European Nuclear Safety Regulators Group
ENSREG

2nd Topical Peer Review – 'Fire Protection'

Country Review Report

France

January 2025

CONTENTS

1. Brief overview of the candidate installations

The following installations were finally selected and included in the national assessment report (NAR).

Installation category	Number of installations	Name of candidate installations
Nuclear power plant	1	TRICASTIN NPP 900 MW Unit 1 (the NAR also indicates differences with 1300 MWe, N4 and EPR series of units)
Research reactor	1	RHF (High Flux Reactor operated by the Institut Laue- Langevin (ILL))
Fuel reprocessing facility	1	UP3A unit T2 at La Hague site
Fuel fabrication facility	2	MELOX Framatome Romans
Fuel enrichment facility	1	George Besse II
Dedicated spent fuel storage Note: please, indicate the type „wet“ or „dry“.	1 (wet)	The spent fuel storage pool at La Hague – Pool D (T0)
Installations under decommissioning	2	OSIRIS research reactor Saint-Laurent des Eaux UNGG reactors
On-site radioactive waste storage	1	La Hague Silo 130
Total	**10**	

2. Regulatory framework

The NAR mentions that "*the requirements regarding the control of fire risks are regulated by the Order of 7 February 2012, supplemented by ASN resolution dedicated to fire safety. These texts stipulate the provisions to be adopted by all nuclear installations' licensees with regard to the control of fire risks*."

The NAR describes the key regulatory requirements related to nuclear safety. Pursuant to the general regulations described above, the licensee shall apply the principle of defence in depth to the control of fire risks. The licensee is required to *"...incorporate the control of fire risks into the safety case. This safety case is produced using a prudent deterministic approach which integrates the technical, organisational and human dimensions, and takes into account all the possible states of the installation, whether permanent or transient*." In addition, it is explained, *"The safety case shall also include probabilistic analyses of accidents and their consequences, unless the licensee demonstrates that this is irrelevant. In practice, the different nuclear power reactor plant series in operation have probabilistic fire risk studies in addition to their deterministic safety cases."* A number of the WENRA safety reference levels are transposed into the French regulatory framework. The NAR does not mention if

the WENRA SRLs are binding. In response to the question of the TPR Team[1], France's answer was: *"The WENRA SRLs related to fire protection are transposed in the following regulatory documents:*

- Order 7 February 2012 that sets the general rules relative to all nuclear installations,

- ASN resolutions (no 2014-DC-0417 28 January 2014) concerning the rules applicable to nuclear installations with regard to the management of fire risks,

- ASN resolutions (n° 2015-DC-0532 17 November 2015) concerning the safety analysis report for nuclear installations.

All these regulatory documents are binding for all nuclear installations."

The NAR indicates that "*ASN's strategy and policies have incorporated the need to transpose the WENRA safety reference levels into the French regulatory framework*." It provides the status of the SRL transposition, depending on the installations, already implemented in the regulatory framework.

3. Findings and significant improvements of approaches on the installations from the national self-assessment

Nuclear power plants

TRICASTIN NPP Unit 1

The following **strengths** related to fire protection were reported in the NAR for **TRICASTIN NPP Unit 1**:

- EDF's fire protection design approach is complete and extensive: deterministic with four levels of defence in depth, probabilistic, incorporating unlikely failures or situations, and is periodically improved on the occasion of the ten-yearly periodic safety reviews. It is based on proven standards or codes.
- Integrated protection against fire risks from the design stage. The implementation of the Fire Action Plan (1999-2006) has already led EDF to significantly reinforce fire prevention, detection and fighting on all the units, from the material and organisational aspects alike.
- Incorporation of non-radiological risks into the Fire Risk Management Case.
- The fire detection equipment and the fixed fire extinguishing systems of the nuclear island and the conventional island are robust to the revised SSE.
- The robustness of the fire sectorisation (doors, fire dampers) and its resistance to the SSE revised without modification for the Tricastin site. Reinforcement works are planned for some of the CPY series NPPs.
- The prohibition on storing fire loads in the fire safety sectors identified as representing a "major fire risk".
- EDF has set up an organisation:
    - Each NPP has a department in charge of risk prevention. The organisation in place for the preparation and tracking of hot work permits is robust.
    - There is a sectorisation officer on each NPP responsible for fire sectorisation management in order to prioritise the addressing of anomalies.
- Probabilistic safety studies specific to fire are enabling the rooms or equipment with the greatest fire safety implications to be better identified and operational measures in these premises to be defined.

[1] 'The NAR in §1.2 presents the regulatory framework. If not yet clearly mentioned in the NAR, could you indicate whether the WENRA SRLs for NPPs, and RRs (if relevant for your country), which are used as reference for this topical peer review on 'fire protection' (as per the Technical specification) are binding or not in your country? If they are not binding, what is the status of the SRLs (non-binding, guidance, advisory..)?'

The following **weaknesses** related to fire protection were reported in the NAR for **TRICASTIN NPP Unit 1**:

- Management of the temporary and permanent storage areas, some of which do not meet all the requirements concerning fire loads, particularly during plant unit outages. Awareness-raising actions have been carried out with those concerned.
- Application of hot work permits (management of disabling permits, inappropriate risk analyses).
- Better operational management of the sectorisation anomalies would nevertheless bring greater reliability of this level of defence.
- Concerning the fire-fighting response:
    - Heavy reliance on the external emergency services in the fire-fighting strategy.
    - On several sites, the on-site fire-fighting personnel must work more closely with the external fire services in order to improve fire-fighting effectiveness.

  As a consequence, EDF has launched a fire-fighting enhancement project which aims to improve the efficiency of the organisation as a whole and to reinforce the operational coverage, including when the emergency services centre is not in the immediate vicinity of the site.

The following **lessons learned** related to fire protection were reported in the NAR for **TRICASTIN NPP Unit 1**:

- There have been no fire events with real safety consequences.
- In order to guard against anomalies in the calibre of the sprinklers installed on the fixed extinguishing systems, the sprinkler replacement procedure is being updated to integrate a specific verification of the calibre of the heat-sensitive system.
- With regard to the hot work permits, the percentage of fire outbreaks linked to hot work has been decreasing over the last few years.
- The period of deployment of the new detection system has been the cause of several significant events. Tricastin NPP suffered partial unavailabilities of the fire detection system that sometimes lasted several days.
- During the last fire inspections at the Tricastin NPP, sectorisation management, particularly in the "major fire risk" fire sectors, was viewed positively as a whole.
- During the last fire inspection on Tricastin NPP, the maintenance of the fire-fighting means was judged particularly unsatisfactory, and more particularly the condition of the site's fire-fighting water standpipes.
- Number of anomalies concerning the emergency assistance and fire-fighting means of certain reactors is too high.
- The personnel do not have sufficient knowledge of the real constraints associated with the fire loads.
- The maintaining of sectorisation in operation (the fire doors in particular) was improving but still required vigilance.
- ASN requested to ensure the permanent presence on its sites of competent fire-fighting personnel, with appropriate equipment for their missions and trained to cope with developed fires. In response, as of 2024 EDF will deploy a new organisation integrating the supply of complete fire-fighting outfits for the EDF response team members and the presence of a posted operational guard of six firemen on a number of NPPs, including Tricastin, which should allow fire outbreaks to be dealt with more rapidly.
- EDF has put in place a monthly indicator on the number of requests for work on the fixed fire protection systems. Sites with a large number of ongoing requests have put in place action plans to reduce them by the end of 2023.
- Recent commitments to improve the fire-fighting organisation:

