European Nuclear Safety Regulators Group

Topical Peer Review II Country Review Workshop
'Fire Protection'
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National Presentation of Italy

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Ispettorato Nazionale per la Sicurezza Nucleare e la Radioprotezione

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List of candidate installations

Installation category	Candidate installations
Nuclear power plant	NA
Research reactor	Lena Triga Mark II Tapiro Fast neutron
Fuel cycle facilities	NA
Dedicated spent fuel storage	ITREC FCF under decommissioning site (Wet in operation and Dry under construction) ESSOR reactor under decommissioning site (Wet and Dry, both into operation) Avogadro (Wet, into operation)
Installations in Decommissioning	Latina NPP (Magnox Reactor) Trino NPP (PWR) EUREX FCF (Reprocessing) ESSOR - RR (now in Safe Store)
On-site radioactive waste storage	D1 – D2 (on Trino NPP site) E1, E2, E3 (on EUREX FCF site) OPEC2 (on CASACCIA site)
Total	17

Location of candidate installations

Research Reactors
LENA Triga, Tapiro

Installations under decommissioning
Trino NPP, Latina NPP, Eurex FCF, ESSOR-RR

Dedicated Spent-fuel storage facilities
ITREC FCF, ESSOR, Avogadro

Waste Storage Facilities on the Site
Trino (D1,D2), Eurex (E1, E2, E3), OPEC 2

Regulations for Fire safety

Fire safety for Nuclear facility

National Inspectorate for Nuclear Safety and Radiation Protection

The national fire safety regulatory framework for nuclear installations is part of the broader national fire safety legislative framework that deals with all installations and activities where there is a fire risk (conventional and nuclear installations).

In the national regulatory framework, the **fire safety of nuclear installations is subject to a dual path of evaluation and verification**:

- *By the **Ministry of Interior** - Department of firefighters, public rescue and civil defense and the National Fire and Rescue Service (CNVVF)* – here in after *"Fire Authority"*
- By the ***National Inspectorate for Nuclear Safety and Radiation Protection*** *(I*SIN) as National Competent Regulatory Authority for Nuclear Safety

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Fire Protection under Fire and Nuclear Authorities

Functions exploited by the competent authorities on Fire protection of nuclear installations has the following objectives:

- **Fire Safety Authority (CNVVF):** his action is addressing to the Fire Protection with the objectives of the **safeguard of public and workers health**, as well as the **protection** of the **environment** and **property**.
- **Nuclear Safety Authority (ISIN):** the oversigth applied with regards to the Fire Protection has the **primary objective** of the **protection of the SSC relevant for the nuclear safety as well as to prevent radioactive releases to the environment**.

Collaboration are in place between the Operators and the off-site Fire Brigades aiming to provide training and to perform exercise to **enhance the capability** of the external emergency services **to operate within the nuclear installation**.

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Regulations for Fire safety by Fire Authority

- For **Category C** activities, (**high risk, including nuclear installations**), the legislation provides the procedure for obtaining the **fire prevention certificate (CPI)** required for authorisation to operate the installation. This procedure requires the assessment of the project by the local Provincial Commands of the Fire Authority.
- **Fire safety analysis must be reviewed when there are changes in the production process or in the organisation of work that are significant for the health and safety.**

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Regulations for Fire safety

- DPR 1 August, 2011 n. 151 (Regulation simplifying the regulation of fire prevention procedures,…)
- DM 20 December 2012 (Fire prevention technical regulation for active fire protection systems installed in activities subject to fire prevention controls)
- DM 3 August 2015 (Approval of fire prevention technical standards, pursuant to article 15 of the legislative decree 8 March 2006, n. 139), modified by DM 12 April 2019 and by DM 18 October 2019, Reg.(UE) n.305/2011

