National Action Plan of Finland

ENSREG 2nd TOPICAL PEER REVIEW ON FIRE PROTECTION

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STUK

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1 Introduction

This document has been prepared for the purpose of the second Topical Peer Review (TPR II) based on the European Union Directive 2014/87/EURATOM amending the 2009 Nuclear Safety Directive. Nuclear Safety Directive introduced a European system of topical peer reviews which began in 2017 and takes place at least every six years thereafter.

The Topical Peer Review (TPR) process in Finland was coordinated by the Radiation and Nuclear Safety Authority (STUK). The licensees were invited to provide material first for the preparation of National Assessment Report (NAR) and later for the TPR process and preparation of National Action Plan (NAcP). The writing of NAcP was coordinated at STUK and the plan was prepared after the TPR process was finished.

This document defines Finland's response in the TPR process, by way of a National Action Plan, which follows a standard format across all participating countries as defined in the guidance on the structure and the contents of the NAcP provided by ENSREG. The NAcP is intended to enable progress to be monitored against the range of findings emerging from the TPR and it will also inform future TPR follow-up activities by ENSREG.

The NAcP is to be delivered to ENSREG and published at the ENSREG's website following its finalization.

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

2.1 AFI (1) – NPP: Olkiluoto 1, 2

Finding A need to complete the replacement of old CO2-gas extinguishing systems, whose design basis does not comply with today's industrial standards.

2.1.1 Identified action(s) and implementation progress

The CO_2 fire suppression systems in the OL1 and OL2 diesel generator rooms have already been replaced by sprinkler systems. The remaining CO_2 systems are scheduled to be replaced with high-pressure water mist systems during 2027-2028.

2.1.2 Applicability to represented installations

No represented installations.

2.2 AFI (2) – NPP: Olkiluoto 1, 2 and Loviisa 1, 2

Finding FSA should consider seismically induced fire.

Justification The fire protection system is not qualified against seismic hazards. The acceptability of this approach should be justified by the fire safety analysis.

2.2.1 Identified action(s) and implementation progress

TVO (Olkiluoto 1 & 2):

The seismic risk to the Olkiluoto plants is assessed through seismic PRA analyses. The seismic PRA for OL1/OL2 was first prepared in the late 1990s and has subsequently been updated in 2008 and 2018. In 2013, additional studies were commissioned, including plant walkdowns, particularly concerning seismic risks

affecting the fire water systems as part of the Fukushima follow-up analyses. The seismic PRA for the spent fuel interim storage facility was completed in 2013.

The seismic PRAs carried out by TVO are based on the EPRI methodology and SQUG (Seismic Qualification Utility Group) guidance. A key element of this methodology is the assessment of earthquake-induced fires and flooding as part of the seismic walkdowns conducted at the plants. For example, the methodology applied follows the EPRI 3002012980 report.

During 2025-2027, an extensive update of the seismic PRAs for OL1/OL2 and the spent fuel interim storage facility will be carried out. In addition to the EPRI methodology, the ASME/ANS RA-S-1.1-2024 standard will be used to guide the scope and level of detail of the analyses. This standard also requires the assessment of earthquake-induced fires and their risk significance with respect to core damage.

The OL1/OL2 fire water system 861 is classified as S1 (seismic class: functional after earthquake).

Fortum (Loviisa 1 & 2):

The effects of seismic-induced fires on plant safety have been assessed in a dedicated study issued in 2026 (LO1-K8048-00079). The study is based on comprehensive seismic plant walkdowns and a methodology consistent with EPRI guidance. The objective of the study is to evaluate whether safe shutdown can be achieved using systems and components classified as S1, even in situations where the initiating seismic event results in a fire or flood. The selection of the systems evaluated was based on criteria specified in the EPRI guidance. For the systems remaining within the scope of the assessment, the risk of seismic-induced fires is mainly associated with diesel fuel, lubricating oil, and high-voltage electrical equipment.

For locations that were preliminarily identified as potentially deficient in a conservative seismic capacity assessment, more detailed evaluations will be performed to determine their actual seismic resistance. Where necessary, these components will be included in ongoing or future seismic improvement projects, the purpose of which is to eliminate identified deficiencies related to seismic resistance. Some of these items are already included in such projects due to other previously identified seismic improvement needs. The results of the assessment will also be used to further develop the Probabilistic Risk Assessment (PRA) model and where necessary, to include seismic events exceeding the design-basis earthquake and other risk-significant systems and components not assigned to S1.

Based on the above, seismic-induced fires have been addressed in the plant's safety assessments through a dedicated study, and the analysis of identified items,

together with any required corrective actions, is progressing as part of the plant's seismic safety improvement program. Fortum will report on the progress at the latest in 2028.