    - avoid necessity for mobilising the SDIS's (Departmental Fire and Emergency Services) by making verifications within the maximum deadline for calling the external emergency services;
    - have teams of EDF voluntary firemen on site during working hours who can supplement the SDIS teams.
- The ongoing fire ambitious EDF R&D project, with development of recognised numerical codes
- Contribution to OECD's fire safety programme.
- Complementing this, EDF is integrating the insurers' recommendations for the nuclear and conventional parts of its facilities. These recommendations have led it to make improvements to its fire protection systems. For example, moving an isolation valve allowing rapid emptying of the hydrogen from the main alternator in the turbine hall.

The following **improvements** related to fire protection were reported in the NAR for **TRICASTIN NPP Unit 1**:

- Fire-proof boxes installed in the buildings of the nuclear and conventional island to complement the existing on-site fire load storage solutions.
- The reliability of the detectors installed in the pumping station was improved.
- The deployment of a digital hot work permit management tool in place of the paper permits.
- With regard to the management of temporarily stored fire loads, EDF is developing a methodology which aims to use the fire studies to identify temporary storage possibilities within the premises for all the plant units.
- The nuclear island protection system (reactor building exterior) shall be robust to the SSE after deployment of the modifications scheduled as part of phase B of the periodic safety review.
- For the detection of and response to fire outbreaks, the renovation of the fleet fire detection systems over the last few years.
- Measures for improving the fire resistance of certain components or reducing the scale or intensity of potential fires (i.e. replacing fire sectorisation components by components with greater fire resistance).
- EDF has identified doors representing a safety risk that will be equipped with "door open" alarms aiming to ensure they are kept closed. Passive sectorisation equipment will be identified as high risk for safety and their in-service requirements will be tightened.
- Development of a new method called PEPSSI (Principle of Evaluation for the Sufficiency of Fire Sectorisation Elements) to check the robustness of fire safety volume sectorisation elements. As outcome, implementation of additional protection provisions (cable protections, replacement or addition of fire doors, reinforcement of Fire sectorisation elements in the pump house…) and implementation of operational measures to reduce the heat load in certain rooms identified as rooms with safety implications.
- The R&D on smoke-induced malfunctions led to the following industrial choices:
    - inclusion in the vulnerability analysis of the effects induced by smoke from fire on the most sensitive equipment (electronic equipment) by adopting criteria temperature, smoke zone, exposure duration) reflecting the possibility of the deposition of soot;
    - this malfunction criterion is also introduced into the probabilistic safety assessments.
- Implementation of automatic closure of the H2 isolation valve of the SGZ system (H2 supply system) if a fire is detected by the JDT system (fire detection system) in certain premises.
- Modifications in passive and fixed extinguishing equipment in case of the failure of passive equipment on the basis of PSA and/or deterministic assessments.
- Sensitivity studies were carried out on operator intervention times. An equipment modification designed to automate sprinkling of the RCV rooms enables these rooms to be excluded from the analysis.
- Reassessment of the consequences of a fire in the rooms producing chilled water for the electrical building (DEL), following replacement of the chillers. Implementation of a

modification aimed at circumventing the DEL loss by fire common mode (protecting the DEL pump train B power supply cable by wrapping).
- Modification deployed to counter the risk of unwanted opening of the SDP following a fire in the RRA (residual heat removal system) not connected states.
- Modifications for the sizing of the protection against cabling common modes and the minimum operating resources with regard to their fire resistance.
- Major modifications concerning fire protection of the RCV (chemical and volume control system) pump houses and the overall renovation of the fire detection system.
- Notable improvements were made in the fire risks management case, in particular by performing sectorisation verification studies, supplemented by the verification of the effects of smoke pressure on the sectorisation components.

Research reactors

RHF

The following **strengths** related to fire protection were reported in the NAR for **RHF** research reactor:

- The concept of applying the four levels of defence in depth when taking fire protection into account is well established at the ILL.
- The renovation and upgrading of the fire safety systems at the ILL over the years proved to be a positive point in achieving the methodological objectives (risk level) for the various rooms containing safety targets or combustible materials.
- The fire risk assessment is updated introducing the new method for the RHF which takes into account the hazard risk for the PIC-S (important safety component).
- The risk analysis prior to facility modifications examines the impact on the fire load or the ignition sources present and any compensatory measures necessary to ensure compliance with the Fire Risk Management Sheet (FGRI).
- The FGRIs of the experimental areas include quantitative limits for the use of inflammable gas cylinders or the use of inflammable liquids.
- Reactor I&C is located in a fire sector of the building adjoining the reactor, equipped with an automatic gas extinguishing system.
- Robust design approach and strategy in terms of fire detection and alarming.
- The automatic gas-type extinguishing systems are well suited to sectors which may be confined and they adequately protect the other equipment items present in them.
- Proximity of the next-door CEA's FLS (Local Safety and Security Force) and the Grenoble fire brigade, with whom exercises are conducted regularly with joint debriefings to improve the coordination between the ILL's internal forces and the external forces. Effectiveness of these arrangements has been demonstrated in recent reactions to fire outbreaks.
- All the ILL personnel are trained in the use of fire extinguishers.

The following **weaknesses** related to fire protection were reported in the NAR for **RHF** research reactor:

- The weak points identified following the fire risk analysis during the latest periodic safety review, led to a number of fire protection improvement projects being launched, the main ones being (passive protection of the target PIC-S, electrical cable penetrations, sprinkler extinguishing systems to protect the PIC-S or to improve defence in depth by controlling any growth of a fire in the experimentation level of the reactor building).
- The configuration of the experimental halls does not allow effective fire sectorization. For some experimental zones situated in the reactor building it is not feasible, for reasons of available space, to fit out a zone or to protect a PIC with a passive protection system, such as a fire-resistant partition. To cope with this weak point, ILL put in place good practices with regard to the room-based fire load management and the management of hot work permits.

