FANC

FEDERAL AGENCY FOR NUCLEAR CONTROL

ENSREG TOPICAL PEER REVIEW II

FIRE PROTECTION

Belgian National Action Plan

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1. Introduction

1.1. ENSREG Topical Peer Review

1.1.1. Context

In 2014, the European Union (EU) Council adopted directive 2014/87/EURATOM [1] amending the 2009 Nuclear Safety Directive (NSD) to incorporate lessons learned following the accident at the Fukushima Daiichi nuclear power plant in 2011. Recognising the importance of peer review in delivering continuous improvement to nuclear safety, the revised Nuclear Safety Directive introduces a European system of topical peer review, which commenced in 2017 and will be repeated every six years thereafter. The purpose is to provide a mechanism for EU Member States to examine topics of importance to nuclear safety, to exchange experience and to identify opportunities to strengthen nuclear safety.

The first topical peer review took place from 2017 to 2018 and its topic was ageing management. In November 2020, at its 41st Plenary Meeting, ENSREG[1] decided that the topic of the second Topical Peer Review (TPR II) would be "Fire Protection". This topical peer review on fire protection aimed to:

- Enable participating countries to review their provisions for fire protection to identify strengths and weaknesses;
- Undertake a European peer review to share operating experience and identify findings: common issues or challenges at EU-level, good practices, areas of good performance and areas for improvement;
- Provide an open and transparent framework for participating countries to develop appropriate follow-up measures to address areas for improvement.

1.1.2. Topic

Fire is a risk that is relevant for most if not all nuclear installations. Combustible materials may be present in many locations in the installation and a fire may be capable of affecting multiple structures, systems and components important to safety. Fire can also affect signaling and power supply of multiple systems and is hence potentially capable to cause common cause failures. In addition, a fire could involve radioactive materials and thus lead to their release and dispersion. Fire may also be caused by or result in other hazards or events.

For these reasons, fire protection, broadly including fire safety analysis, fire prevention, active and passive fire protection, is a relevant topic that needs to be considered for every nuclear installation.

1.1.3. Installations

It was decided by ENSREG that TPR II should consider all installations under the NSD [1] for the selection of installations to be covered in the National Assessment Reports (NAR):

- nuclear power plants (NPPs),
- research reactors (RRs)[2]
- spent fuel storage facilities,
- enrichment plants,

[1] EU topical peer reviews | ENSREG

[2] In line with the scope of the SRL for existing research reactors published in 2020, all research reactors independent of their type and thermal power with the exception of the critical, sub-critical assemblies, homogeneous zero-power reactors and accelerator driven systems are covered by the term "research reactor"

- nuclear fuel fabrication plants,
- reprocessing plants,
- storage facilities for radioactive waste that are on the same site and are directly related to the types of nuclear installations listed above.

TPR II covers installations under construction, under operation and under decommissioning. More precisely, the scope includes all nuclear installations that on 30th June 2022:

- were operating or in an outage or shutdown (temporarily or permanently),
- were defueled or in the process of being decommissioned,
- were under safe enclosure, excepting those from which all non-fixed radioactivity had been removed.

1.1.4. Process and TPR II phases

The following phases are carried out sequentially and in accordance with the EU Directive:

- Preparation (2020-2022):
  - Selection of topic;
  - Drafting and approval of the "Terms of Reference for the Topical Peer Review Process on Fire Protection" [2] and the "Fire Protection Technical Specification for the National Assessment Reports" (NAR) [3];
  - Selection by regulatory bodies of the list of installations, see §1.2.1.
- National self-assessment (2022-2023):
  - Self-assessment by licensees of the selected TPR II installations;
  - Review of self-assessments by regulator body and drafting of National Assessment Report [4].
- Peer review (2023-2024):
  - Review of National Assessment Reports by experts and exchange of questions and answers;
  - Workshops to discuss the results of the self-assessments, the questions and comments on the NARs, the replies to the questions, as well as the findings from the experts with a view to identifying and discussing both generic and country-specific findings on fire protection;
  - Issuing Topical Peer Review Summary Report addressing the generic findings of the review process as well as country review reports with country-specific findings [5].
- Follow-up (2025-current):
  - Development of National Action Plan (NAcP) by Regulatory Bodies based on the results of the peer review phase.
  - Follow-up of the implementation of the actions in the National Action Plans.

1.2. Summary for Belgian National Assessment report and peer review findings

1.2.1. Summary for Belgian National Assessment report and peer review findings

The following representative installations were selected and included in the Belgian NAR:

Candidate for assessment	Type	Site location	Status	Represented installations[3]
CNT3	NPP	Tihange	operation	All other operating NPPs (CNT1 and 2 KCD 1,2 and 4) DE Tihange (wet SNF storage)
KCD3	NPP	Doel	decommissioning	(and CNT2 which went into decommissioning in February 2023)
BR2	RR	Mol	operation	BR1
SCG	SFSF	Doel	operation	Doel SF2, Tihange SF2

1.2.2. Belgian regulatory framework

Within the Belgian national regulatory framework for nuclear safety and radiation protection, the Royal Decree of 30/11/2011 with Safety Requirements for Nuclear Installations (SRNI) transposes the WENRA Safety Reference Levels, including those related to fire prevention and protection. This Royal Decree consists of several sections: the generic section of SRNI applies to all Class I facilities, which includes nuclear power plants, research reactors and spent fuel storage facilities. Specific articles deal with protection against internal fires, including fire protection strategy, design principles, fire hazard analysis, fire protection systems, inspections and maintenance and the fire-fighting organisation. This Royal Decree transposes the WENRA SRLs and is binding.

