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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   - 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

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

Safety objectives and safety principles

Functional conditions required for safety

Guidance on how to fulfil the requirements

www.ns.iaea.org/standards/

- Safety objectives and safety principles
- Functional conditions required for safety
- Guidance on how to fulfil the requirements

Guides include Fire Safety in Design / Safety Assessment

- NS-G-1.7
- NS-G-1.11
- SSG-2
- SSG-3
- SSG-4

Guides include Fire Safety in Operation

- NS-G-2.1
- SSG-XX (DS503)

Protection against Internal Hazards in the Design of NPPs

- Protection against Internal Hazards in the Design of NPPs

Protection against Internal and External Hazards in the Operation of NPPs

SSG-64 (DS494)

www.ns.iaea.org/standards/
Specific Draft Standard DS503 “Protection against Internal and External Hazards in the Operation of Nuclear Power Plants”

  - 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

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

  - External Hazards
    - 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

  - Combined Hazards

- Fire protection management
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](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”

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.
Thank you!

Questions?

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# DS503 Proposed Structure (Step 11)

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**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

Operation
- SSR-2/2 (Rev.1)
- GSR Part 2,7
- DS497s
- GSG-7
- SSG-54
- DS504
- etc.

Design
- SSR-2/1 (Rev.1)
- GSR Part 4
- SSG-25
- SSG-64
- SSG-67
- SSG-68 etc.

Guides for Operation, EPR
- GSR Part 2,7
- DS504
- etc.

Security Series
- Safety Reports
- etc.

Other documents
- (TECDOC-1944 etc.)

Guides for Siting, Design, Assessments
- Design for Internal Hazards
- Design for External Hazards
- PSR, PSA, etc.