- The large number of experiments carried out in the reactor building leads to complex control of the heat loads: limitations on the quantity of combustible material authorised per zone must be defined by the licensee and the users must be regularly reminded of them.
- The ILL does not have its own fire-fighting force beyond the first aid team members and many areas are not equipped with automatic fire-extinguishing systems due to the initial design of the facility.

The following **lessons learned** related to fire protection were reported in the NAR for **RHF** research reactor:

- Automatic gas or sprinkler extinguishing systems have yet never been activated under real fire conditions, or accidentally.
- A few rare fires did actually break out, outside sensitive areas (waste bins, ashtray, etc.). These were the result of human negligence and apart from enabling the response instructions to be put into practice, they highlighted the need to periodically recall common-sense operational instructions and to regularly make the ILL personnel and visiting scientists aware of the fire risk within the BNI.
- The few actual fire outbreak events having required the use of hand-held fire extinguishers by the ILL personnel have shown that these means, and the way of using them, were effective for smothering or rapidly putting out an incipient fire or a combustion phenomenon in its early stages.
- The management of permanent storage of inflammable and hazardous materials has been the subject of ASN inspections which have revealed weak points in the control of certain aspects.
- The retrofitting of passive protection systems in an old facility has proved to be a complex and long process. The installation of passive protections on numerous cable penetrations between buildings in 2022 provides a good illustration of the difficulties in carrying out this type of work.
- A particular risk of potential harm to the PICs-S related to possible rupture of gas cylinders in case of fire was identified. ILL has undertaken to develop a solution to address this risk.
- Given that the weak point common to the active systems (gas extinguishing systems and sprinklers) is their potential unavailability or sudden failure, they must be rigorously monitored by periodic testing.
- The demonstration of the effectiveness of the fire protection measures is not systematically incorporated into the studies performed as part of the periodic safety review.
- The principle of pre-starting patrols to be rendered systematic, with one of the focal points being the presence of unnecessary fire loads (such as those associated with the work that has just been finished). These fire loads are removed before the reactor is restarted.
- Good coordination between the internal fire-fighting teams and the external forces (FLS, SDIS) can only be maintained through regular exercises with joint debriefing.
- The complexity of some of the ILL buildings requires the SDIS off-site firemen to be accompanied by the ILL Local Initial Response Team in order to identify certain specific risks or particular topographies of the sites (e.g. inside the reactor building).

The following **improvements** related to fire protection were reported in the NAR for **RHF** research reactor:

- The ILL updated its fire risks assessment. The method is improved with regard to the PIC-S fire hazard risk. The ILL has made a number of commitments to improving fire prevention and mitigating the consequences of any fire.
- Management of flammable and hazardous materials has been weak, new procedures introduced in 2022.
- Reducing risk related to rupture of gas (inflammable or inert) cylinders at reactor building.
- Tightening of monitoring of the chemical products inventory in order to reduce the risk of toxic substance discharges, a potential consequence of an uncontrolled widespread fire.

- Installing passive protections to prevent the propagation of a fire from one experimental area to the next are planned and implemented on a case-by-case basis when the experimental areas undergo modifications, always with the available space constraint.
- Some improvements resulting from periodic safety review in 2017:
    - Installation of a manual water sprinkler system in the radiological zone rooms housing the most important PIC-S;
    - Installation of protection on electrical cables at the reactor building concrete containment penetrations;
    - Installation of a heat screen between the electrical cabinets and the gas tank of the Horizontal cold neutron source;
    - Installation of fire protection on one of the trains of the “Hardened safety core” backup systems;
    - Installation of a sprinkler type control system over all of level C of the reactor building;
    - Installation of gas extinguishing system in the bunkers with radioprotection constraints at the level C (ongoing).
- In 2022, a manual spray system equipped with sprinkler heads was installed in the bunkers of the heat exchangers and the reactor coolant pumps on level B of the reactor building, which are prohibited areas (red) when the reactor is in operation.
- Management of the fire-fighting water, which can lead to discharges, has also undergone improvements.
- Since 2022, room managers have been appointed and trained concerning fire protection aspects.

Fuel reprocessing facility

UP3A

The following **strengths** related to fire protection were reported in the NAR for **UP3A** fuel reprocessing facility:

- The division of the unit into numerous rooms with reinforced concrete walls greatly limits the development and propagation of a fire.
- Consolidation of the categories of rooms identified in the design.
- A system of operational management of transient fire loads is in place.
- The fire alarms are transmitted to the T2 unit operational control room and to the PSM's control and monitoring room. The chosen ergonomics enable the location of the fire alarm triggered in the T2 unit to be identified rapidly and with certainty.
- The 24h/24 presence of the PSM service fire-fighting teams enables fire-fighting to begin immediately with heavy-duty means without waiting for the external emergency services (SDIS).

The following **weaknesses** related to fire protection were reported in the NAR for **UP3A** fuel reprocessing facility:

- Greater rigour with the prevention means specific to the worksites.
- Greater attention must be paid to the site's fire sectorisation. Not all the rooms are equipped with fire doors. Therefore the periodic safety review methodology aims to confirm the adequacy of the measures.
- Improvements are expected in terms of the proximity fire-fighting means, particularly with regard to their appropriateness for the types of fire loads encountered in the facility.
- Additional water spray fire extinguishers must be planned to comply with regulations (Labour Code).

The following **lessons learned** related to fire protection were reported in the NAR for **UP3A** fuel reprocessing facility:

- The last periodic safety review of the T2 unit led to the approximate doubling of the number of T2 unit rooms equipped with automatic fire detection (AFD) systems.
- The last inspections reveal numerous defects of the fire doors, some of which were installed recently.
- The significant fire loads necessary for operation (consumables) or resulting from operation (combustible waste) have been grouped together in dedicated and identified rooms (e.g. consumables storerooms, rooms for interim storage of waste).
- With regard to the heavy fire-fighting means (PSM), for several years now it has been difficult to check their implementation during the exercises organised for the inspections. The multitude of missions assigned to these teams on this site means that they can only rarely participate in the exercises in a satisfactory manner.

The following **improvements** related to fire protection were reported in the NAR for **UP3A** fuel reprocessing facility:

- The obsolescence of the fire control panels installed when the T2 unit was built combined with the growth in the number of rooms equipped with fire detection systems further to the periodic safety reviews, means that the obsolete equipment is being replaced with recent technology equipment.
- Dedicated project, following last PSR, for addressing active protection (fire detection) and passive protection (fire doors, fire dampers, thermal shields, protection of the power supplies of redundant electrical equipment serving to maintain the unit in a safe state).
- The redundant electrical equipment items serving to maintain the unit in a safe state have been subject to the following measures:
    - Installation of a thermal shield between the redundant electrical equipment items;
    - Installation of fire protection around at least one of the two channels providing electrical power to these equipment items.
- The unavailability or failure of a means of controlling the fire-related risks was analysed in the last periodic safety review and it resulted to some measures:
    - The installation of fire doors has been recommended;
    - The installation of fire protections around the electrical power supplies of the redundant electrical equipment for maintaining the T2 unit in a safe state has been recommended.
- Deployment and application of the combustible materials management guide in the Orano site units.
- Updating of the fire load in "fire sector" rooms.
- Passive means of protection (fire doors, fire dampers, thermal shields, protection of the power supplies of redundant electrical equipment serving to maintain the unit in a safe state) have been installed further to the last safety review.
- Reinforcement of the fire detection provisions.

