ENSREG
European Nuclear Safety Regulators Group

National Presentation of the United Kingdom (UK)

Topical Peer Review II Country Review Workshop
‘Fire Protection’
30 September – 3 October 2024

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▪ List of installations reported in the NAR

Installation category	Number of installations	Name of Candidate installations
Nuclear power plant	3	Heysham 2 (AGR, 2nd generation in operation) Sizewell B (PWR in operation) Hinkley Point C (PWR in construction)
Research reactor	N/A	N/A
Fuel reprocessing facility	1	Magnox reprocessing plant at Sellafield Ltd*
Fuel fabrication facility	1	Springfields Fuels Ltd
Uranium enrichment facility	1	Urenco UK Limited (Urenco's Capenhurst site)
Dedicated spent fuel storage Note: please, indicate the type "wet" or "dry".	1 dry 1 wet	Sizewell B dry store* Spent fuel ponds at the candidate installations (Sizewell B, Hunterston B and Heysham 2)*
Installations under decommissioning	3	Hunterston B NPP* (undergoing defueling) Dounreay Prototype Fast Reactor, including the Irradiated Fuel Cave Pile 1 - Sellafield Ltd*
On-site radioactive waste storage	3	Sellafield High Level Waste Plant /Waste Vitrification Plant/ or Encapsulation (HLW) Sellafield Box Encapsulation Plant Product Store – Direct Import Facility (BEPPS-DIF (ILW – interim storage) Sellafield Product and Residues Store (interim storage)

*Hunterston B NPP, the AGR spent fuel ponds and dry storage technology at Sizewell B (Sizewell B) are reported as part of the NPP sites. Magnox reprocessing plant and Pile 1 reported with Sellafield Ltd on-site radioactive waste storage facilities

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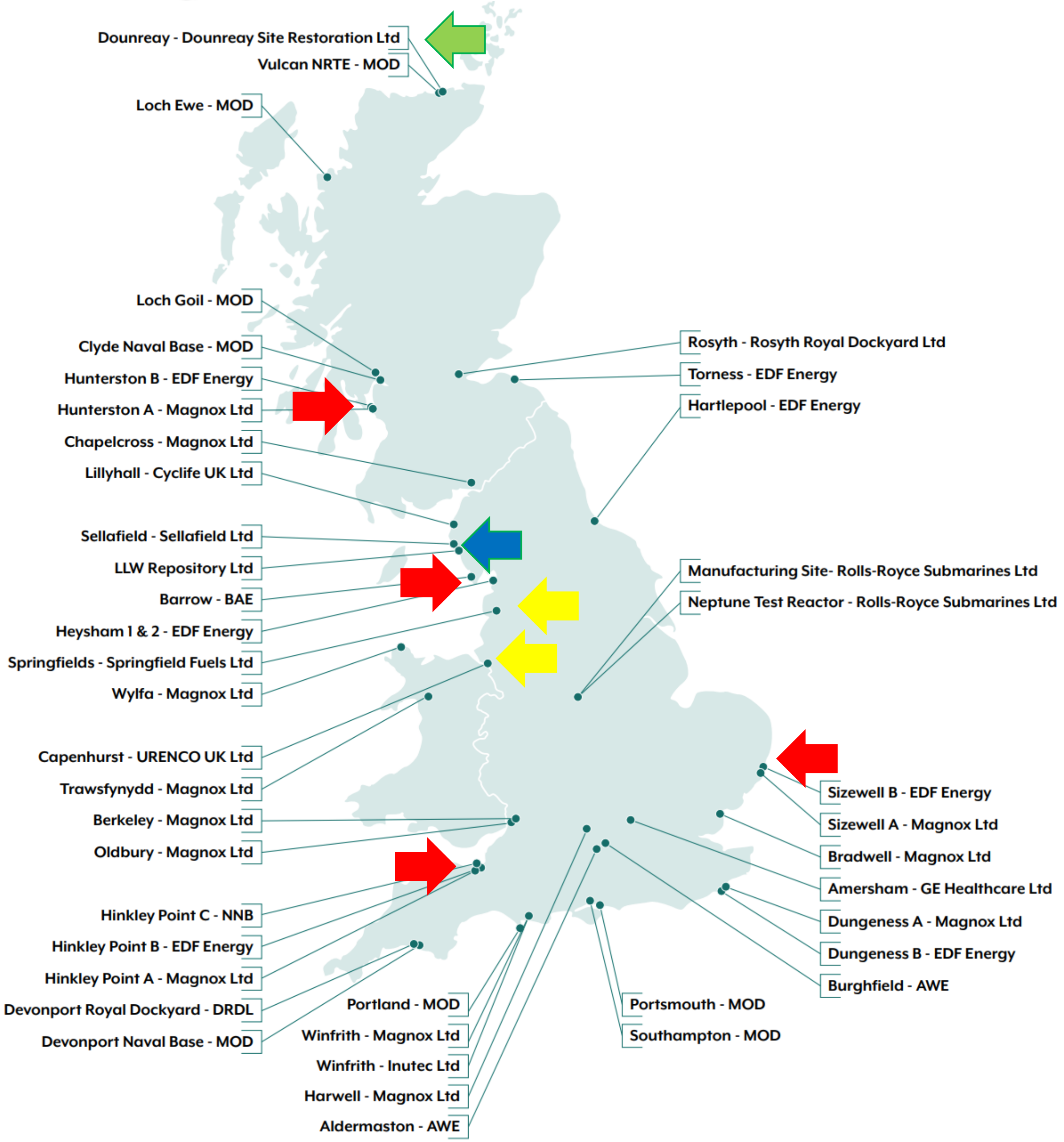

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Regulatory Framework

The principal **primary legislation** for ensuring the safety of nuclear installations consists of:

- Energy Act 2013 (TEA13)
- Nuclear Installations Act 1965 (NIA65)
- Health and Safety at Work etc. Act 1974 (HSWA74)

TEA13 sets out the provisions which set up the regulatory body as a statutory body (ONR), establishing its purpose, its powers and functions.

Under the **NIA65** no site can be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence granted by ONR is currently in force. NIA65 requires and permits ONR to attach such conditions to a site licence as it sees appropriate in the interests of safety or radioactive waste management. It is an offence under the law not to comply with the licence conditions.

Under **HSWA74** a general duty is placed on all employers and the self-employed to conduct their undertaking in such a way as to ensure the health and safety at work of their employees and those affected by their work activities, so far as is reasonably practicable (SFAIRP).

TS 01.1 & 01.2

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▪ Regulatory Framework

The principle of **SFAIRP** is underpinned by the concept of relevant good practice (RGP). **RGP** is the generic term used for **those standards or approaches to controlling risk that have been judged and recognised by ONR and the industry as satisfying the law when applied to a particular relevant case in an appropriate manner**.

The technical principles ONR uses to judge safety cases are set out in its **safety assessment principles** (SAPs). The **SAPs** are supported by more detailed guidance in a suite of **technical assessment guides** (**TAGs**), which provide detailed guidance to ONR inspectors on the interpretation and application of ONR's SAPs when assessing the adequacy of licensees' safety cases and other safety documentation within the nuclear safety regulatory process. **ONR SAPs and TAGs implement the full suite of IAEA Standards and Guides including SSG64 and SSG77.**

The full suite of SAPs is applied **holistically** by internal hazards and fire safety inspectors when making judgements on duty holders' consideration of fire safety in nuclear installations.

ONR Office for Nuclear Regulation

SAFETY ASSESSMENT PRINCIPLES FOR NUCLEAR FACILITIES
2014 EDITION, REVISION 1 (JANUARY 2020)

Internal Hazards			
Doc. Type	ONR Technical Assessment Guide (TAG)		
Unique Doc. ID:	NS-TAST-GD-014	**Issue No.:**	7.1
Record Reference:	2021/63258		
Date Issued:	Dec-2022	**Next Major Review Date:**	Oct-2026
Prepared by:		Nuclear Safety Inspector	
Approved by:		Deputy Professional Lead	
Professional Lead:		Nuclear Internal Hazards and Site Safety	
Revision Commentary:	Incorporates the 2020 revision of the WENRA Safety Reference Levels for Existing Reactors and reference to IAEA guidance issued in 2021 since Issue 6 of the TAG. Typographical and editorial review. ONR regulatory expectations in internal hazards have not changed. Issue 7.1 - Minor update to remove extant URLs from the document to mitigate potential configuration control issues arising because of changes to third-party web domains.		