2.2.2 Applicability to represented installations

No represented installations.

3 Follow-up of other findings resulting from the self-assessment

3.1 NPP: Olkiluoto 1, 2

3.1.1 Fire Safety Analysis

3.1.1.1 Fire PRA is mainly based on conservative assumptions in the scope of fire induced damages inside the compartment.

Identified action(s) and implementation progress:

Fire PRA is constantly improved to incorporate new data and to improve accuracy.

3.1.2 Fire Prevention

No relevant weaknesses.

3.1.3 Passive Fire Protection

No relevant weaknesses.

3.1.4 Active Fire Protection

No relevant weaknesses.

3.2 NPP: Olkiluoto 3

3.2.1 Fire Safety Analysis

No relevant weaknesses.

3.2.2 Fire Prevention

No relevant weaknesses.

3.2.3 Passive Fire Protection

No relevant weaknesses.

3.2.4 Active Fire Protection

3.2.4.1 Authority communications network does not exist at the plant

Identified action(s) and implementation progress:

TVO has justified and STUK approved the current situation to be sufficient for the conduct of operational firefighting. The network doesn't cover the entire plant but can be used in pre-defined locations. No further actions are considered necessary.

3.3 NPP: Loviisa 1, 2

3.3.1 Fire Safety Analysis

3.3.1.1 Fire PRA is mainly based on conservative assumptions especially considering consequences of instrumentation and control circuit failures (possibility of spurious signals is included). This ensures scope of possible initiating events but simultaneously increases the quantified fire induced core damage frequency.

Identified action(s) and implementation progress:

Fire PRA is constantly improved to incorporate new data and to improve accuracy.

3.3.2 Fire Prevention

No relevant weaknesses.

3.3.3 Passive Fire Protection

3.3.3.1 Weaknesses in the original design regarding compartmentation

Identified action(s) and implementation progress:

The improvements made regarding passive fire protection were listed in the NAR and addressed in the country workshops. These include new walls built, some doors closed permanently, protection of load-bearing steel structures, and moving of fire loads to different fire compartments. The passive fire protection is supported by active fire protection systems and operative firefighting where necessary. There are no further improvements planned.

3.3.4 Active Fire Protection

3.3.4.1 Original piping of firefighting water distribution system has had some leakages, which have been repaired

Identified action(s) and implementation progress:

Part of the main distribution pipeline is renewed with added valve to secure the separation between plant units during the annual outage of 2026. Further pipe renewals are planned in the future.

4 Consideration of the other findings from the peer review to enhance fire protection

To start the process on evaluation of findings, a pre-screening of findings was done to screen out the findings that would definitely not demand further action from the licensees or the regulatory body. Bases for the pre-screening were type of installation, life-cycle phase, clear compliance to regulations at Finnish nuclear installations and general non-applicability. The pre-screening could be considered coarse, ie. majority of findings selected for further evaluation should still not be considered prime candidates for necessary action, but there was at least some component in them that should be checked or clarified to be able to verify status. After the pre-screening, the findings that were evaluated more thoroughly included the four GPs, 26 AGPs and 11 AFIs, excluding the ones issued to Finland, which have been considered separately.

4.1 Applicability of good practices identified in the peer review

There are no major actions planned based on the four good practices found in the review. Short justifications for each GP can be found below.

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

Finland has utilized OPEX from non-nuclear fire events, including Grenfell tower fire mentioned in TPR II summary report as a justification for this good practice. There is regular sharing of information in forums such as Finnish Fire Officers' Association.

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’

Finland has established research projects on fire phenomena and modelling in national research programmes such as SAFIR2022 and SAFER2028. The scope of

the projects is not as wide as in France due to available resources based on the size of nuclear fleet. There are some examples of supplemental fire testing commissioned by the licensees to verify product properties.

GP-3 'A dynamic system to manage storage area for transient fire loads and other non-combustible materials'

Finnish NPPs have continuous evaluation of the fire loads, and consideration of nuclear safety significance of rooms and SSCs in decisions as to the allowable fire load, including temporary storage.

TVO has similar bar code system is utilized for inspection rounds but not for fire load management. The management of fire load will be integrated in the new work order system.

Fortum uses fire load logbook and permit IDs the validity of which is checked daily. There are no plans to integrate a bar code system.

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

Fire detection system is the primary arrangement for fire detection. Thermographic cameras are utilized e.g. after hot works when inspecting the site.

TVO's maintenance performs thermal imaging as a preventive measure. The thermal imaging camera is used to photograph electrical switchgear.

Fortum has existing approved procedures to compensate the detection capabilities if there is a failure in fire detectors. Camera surveillance can also be used as a compensatory measure.