In addition, international standards and guidelines are or were used including IAEA Safety Requirements and Guides, US NRC regulatory guides and standard review plans, Eurocodes, ASME codes, NUREG reports, EPRI reports and other sources.

In addition to the regulatory framework for nuclear safety and radiation protection, national regulations relevant to general fire protection, also apply to nuclear installations.

1.2.3. Conclusion from Belgian self-assessment

The WENRA Safety Reference Levels [6][7][8][9] related to fire safety were implemented in the Belgian regulatory framework by articles 17 and 32 SNRI-2011 [10]. Article 17 covers WENRA SRLs and is applicable to all Belgium “class I” installations including research reactors, waste and spent fuel storage facilities and nuclear power plants. Article 32, which applies only to nuclear power plants, implements requirements related to probabilistic safety assessments for fire and requirements related to the fire hydrant distribution system.

[3] Status at the time of the initial assessment which may be different from the current operational state.

As part of the regulatory-change management or resulting from periodic safety reviews, licensees had already developed gap-analyses and corresponding action plans. It is also common for licensees to identify and implement further improvements based on internal and external experience feedback, and as a result of independent assessments by other third parties.

The Belgian regulatory body could therefore conclude that all Belgian nuclear installations that fall under the scope of the TPR-II comply with the regulatory requirements and with the WENRA Safety Reference Levels related to fire safety.

2. Follow-up of findings from the peer review

The Country Review Report for Belgium [5] identified two Areas For Improvement (AFI) that are reported upon below.

2.1. BE-AFI-1– NPP/CNT3: The verification and inspection process of the seals in fire resistant concrete dals is implemented but not yet integrated in all the maintenance procedures.

2.1.1. Identified action(s) and implementation progress

Maintenance procedures should be extended to include the verification and inspection process of these components. This action is on-going.

2.1.2. Applicability to represented installations

The action for CNT3 applies also to the other NPPs, like KCD4, and this was included in the action.

2.2. BE-AFI-2– NPP/CNT3: FSA should consider seismically induced fire

2.2.1. Identified action(s) and implementation progress

Seismically induced fire should be included as part of the fire hazard assessment.

This action was included as action 0006 of the global action list for LTO of KCD4 and CNT3 and was completed on 25-11-2025.

2.2.2. Applicability to represented installations

The action for CNT3 applies also to KCD4 and this is included in the action.

3. Follow-up of findings from the peer review – national areas for improvement

Besides the two Areas For Improvement resulting from the peer review, the Belgian self-assessment resulted in one additional weakness for which an action was defined and which is reported upon below.

3.1. NPP/CNT3: - The number of notifications by the licensee related to issues concerning fire-rated penetrations was found to be elevated.

In response, an inspection campaign was developed by the regulatory body to ensure that the related procedures were still appropriate and applied. This campaign was carried out and the action is considered closed.

4. Consideration of the other findings from the peer review

The peer review also identified Good Practices and Good Performances for the several countries. On a voluntary basis the Belgian regulatory body assessed these good practices and performances for their relevance and applicability to Belgian nuclear installations. In addition and to ensure that nothing had been missed during the peer review also the Areas For Improvement for other countries were screened.

All Good Practices, Good Performances and Areas For Improvement, provided in annex B, C and D of the structure and contents of the National Action Plans (NAcP) responding to the country-specific and other findings of TPR II on Fire Protection at nuclear installations as endorsed by ENSREG, 30/10/2025 were screened and categorized in function of their potential applicability and benefit.

4.1. Applicability of good practices identified in the peer review.

Four good practices were identified during the peer review. Their relevance and applicability to Belgium installations is discussed below.

GP-1 'Implementing learning from experience feedback from fire events in non-nuclear settings'

> Limited applicability since experience feedback from non-nuclear settings is already considered, because fire brigades (both internal private fire brigades and public fire brigades) in Belgium already cooperate (e.g. Harbour of Antwerpen where the Doel NPP is sited) and most firefighters at nuclear installations are also working externally as professional firefighters.

GP-2 'Extensive series of tests carried out to assess the effects of fire on elements (electrical equipment, fire doors, cables, seals, etc.) credited in the fire safety analyses to confirm their assumed resistance to the fire-induced phenomena'

> Possibility for improvement of fire R&D capabilities specifically dedicated to nuclear applications and/or extent involvement in international R&D.

GP-3 'A dynamic system to manage storage area for transient fire loads and other non-combustible materials' is a good performance for Belgian NPP.

GP-4 'Thermographic cameras installed on worksites, or in case of the failure of a detector, with different detection zones and alarms'

> Limited applicability and benefit: Thermographic cameras are available for punctual controls, but are not permanently installed for continuous monitoring. Replacing all cameras is considered excessive and not justified by current operating experience.