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- **Regulatory Framework**

A suite of **secondary legislation** (Fire Safety Order 2005 and Fire Scotland Act 2005) sets the regulatory requirements to **protect people from fire** and specifically covers fire precautions and other fire safety duties [that are] relevant to fire safety in nuclear installations.

In addition, several **complementary sets of regulations** (e.g. Dangerous Substances & Explosive Atmospheres Regulations) **overlap with nuclear and life fire safety** requirements.

Fire safety analysis (FSA)
(cf TS 02.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Objectives, scope and main assumptions for the deterministic safety analyses (single failure, operator action, credit for fire safety unit, consideration of induced phenomena (soot, pressure effects…)**

EDF NGL's fire protection safety principle: *In the event of a fire in any single location with all plant available prior to the fire, sufficient plant should remain available to ensure satisfactory operation of the trip, shutdown and post-trip cooling function, taking into account the* ***effect of any single random active failure of the plant or fire protection systems.***

No reliance on operation action or credit for fire fighting in the safety case (available as part of DiD)

PSA scope / contribution of Fire PSA

ONR mandated a modern standards fire PSA at **Hinkley Point B** in 2007; Fire contributed to about **10% of the large (DB5) release**. From the 2018/19 major PSA update for **Heysham 2**, the contribution to the overall station risk from hazards (both internal and external) is roughly one fifth of that from plant faults. Of all hazards, the contribution to station risk is 43% from external events and 57% for internal hazards. Amongst internal hazards, **fire hazards contribute 10% to the overall station risk**. The **total predicted frequency for large release sequences is 7.87 x 10^{-7} per reactor year for all hazard faults**.

- **Most penalising scenarios (deterministic/PSA)**

For the AGR stations, the fire hazard assessment is not linked to the reactor power operating states or the refuelling outage, as the original AGR design was for on-load refuelling. The **fire hazard is treated equally at all times on a conservative basis**. The deterministic fire hazard analyses for Sizewell B cover **all operating states, i.e., power operation/hot shutdown and cold shutdown/refuelling**

Fire detection (cf TS 03.2.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- ### Strategy for the location of the detectors

  Fire detection at EDF NGL sites is for mainly for life safety directly, but also **for defence in depth** for areas with a nuclear safety requirement (except for the **first generation AGRs** – see below).

  The following generally applies:

  – There is **Liner Heat Detection Cable** (LHDC) at Hunterston B and other first generation AGRs in the cable flats. These plants also have **back-up auxiliary feed**.

  – There are **thermocouples on the Dungeness B Gas Circulator penetration tubes** and associated panels to detect fire, initiate CO_2 fire suppression and close dampers to protect the pressure boundary.

- ### Characteristics of detectors (providing their location, initiation of automatic actions, withstanding hazards and ambient conditions….)

  Second Generation AGRs (Heysham 2) - These stations were built utilising **passive protection/ fire confinement for the four safety trains**. Fire detection is provided regardless of how nuclear safety considerations are dealt with subsequently. Two locations, the safety room and the pilecap are provided with high temperature detection in these areas to ensure that a reactor trip and initiation of post-trip cooling systems occurs before significant damage could be caused.

  Sizewell B: The **Fire Protection System** (FPS) is to provide defence in depth in order to complement the principal fire barriers and to detect fires, to protect the plant against damage or to minimise damage from fire, and to reduce hazards to personnel. EDF NGL does not claim the fire detection system within the nuclear safety case.

Fire detection (cf TS 03.2.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Characteristics of detectors (providing their location, initiation of automatic actions, withstanding hazards and ambient conditions….)**

Design standards used were originally the relevant **British Standards, BS 5839 part 1**. Each station has had a **site-wide upgrade of the fire detection panels** to help prevent the spurious activation of unwanted fire alarms, and all new fire alarm systems are designed and commissioned by accredited companies.

Each station has a good mix of **manual call points and automatic fire detection systems**.

Each station has its own mixture of coverage and network arrangements, however all the stations have their own building and site-wide fire detection networks to inform the Control Room and site personnel.

General smoke detection is provided through the plant in electrical switchgear rooms, cable flats, plant rooms, administration facilities.

Heat detection for the turbo generators – this is part of the turbine fire protection system as smoke detectors may give false alarms.

Use of frangible bulbs as heat detection throughout the plant where water suppression is installed. It also uses frangible bulbs on compressed air lines, which on fracturing, lower the air pressure and activate the deluge valves and water spray pumps.

Active fire protection

Fire detection (cf TS 03.2.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Characteristics of detectors (providing their location, initiation of automatic actions, withstanding hazards and ambient conditions….)**

EDF NGL provides **Liner Heat Detection Cable (LHDC) on all AGRs in cable routes and cable risers**. This is due to the requirement for **fast acting detection and suppression** if there is overheating or fire in sensitive cable routes. These activate a metron head device which fires a pin and fractures the Quartzoid bulbs quickly. It is, therefore, a fast-acting suppression system activated by the LHDC. Sizewell B also has LHDC on cable flats but does not have metron heads

First Generation AGRs (Hunterston B) – Hunterston B has aspirating fire detection within the main stores, workshops, and document centre. CCTV is located in the turbine halls for flame detection. In addition, fourteen new aspirating smoke detection panels are mounted in various locations.

Second Generation AGRs (Heysham 2) – Heat Detectors are installed along the Turbine and Generator Centre line. Detectors initiate an alarm at the panel located in the Fixed Firefighting (FFF) room. Operators would then respond to the alarm signal. If a genuine fire is found, the deluge valve is manually opened to suppress the fire. Offsite stores buildings are protected by Beam Detection. LHDC protect Cable Tunnels, Flats and Risers. The conventional areas are covered by aspirating systems.

Sizewell B – Numerous designs are used across Sizewell B (page 179 of NAR)

Fire suppression (cf TS 03.2.2)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics (gas, foam, water…)**

EDF NGL uses **BS EN 12845:2015+A1:2019** (Fixed Firefighting Systems. Automatic Sprinkler Systems, Design, Installation and Maintenance)

First Generation AGRs (Hunterston B) – The Hunterston B design predates the Browns Ferry fire of 1975, thus has more nuclear safety claims upon water spray systems.

Second Generation AGRs (Heysham 2) – Heysham 2 is a post-Browns Ferry fire design and is therefore designed with the fire containment approach in mind. However, EDF NGL reports an issue with cable segregation in one critical area raised during the PSR1 review. As a result EDF NGL claims some sprinkler systems in the Heysham 2 fire safety case.

Sprinklers are located in various positions across the plant. The **cable races for Hunterston B and Heysham 2 use metron head devices attached to LHDC (Linear Heating Detection cable) to act as fast acting detection and suppression**.

Other types of fire suppression at Hunterston B include Inergen, Pyrogen and, Fluorine Free foam. Systems currently being retired at Hunterston B include the turbine bearing CO_2 systems and some foam suppression systems.

Other types of fire suppression used for Heysham 2 include Inergen, protecting sub-floor cable rods (Control Room, Safety Rooms, etc.). Heysham 2 does not use any fixed foam systems. Only mobile foam is used for firefighting capability.

Sizewell B – Sizewell B has no direct nuclear safety claims on fire suppression systems. Water spray systems are only claimed as part of the defence in depth arguments and this is mainly because the 4-train system is well segregated. Sizewell B does not use any fixed foam systems. Only mobile foam is used for firefighting capability. **There are sprinklers in all the cable races** but no metron head devices are incorporated.

Compartmentation (cf TS 03.3.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Methods for determining suitable fire barriers**

  First generation AGRs (Hunterston B): at the design stage of Hunterston B, the fire protection philosophy was biased towards ‘fire influence’, i.e., fire detection and suppression.