4.2 Applicability of national areas of good performance in other countries

There are no major actions planned based on areas of good performance of other countries. Short justifications for considered relevant AGPs can be found below.

Several AGPs concern similar topics to GPs or are actually the same finding, and the justifications given in chapter 4.1 were considered to cover these as well. The related topics were OPEX and lessons learned from outside of the nuclear field (FR-AGP-7, UK-AGP-2, ES-AGP-3 and GP-1), testing and modelling (FR-AGP-4 and GP-2), fire load management (BE-AGP-3 and GP-3) and thermal imaging (FR-AGP-2 and GP-4).

Some AGPs were grouped together also for being similar. For hot work provisions, UK-AGP-1 and ES-AGP-2 were considered together. Finnish licensees follow a

rigorous process in issuing permits for, supervising and conducting hot work. Some aspects of the processes were highlighted in TPR II Summary Report. The processes have been developed based on OPEX. UK and Spain have earned an AGP for their hot work processes with few functional differences to the Finnish processes. The incorporation of aspects of the processes highlighted in the AGPs to Finnish hot work processes is not considered necessary.

For aircraft crash, CH-AGP-1, SI-AGP-1 and IT-AGP-1 were considered together. The older Finnish NPPs did not have large commercial aircraft crash as a design basis, but the event has been analysed. Olkiluoto ISFS has been protected with an embankment and concrete structures. No actions are considered necessary.

Emergency instructions were commended in FR-AGP-3 and SE-AGP-1. Similar but perhaps less granular sets of instructions are available at Finnish plants. Actions are to be taken by the operators or the plant fire brigade. No need for further actions.

CH-AGP-2 and SE-AGP-1 cover robustness of fire detection system against a single failure. At Olkiluoto NPPs the fire alarm system is divided into parts following the redundancies of safety systems. At Loviisa, the separation is done by building. Full separation of redundancies is not practically possible due to the design of the plants. No actions are considered necessary.

Position alarms for doors were included in both FR-AGP-3 and UK-AGP-3. At Finnish NPPs, position alarms for doors have been implemented based on risk considerations, but not systematically from fire safety point of view. No further actions are considered necessary.

NL-AGP-1 regards level 3 PSA, which is not required in Finnish regulations. It's not expected that the licensees would independently decide to pursue action on this topic.

UK-AGP-4 regards fire suppression systems in transporter tugs. There are a couple of TVO and Posiva vehicles equipped with suppression systems. No further actions are considered necessary.

BE-AGP-1 regards process of controlling open fire doors with special wedges. Both Finnish licensees have solid procedures for handling open fire doors.

BE-AGP-4 regards software tools to facilitate assessment of fire protection measures. Finnish licensees have pre-defined compensatory measures for cases where fire protection equipment is unavailable. Similarly processes for fire load management and storage are in place. No further actions are considered necessary.

ES-AGP-1 regards flooding protection from harmful effects of fire water. Both Finnish licensees have analysed flooding from fire water systems, and no additional protective measures were deemed necessary.

FI-AGP-2 regards gas detectors at EDG fuel tanks. AGP is given to Loviisa 1 & 2. At Olkiluoto, diesel day tanks are housed in a separate fire compartment provided with its own ventilation system and multi-criteria fire detection system. No actions are considered necessary.

FR-AGP-5 regards fire risk assessment methodology and transparency. At Finnish facilities, fire risks are assessed, but the results are not displayed at the plant site. Displaying the results might have negative effects on security.

NL-AGP-2 regards combination of hazards. This aspect is discussed in chapter 2.2 with FI-AFI-2.

4.3 Applicability of national areas of improvement in other countries

11 relevant AFIs of other countries were assessed for possible need for action. There are no major actions planned based on these. Short justifications for considered relevant AFIs can be found below.

BE-AFI-2, HU-AFI-4, NL-AFI-4 and RO-AFI-3 are related to seismically induced fire or seismic qualification. This aspect is discussed in chapter 2.2 with FI-AFI-2.

BG-AFI-1 regards the aging of fire detectors. At Finnish NPPs, the fire detectors are included in the maintenance and aging management processes and are replaced based on pre-defined intervals or criteria of acceptance. No actions are considered necessary.

CH-AFI-2 regards fire load management. This topic has been covered above with GP-3 and BE-AGP-4.

ES-AFI-1 regards OPEX databases. In Finland, OPEX is analysed and taken into account. No actions are considered necessary.

SI-AFI-1 regards consideration of multiple spurious operations (MSO) in FHA. At Loviisa 1 & 2 and Olkiluoto 1 & 2, the spurious signals are assessed as part of PSA analysis. At Olkiluoto 3, issue is also covered in the deterministic analyses.