Fuel fabrication facilities

MELOX

The following **strengths** related to fire protection were reported in the NAR for **MELOX** fuel fabrication facility:

- Consideration of the common mode risk: The redundancy of the PICs to be protected from the effects of the fire and their physical separation.
- Consideration of the risk of internal failure: the plausible failures of the fire protection provisions are determined in order to ensure that despite the unavailability of the PIC

required, the fire growth scenario cannot on its own experience a cliff-edge effect and lead to unacceptable consequences.
- Control of hydrogen proportion in argon and inerting glove boxes.
- Broad coverage by the AFD network, fostering early fire detection.
- The transmission of alarms to a permanently manned station in order to rapidly mobilise the firefighting personnel and to place and maintain the facility in a safe state in a fire situation.
- The on-site presence of a service specialised in firefighting with the personnel and technical means of the MELOX site.

The following **weaknesses** related to fire protection were reported in the NAR for **MELOX** fuel fabrication facility:

- Certain partitions separating a production room and a passageway constitute a single wall situated both at the boundary of a fire sector and at the boundary of a containment sector. They have a fire resistance rating and a sealing requirement. One of these partitions must be reinforced to prove the sealing (against nuclear materials) despite the temperature and pressure effects created by a fire.
- As the facility uses materials that present a criticality risk, the use of water as an extinguishing agent is strongly restricted in many premises, which means that particular attention must be paid to fire protection measures to prevent fires from starting and spreading.

The following **lessons learned** related to fire protection were reported in the NAR for **MELOX** fuel fabrication facility:

- No major anomaly has been found during the inspections over the past five years on topics related to fire risk management provisions.
- The emission of smoke from the suction system of the cutting tool situated in a maintenance clove box was observed. The fire risk control provisions take into account the lessons learned from this event through the control of hot work, the risk of ignition in a glove box in an atmosphere of air and the protection of the suction or ventilation equipment.
- The disconnection of a fire detector cable in a glove box caused a detection fault (absence of detection), not detected in the main monitoring station. A technical change was made to the system to take this event into account.
- Several unintentional activations of automatic systems linked to fire risk control have been observed that have resulted in changes in the maintenance procedures and in the oven cooling system safety devices. These concerned:
    - Automatic closure of the valves of the argon / hydrogen mix distribution network in the production building (during a maintenance operation and when using analysis ovens in the laboratory).
    - Discharge of extinguishing gas in the false floor of the room housing a control console used in backup situations.

The following **improvements** related to fire protection were reported in the NAR for **MELOX** fuel fabrication facility:

- MELOX has a project to install temperature sensors in the production rooms containing nuclear material and in the extraction ventilation ducts of the MOX pellet interim storage rooms.
- The control of fire-related risks has been improved in the past by replacing all the detectors taking the best available technologies into consideration.

Framatome Romans

The following **strengths** related to fire protection were reported in the NAR for **Framatome Romans** fuel fabrication facility:

- The processes linked to control of the fire risks, whether in the design, production, operation and in-service monitoring phase, are robust and tried and tested.

- The independent safety organisation maintains an effective surveillance over the risks as a whole.
- The site is a partner of the inter-licensee working group on the fire theme. This group shares experience on topical subjects, such as singular events.
- Distance between the buildings accommodating nuclear materials and the structure of these buildings enable a fire-resistance rating of at least 2 hours to be achieved with respect to an external fire.
- Structural load-bearing elements of the main buildings housing nuclear materials are stable to fire for at least 2 hours.
- The site is equipped with a fire safety system (FSS), an automatic fire detection system and automatic safeguarding systems deployed in all the buildings, and constant monitoring on a centralised site by dedicated personnel.
- The site has human resources, including firemen, who are trained and undergo periodic refresher courses, and it has emergency response equipment. These human and material resources are available and maintained on the site at all times to intervene in a fire situation.
- A robust emergency organisation is in place, with the periodic organisation of exercises, some carried out jointly with the external emergency services and the other stakeholders.
- The site has shared and formalised design rules concerning fire sectorisation and ventilation.
- The large majority of the actionable safety devices (fire doors, other openings, fire dampers, etc.) are covered by automatic systems (by interlocking or by design).
- The fire sectorisation elements and the safeguarding measures are subject to periodic inspections and tests.
- The fire-fighting devices that can be used by the personnel are stowed within the facility BNI No. 63-U in a protected building designed to earthquake standards.

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The following **weaknesses** related to fire protection were reported in the NAR for **Framatome Romans** fuel fabrication facility:

- The culture with respect to fire risks, especially their prevention, must be further developed at all hierarchical and activity levels.
- There are difficulties in freeing up resources to acquire knowledge on the new or emerging risks associated with new battery technologies (lithium-ion, etc.), to establish robust and shared recommendations and to implement them.
- Particular attention must be paid to minimising the fire loads present in the facility.
- The site's fire standard must be updated with regard to the applicable regulations and good practices.
- The FDS currently in service, and its communication network, will soon be obsolete, which will create system maintenance problems (software, spare parts).
- The organisation of the site does not include the FSS coordination missions.
- Two buildings must undergo improvements in order to retain and recover fire extinguishing effluents. If water runs off to the exterior of the buildings, it is taken up by the stormwater drainage network and retained in stormwater tanks.
- The time taken to deploy the improvement measures identified following the recent updates of the DMRIs should be reduced.
- Although the design rules of the sectorisation and ventilation components are formalised, there is substantial variability between the site buildings housing uranium-bearing materials, notably for historical reasons, requiring procedures specific to each building, particularly regarding ventilation management in fire situations.
- Protected paths must be defined and deployed for the buildings housing uranium-bearing materials.

The following **lessons learned** related to fire protection were reported in the NAR for **Framatome Romans** fuel fabrication facility:

- The experience feedback concerning the provisions to control fire-related risks to be implemented for the electrical cubicles and cabinets revealed the need for harmonisation and consolidation of the analyses.
- Following a fire in 2022, the conformity of all the sectorisation components and of the safeguarding measures has been verified.
- An analysis method which must be systematically implemented for the electrical cubicles and cabinets, with the aim of evaluating the need to protect them with an automatic gas extinguishing system.