  After the Browns Ferry fire, the **AGR fire containment was improved**, i.e., more fire compartmentation was added to prevent fire spread if fire suppression failed.

  Additional lines of protection were added, including diverse Pressure Vessel Cooling Water (PVCW) and the Back-Up Cooling System (BUCS), which are both physically remote or separated from the other lines of protection such that fire cannot affect both at the same time.

  As a result, the nuclear **fire safety case can tolerate full compartment burn out**, such as loss of the contents of entire cable flat due to fire and all the equipment that it supports.

  Detection, suppression and compartmentation prevents the fire spreading beyond the compartment of origin. Specific plant items were also given dedicated fire protection.

Compartmentation (cf TS 03.3.1)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Methods for determining suitable fire barriers**

Second generation AGRs (Heysham 2): The Heysham 2 design is based on quadrantisation of the safety systems providing essential safety functions, with either distance or physical barriers between them. The **fire barriers separating trains 1 and 2 from trains 3 and 4 are four hour-rated barriers**; the **fire barriers between trains 1 and 2 are one hour-rated barriers, as are the fire barriers between trains 3 and 4**. The overall approach for faults and hazards, including fire, is based on the concept of defence in depth i.e. overlapping provisions that are built into the fundamental design and operation of the plant in order to prevent, protect and mitigate the effects of an initiating event.

Sizewell B: the Sizewell B design **has four trains of equipment that are segregated from each other by three-hour fire barriers**. The combustible loads within these fire barriers were assessed as part of the design process, and EDF NGL confirmed that the **fire loads are within the capability of the fire barriers**.

The deterministic design against internal hazards, including fire, was based on the so-called ‘single failure criterion’, which is:

- one train may fail due to the hazard
- one train may be unavailable due to maintenance
- one train may fail to start
- the remaining train is available to carry out the required safety functions

In terms of the installation of fire barriers, **fire doors and penetration sealing products, these are third-party accredited products** and it is mandatory to have all the contractors carrying out workmanship across the stations to be on Third-Party Accredited auditing schemes.

Ventilation management (cf TS 03.3.2)

NPP
Heysham 2, Hunterston B, Sizewell B

- **Maintenance of fire dampers (inspection , functionality testing, lessons learnt)**

Many types of penetration sealing are utilised throughout the fleet to ensure the fire barrier rating is maintained for the nuclear claims required.

All of these penetration seals utilise EPRI/NFPA and British Standards as a way to ensure adequacy by regular inspections. The same applies for any item that is a penetration on any fire barrier, such as fire doors, fire dampers.

All of these are **inspected, tested and maintained at intervals to reflect these standards**. Relevant EDF NGL documentation is given in the company standards for inspection testing and maintenance of passive fire systems and maintenance, inspection and testing of HVAC fire dampers.

EDF NGL uses **multi-hazard flexible bellows seals at Sizewell B and Heysham 2**. In the case of Heysham 2, there are many flexible multi-hazard seals between the Turbine Hall and the Reactor Island. These have **claims on fire, hot-gas, steam and blast**

Heysham 2 **newly installed seals have a 4-hour fire rating and they are installed on both sides of the 4-hour fire barrier**. EDF regards a major fire within the Turbine Hall as 1-hour duration fire, therefore EDF NGL concluded that there is much defence in depth, even without the availability of the water spray systems working within the Turbine Hall.

Conclusion

TS 01.3 and TS 04

NPP
Heysham 2, Hunterston B, Sizewell B

- **Significant improvements resulting from PSR/PSA, OPEX, updated regulations and insurers requests, and potential updates since the NAR production**

Introduction of **hot work independent verification** as an additional step to ensure work sites are prepared in accordance with the hot work permits before permission to start work is granted.

Fleet-wide review of Electricity at Work Regulations compliance and electrical motor maintenance arrangements.

In the categorisation of fire event, **creation of the smouldering fire category** to give greater visibility of events that had not reached the flaming stage but left unaddressed could escalate to a flaming fire.

All major and minor fire events are shared across the sites as well as with the regulator. Outcome of regulator fire safety inspections are shared across sites for learning and proactive action to address any similar shortfalls elsewhere in the EDF NGL fleet.

HEYSHAM 2: EDF NGL is currently undertaking Consolidated Model of Fire And Smoke Transport **(CFAST) and Fire Dynamics Simulator (FDS) fire modelling** for certain critical areas. The intent is to predict time-temperature profiles and hot gas layer descent primarily using CFAST with secondary comparative work also being carried using FDS. This work will bring the Heysham 2 fire references up to date using modern standards

SIZEWELL B: fire modelling was carried out for the increased fuel load following the upgrade of the Battery Charging Diesel Generators.

Conclusion

TS 01.3 and TS 04

NPP
Heysham 2, Hunterston B, Sizewell B

- **Strengths**

Proactive changes in fire modelling tools, practice and experimental data, checking the ongoing validity of its safety cases, identifying gaps and addressing them;

Hot work control arrangements recognised as industry best practice both within the UK and within the World Association of Nuclear Operator Fire Safety Peer Groups;

Four safety trains at Heysham 2 well segregated for fire protection purposes. Redundant equipment that contain significant quantities of oil are separated in the four reactor quadrants and segregated by fire barriers;

EDF NGL tracks fire safety metrics for fire safety system health across all sites. The metrics track defects relating to detection, suppression, fire barriers, fire doors, fire dampers etc. to identify at a glance whether the stations are meeting the requirements to maintain safe systems under fire safety;

There are fire safety action teams at all the stations. Actions and implementation of the actions are managed by the Fleet Fire Safety Manager and deputy Fleet Fire Safety Manager. EDF NGL has two Fire Safety Engineers in EDF NGL’s Engineering Function, who also provide hazards advice to the Design Authority;

Fire and rescue service provision on the sites: while fire service intervention is not credited in the fire hazard analyses, demonstration of robust arrangements for onsite firefighting and coordination with local fire and rescue services provides defence in depth.

Conclusion

TS 01.3 and TS 04

NPP
Heysham 2, Hunterston B, Sizewell B

- ## Weaknesses

  EDF NGL recognised that the fire containment approach had been challenged in some areas by poor quality of the original build such as linear gap seals not installed correctly originally, or through time-based degradation of flexible barrier materials.

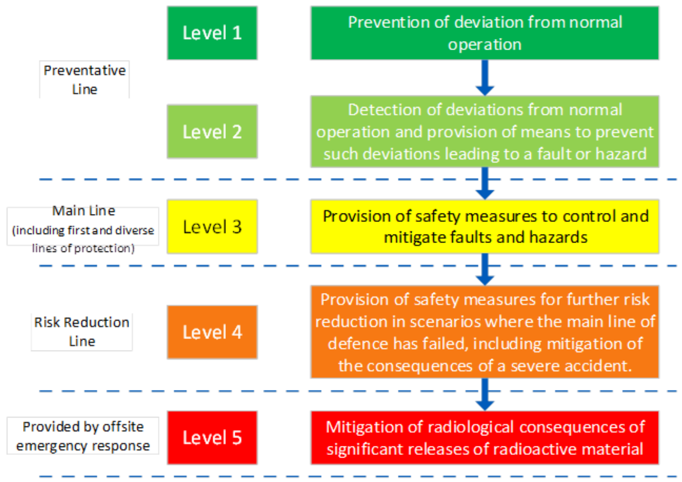
  EDF NGL manages the potential impairments of the containment approach by regular inspections of the plant and subsequent repairs.

Fire safety analysis (FSA)
(cf TS 02.1)

NPP
Hinkley Point C

- **Objectives, scope and main assumptions for the deterministic safety analyses (single failure, operator action, credit for fire safety unit, consideration of induced phenomena (soot, pressure effects…)**

- **A fire must not cause the loss of more than one redundant system** whose safety function is required to reach and maintain the safe state of the plant.
- **A fire must not compromise the control room**; habitability must be assured. If the control room cannot be accessed, the accessibility and habitability of **the Remote Shutdown Station** (RSS) must be ensured. Access must also be possible for local actions that are needed.
- **A fire must not lead to the loss of safety equipment whose failure is not accounted for in the safety case**. This applies to the enclosures of major components of the primary circuit, and piping for which break preclusion applies.
- **A fire must not cause the loss of non-redundant safety equipment required to reach and maintain the safe state of the plant**. If loss of such equipment cannot be ruled out, the potential for a fire must be eliminated or the equipment must be protected.
- A fire must not cause loss of equipment where loss would lead to core melt, large releases following core melt (severe accidents) or a further event with an anticipated frequency of occurrence less than 0.01 per year, as far as reasonably practicable.