UA-AFI-1 regards the FHA in relation to plant safety functions. This topic is covered by Finnish regulations. At Loviisa 1 & 2 and Olkiluoto 1 & 2, PSA is used as primary tool for fire risk assessment. At Olkiluoto 3, deterministic functional FHAs consider plant safety systems comprehensively. No actions are considered necessary.

LT-AFI-2 regards the reliability of fire detectors that are operating in hard conditions. This issue has been recognized at Finnish facilities, especially for rooms with high radiation. At Loviisa 1& 2, detectors have been situated in ventilation channels leading out of high-radiation rooms to ensure fire detection. At Olkiluoto 1 & 2, the fire detection system in the turbine building has been upgraded to mitigate the effects of radiation on detector performance and system reliability. Similar renewals are under design for reactor building.

5 Overall conclusions

The second Topical Peer Review (TPR II) on fire protection provided an opportunity to assess the status of fire safety at Finnish nuclear facilities, to identify areas for further improvement, and to evaluate relevant good practices and findings identified in other participating countries. The review confirmed that the fire protection arrangements at Finnish nuclear power plants are generally comprehensive and effective, supported by established regulatory requirements, safety analyses, defence-in-depth principle, and improvement programmes implemented by the licensees.

The peer review identified two Areas for Improvement (AFIs) for Finland. The first concerns the replacement of legacy CO_2 fire suppression systems at Olkiluoto 1 and 2. Significant progress has already been made, with the systems in the diesel generator rooms replaced and the remaining systems scheduled for modernization during 2027–2028. The second AFI concerns the consideration of seismically induced fires in fire safety analyses. Both licensees have addressed this issue through seismic probabilistic risk assessments, dedicated studies, plant walkdowns, and ongoing seismic safety improvement programmes. Additional work planned during the coming years will further strengthen the assessment of combined seismic and fire hazards.

The self-assessments carried out by the licensees identified a limited number of topics for continued improvement, primarily related to the development of Fire Probabilistic Risk Assessments, passive fire protection in older plant designs, and renewal of parts of fire-fighting water distribution systems. These issues are already included in existing plant improvements and maintenance programmes and do not indicate any immediate safety concerns.

Finland also evaluated the applicability of the good practices, areas of good performance, and areas for improvement identified in other countries during the peer review. The assessment concluded that Finnish nuclear facilities already address the majority of these topics through existing arrangements, analyses, operating experience programmes, maintenance practices, and regulatory requirements. Consequently, no additional major actions were considered necessary based on the findings from other participating countries.

Overall, the TPR II process confirmed that Finnish nuclear facilities maintain a high level of fire safety and that the remaining improvement actions are well understood,

appropriately prioritized, and incorporated into ongoing safety enhancement programmes. Finland remains committed to the continuous improvement of nuclear safety and fire protection and will continue to monitor the implementation and effectiveness of the actions identified through the TPR II process.

Annex A - Summary table of the actions planned/implemented

Section of NAcP	Reference no of the finding	Installation type/name	Thematic	Finding	Action	Deadline	Regulatory authority's comment on progress
2	FI-AFI-1	NPP – Olkiluoto 1, 2	Active fire protection	A need to complete the replacement of old CO2-gas extinguishing systems, whose design basis does not comply with today's industrial standards.	The CO_2 fire suppression systems in the OL1 and OL2 diesel generator rooms have already been replaced by sprinkler systems. The remaining CO_2 systems are scheduled to be replaced with high-pressure water mist systems during the period 2027-2028.	2028	The licensee has already completed most of the replacements, and the final ones are being designed. This issue is progressing as planned.
2	FI-AFI-2	NPP – Olkiluoto 1, 2	Fire safety analyses	FSA should consider seismically induced fire.	During 2025-2027, an extensive update of the seismic PRAs for OL1/OL2 and the spent fuel interim storage facility will be carried out. In addition to the EPRI methodology, the ASME/ANS RA-S-1.1-2024 standard will be used to guide the scope and level of detail of the	2027	The licensee clarified the current situation and is in the process of updating analyses. The work is underway.

					analyses. This standard also requires the assessment of earthquake-induced fires and their risk significance with respect to core damage.		
2	FI-AFI-2	NPP – Loviisa 1, 2	Fire safety analyses	FSA should consider seismically induced fire.	The effects of seismic-induced fires on plant safety have been assessed in a dedicated study issued in 2026. For locations that were preliminarily identified as potentially deficient in a conservative seismic capacity assessment, more detailed evaluations will be performed to determine their actual seismic resistance. Where necessary, these components will be included in ongoing or future seismic improvement projects, the purpose of which is to eliminate identified deficiencies related to seismic resistance. Some of these items are already included in such projects due to other previously identified seismic improvement needs.	2028	The licensee has completed a dedicated study on the issue. More detailed evaluations are planned to determine improvement needs. The work is underway.