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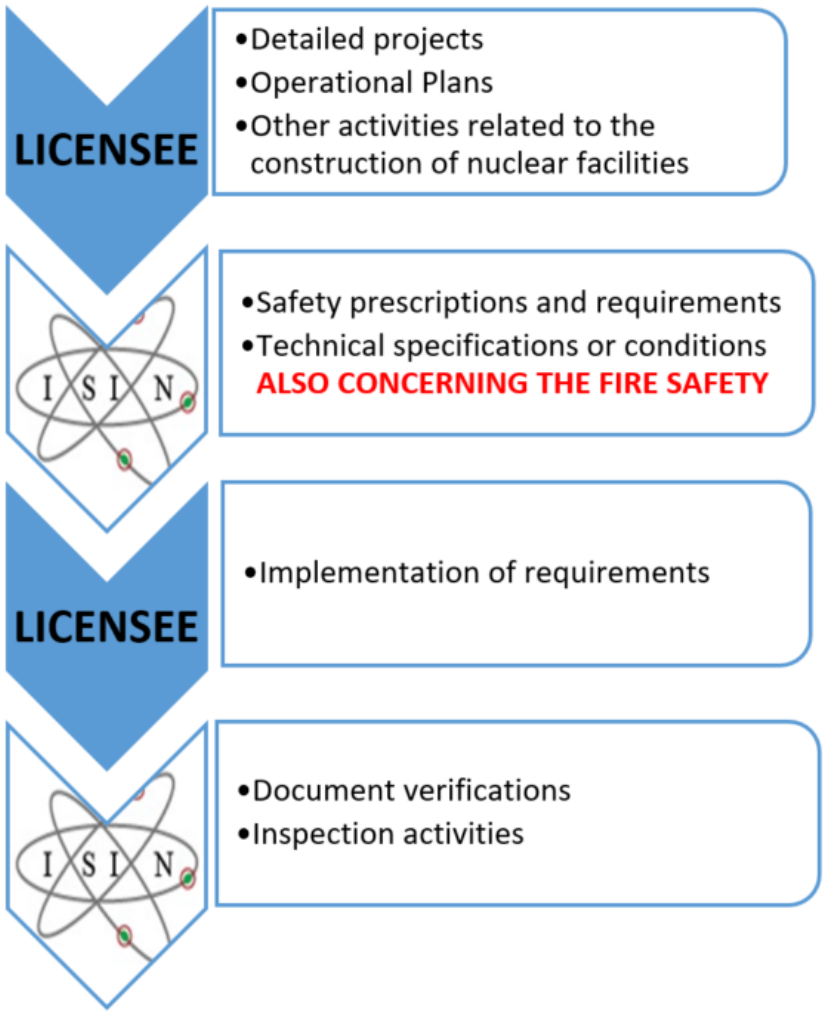
Regulation for Nuclear Safety including Fire Safety aspects

For nuclear installations, any licence/authorization issued by the Ministry of Environment and Energy Security is based on the binding technical advice with condition/specifications formulated by ISIN.

Technical specifications include fire safety requirements



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Regulation for Nuclear Safety including Fire Safety aspects

- **Technical Guides issued by ISIN** are regulatory documents by which ISIN discloses requirements and best practices on operational and technical measures to implement legislative provisions in the field of nuclear safety and radiation protection, as well as project criteria.
- Technical Guides adopt the **WENRA Safety Reference levels**.

Fire protection system must be designed in accordance with the applicable national regulations and international standards.

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Regulation for Nuclear Safety including Fire Safety aspects

In the Technical Guides n. 30 and 31, relevance is given to the requirements for the performance of the Fire Hazard Analysis and measures to be provided for fire prevention and protection of:

- Installations under Decommissioning (Technical Guide n.31): The 'Fire Prevention and Protection Programme' ➔ **Fire Risk Assessment guidelines** for the definition of fire prevention and protection measures for each activity **relevant to nuclear safety and radiation protection** during decommissioning. It shall be submitted for approval;
- Waste and Spent fuel storage facilities (Technical Guide n.30): Fire prevention and Protection measures shall be defined according to the storage facility's Fire Hazard Analysis, based on the general criteria of defence in depth.