NNB levels of defence in depth

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.1)

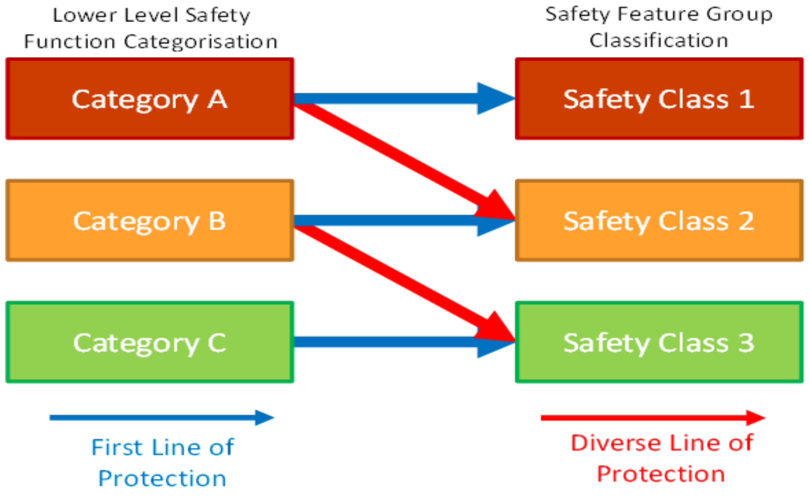
NPP
Hinkley Point C

NNB GenCo uses the EPRESSI methodology to demonstrate the fire resistance performance of fire safety volumes and justify the absence of fire propagation outside the fire safety volume, including propagation to adjacent buildings.

- **PSA scope / contribution of Fire PSA**

NNB GenCo is currently developing the fire PSA to support the current HPC design, which will be reported on timescales commensurate with the HPC Pre-Commissioning Safety Report (PCmSR) report.

As such, NNB GenCo considers that it would be premature to provide any indication of risk at this time. Currently the work is undergoing phase 3 (as presented in Section II-2.1.1.4 of NAR) and is being applied to the whole HPC plant for all reactor states – initially for the level 1 PSA, with it being extended to the level 2 and level 3 PSA on PCmSR timescales.



Fire detection (cf TS 03.2.1)

NPP
Hinkley Point C

- ### Fire Detection systems

The Fire Detection System (JDT [FDS]) is a dedicated I&C system that monitors detection, actuates fire protection actions, and monitors the state of some interfacing fire protection systems.

The JDT [FDS] system's role is detecting fire, transmitting the location of the source of any detected fire, and any smoke-filled zones, to a central operator station, and initiating the appropriate fire protection equipment.

The choice of detector type considers the environment in which it has to operate, such as temperature, flame, smoke, combustion gases and environmental conditions that restrict accessibility such as room temperature and humidity, ionising radiation and hazardous gases.

NNB choses the detector type in accordance with BS 5839-1, and nuclear safety requirements.

NNB GenCo uses diverse detector types in locations where spurious activation of fire suppression systems could release water onto safety systems.

For asset protection purposes, NNB GenCo will provide aspirating fire detection systems to electrical plant rooms containing Instrumentation and Control (I&C) cabinets and or electrical switchgear in accordance with guidance in BS 6266.

NNB GenCo will provide an **independent fire detection system to areas with a critical cooling issue for closing fire dampers in associated HVAC systems with a Class 1 or Class 2 cooling function**.

NNB GenCo reports that components of the JDT [FDS] will **be Safety Class 3**, and precautions are taken to prevent the system having an unacceptable impact on safety class 1 or 2 equipment.

Fire Detection systems

The fire detectors are linked to fire alarm control panels and automatic alarms. All fire detectors are permanently monitored, and any fault is shown in the fire alarm control panels. Detectors of Safety fire Compartments are generally Class 3 Safety Features.

Fire Alarm Control Panels (FACP) – Create visual and audible alarms in the Main Control Room (MCR), monitor the progress of the fire, as well as providing the logical processing of the fire alarms and the firefighting actions. Each one has its own back-up 24hr electrical supply and is provided for each safety train. One is located on each building throughout the plant, they are all connected to each other and the Fire Alarm Repeater Panel. The FACPs generate corresponding fire alarms and automatic firefighting actions. FACPs and local panels for Safety fire compartments are Class 3.

Fire Alarm Repeater Panels (FARP) – Located in the MCR and the Remote Shutdown Station (RSS), it displays the state of all detectors (such as fire alarms, malfunction alarms, etc.), the control of the fire dampers and the automatic firefighting equipment.

NNB GenCo states that **Fire Detection Systems will be provided with a diesel backed up power supply in addition to local batteries.** Fire detection cabling will be rated C1 in accordance with NF C 32070 and enhanced fire resistance in accordance with BS 5839-1. Where aspirating smoke detection systems are used in the reactor building or SFS/ZFS spaces that are inaccessible in service, NNB GenCo states that the extraction system featuring a fan should have two independent power supplies.

Hazard Tolerance: NNB GenCo reports that **protection is considered for internal fire, earthquake, aircraft crash, marine corrosion, lightning, and electromagnetic interference**.

NNB GenCo reports that the JDT system is designed to be **continuously self-monitoring and any faults detected are indicated in the MCR, and detectors are designed and positioned to allow regular maintenance** and testing as far as possible. The division of the system into zones, lines and loops allows one part of the system to be isolated for modification without having to shut the whole system down.

Fire suppression (cf TS 03.2.2)

NPP
Hinkley Point C

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics (gas, foam, water…)**

NNB does **not claim manual firefighting for nuclear safety**, but considers it important for life safety and asset protection, and it makes provision for personnel access in the design of the building and fire compartments described in Section A-II-3.3.1

The **provision of fixed firefighting systems is based on a risk analysis approach** taking account of the fire load and the presence of ignition sources in each relevant location

- (JPI) Nuclear Island Protection and Firefighting Water Distribution system (NIFPS) – **Classified system for protection and distribution of firefighting water in the Nuclear Island** (NI) including the reactor building and fuel buildings.
- (9JPI) Nuclear Island Protection and Firefighting Water Distribution System for other buildings containing radioactive material (ETBFPS). **Predominantly water sprinklers but includes foam systems for solvent and oil storage facilities.** The sprinkler response to a fire is similar to that for JPI. For the foam systems, opening of a motorised valve will activate the foam storage and dosing unit so that foam is ejected to the proportioner.
- (JPD) Firefighting System for Conventional Island – **Classified system** (with non-classified parts) for distribution of firefighting water for the Conventional Island, Balance of Plant, and site buildings, and is **predominantly water sprinkler systems with some water deluge systems**.

Fire suppression (cf TS 03.2.2)

NPP
Hinkley Point C

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics (gas, foam, water…)**

  - (JPV) **Diesel Fire Protection System** – Classified system for fire protection for the Diesel buildings. It includes automatically **activated water or foam deluge systems and wet sprinkler systems**.
  - (JPH) **Turbine Hall Oil Tank Firefighting System**– System for extinguishing fires in the Turbine Hall oil tank, comprising **water deluge systems** for individual plant items. Most of the systems are activated automatically on detection of a fire by the JDT system, except the system serving the turbine generator bearings which is activated manually from either the MCR or locally within the Turbine Hall.
  - (JPT) **Transformer Fire Protection System** – System for fire protection of the transformers, comprising an **automatically activated deluge system**. Protection is for life safety and asset protection only.
  - (0JPU) **HUM/HDU Fixed Fire Suppression System** – System for fire protection of the Emergency Response Centre (HUM) and Emergency Response Energy Centre (HDU). A **water mist system** to protect the emergency diesel generator and its fuel storage tank rooms in HDU, **water deluge** for the plant room carbon filter housings in HUM, and **inert gas suppression** for other areas of HUM. The system is triggered automatically by 0JPU fire detectors but can also be activated manually via the local control panel.