Annex B - Compilation of Good Practices

Ref. no.	Good Practice
GP-1	‘Implementing learning from experience feedback from fire events in non-nuclear settings’
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’
GP-3	‘A dynamic system to manage storage area for transient fire loads and other non-combustible materials’
GP-4	‘Thermographic cameras installed on worksites, or in case of the failure of a detector, with different detection zones and alarms’

Annex C - Compilation of National Areas of Good Performance

Ref. no.	Finding	Identified in the TPR for the installation
ALL/MULTIPLE INSTALLATIONS		
FR-AGP-7	Comprehensive national review after Lubrizol (chemical industry) fire accident resulting in ASN requests and consequently in concrete actions in all nuclear installations.	All installations (FR)
NL-AGP-1	Full-scope fire PSA in all operational states for Level 1 to 3 PSA.	Borssele NPP, HFR RR (NL)
UK-AGP-1	There is an independent verification of hot work in addition to the assessment by the 'Hot Work Selected Person' and review by the 'Hot Work Controller' for enhanced control of work areas.	All installations (UK)
UK-AGP-2	The nuclear sector-wide review of combustible cladding risks instigated by the nuclear regulator, to identify and implement any transferable learning from the Grenfell fire.	All installations (UK)
UK-AGP-4	Implementation of automatic fire suppression system to transporter tug engines across the site.	Sellafield (UK)
NPPs		
BE-AGP-1	A solid process is in place to manage the authorisations to have fire doors opened: the wedge to block the fire door can be collected at the Main Control Room after approval.	Tihange 3 NPP (BE)
BE-AGP-2	The existence of first-intervention teams (composed of operators) and second- intervention teams (composed of professional fire fighters) with proper equipment and,	Tihange 3 NPP (BE)

Ref. no.	Finding	Identified in the TPR for the installation
	in the case of Tihange NPP-external firefighters quartered opposite the site, ensures an appropriate response to any fire event.	
BE-AGP-3	Use of a mobile scanner device with an intuitive IT tool and barcode on items to easily identify equipment or material allowed to be stored.	Tihange 3 NPP (BE)
BE-AGP-4	Implementation of a software tool to easily assess the adequacy of the fire protection measures.	Tihange 3 NPP (BE)
CH-AGP-2	Robustness of the fire detection system against single failure.	NPPs (CH)
CZ-AGP-1	A large professional fire brigade (FRSU) ranging from 12 to 18 depending on the NPP, is deployed on a permanent basis on the NPP site providing fire prevention, firefighting and rescue services.	NPPs (CZ)
CZ-AGP-2	A large modernisation of fire detection system has been carried out with the use of new generation, multi-criteria detectors.	NPPs (CZ)
ES-AGP-1	Implementation of effective flooding protection of critical equipment from the harmful effects of firefighting water extinguishing system.	Almaraz and Cofrentes NPP (ES)
ES-AGP-2	Detailed arrangements for the management of hot works are provided (covering e.g. scope of works, supervision, necessary firefighting equipment).	Cofrentes NPP (ES)
ES-AGP-3	New fire-fighting procedures and training have been implemented as a result of the lessons learnt from conventional industry.	Vandellos 2 NPP (ES)
FI-AGP-1	Use of a battery for powering fire valves and smoke removal valves for a period of at least 10 minutes as a compensatory measure.	Olkiluoto 3 (FI)
FI-AGP-2	Gas detectors are installed in premises where diesel generators are located which signal the leakage of combustible gases from fuel tanks.	Lovisa 1, 2 NPP (FI)

Ref. no.	Finding	Identified in the TPR for the installation
FR-AGP-1	Implementation of door-open alarms for the ones representing a safety risk (PSA based).	Tricastin 900 MWe NPP (FR)
FR-AGP-2	Implementation of thermal cameras on particular worksites providing an alarm in the main control room in order to be alerted of a fire outbreak.	NPPs (FR)
FR-AGP-3	Measures to be taken by the operators in the control room are pre-defined in written instructions (FAIOp).	NPPs (FR)
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) performance.	NPPs (FR)
HU-AGP-1	There is a permanent presence of a well-resourced on-site fire brigade.	Paks NPP (HU)
RO-AGP-1	Since 2022, a professional unit of firefighters (15 firefighters, 3 fire trucks) is deployed on a permanent basis on the Cernavoda NPP site.	Cernavoda NPP Unit 1 (RO)
SE-AGP-1	The design approach of the fire detection and alarm system is robust regarding the separation of redundant trains.	NPPs (SE)
SE-AGP-2	Measures to be taken by the operators in the control room are pre-defined in written instructions for every single fire compartment depending on the area affected. For complex spaces, intervention layouts (rooms, detectors and so on) and fire compartment layouts are complemented with specially developed intervention plans.	Ringhals 3 NPP (SE)
SK-AGP-1	A professional multi-functional fire brigade (minimum 18 staff) is deployed on a permanent basis on the NPP site. In addition, an external fire brigade is available whose intervention is planned in the event of a fire. The effectiveness of the joint intervention is verified via annual drills.	Mohovce 3, 4 NPP (SK)