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Research Reactors

- LENA TRIGA 250 kW
- TAPIRO 5 kW

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Fire safety analysis

Fire safety analysis (FSA) (cf TS 02.2)

RR
LENA Research reactor

Deterministic fire safety analyses (Fire Hazard Analysis - FHA) is applied with a graded approach using also a simplified probabilistic method for event combinations.

OBJECTIVES

Prevention and mitigation on *internal* and *external* hazards…

Classified zones, solid waste storage, free areas

Risk of fire of material containing radioactive substances can generate dust, aerosols, vapors or gases themselves containing radioactivity, thus generating or increasing the risk of exposure and contamination

Outside the reactor building and outside the site

Risk of fire spread

Fire safety analysis (FSA)
(cf TS 02.2)

RR
LENA Research reactor

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…and combined/Initial events of an internal hazards

Probability, severity	Flood	External fire	Internal fire	Adverse weather condition	Earthquake
Reactivity 1	1	1	1	2	2
Power Supplier failure 1	1	1	1	2	2
Tank failure 1	1	1	1	2	2
Leakage 2	2	2	2	4	4
Design event 3	3	3	3	6	6

Fire safety objective

Limit damage to people as well as to SSCs and related equipment ➔ prevent radiological risks to personnel, public and environment.

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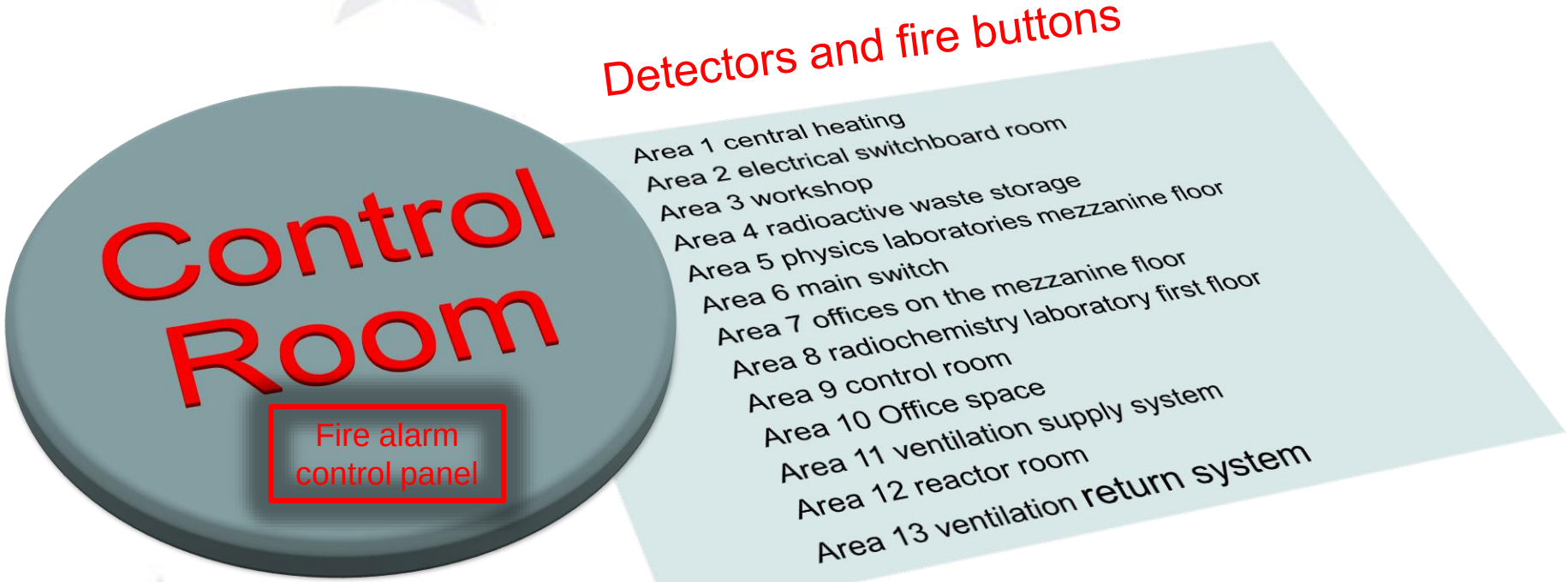
Active fire protection