Passive fire protection

Compartmentation (cf TS 03.3.1)

NPP
Hinkley Point C

- **Methods for determining suitable fire barriers**

NNB GenCo's approach to fire zoning is described in Section 4 of the HPC FAD [48]: *Preference is given in the design to passive fire protection instead of relying on active fire protection.*

NNB Genco states that it will provide **fire compartmentation** in accordance with the HPC Fire Application Document requirements ([48], Section 4.5.6); **typically either 120 minute or 60 minute fire separation of escape routes, firefighting access routes, external envelopes, areas with a PFG risk, storage spaces, and areas with safety systems and or safety equipment**

Section A-II-3.3.1.1 details how NNB GenCo applies fire containment via the physical segregation of areas through the use of fire rated barriers. NNB GenCo has set out how fire barrier designation is driven by fire hazard analysis. This meets ONR's expectations that fire barriers should be provided to provide the fire resistance as required by the fire hazard analysis and is consistent with the ONR internal hazards TAG [16], IAEA SSG-64 [17] and WENRA SRL SV 6.5. ONR also judges the licensee's approach for ventilation systems and fire dampers meets RGP.

NPP
Hinkley Point C

- **Maintenance of fire dampers (inspection , functionality testing, lessons learnt)**

- HPC is under construction and design provisions are made for the maintainability of dampers.
- Fire dampers are considered to be active elements of the protection systems so single failure must be taken into account when the fire containment function is a nuclear safety requirement. Accordingly, when required, two fire dampers are provided in series. If redundancy is not possible due to layout constraints, alternative measures will be taken, such as fire resistance of the ductwork.
- Fire dampers close automatically in the event of fire by automatically closing these dampers when a fire is detected by the JDT system or by operation of the damper’s thermal fuse(s).
- The design takes account of the risk of spurious operation of fire dampers interfering with the radiological containment function of the ventilation system, for example if closing an exhaust damper could increase the pressure in a ventilated area which is intended to be maintained under a negative pressure with respect to its surroundings.

TS 01.3 and TS 04

NPP
Hinkley Point C

Focus on significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production

The NAR already reported modifications to the EPR design implemented to align with British Standards and in response to ONR comments, including:

- Addition of secondary power supplies to firefighting shaft lighting;
- Addition of fixed firefighting to areas with significant risk;
- Changes to fire sectorisation and openings for personnel evacuation;
- Upgrade of Safeguard Building lifts to firefighting lifts;
- Additional dry riser outlet in radwaste building to improve coverage;
- Additional fire compartmentation to Nuclear Island buildings following discussions with NNB, ONR meetings, and development of Fire Strategy documents;
- Addition of fire dampers for redundancy and after re-routing of a HVAC duct;
- 40 mm thickness was assumed in the 3D model during early stages of the design where 1-hour fire resistance, but no commercially available product was found with the required fire resistance, so model was modified to assume 80mm thickness.

NPP
Hinkley Point C

- **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**

ONR raised an action for **further consideration of the potential effects of combined hazards** on the types, main characteristics and performance expectations for **active fire protective systems**, the potential for combined hazards to affect the capacity for firefighting and how the firefighting system may contribute to combined hazards.

Provision of detectors in all rooms is the expected base position for HPC in construction **in line with BS 5839-1 AND nuclear safety requirements. Exceptions are possible in line with IAEA SSG-64 and room accessibility is not a dominant factor in individual detector provision**. There are different technologies (LHDC) applied in certain rooms which is consistent with SSG-64.

TS 01.3 and TS 04

NPP
Hinkley Point C

Strengths

- **Fire prevention measures developed from modern standards**.
- The fire safety analysis has been developed using **standards that are more recent than those that were in place during the design and construction of other stations** within the UK fleet, and close **collaborative working between the UK and France**. The analysis has also had the benefit of development of modelling techniques and use of 3D computer models of the buildings and structures that were not available during the design of other stations in the UK fleet.
- Fire Detection System (JDT) is a dedicated I&C system that monitors detection, transmits the location of the source of any detected fire and any smoke-filled zones, to a central operator station and actuates fire protection actions.
- The Fire Alarm Repeater Panels (FARP) are located in the MCR and in the Remote Shutdown Station (RSS). It displays the state of all detectors (such as fire alarms, malfunction alarms, etc.), the control of the fire dampers and the automatic firefighting equipment. In addition, a Graphical User Interface (GUI) is installed to show plan view drawings identifying the location of the fire and state of detectors. FARPs are Class 3.

Conclusion

TS 01.3 and TS 04

NPP
Hinkley Point C

- **Weaknesses**

- The NAR identified a weakness in analysis for fires outside buildings. However, **since the production of the NAR, the licensee has undertaken analysis of internal fires external to buildings** for various scenarios such as diesel truck fires, DVI, aircraft crash, refuelling accidents, earthquake and internal fires in adjacent buildings. This analysis considers the thermal propagation and smoke ingress into other buildings as part of its scope (e.g. smoke ingress into HVAC intake and outtake ducting).

- The NAR noted that for the Reactor building (HR) the assessment techniques used for most of the fire HSVs were found not to be directly applicable to the reactor building because the large volumes were beyond the range of applicability of the models used for other buildings. However, **since the production of the NAR, the licensee has completed the HR Methodology and a Detailed Design Hazard Verification Study** has been carried out. The methodology assumes localised fire temperatures for checks on HSV integrity, and uses conservative abacuses for convective & radiative heat to check on potential impacts on SSCs. The usual FRA methodology is used for rooms in which the MAGIC model is still within its validity domain.

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.3)

Fuel fabrication facilities

- ## Objectives, scope

  Assessment of all fault sequences identified in Radiological Safety Assessments (and Criticality Assessments if applicable)

  Nuclear and chemotoxic fire hazard analysis undertaken in support of the Continued Operations Safety Report (COSR) process. It also considers the potential for fire as an initiator for faults elsewhere in the analysis e.g., fault sequences in the Radiological and Criticality HAZANS. Where Springfields Fuels Ltd. considers that there is a significant consequence either to the worker or public, it assesses the effects of fire on engineered safety measures such as Safety Mechanisms (SM's) or Safety Features (SF's), to demonstrate that they are robust to fire and the contribution to risk is low.

- ## Scenarios (quantification of radioactive dispersion and release due to fire combination of hazards..)

  Fire scenarios are not specifically quantified. Practice is to compare **each Fault Sequence Group in the assessments against company criteria and Design Basis Accident (DBA) Analysis criteria**. Springfields Fuels Ltd. stated that any fault with **an Initiating Event frequency in excess of 10-5 per year and an unmitigated consequence in excess of 20mSv (on site) or 0.1mSv aerial (off site) is subject to DBA**. Where consequences of the fault sequence exceed company criteria, Springfields Fuels Limited specifies Operating Rules and each would be supported by two suitable Safety Measures meeting company criteria. Where it identifies two safety measures, Springfields Fuels Ltd gives consideration to the potential for **common cause failure due to fire**. Hazard combinations are not specifically assessed. The development of a methodology to consider combinations systematically is one of the recommendations captured within the UK NAR.

- ## Most penalising scenarios

  Fire scenarios are not specifically quantified and **no PSA is performed**.

Compartmentation (cf TS 03.3.1)

Fuel fabrication facilities

- **Methods for determining suitable fire barriers**

  Springfields Fuels Limited reported that it initially designates **fire compartment boundaries for new builds following guidance in the Approved Document B** to the England Building Regulations for life safety (maximum compartment sizes, fire service access and means of escape). Springfields Fuels Limited uses the results of **fire loading studies to confirm that the fire resistance (integrity, insulation and load bearing capacity) of the fire compartment boundaries** (integrity and insulation) or main structural members (load bearing capacity) is below the calculated fire load density. Springfields Fuels Limited reported that if fire loads are found to exceed the designated fire resistance, it typically reduces the fire loading or, if this is not practicable, applies enhancements to structural protection.