The following **improvements** related to fire protection were reported in the NAR for **Framatome Romans** fuel fabrication facility:

- The previous and current ten-yearly periodic safety reviews led to significant updates, carried out between 2018 and 2019, for the buildings containing uranium-bearing materials. Additional updates were started in 2022 for two buildings and completion thereof is scheduled for 2023.
- The Fire Risks Management Cases (DMRIs) for the buildings with significant safety issues have been brought into conformity with the applicable regulations and standards.
- Deploy the monitoring of transient fire loads in the buildings housing uranium-bearing materials.
- The dynamic containment and the operational management of this containment in the event of fire have been worked on.
- New walls preventing any fire propagation have been installed in the facility and the fire loads have been moved away as much as possible.
- The permanently operational condition of the automatic extinguishing system actuators was improved.
- Modernisation of the site's FDS and communication network.
- Deployment of protected routes in the buildings housing uranium-bearing materials.
- Definition of the actions of the first response teams and improvement of the training of the personnel in charge of fire-fighting.
- Integration in the periodic "Safety culture" training of a part devoted specifically to the prevention of fire risks.

Fuel enrichment facility

George Besse II

The following **strengths** related to fire protection were reported in the NAR for **George Besse II** fuel enrichment facility:

- Recent installation designed on the basis of the regulations then in force, principles, including that of defence in depth, modern design tools and national and international operating experience feedback associated with all representative installations in terms of design and operation.
- Application of the principle of defence in depth via a deterministic method with calculations whenever necessary to model dangerous phenomena complemented by probabilistic assessments enables a robust demonstration to be achieved.
- The general design and maintenance measures and the operating procedures to limit the sources of ignition (electrical installations, hot work) are satisfactory, as are the prevention measures to limit the risks associated with inflammable liquids. Fire loads are kept to a minimum in the premises.

- Located on a nuclear site comprising other nuclear installations. The fire response services are shared, enabling the facility to benefit from a large-scale response force not limited to its own requirements alone.
- Broad coverage by the automatic fire detection network fostering early detection and enabling the personnel involved in fighting the fire to be mobilised rapidly and to place and maintain the facility in a safe state in a fire situation.
- The on-site presence of a service specialised in fire fighting with personnel and technical means equivalent to those of the fire brigade.

The following **weakness** related to fire protection was reported in the NAR for **George Besse II** fuel enrichment facility:

- The large number of rooms and the differences between them required numerous models to be made, thus making it difficult to gain an overall appreciation of the assessment as a whole.

The following **lessons learned** related to fire protection were reported in the NAR for **George Besse II** fuel enrichment facility:

- Particular vigilance had to be maintained regarding keeping all fire doors closed: the fire doors are sometimes kept open to bring the comfort of air circulation.
- The analysis of interesting events has also led to the identification of events relating to electrical equipment heating incidents. These events have led to the taking of thermographs and replacing or repairing the equipment concerned (batteries, cables, electrical cabinets, terminal blocks, etc).
- The licensee takes care to maintain its facility in good working order and replace the fire door seals.

The following **improvements** related to fire protection were reported in the NAR for **George Besse II** fuel enrichment facility:

- The following maintenance improvements have been made:
    - Periodic verification of the fire-resistant doors to ensure that the peripheral plays remain within the acceptable range specified on their fire resistance report;
    - Repair of the intumescent seals of doors having a fire-resistance criterion;
    - Updating of the procedure for inspecting the condition of openings to integrate complementary verifications of the sealing materials and monitoring of their ageing with the identification of a control sample of openings.
- The lessons learned from experience have led to make additional modifications to the facility to prevent incipient fires:
    - Smoke emission linked to the degradation of a cardan joint bellows caused by the incorrect positioning of the hot air blowing system at a cylinder needle valve. This led to the replacement of all the bellows by a more suitable material;
    - Following the heating of electrical devices, thermographic measurements were carried out on the electrical installations and all equipment items that were defective or did not comply with the standards in effect were replaced;
    - Some active charcoal filters were replaced in the light of feedback from the company Urenco concerning a chemical reaction between the active charcoal substrate and fluorine.

Spent fuel storage

La Hague – Pool D (T0)

The following **strengths** related to fire protection were reported in the NAR for **La Hague – Pool D (T0)** fuel enrichment facility:

- The pool D building does not have rooms with significant fire loads necessary for operation (consumables) or resulting from operation (combustible waste).

- The rooms necessary for operation are situated in the T0 unit, which greatly limits the risks of the pool hall suffering fire damage.
- The pool D building is equipped with EI 120 doors separating it from the adjacent to building.
- Consolidation of the categories of rooms identified in the design.
- The fire alarms are transmitted to the T0 unit/pool D operational control room and to the PSM's control and monitoring room. The chosen ergonomics enable the location of the fire alarm triggered in the pool D building to be identified rapidly and with certainty.
- The 24h/24 presence of the PSM service fire-fighting teams enables fire-fighting to begin immediately with heavy-duty means without waiting for the external emergency services (SDIS).

The following **weaknesses** related to fire protection were reported in the NAR for **La Hague – Pool D (T0)** fuel enrichment facility:

- For the fire prevention, the pool D building does not have rooms with significant fire loads necessary for operation (consumables) or resulting from operation (combustible waste) because they have been grouped together in dedicated and identified rooms in the T0 unit (e.g. consumables storerooms, rooms for interim storage of waste). However, the pool-side passageways are narrow, which can complicate the positioning of the equipment used for maintenance and operation.
- The building comprises just 3 rooms presenting a low fire load. Due to their design functionality, these rooms (pool hall and below pool) have large dimensions and cannot have any fire walls.
- The fire control panels in T0 that were installed when the T0 unit was built should be replaced due to ageing.
- The passive fire risk control systems are satisfactory. The licensee must nevertheless redouble its sectorisation efforts to achieve an adequate level of passive protection.

The following **lessons learned** related to fire protection were reported in the NAR for **La Hague – Pool D (T0)** fuel enrichment facility:

- As the ignition sources located in the pool hall cannot be moved to a dedicated room, the adequacy of the level of fire protection with respect to these sources is currently undergoing a confirmation study as part of the lessons learned from the periodic safety review.
- ASN asked the licensee to implement the risks management provisions decided upon after completing the periodic safety review examination. The last inspections conducted on the T0 unit concluded that its standard of fire risks management is satisfactory. The provisions mentioned at the end of the safety review have been put in place and the required procedures were known to the personnel.
- Difficult to check the implementation of the heavy fire-fighting means (PSM) during the exercises organised for the inspections: the multitude of missions assigned to these teams on this site means that they can only rarely participate in the exercises in a satisfactory manner.