Fire detection (cf TS 03.2.1)

RR
LENA Research reactor

Design approach

Whole protection: each area is equipped with at least one detector (numbers are evaluated based on dimension, safety relevance and fire loads)



Types, main characteristics

Optical smoke detectors in all areas and thermosensitive cables in Control Room.

Fire suppression (cf TS 03.2.2)

RR
LENA Research reactor

Design approach

Based on the results of the
Fire Hazard Analysis

Internal

Mobile fire extinguisher
(CO_2, powder)

Outside reactor building

External hydrants (UNI 70)

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RR
LENA Research reactor

Design approach

Based on the results of the
Fire Hazard Analysis (FHA)

➔ Different areas inside the building (fire compartments)

The facility consists of two adjacent buildings. The compartmentalization consists of concrete walls and a fire damper on the ventilation. Each system (e.g. electrical, etc.) is completely separate and independent

➔ Reactor building is only one compartment divided in sections

The ventilation is unique and the systems are shared in the various sections. The sections have a partial compartmentalization with fire dampers, windows and REI doors

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Performance assurance through lifetime

- ✓ Periodic testing and re-evaluation (annual review)
- ✓ Ageing management plan

Compensatory fire protection measures

Dedicated procedures for control and limitation of fire-loads

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LENA Research reactor

Ventilation system design

Each facility is equipped with its *dedicated* ventilation system.

The compartment of the Reactor building can be separated from the others areas by shutters.

Following an alarm by the system or evidence from operators, the emergency configuration of ventilation is activated by a dedicated push button that provides:

- ✓ the interruption of conventional ventilation
- ✓ the activation of emergency ventilation
- ✓ the closing of the subdivision fire damper

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Conclusion

TS 01.3 and TS 04

RR
LENA Research reactor

Strengths

- Limited ignition sources and fire loads (low risk profile);
- Regular tests and monitoring of the fire systems and fire-fighting periodic drills;
- Strong collaboration with local fire brigade;
- Policy, procedures, training programs (both for management and employees)

Weaknesses

- Additional human resources is required
- Additional specialized personnel are needed for the fire safety analysis reviews

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.2)

RR
RSV TAPIRO

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Fire hazard analysis has been recently conducted according to Italian law on fire protection and prevention

OBJECTIVES

Protect operators and the building with associated facilities

Reactor hall and adjacent areas

Risk of fire and combustion of low density solid combustibles

Outside the reactor building and outside the site

No FSA for outside events has been performed

BUT external fire protection system is present

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Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.2)

RR
RSV TAPIRO

Design approach

1. • identification of any fire hazard (e.g. presence of easily combustible and flammable substances, ignition sources, situations that can cause the fire to spread easily);
   • identification of personnel in the workplace exposed to fire risks;
2. • identification of assets exposed to fire risks;
3. • elimination or mitigation of fire risk;
   • assessment of residual fire risk;
4. • verification of the adequacy of existing fire safety measures or identification of any additional ones
   • provisions and measures aimed at eliminating or mitigating residual fire risks.

RSV TAPIRO → LOW RISK PROFILE

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Active fire protection

Fire detection (cf TS 03.2.1)

RR
RSV TAPIRO

Design approach

Engineering assessments

Fire risk internal areas

Detectors and fire buttons

Control room (30 m^2);

Offices (93 m^2);

Technical room (61 m^2):

Main entrance + Corridor (49 m^2);

Reactor hall (160 m^2);

Helium pump room (53 m^2).