Ref. no.	Finding	Identified in the TPR for the installation
TR-AGP-1	The presence of a well-resourced on-site fire brigade contributes to responding to fires in a timely and robust manner.	Akkuyu NPP (TR)
UA-AGP-1	An extensive and targeted modernisation programme of fire protection equipment and systems has been undertaken at the NPPs.	NPPs (UA)
UK-AGP-3	Fire doors and hatches which form part of the nuclear fire compartment have position monitoring that initiate an alarm in the MCR if the door is left open.	Hinkley Point C, Sizewell B and 2nd generation AGRs (UK)
RESEARCH REACTORS		
FR-AGP-5	Use of a semi-quantitative fire risk assessment methodology for each of the 600 rooms of the reactor building.	RHF RR (FR)
FR-AGP-6	Modernisation of the facility with significant improvements (both on passive and active components) including the ones in the frame of the PSR.	RHF RR (FR)
HU-AGP-2	A significant number of the staff and reactor operator personnel are certified fire safety engineers.	Budapest Research Reactor (HU)
NL-AGP-2	A systematic approach for combination of hazards is applied.	HFR RR (NL)
PL-AGP-1	Implementation of new and modern provisions, in particular to meet the current fire protection regulations.	MARIA, Świerk (PL)
TR-AGP-2	Formalised arrangements between the reactor facility and the city fire brigade contributes to an effective response in case of a fire.	İTÜ Research Reactor (TR)
DECOMMISSIONING		
IT-AGP-2	Permanent presence on the site of the research reactor under decommissioning of a well-resourced on-site fire brigade.	ESSOR RR - Decommissioning (IT)

Ref. no.	Finding	Identified in the TPR for the installation
Spent fuel storage		
CH-AGP-1	Fires resulting from military aircraft crash were considered at the design stage of the spent fuel storage facility and also the radioactive waste storage buildings.	Zwilag SFS (CH)
SI-AGP-1	Fire resulting from large commercial aircraft crash are considered in the design basis in the deterministic studies for storage casks for spent fuel.	Dry SFDS Krško NPP site (SI)
waste		
IT-AGP-1	Fires resulting from a military aircraft crash onto waste buildings are considered at the design stage and compliance of the consequential impact with established radiological objectives verified.	OPEC2 and D2 EUREX - Waste (IT)

Annex D - Compilation of National Areas for Improvement

Ref. no.	Finding	Identified in the TPR for the Installation
ALL/MULTIPLE INSTALLATIONS		
DK-AFI-2	Fire preventive measures rely to a higher degree on the adherence to operational procedures than on the structural and layout features of the building itself.	Risø site (DK)
LT-AFI-3	A need for standardisation of inspections and functionality testing procedures for fire dampers. Fire dampers must be visually inspected on site for actuation condition and such a method shall be properly addressed in relevant Ignalina NPP operating and maintenance procedures.	All installations (LT)
UK-AFI-3	Holistic Fire Safety Strategies (FSSs) covering fire objectives: nuclear safety, life safety, property protection not currently available for all nuclear facilities.	Sellafield (UK)
NPPs		
BE-AFI-1	The verification and inspection process of the seals in fire resistant concrete dals is implemented but not yet integrated in all the maintenance procedures.	Tihange 3 NPP (BE)
BE-AFI-2	FSA should consider seismically induced fire.	Tihange 3 NPP (BE)
BG-AFI-1	The need for replacement of fire detectors due to ageing management.	Kozloduy Unit 5 NPP (BG)