The following **improvements** related to fire protection were reported in the NAR for **La Hague – Pool D (T0)** fuel enrichment facility:

- The changes to the regulations led to the reinforcement of the typology of rooms identified in the design. Additional room types with an identical fire risk were define to strengthen the definition of their generic provisions for controlling fire-related risks.
- The ageing of the fire control panels installed when the T0 unit was built means that they sometimes have to be replaced. The replacement equipment will incorporate recent technologies.
- Update of the “fire safety baseline requirements” following the latest periodic safety review. This led to a certain number of improvements to management of the fire risk.
- Following the last safety review, the following improvements were implemented:
    - installation of fire doors;
    - installation of an AFD system for the pool D hall;

- installation of an automatic linear smoke detection system for the pool D hall;
- regarding the electrical equipment for maintaining the pool D building in a safe state, installation of a thermal shield between the redundant electrical equipment items (cooling pumps) and fire protection around at least one of the two channels providing electrical power to these equipment items.

Installations under decommissioning

OSIRIS research reactor

The following **strengths** related to fire protection were reported in the NAR for **OSIRIS research reactor** under decommissioning:

- The fire safety analysis is part of a performance obligation approach enshrined in the regulations relating to the fire safety of nuclear installations. This approach, which is the opposite of the best efforts obligation approach, enables the provisions to be adapted to the safety issues.
- The calorific potential (fire load) per unit surface area is checked annually in the sensitive rooms and every three years in the non-sensitive rooms.
- The management of the hot work permits for the facility's worksites is clear and duly traced.
- The zones housing the electrical rooms and equipment associated with nuclear ventilation have numerous provisions for limiting the propagation of a fire, such as fire dampers and fire doors. The openings and penetrations are sealed with materials that are non-combustible and/or are fire resistance rated.
- The fire safety system of the installation was renovated in 2016. The technology used allows rapid detection and intervention of the FLS.
- As part of the decommissioning preparation work, worksite air locks and radioactive waste temporary storage zones are set up, bringing changes in the fire risk (introduction of fire loads, ignition sources, dispersibility of the radioactive inventory, etc.). These changes were taken into account in the fire risks control study carried out for the first periodic safety review and the specified measures have been deployed.

The following **weaknesses** related to fire protection were reported in the NAR for **OSIRIS research reactor** under decommissioning:

- Complex nature of the fire safety analysis and scale of the human resources and expertise needed.
- The fire risk study of BNI No. 40 sets out a diagnosis of the risk control and several actions have been started but are still to be finalised.
- In the particular case of the hot cell fire detectors, the lack of accessibility complicates the periodic inspections and any necessary maintenance operations. The periodic operating checks are carried out applying specific procedures.
- By virtue of their design, the nuclear zones are not partitioned. Nevertheless, the risk analysis substantiates the adequacy of the measures adopted.
- The list of equipment contributing to the control of propagation of the fire risk (fire doors, smoke removal systems) is presented in the fire risk management study, but some of these equipment items are not subject to any periodic operating checks.
- Procedures for checking these detection systems and proving performance of the checks are to be specified by the licensee.

The following **lessons learned** related to fire protection were reported in the NAR for **OSIRIS research reactor** under decommissioning:

- The experience acquired by CEA reveals incipient fires linked to hot-spot work within the nuclear installations. The risk analysis and the compensatory measures defined in the fire permit must be carried out rigorously.
- The need to involve the site fire-fighters in these analyses in order to ensure that they are able to respond rapidly and effectively in the installation.

- The fire protection equipment included in these analyses being appropriate in terms of their level of confidence/qualification (periodic checks and tests, maintenance, etc).
- Periodic tests and maintenance campaigns highlighted deviations on the functioning of fire dampers or fire hatches. The systematic resolving of deviations observed during the periodic tests and preventive maintenance work (for example, slight impact damage on a fire hatch) bear witness to the effectiveness of the process for maintaining the systems limiting the risk of fire propagation in operational and safe condition.

The following **improvements** related to fire protection were reported in the NAR for **OSIRIS research reactor** under decommissioning:

- As part of the action plant resulting from the review EMRI, a feasibility study was carried out into the closing off of fire hatches in several rooms.
- The Fire Risks Management Study (EMRI) carried out in 2018 as part of the facility's periodic safety review led to several fire risk prevention measures being put in place.
- The insulation of the penetrations in walls identified by the study has been correctly carried out and identified in the field.
- supplement the existing prevention measures (management of fire loads, formalising instructions).
- integration of the needs associated with preparation for decommission of the facility (equipment dismantling worksites with the installation of a containment air lock if necessary, increase in the temporary storage capacities for nuclear waste).
- The fire risk management study carried out during the last periodic safety review led to:
    - limiting of the fire load in certain rooms (particularly near penetrations that are sensitive to the fire propagation risk) and/or the removal of combustible equipment;
    - identification of fire load exclusion zones and rules for the temporary storage areas;
    - the deployment of measures specific to the use of motorised machines (for example, prohibiting the use of electric trolleys in certain rooms);
    - the deployment of specific measures when setting up worksite air locks;
    - the installation of complementary sealing means;
    - the installation of fire dampers, fire doors and protective thermal shields;
    - the installation of blanking covers or isolating hatches;
    - the updating of some existing instructions (ventilation management in fire situation);
    - the addition of fire detectors and mobile fire extinguishers;
    - the addition of systems for injecting extinguishing agent (foam) from outside the buildings into the basement rooms in which the inverter battery banks are installed;
    - the installation of extinguishing water retention devices (cofferdams or movable barriers).
- AFD systems were installed in 30 rooms in the second quarter of 2022.
- The event concerning the failure of the automatic fire detection system in the ISIS reactor hall led to improvements in the tracking of the periodic tests and maintenance work.
- Further to the analysis of the fire event in ISIS in 2015, tracking of the periodic tests and maintenance operations has been improved, as has the layout of the event reports.

Saint-Laurent des Eaux UNGG reactors

The following **strengths** related to fire protection were reported in the NAR for **Saint-Laurent des Eaux UNGG reactors** under decommissioning:

- The centralisation on the Saint Laurent site provides an overall view of the site's installations as a whole in a fire situation and allows better coordination of the means. The fire exercises and discussion meetings with the external emergency services enables certain issues to be planned for in advance and ensure a fast and proportionate response.
- As EDF facility, use first and foremost of the experience feedback and lessons learned from its BNIs, as well as from other external sources whether French or international.

The following **weaknesses** related to fire protection were reported in the NAR for **Saint-Laurent des Eaux UNGG reactors** under decommissioning:

- The improvements concerning the hot work permits must be continued, more specifically in the lifting of the hold points on the decommissioning worksites.
- The changes in the facility due to its decommissioning necessitate vigilance with respect to the fire risk, particularly when setting up and putting into operation the containments associated with the worksites.
- The presence of carboxide and hydrogenated carboxide deposits, which cause risks of fire, explosion and poisoning during thermal cutting operations.