In total there are 20 fire detectors, 6 buttons and 2 fire sirens are located in the installation

Types, main characteristics

Optical detectors

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Active fire protection

Fire suppression (cf TS 03.2.2)

RR
RSV TAPIRO

Design approach

Engineering assessments

Outside reactor building

External hydrants (UNI 70)

Internal

Mobile fire extinguisher
(powder and 10 CO_2)

Automatic fire extinguishing system
(agent: inert gas IG-541)

- Control room
- Console power cord tunnel
- Electrical room

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Availability of site fire brigade

- A dedicated on site Fire Brigade is available:
  - point-point connection of the TAPIRO fire alarm station to the on site fire brigade central station;
  - 24/7, at about 250 m and 5-6 minute of response time;
  - every on site team is composed of 3 firefighters, 2 operators and one team leader.

NOTE: Since 2023 **all the reactor staff** members are trained by the National Fire Brigade department to operate in case of fire (high-risk fire course).

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RR
RSV TAPIRO

Design approach

From the original reactor project

➔ Reactor building is only one compartment

- ✓ Compensatory measures:
  - Flammable waste must be contained in metallic drums;
  - in the RSV TAPIRO installation are forbidden:
    - the use of open flames
    - the deposit of flammable substances
    - the use of equipment that may cause ignition of fire
- ✓ For experimental apparatus, the need for additional fire detection and extinguishing systems must be evaluated.

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Ventilation system design

Designed to ensure that the vital areas are depressed respect to the external environment (Dp > 20mm H2O)

- Main ventilation system
- Emergency ventilation system
- Under-pile zone ventilation

The ventilation system is automatically shut-down in case of fire alarm

At the moment, the ventilation system is NOT equipped with fire dampers

Conclusion

TS 01.3 and TS 04

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RR
RSV TAPIRO

STRENGTHS

- The **point-point connection** of the TAPIRO fire alarm station to the local fire brigade central station;
- The **availability of the local fire brigade 24/7**, at about 250 m and a response time of 5-6 minutes;
- Limited source factor and fire loads (**low risk profile**)
- Since November 2023, **all** the **reactor staff members** have been **trained** by the National Fire Brigade department to operate in case of fire (high-risk fire course).

WEAKNESSES

- **FHA** has **to be complemented with an assessment** on the possible effects of the worst fire scenario with demonstration of the capability to preserve systems exploiting key nuclear safety functions.
- **Protection systems shall be re-evaluated** according to the recent FHA **and** consequently **upgraded** where needed (e.g, strengthen compartmentalization/additional compensatory measurements, Fire dampers installation)

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Spent Fuel Facilities

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Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.3)

FHA, is conducted with the implementation of the prescriptive approach established by Ministerial Decree 10/03/1998 in which the standards and technical rules for fire prevention, impose compliance with minimum safety requirements identified in the same regulation.

Prescriptions of the Licence Safe Store Operations of the ITREC installation also cover *fire safety related aspects*.

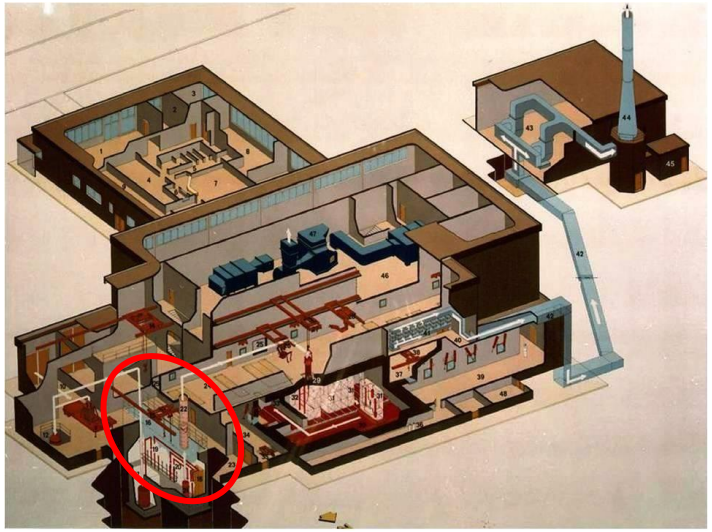
OBJECTIVES

Maintaining safety

for workers, public and environment

Spent fuel storage

Spent Fuel Pool at ITREC



built in the 1960s

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Active fire protection

Fire detection (cf TS 03.2.1)

Spent fuel storage

Spent Fuel Pool at ITREC

ignition sources: No equipment/device that can be an ignition source

combustible material: No substances present that could generate a fire or an explosion

Fire detection: No fire detection system

In case of initiating fire the operators activate the alarm with the dedicated manual bottons present in the area.