Ref. no.	Finding	Identified in the TPR for the Installation
CH-AFI-2	There are two different systems to support the fire load management. It does not allow to get information efficiently.	Leibstadt NPP (CH)
CH-AFI-4	There is a need to reassess the detection strategy in area/rooms with harsh environment, in particular high radiation, according to the FSA, and consider the adoption of appropriate fire detection solutions where needed.	All NPPs (CH)
CZ-AFI-1	The water fire extinguishing system which protects the cable compartments is obsolete.	Dukovany NPP (CZ)
ES-AFI-1	Licensees to make a better use of fire operational experience database, such as 'FIRE'.	NPPs (ES)
FI-AFI-1	A need to complete replacement of old CO2-gas extinguishing systems, whose design basis does not comply with today’s industrial standards.	Olkiluoto 1,2 NPP (FI)
FI-AFI-2	FSA should consider seismically induced fire.	Lovisa 1, 2 & Olkiluoto 1,2 NPP (FI)
HU-AFI-3	Lack of detector for an area with combustible materials temporary storage.	Paks NPP (HU)
HU-AFI-4	Fire detection systems for buildings other than the reactor and turbine buildings and water extraction plant are not seismically qualified and not independent between adjacent compartments. A risk-based justification is not provided.	Paks NPP (HU)
HU-AFI-5	There is a need to reassess the detection strategy in area/rooms with harsh environment, in particular high radiation, according to FSA, and consider the adoption of appropriate fire detection solutions where needed.	Paks NPP (HU)
NL-AFI-1	Several automatic extinguishing systems do not fully comply with the current design requirements and regulations.	Borssele NPP (NL)

Ref. no.	Finding	Identified in the TPR for the Installation
NL-AFI-2	The fire detection alarms are not simulated in the control room simulator.	Borssele NPP (NL)
NL-AFI-4	Automatic fire suppression is not guaranteed in case of SSE.	Borssele NPP (NL)
RO-AFI-1	Fire hydrants and piping not yet installed in the Reactor Building of Unit 1.	Cernavoda NPP Unit 1 (RO)
RO-AFI-3	The combination of fire and earthquake events is not systematically considered and documented in all nuclear installations, as applicable.	Cernavoda NPP Unit 1 (RO)
SI-AFI-1	Absence of multiple spurious operation (MSO) in FHA.	Krško NPP (SI)
SK-AFI-1	The intervention time of the intervention units may be delayed due to restricted access to certain rooms.	Mochovce 3,4 NPP (SK)
UA-AFI-1	A need to enhance fire hazard analysis by further development of deterministic analyses to specifically assess the potential consequences of fire events on the performance of the safety functions.	NPPs (UA)
RESEARCH REACTORS		
AT-AFI-1	Absence of fire extinguishing blankets that could prevent fires from developing and causing damage to the infrastructure.	TRIGA Mark II Vienna RR (AT)
HU-AFI-2	No inventory of the flammable materials transported into the facility (e.g. packaging materials, paints).	Budapest Training Reactor (HU)
HU-AFI-1	The site conditions create conflicting responsibilities between the site owner and reactor operator organisation, which complicates the approval processes for certain modifications or corrective actions.	RRs (HU)
HU-AFI-6	Insufficient physical separation between redundant safety-related components (i.e. diesel generators, ventilators).	Budapest Research Reactor (HU)

Ref. no.	Finding	Identified in the TPR for the Installation
IT-AFI-1	Based on the FHA results, the fire protection system for RSV TAPIRO has to be improved, in particular with regard to the fire compartmentation and to the ventilation system.	TAPIRO Fast Neutron RR (IT)
NL-AFI-5	Inadequate management and qualification of isolation valves in the reactor building.	Hoger Onderwijs Reactor- HOR (NL)
NL-AFI-6	In the reactor building fire detectors are located only in the ventilation ducts.	Hoger Onderwijs Reactor- HOR (NL)
PL-AFI-1	Lack of automatic extinguishing systems.	MARIA, Świerk (PL)
PL-AFI-2	Lack of compartmentation or compensatory measures between redundant SSCs (UPS, diesel generators).	MARIA, Świerk (PL)
RO-AFI-2	The fire hazard analysis performed in 2013 has not been revised and updated yet. It should be updated as part of Periodic Safety Review of the RR which is currently under development. According to the TPR Team, FHA should be revised at least every 10-years as part of the PSR.	TRIGA Research Reactor in Pitesti (RO)
TR-AFI-1	Need for review and upgrading of the fire safety-related systems in order to adapt to the design requirements in the new regulation on fire safety of nuclear facilities.	İTÜ Research Reactor (TR)
TR-AFI-2	Due to the new regulation on fire safety, the licensee will have to perform a fire safety analysis and hazard assessment. It should include justification of the acceptability of the fire protection measures including the seismic robustness of fire protection equipment.	İTÜ Research Reactor (TR)
FUEL CYCLE FACILITIES		