The following **lessons learned** related to fire protection were reported in the NAR for **Saint-Laurent des Eaux UNGG reactors** under decommissioning:

- The number of fire outbreaks on the Saint Laurent A site (none in 2021 and 2022) testifies to good management of the fire risk.
- The licensee's periodic checks of the fire detection systems and associated alarms and of the fixed and mobile fire-fighting means are satisfactory.
- The improvements concerning the hot work permits must be continued.
- Improvements are expected in tracking the fire extinguisher inspections and lifting hot work permit hold points on worksites.
- A number of deficiencies in risk management whose causes are mainly linked to the interfaces with operation of the two in-service reactors of the Saint-Laurent NPP.

The following **improvements** related to fire protection were reported in the NAR for **Saint-Laurent des Eaux UNGG reactors** under decommissioning:

- This feedback from the fire at Brennilis site in 2015 led to the several actions:
    - revising of the worksite demobilisation procedure in order to take into account all the activities;
    - including the demobilisation phase itself (specific risk analysis to be carried out);
    - tightening of the checking of workers' authorisations;
    - reminder of the compliance with the requirements specified in the general monitoring and maintenance rules applicable to the site facilities;
    - a detailed risk analysis of the liquid wastes from the worksites shall be provided in the production file;
    - improvement in the robustness of the procedure for applying to use chemical products in the facilities;
    - vigilance and raising awareness concerning the hot work permit risks analysis (identification of the risks and putting in place the associated prevention measures in particular).
- The lessons learned from the Brennilis fire of 2015 led to prioritising instructions to stop the ventilation systems and air extraction rapidly in the event of fire detection on the EDF sites undergoing dismantling.

On-site radioactive waste storage

La Hague Silo 130

The following **strengths** related to fire protection were reported in the NAR for radioactive waste storage **La Hague Silo 130**:

- The waste retrieval and packaging (WRP) facilities of pit 43 were designed in accordance with the most recent fire protection principles. Implementation of WRP have considerably reinforced the fire risk control of the Silo 130 unit.

- Comprehensive tests in order to confirm the factors limiting the risks of an outbreak of fire in the pit during the retrieval operations were performed.
- The 24h/24 presence of the PSM service fire-fighting teams enables fire-fighting to begin immediately with heavy-duty means without waiting for the external emergency services (SDIS).
- Fire detection ensured now by several fixed means by a fire detection system specific to pit 43 and surveillance cameras whose images are transferred to the Silo 130 unit operational control station for viewing.

The following **weaknesses** related to fire protection were reported in the NAR for radioactive waste storage **La Hague Silo 130**:

- The original design of the storage pit comprised no fire detection or extinguishing systems
- The initial design of the silo did not take into account the fire risk associated with the types of waste stored. The waste stored in pit 43 contains graphite, magnesium and uranium. Combustion of the magnesium and graphite can be initiated in the event of impact (such as during retrieval) by uranium hydride (UH3) which forms in the presence of humidity.
- In an earthquake situation, the functioning of the existing means cannot be guaranteed as Silo 130 is not designed to withstand this extreme hazard. In this case the detection of a fire in silo 130 relies on detection by personnel during the ""site diagnosis"" patrol round which is planned in the first phase of emergency management after an extreme event. In case of occurrence of a strong earthquake, the maintenance of the watertightness of silo 130 cannot be demonstrated but the latter would still ensure containment of the waste.
- Part of the effectiveness of the active fire-fighting systems is dependent on the personnel and their skills.
- The fact that part of the fire risk is due to the composition of the waste, which is not always fully characterised when it is removed from the pits, means that controlling the fire risk imposes constraints on retrieval operations that can slow down the rate (need for identification or characterisation) or limit productivity (limited filling of drums).

The following **lessons learned** related to fire protection were reported in the NAR for radioactive waste storage **La Hague Silo 130**:

- The lessons learned from silo fire in 1981 the cause of which could not be identified and which demonstrated weak response, were taken into account adequately concerning design of WRP and further operation of the silo. To compensate for this aspect, a specific R&D process was carried out to refine the understanding of the phenomenology of the risks linked to fire inherent in the waste contained in silo 130. Some related factors assuring the fire safety are:
    - a detection system that is reinforced for the WRP operations and in the places representing risks;
    - appropriate fire-fighting means (three fire-fighting water standpipes, one fixed manual extinguishing system in pit 43 in case inerting fails, one nozzle for massive injection of water, etc.);
    - good accessibility of the Silo 130 unit to fire brigade fire appliances, with two main entrances;
    - a three-level response organisation (a Local Response Group (LRG) specific to the unit, a PSM service equipped with heavy intervention and fire-fighting means specific to the Site and available 24h/24, plus the public fire and emergency services.
- Assessments of the aggression of the last level of filtration were carried out and the argon extinguishing system was designed accordingly.

The following **improvements** related to fire protection were reported in the NAR for radioactive waste storage **La Hague Silo 130**:

- Since the January 1981 fire in the silo 130 pit 43, most of the waste stored has been immersed in this volume of water. To meet any possible need, an additional water injection system has

been installed. The licensee has reinforced the prevention means with the design of a new waste retrieval and packaging (WRP) unit and the setting up of a system for automatic argon inerting of the pit containing the immersed waste. The following measures were taken further to the fire of 1981:
    - stopping of the acceptance of magnesian waste;
    - installation (in 1982) of a fire extinguishing network on the silo cover slab;
    - installation of a system for recovering water from the silo;
    - improvement in the silo containment.
- The changes to the fire protection of silo 130 led to the recommendation and installation of new active and passive protections on the design of the retrieval and conditioning of the waste (RCD) system.
- The methodological changes led to specific analyses being conducted, concluding that fire risk management provisions were needed, in particular an automatic argon extinguishing systems for the pit. The effectiveness of this system has been confirmed by R&D tests.

4. Peer-review conclusions

4.1 Attributes of the NAR and the information provided

The candidate installations included were the ones which were the subject of the Board's review prior to the national self-assessment, plus the one (gas-cooled graphite moderated reactors under decommissioning) recommended by the Board. The recommendation of the Board (consideration of on-site waste storage) was addressed in the NAR. The suggestions from the Board (description of differences between the candidate facilities and other series of reactors: 1300 MWe, N4 and EPR with regard to fire safety and ATPu justification) were addressed as well.

In general, the information provided in the NAR was sufficient for the peer review.

The document was reader-friendly and facilitated the finding of relevant information.

In general, the outcomes of the self-assessment were clearly mentioned.

In general, replies to the written questions allowed to clarify the identified issues.

Additional information and updates provided in reply to written questions, the site visit, and in the national presentation in the country review workshop were taken into account in the definition of the findings below in section 4.3.

4.2 Conclusions from the site visit

The site visit to the ILL High-Flux Research Reactor (France) took place on 29 August 2024.

