in hazard management for protection against external hazards

- Seismic hazards
- External floods
- Extreme winds
- External fires
- Other extreme meteorological conditions
- Volcanism
- Aircraft crash
- Biological phenomena, etc

DS503 Interface with other documents