- **Compensatory fire protection measures in cases where the use of ‘state-of-the-art’ compartmentation is not (fully) possible (e.g. when modern regulations have to be followed for older installations)**

  As above fire loading studies are used to confirm the suitability of fire compartments. If fire loads are found to exceed barrier requirements fire loading may be reduced or enhancements to the structural protection considered. Springfields Fuels Limited reported a specific example where, ablative paint was applied to structural steelwork to increase the associated fire resistance and reduce the risk of fire spread.

Ventilation management (cf TS 03.3.2)

Fuel fabrication facilities

- **Confinement provisions used in case of fire (static or/and dynamic confinement)**

  Springfields Fuels Ltd reported that **dynamic containment systems are used to create airflow towards areas with higher levels of contamination for treatment before discharge**. The **static containment** system consists of physical barriers between radioactive material and the personnel or the environment typically steel and glazed partitions to separate Operator areas from Secondary areas. Primary areas are typically kilns, autoclaves, hoppers, pipework etc.

- **Strategy regarding the maintenance of dynamic confinement considering the risk of fire propagation through ventilation systems**

  Springfields Fuels Ltd reported that the **minimum fire resistance rating of fire dampers is determined based on the rating of the fire compartmentation** through which the ventilation system passes. This is confirmed as part of the periodic COSR reviews by undertaking fire loading studies and confirmed that the fire resistance period exceeds the calculated fire load equivalent.

  Springfields provided a specific example of review of **fire damper and ductwork requirements** within their oxide fuels complex. Springfields Fuels Ltd reported that **upgrades** were carried out to the ventilation system early in the life of the plant. These included the **addition of fire dampers fitted at strategic locations to prevent smoke spread** from one side of the facility to the other. Springfields Fuels Limited reported that the ductwork was left unprotected as the principal requirement was for preventing smoke spread. Springfields Fuels Limited considered that, even unprotected, the **steel ductwork was capable of providing at least 30 minutes fire resistance** and this was explicitly claimed.

TS 01.3 and TS 04

Fuel fabrication facilities

- **Focus on**
  - **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**

In 2000 a **fire occurred in a laboratory fume cupboard**. As a result of the incident, Springfields Fuels Ltd. undertook a fire risk assessment of all fume cupboards where fusion processes took place and made a recommendation that the duct leading from one of the cupboards was cleaned of oil residues and that future work be carried out in a fume cupboard with the scrubber operational. Other recommendations made included improvements to the control of transient combustibles, the method of igniting the burner and fitting of ventilation low flow alarms.

In February 2000 a **fire** occurred **involving a vibrating table powder feeder.** Springfields Fuels Ltd. made the following recommendations following the fire: RCD protection to be provided, consideration be given to using components within the powder feeder that will not support fire propagation, a suitable gland was fitted to the cable where it passed through the table base to prevent damage to the cable caused by vibration, consideration be given to continual oxygen monitoring and the design of the powder feeder was modified to allow nitrogen into the inner area containing the solenoid.

Conclusion

TS 01.3 and TS 04

Fuel fabrication facilities

- **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**

In July 2000 a **fire occurred in an electrical cubicle in a switchroom** of a building. Springfields Fuels Ltd. listed the following recommendations: **Connections to be periodically checked** to confirm that they are tight, consideration be given to **firestopping open cable penetrations between cubicles** and at the top of cubicles to prevent fire spread in the event of fire and **procedures for fighting electrical cubicle fires** to be reviewed in the knowledge of the significant number of carbon dioxide extinguishers required to control the fire and their availability within the building.

In April 2006 a fire occurred due to **ignition of oil mist in a shredder** ignited by sparks due to rapid oxidation of Depleted Uranium (DU) swarf during shredding. Springfields Fuels Ltd. recognised that it was possible that other equipment on the Springfields site may be generating oil mists and undertook a review. Springfields Fuels Ltd. reported learning included the **acknowledgement that safety cases needed to consider the possibility of oil mists**, in the same way as explosion hazards are considered.

Springfields Fuels Ltd. Noted significant improvements to the Oxides Fuels complex as a result of fire safety assessment. These include a **full fire damper survey** and assessment of whether each could be declared redundant, left permanently open or was required to operate in the event of a fire. Additionally, a **full ratification of the fire compartment scheme was undertaken** and updated drawings produced.

Conclusion

TS 01.3 and TS 04

Fuel fabrication facilities

- **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**

  Following the **Grenfell tower fire in 2017** and in response to a letter from ONR, Springfields Fuels Ltd reviewed all cladding systems on site irrespective of building height or location. Key actions arising from this review are discussed in the NAR. **ONR's request to implement learning from Grenfell (from outside the nuclear sector) was applied to all licensed sites in the UK.**

- **Strengths and weaknesses**

  Springfields Fuels Ltd. did not identify specific strengths and weaknesses related to fire safety analysis.

  Springfields Fuels Ltd. did not identify specific strengths and weaknesses related to fire prevention.

  Springfields Fuels Limited reported as a strength that MITIE emergency response has brought in several initiatives since taking over the site fire service role, based on National operational guidance (Incident command structure) and the JESIP model. These included the use of Dictaphones, debriefing after protracted incidents, use of a decontamination tent for firefighters and casualties and beginning of shift briefs with site management and security.

  Springfields Fuels Ltd. did not identify specific strengths and weaknesses related to passive fire protection.

Fire safety analysis

Enrichment

Strengths

UUK's self-assessment submission considered that a **low nuclear fire risk exists**, due to the inherent properties of the nuclear material handled and its treatment during operational processes. It also considered that safety case conclusions are not significantly impacted by fire events and that focus is therefore on an adequate programme of conventional fire safety.

UUK's self-assessment described a dominant fire hazard in terms of structural building fire loading, which had been sampled in a recent ONR intervention and confirmed as being adequately assessed.

Weaknesses

UUK recognised a **need to update its safety case arrangements and guidance for consideration of nuclear fire safety in light of IAEA e.g. SSG-64 in so far they are transferable to fuel cycle facilities**, applying a graded approach.

Through TPR and ONR inspections UUK recognised an opportunity to make secondary improvements to documents to fire safety action and follow up, closure and link with safety cases.

ONR has raised a recommendation that **UUK reviews and makes any necessary improvements to its safety case arrangements and guidance in relation to the consideration of fire and of its combinations with other hazards** including traceability of fire-related action follow up and closure in safety cases.

Fire protection concept and its implementation

Enrichment

Fire prevention strengths

UUK described that its arrangements for preventative measures included a site fire prevention strategy to drive the implementation of relevant good practice, including BS9997: 2019 Fire Risk Management Systems and BS9999 [71]. UUK provided specific examples in relation to preventative measures that are aligned with ONR expectations in the ONR internal Hazards TAG [16]:

- Adequate arrangements for the control of hot works.
- Arrangements are in place for the quantification of transient fire load, the capture of this information via fire risk assessments, communication to building owner and monitoring through area walkdowns.
- Specific examples regarding reduction of combustibles are described including, for example, control of pallets/wooden scaffolding and a **ban on the use of combustible cladding in buildings**.
- The approach to the control of flammable liquids and gases is described with reference to RGP in the form of the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), Health and Safety Executive Guidance HSG 51 and British Compressed Gas Association Guidance (BCGA Flammable liquids and gases).

Fire prevention weaknesses

UUK's self-assessment does not demonstrate significant weakness in terms of preventative measures.

Enrichment

- ## Active fire protection strengths

UUK reports that **no active systems are claimed for nuclear safety** and that the fire alarm and detection system is provided for prompt personnel evacuation and to alert the on-site IRS. The licensee described a **fire alarm and detection system improvement project to upgrade to BS 5839 (Reference) Part 1 L1/P1 standard** with benefits in terms of life safety, property protection and emergency response. ONR considers that UUK's self-assessment adequately describes emergency response arrangements on site and for liaison with the Local Authority, and the suppression systems in place to protect specific areas from fire risks to life safety.