The visit was conducted according to the preliminarily agreed agenda, also highlighting the main questions and requests of clarification posed by the TPR II team.

In particular, the following topics were discussed: General fire protection concept, outcomes from the last PSR in 2017, methodology for the individual assessment of each of the 600 rooms of the facility for identifying the individual risks and the required actions to lower this risk, fire risk management procedure, the concept for the detection of fire and the intervention of the different teams, the recent and still ongoing improvements related to passive and active fire protection of the reactors.

In order to answer questions and requests of clarifications ILL provided some well-structured and informative presentations which offered, together with answers provided to questions posed during the discussion, the opportunity to clarify all the points raised by the TPR II team as reported in the visit agenda.

During the visit a walk down was conducted in the reactor building, in the main control room with associated electrical rooms and in the emergency control room.

As result of the conducted site visit, taking into account the provided presentations as well as the undertaken discussions and observations of the site walk down the following points were highlighted by the TPR II team:

- a well-structured fire protection concept is in place with well-developed methodologies for identifying the fire risks and solving it with appropriate and diversified actions
- the PSR 2017 appears to have been conducted in a thorough and very deep way leading to a significant action plan in order to reduce the fire risks: introduction of compartmentation despite the old design of the reactor, implementation of automatic or manual sprinkler systems, renovation of the detection system and implementation of a

fully addressable detection system for all the 600 rooms, new and diversified tanks for firefighting water, arrangements for nearby and off-site fire-fighting services to support the on-site incident response team.

- The post-Fukushima action plan with the introduction of a hardened core, specially protected against fires, has also contributed to the improvement of the fire protection concept.
- The TPR II team did not identify potential improvements for the fire protection concept of ILL, taking account of the ongoing improvements to be finalised.

The TPR II team appreciated the willingness and cooperation of France to host site visit to ILL. The TPR II team encourages ILL to participate in, and eventually host other international peer reviews as the implementation of the fire protection concept at the research reactor can lead to valuable opportunities for information exchange and sharing of experience with other players in the nuclear field.

4.3 Peer review findings

The self-assessment revealed some weaknesses in the fire protection of the nuclear installations. The findings in the table below were acknowledged as areas of improvement by the TPR Team:

Areas For Improvement mentioned in the NAR as weaknesses and acknowledged as such by the TPR Team	
Nuclear installation: Framatome Romans fuel fabrication facility	
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.
Nuclear installation: Fuel cycle facilities	
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.

The TPR team recommends that France addresses these areas for improvement in the National Action plan.

During the country review workshop, the findings identified during the peer review phase have been discussed. Based on these discussions, the TPR team concluded on the following findings:

Areas of Good performance		
Nuclear installation: Tricastin NPP		
AGP (1)	**Finding**	Implementation of door-open alarms for the ones representing a safety risk (PSA based)

	Justification	Open-door alarms are being installed on the doors to areas with the highest risks. These sound locally if the door is kept open, and if not closed, an alarm sounds in the MCR upon which the operator sends an agent to check the door.
AGP (2)	**Finding**	Implementation of thermal cameras on particular worksites providing an alarm in the main control room in order to be alerted of a fire outbreak.
	Justification	Thermographic cameras are implemented in particular worksites to provide permanent monitoring of areas with a fire risk. Each camera can be programmed to monitor one or more zones with specific detection criteria, assigned to each zone. It enables as well to detect a "smouldering fire" that cannot be detected by the naked eye.
AGP (3)	**Finding**	Measures to be taken by the operators in the control room are pre-defined in written instructions (FAIOp).
	Justification	In the event of a confirmed fire in certain electrical rooms supplying safety equipment, incidental or accidental rules of conduct (FAIOp) define actions and guidelines to be followed in order to return to a safe state using only equipment not likely to be affected by the fire. Typical actions are: • Preventive electrical cut-off rules, e.g. preventively switching off equipment to avoid alarms or spurious actions (automatic trip or ECCS start) or by amending incidental or accidental rules because of equipment that may be unavailable or giving information that has become unreliable as a result of the fire. • Opening of valve for startup of extinguishing systems • Shutdown of certain ventilations
AGP (4)	**Finding**	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.
	Justification	EDF has developed an extensive series of tests to enable the modelling the effects of fire (soot, pressure effects…) and analyse their effects on elements credited in the fire safety analyses to confirm their performance (electrical equipment, fire doors, cables, seals…). As part of the latest periodic safety review, EDF took advantage of progress in modelling in order to improve how fire-related phenomena are taken into account, notably for verification of the correct design and sizing of compartmentation.

Nuclear installation: Research reactor RHF (ILL)		
AGP (5)	**Finding**	Use of a semi-quantitative fire risk assessment methodology for each of the 600 rooms of the reactor building.
	Justification	The fire risk assessment methodology is based on combustion type and ignition sources, fire load and prevention and protection measures. The results of these analyses are regularly reviewed and displayed in each room with a clear colour coding, which gives an immediate impression of fire risk to users of the facility.
AGP (6)	**Finding**	Modernisation of the facility with significant improvements (both on passive and active components) including the ones in the frame of the PSR.
	Justification	The extensive modernisation of the facility and related improvements were acknowledged during the site visit.
All actors (Regulatory authority/licensees)		
AGP (7)	**Finding**	Comprehensive national review after Lubrizol (chemical industry) fire accident resulting in ASN requests and consequently in concrete actions in all nuclear installations.
	Justification	Following the Lubrizol accident in September 2019 and the review performed upon the request of the Government to draw lessons and enhance management of fire risks, the French Government issued a circular regarding risk prevention in industrial facilities. Similarly, ASN asked all the nuclear operators to take into account the lessons learned from this accident that happened in the chemical industry. Notably, ASN required them to re-examine workers' and subcontractors' knowledge of the risks and to maintain an up-to-date inventory of dangerous substances for intervention teams. Among the requests from ASN was also a reminder that non-radiological risks (direct effects of fire or explosion, chemical releases) had to be included in the safety case. The appendix of the ASN letter presented what was expected in the dangerous substances register which is mandatory for any facility. ASN performs inspections regarding the implementation of the actions by the operators.

Definition of the types of findings

According to the TPR II Terms of Reference, the country group workshop discussions should lead to conclude on the findings categorised as an 'area of good performance' or 'area for improvement'. These are defined therein as follows:

A National area of good performance which should be understood as an arrangement, practice, policy or programme related to fire protection that is recognized by the TPR Review Team as a significant accomplishment for the country and has been undertaken and implemented effectively in the country and is worthwhile to commend.

A National area for improvement which should be understood as an aspect of fire protection identified by the TPR Peer Review Team where improvement is expected, considering the arrangement, practice, policy or programme generally observed in other participating countries. It may also be self-identified by the country itself (i.e. self-assessment) where improvement is appropriate.