4.2. Applicability of good performances and areas for improvement

As explained, all good performances and areas for improvement were screened for applicability in Belgium. Many, in particular the AFIs, are already covered in Belgium or are very specific to a certain country/installation. Some AFIs are related to seismic events and are covered by BE-AFI-2 (AFI(2) – NPP/CNT3). Of the good performances, a number are directly related to GP-1 and GP-4, see §4.1.

Of particular interest are

- FR-AGP-4: "High-level modelling of the effects of fire (soot, pressure effects…) to confirm the fire resistance of compartmentation elements and Structures, Systems, Components (SSCs)" which has a link with GP-2, see §4.1, and
- ES-AFI-1 "Licensees to make a better use of fire operational experience database, such as 'FIRE'." since a more systematic follow-up of the use of the external fire-relevant REX for NPPs could potentially be set up.

5. Overall conclusions

As part of the ENSREG Topical Peer Review II on Fire Protection, Belgium reported on the national practises relative to the Terms of Reference that reflect the relevant Safety Reference Levels developed by WENRA. These safety reference levels had already been implemented in the Belgian regulatory framework and the licensees already had time to implement the requirements which allowed the regulatory body to conclude that all Belgian nuclear installations that fall under the scope of the TPR-II comply with the regulatory requirements and with the WENRA Safety Reference Levels related to fire safety.

The assessment did allow the regulatory body Belgium to identify strengths and some weakness related to fire protection. The subsequent European peer review and expert exchanges allowed for the identification of possible actions for further improvement. In total this resulted in 5 actions that have been included in the underlying action plan. Of these 5 actions, one has already been resolved, two have been initiated and are ongoing and another two have been identified only recently and still need to be planned.

References

[1] EU, “Council Directive 2014/87/Euratom amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations “, 8 July 2014

[2] ENSREG, “Terms of Reference for the Topical Peer Review process on Fire Protection”, 16 June 2022

[3] WENRA, “Topical Peer Review 2023 Fire Protection Technical Specification for the National Assessment Reports”, 21 June 2022

[4] FANC, “ENSREG Topical Peer Review II – Fire Protection. Belgian National Assessment Report“, FANC/2023-10-31-RK-5-4-5-EN, October 2023

[5] ENSREG, “2nd Topical Peer Review – ‘Fire Protection’ – Country Review Report Belgium”, January 2025

[6] WENRA, “WENRA Safety Reference Levels for Existing Reactors 2020”, 17 February 2021

[7] WENRA, “WENRA Safety Reference Levels for Existing Research Reactors”, November 2020

[8] WENRA, “Waste and Spent Fuel Storage Safety Reference Levels”, April 2014

[9] WENRA, “Decommissioning Safety Reference Levels”, 22 April 2015

[10] Belgian Royal Decree of 30 November 2011 on the safety requirements for nuclear installations

Acronyms

AFI	Area For Improvement
AGP	Area of Good Performance
ASME	American Society of Mechanical Engineers
EPRI	Electric Power Research Institute
FANC	Federal Agency for Nuclear Control
FSA	Fire Safety Analysis
LTO	Long Term Operation
NAcP	National Action Plan
NAR	National Assessment Report on TPR
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission (USA)
NSD	Nuclear Safety Directive
NUREG	Nuclear Regulatory Report (US NRC)
R&D	Research and Development
RR	Research Reactor
SFSF	Spent Fuel Storage Facility
SNF	Spent Nuclear Fuel
SNRI	Safety Requirements for Nuclear Installations [10]
SRL	(WENRA) Safety Reference Level [6][7][8][9]
TPR	Topical Peer Review
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association

Annex A - Summary table of the actions planned/implemented

Section of NAcP	Reference no of the finding	Installation type/name (as relevant)	Thematic	Finding	Action	Deadline	Comment on progress
2.1	BE-AFI-1	NPP	Fire protection concept	The verification and inspection process of the seals in fire resistant concrete dals is implemented but not yet integrated in all maintenance procedures	Ongoing	12-2027	
2.2	BE-AFI-2	NPP	Fire safety analysis	Seismically induced fire should be included as part of the fire hazard assessment	Completed		This action was included as action 0006 of the global action list for LTO of KCD4 and CNT3 and was completed on 25-11-2025
3.1	NAR-§3.5.1	NPP	Fire protection concept	The number of notifications by the licensee related to issues concerning fire-rated penetrations was found to be elevated.	Completed		Inspection campaign was developed by the regulatory body to ensure that the related procedures were still appropriate and applied.
4	GP-2/FR-AGP-4	NPP	Fire protection concept	Fire R&D capabilities specifically dedicated to nuclear applications and/or extent involvement in international R&D can be strengthened.	Investigate possibility for improvement of fire R&D capabilities specifically dedicated to nuclear applications and/or extent involvement in international R&D.		To be planned

4	ES-AFI-1	NPP	Fire protection concept	Follow-up of the use of the external fire-relevant REX (FIRE) can be improved.	Develop a more systematic follow-up of the external fire-relevant REX (e.g. FIRE database).		To be planned

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