Compartmentation

Enrichment

- **Passive fire protection strengths**

ONR considers the main strengths of UUK's self-assessment in the area as passive fire protection as follows:

- The licensee described a site compartmentation project supported by appropriate guidance BS9999 and accredited contractors.
- The site has lifetime quality asset management arrangements for compartmentation.
- The site has implemented a fire damper upgrade project improving the original design and referencing appropriate guidance (BS15650 Ventilation for buildings).

- **Passive fire protection weaknesses**

No specific weaknesses regarding passive fire protection have been identified by the licensee.

Conclusion

TPR2 conclusions

Enrichment

- **Urenco UK Limited enrichment facilities**

Based on this review, ONR has judged that UUK has a fire safety programme commensurate with its radiological risks from fire, noting that the dominant fire hazard is to building structures. UUK has recognised a need to update its safety case arrangements and guidance for consideration of nuclear fire safety in light of new IAEA guides e.g. SSG-64 in so far they are transferable to fuel cycle facilities, applying a graded approach.

Through this review and ONR inspections, UUK also recognised an opportunity to make secondary improvements to document fire safety action follow up, closure and linkage with safety cases. ONR therefore raised a recommendation:

UUK reviews and makes any necessary improvements to its safety case arrangements and guidance in relation to the consideration of fire in light of new IAEA guides e.g. SSG-64 in so far they are transferable to fuel cycle facilities, applying a graded approach.

A combined nuclear fire safety and life fire safety inspection was conducted at the Capenhurst site in early 2024. This examined the linkage between the nuclear fire safety case and implementation of fire safety measures, in line with RGP, including any identified hazard combinations. The inspection identified shortfalls in the extant safety case aligned with the findings and recommendations raised in the NAR and will seek resolution in line with the action above.

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.4)

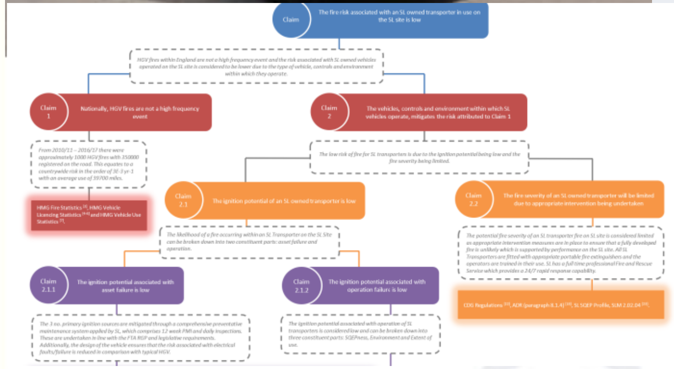
Waste

- **Objectives:**
  - Assessment of all fault sequences identified in supporting documentation (i.e. Radiological Safety Assessments (and Criticality Assessments if applicable)) is carried out to ascertain whether fire could credibly impact upon them.
- **Scope:**
  - Can a fire event prevent the identified Safety Measures (SMs) from completing their Safety Function in an unrevealed manner?
  - Could a fire event initiate the fault sequence and if so, are there any common failures, i.e. can the fire initiate the fault sequence whilst disabling the associated Safety Measures?
  - If the fault sequence exceeds Design Basis Accident Analysis (DBAA) threshold bands, could a fire event increase the Initiating Event Frequency (IEF) of the fault sequence, such that a DBAA threshold band is exceeded?
  - If the fault sequence does not exceed DBAA threshold bands, could a fire event increase the radiological consequences of the fault sequence, such that a DBAA threshold band is exceeded?
- **Main assumptions for the deterministic safety analyses**
  - Fire loading calculation contains assumptions such as fire load density of cabinets and cables, cable tray fill factor, heat release rates of common items, transient combustible loading (laydown area quantification tool is used).
  - Which fire analysis technique is applied to a particular review will depend upon numerous factors including whether or not the equations and assumptions in the model are appropriate for the problem under review.
- **Most penalising scenarios**
  - In Sellafield’s BEPPS-DIF waste store, CFAST modelling was used to understand the most severe fire scenario, a transporter fire in the vehicle bay.

Fire safety analysis

Fire safety analysis (FSA) (cf TS 02.4)

Waste



- Transporters used on site for waste retrievals and transfer of repackaged radiological waste to modern waste storage facilities e.g. BEPPS-DIF
- **Implementation of engine fire suppression systems** to tackle incipient engine fires
- **Additional controls to minimise access to buildings** by decoupling transporter tugs
- Selection of additional measures which may be practicable
- Driven by systematic transporter fire safety assessment methodology developed by Sellafield Ltd and shared across all Licensees through **UK Nuclear Safety Coordinating committee/ licensee forum attended by regulator**

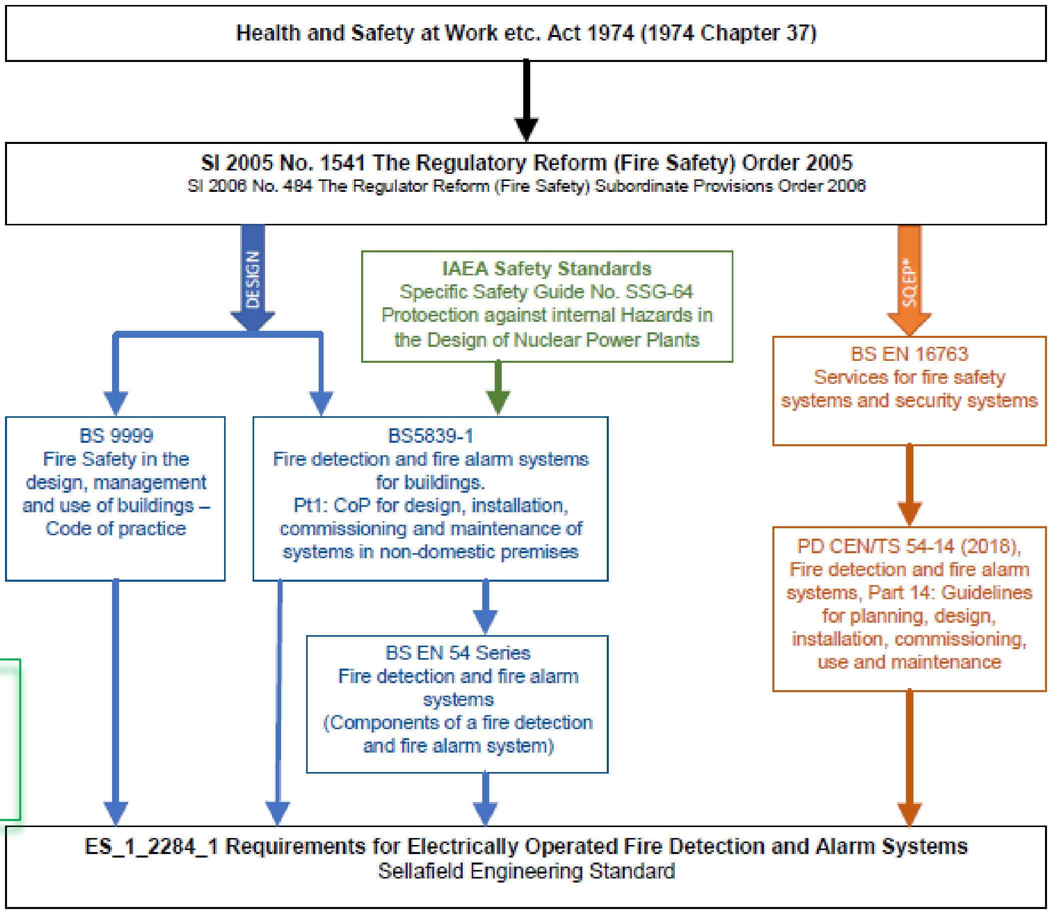
Active fire protection

Fire detection and fire suppression (cf TS 03.2.1/TS 03.2.2)

Waste

- **Strategy for the location of the detectors**
  - Sellafield Ltd. Engineering Standards provide the process for assessing the fire risk to inform the category and details specific design system performance requirements for an SL nuclear facility.
  - Waste Vitrification Plants 1 and 2 is separated into two main areas (buildings), both have an automatic addressable system with one categorised as L3, P2, M and the other categorised as L1, P1, M. Both systems also have manual call points.
  - The fire detection and alarm system installed in BEPPS-DIF is an L2, P2, M category automatic addressable system with detection devices in all areas of the building except areas not normally accessible such as cells.
- **Strategy for the selection of the location of the fire extinguishing systems**
  - **There is a suppression system in the engine bay within BEPPS-DIF transporters to mitigate the consequences of a vehicle fire. This system is designated as safety related equipment.**
  - In Magnox Repro, an In-Cell CO_2 suppression system is used to suppress any potential fire occurring in the Cells.