Ref. no.	Finding	Identified in the TPR for the Installation
ES-AFI-2	Need for consideration of the radiological risks in the FHA.	Juzbado FCF (ES)
FR-AFI-1	In the event of fire extinguished with water, the extinguishing water has to be retained and collected within the building concerned or its immediate vicinity. For two buildings out of the eight harbouring uranium-bearing materials, part of the extinguishing water is liable to infiltrate the soil. Thus, these two buildings must undergo improvements in order to retain and recover fire extinguishing effluents. These improvements are taken into account as part of the installation's ongoing periodic safety review.	Framatome Romans fuel fabrication facility (FR)
FR-AFI-2	Improve the implementation of spray water extinguishers regarding the Labour Code requirements. Incompatibilities with the process or particular water-reactive substances should be assessed in order to not degrade the safety of nuclear installations.	La Hague (FR)
NL-AFI-3	No obvious connection between the diverse fire analyses performed with different requirements, guidelines and scenarios depending on the fire analyses.	FCF Urenco (NL)
UK-AFI-1	Lack of systematic consideration of combined or consequential hazards assessment as part of the current safety case.	Springfields Fuels Ltd (UK)
SPENT FUEL STORAGE		
CH-AFI-1	A need for a revision of the fire protection concept into an 'overarching fire protection concept' and detailed building-specific fire protection concepts.	Beznau and Gösgen NPP and Zwibez spent fuel storage (CH)
CH-AFI-3	Necessary to update and supplement the fire protection concepts and associated documentation in	Zwilag SFS (CH)

Ref. no.	Finding	Identified in the TPR for the Installation
	accordance with the national fire protection regulations.	
IT-AFI-2	There is a need to strengthen the fire detection provisions in the context of the planned fuel transfer into the new dry storage facility.	ITREC plant - SFS (IT)
IT-AFI-4	There is a need to reassess the fire protection measures to decide whether to install new provisions (e.g. fire dampers, smoke detectors, ventilation ducts, …).	ESSOR Plant-SFS (IT)
LT-AFI-1	A need to install additional equipment that would allow remote monitoring of the situation in SNFSF-1 from INPP main control room.	SNFSF-1 (LT)
SK-AFI-2	There is a need to complete the replacement of external underground fire hydrants with external over-ground fire hydrants.	Interim spent fuel (SK)
SK-AFI-3	Additional work is needed to review the components and replace the cable connections of the fire detection and protection system (FDPS).	Interim spent fuel (SK)
SK-AFI-4	There is a need to re-evaluate the use of voice alarm in the civil structure.	Interim spent fuel (SK)
SK-AFI-5	There is a need to re-evaluate the possibility of controlling important fire equipment (HVAC equipment, ventilation of protected escape routes, fire doors, power shutdown) via the FDPS.	Interim spent fuel (SK)
SK-AFI-6	There is a need to elaborate procedures for the repair, the operability and the identification of fire protection system components.	Interim spent fuel (SK)
DECOMMISSIONING		
DK-AFI-1	Since there are no dampers installed in the ventilation system, the fire in the building can spread through the duct system.	Hot Cell facility - Risø site - Decommissioning (DK)

Ref. no.	Finding	Identified in the TPR for the Installation
IT-AFI-3	There is a need to update the fire protection provisions in compliance with technical guide n. 31, in the context of the ongoing licensing process for decommissioning.	ESSOR RR, EUREX FCF - Decommissioning (IT)
UK-AFI-2	No explicit fire loading limits: a proportionate approach is needed to implement the day-to-day management of fire loading with the assessment of fire loadings in the nuclear safety case.	Dounreay Prototype Fast Reactor - Decommissioning (UK)
WASTE STORAGE		
DK-AFI-3	The lack of compartmentation (rooms not everywhere separated by doors and absence of floor to ceiling wall) requires complementary analysis to verify and implement, if necessary, compensatory measures to ensure that fire does not spread from between different activities.	Risø - Waste (DK)
DK-AFI-4	There is a need to implement a system to document the inventory of fire loads (e.g. computer system).	Risø -Waste (DK)
LT-AFI-2	A need to implement solutions to improve the reliability of fire detectors that are operating in hard conditions (for instance, high radiation, humidity) in Solid waste treatment and storage facilities (B3/4 project) and Solid waste storage buildings 157, 157/1.	Waste (LT)

References

TERMS OF REFERENCE FOR THE TOPICAL PEER REVIEW PROCESS ON FIRE PROTECTION, ENSREG, 2022

National Assessment Report of Finland - for the Purposes of Topical Peer Review “Fire Protection” under the Nuclear Safety Directive 2014/87/EURATOM, STUK, 2023

2nd Topical Peer Review – ‘Fire Protection’ - Country Review Report – Finland, ENSREG, 2025