Fire Detection and Alarm System Design flow down to Sellafield Limited Engineering Standard



Compartmentation (cf TS 03.3.1)

Waste

Methods for determining suitable fire barriers

- An appropriate level of analysis is undertaken to confirm the required level of fire resistance to be provided by the fire barriers and their location. This is evaluated as part of the Nuclear Fire Collaborative Review Meeting and Nuclear Fire Hazard Analysis as required by the Safety Case.
- Fire load assessment generates quantified specification. If the fire barrier fire resistance performance in minutes is close to the calculated as built actual fire load and fire resistance equivalence required to protect against – Sellafield normally increases the fire resistance of that barrier depending on context, fire type and fire severity to ensure it is robust, for example from 60 to 90 minutes.
- The fire load assessments and Nuclear Fire Collaborative Review identifies where barriers should be provided and these assessments are maintained throughout the lifecycle of the plant to ensure the barriers are suitable and sufficient for the fire load and fire risk.
- The fire compartments and barriers are identified in the fire analyses and detailed on the fire compartmentation and fire incident drawings for the nuclear facilities.
- The nuclear fire barriers are identified within the Engineering Schedule of the Safety Case. This details the Safety Function Class (SFC) and level of importance, performance and maintenance requirements that must be implemented for nuclear safety.

Compartmentation (cf TS 03.3.1)

Waste

- **Use of fire dampers**
  - In building ventilation systems, fire dampers are installed in ductwork where fire compartment boundaries are crossed. The fire dampers comply with BS EN 15650 and bear the UKCA marking.
  - In ventilation systems which extract potentially radiologically contaminated air or gases from within radiologically classified containments, such as vessels, cells and glove boxes, the extract ductwork will not incorporate fire dampers where fire boundaries are crossed. Reasons for this include the risk that spurious closure could lead to a loss of radiological containment and potentially result in a radiological release within a facility.
  - On most modern facilities the building ventilation systems are shut down and all fire dampers closed in the event of a fire being detected in any area of the building.
- **Compensatory fire protection measures in cases where the use of ‘state-of-the-art’ compartmentation is not (fully) possible**
  - Sellafield Ltd. fire engineering team are currently engaged to undertake a review and rationalisation of the fire compartmentation and fire damper system at several legacy facilities. This process seeks to bring provision to a modern standard. Where compartmentation is required but not provided by existing dampers, contingency measures such as strict local combustible load limits are applied.

Conclusion

TS 01.3 and TS 04

Waste

- **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**
  - OPEX: Fire damper maintenance project launched at engineering centre of excellence to explore novel technical solutions to maintaining hard to access dampers.
  - OPEX: Utilisation of new technologies to enable rapid deployment of wireless systems to replace ageing fire alarm systems.
  - FSA: All transporters in use at Sellafield fitted with automatic engine bay fire suppression systems
  - Since NAR: ENCAPS fire damper maintenance programme implemented and progressed. Regulatory issue closed.
- **Strengths**
  - Mandatory to use third-party accredited fire stopping products, designers, installers and maintainers to ensure that the fire barriers are built and maintained as required by the fire analyses. A Fire Damper Asset register is maintained for all buildings where such devices are installed.
  - Provision of a modern professional fire service permanently based on site;
  - Low reliance placed on suppression systems to deliver nuclear safety.
  - Sellafield Ltd. identified a positive reporting culture allowing trending and learning from fire events and near misses. This has allowed Sellafield Ltd. to share learning within the nuclear industry and increase visibility of obsolescence/maintenance issues which had led to electrical fires. Identifying likely causes of fires (electrical failures) allows more targeted assurance to be carried out.
- **Weaknesses**
  - Holistic Fire Safety Strategies (FSSs) are not yet currently available for all nuclear facilities. A programme is in place to deliver this work on a risk-prioritised basis. This is not a legal shortfall.

TS 02.6, TS 03.2, TS 03.3

Decommissioning

- **Adaptations to the fire protection strategy in operation when moving to decommissioning**

The Prototype Fast Reactor (PFR) facility ceased operations in 1994 and therefore the facility has been undertaking defuelling, decontamination and decommissioning work for ~30 years. Fire safety strategies and provisions are therefore well established. Dounreay did not identify any specific adaptations to fire protection strategies when moving to Decommissioning.

- **Management of fire loads and ignition sources during hot works**

Prior to commencement of any hot work, Dounreay requires a **Hot Works Permit** to be issued, including the following (taken from Dounreay's self-assessment): Dounreay Fire & Rescue Service (DFARS) are the Appointed Persons for issuing hot works permits after an inspection of the work area and equipment. All fire safety prevention measures are detailed on the permit, a permanent fire permit is issued for areas where the use of flames, heat-producing apparatus, or fire is part of the routine work.

A permanent fire permit is valid for one year and is renewed and re-authorised by DFARS, prior to commencing any work, an inspection of the work location and fire prevention equipment must be carried out by a member of the DFARS, and a building representative and a Temporary Use Permit for Hot Work Form must be completed at the start of each shift prior to the specified hot work commencing.

Any changes to the conditions must be reassessed by DFARS. The Fire Safety Advisor and DFARS have the authority to carry out checks at any time. Specific control measures for fire loading and ignition sources would be detailed on the associated permit.

TS 02.6, TS 03.2, TS 03.3

Decommissioning

- **New systems put in place**

Dounreay did not identify any specific new systems put in place for the purposes of fire protection. However, it is understood that a new ventilation system is planned for the PFR facility, and the site is currently undertaking a rolling program of fire alarm system replacements which is prioritised based on risk, degree of obsolescence (availability of spare parts) and the asset condition.

Conclusion

TS 01.3 and TS 04

Decommissioning

- **Focus on**
  - **Significant improvements resulting from PSR, FSA and OPEX and potential updates since the NAR production**

Dounreay did not identify any specific improvements resulting from safety reviews or fire analysis however, ONR have undertaken targeted inspections at the site in July 2022, February 2023 and January 2024. These inspections have resulted in two regulatory issues one and Level 4 and one at Level 3.

The Level 4 issue related to **record keeping of fire alarm maintenance work**. Whilst the licensee was able to demonstrate that all alarm addresses were working on the fire alarm panel, the documented trail of repairs was not fully traceable to closure. This action has now been closed as Dounreay has provided adequate evidence of improvements to record keeping and confirmed that any residual defects on the PFR fire alarm and detection system have been resolved or a suitable work order is in place.

The Level 3 issue related to the control of dangerous substances & explosive atmospheres and the site's compliance with the Dangerous Substances & Explosive Atmospheres Regulations (DSEAR), which is the GB implementation of the ATEX 99/92/EC directive. The resolution of this issue is ongoing however, this is expected to lead to improvements in the site's process for the assessment and control of DSEAR zones.

Conclusion

TS 01.3 and TS 04

Decommissioning

- **Focus on**
  - **Strengths and weaknesses**

Dounreay reports as strengths that it has an on-site Fire Safety Advisor who is familiar with the on-site hazards and can provide advice on optioneering, modification and design. It considers that, given the on-site capability of DFARS, a prompt response to fire is assured. Dounreay reports as a weakness that it does not have in-house fire engineers to complete Deterministic Fire Risk Assessments and is reliant upon the expertise of contracting organisations.

Additionally, ONR identified that a weakness of the site is that there is no formalised process for characterising fire loading and no systematic process for considering combined hazards. These two findings have been captured as Recommendations 4 and 5 within the NAR.

Thank you for your attention

Any questions?