Fire buttons activated by operators

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Active fire protection

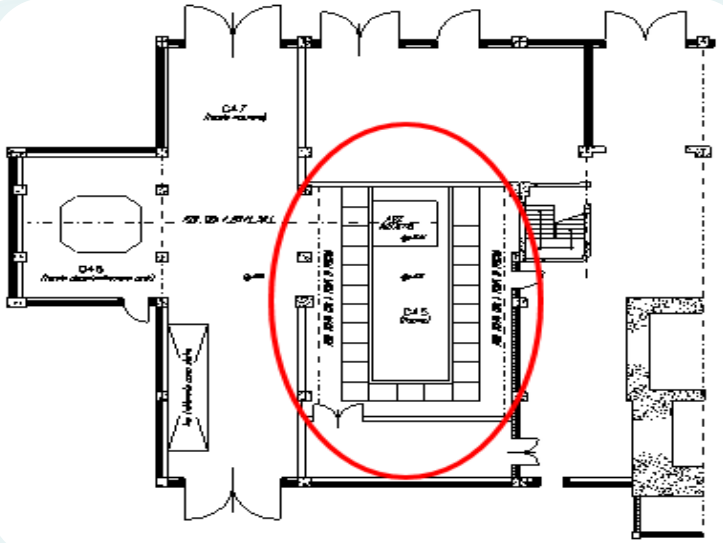
Fire suppression (cf TS 03.2.2)

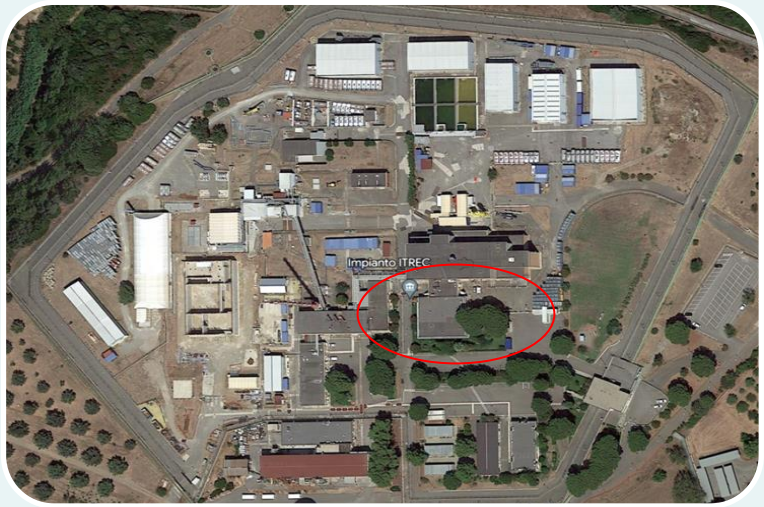
Spent fuel storage

Spent Fuel Pool at ITREC

Design approach

Methodologies used in the 1960s + improvements





Internal

Internal hydrants (UNI 45)

Mobile fire extinguisher

Outside (ITREC site)

External hydrants (UNI 70)

Fire-fighting vehicle

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Conclusion

TS 01.3 and TS 04

Spent fuel storage

Spent Fuel Pool at ITREC

STRENGTHS

- The spent fuel stored in the pool is quite old and therefore there is **no need for an active heat removal**.

WEAKNESSES

The installation is rather old and **the fire safety system was designed according to a fire risk analysis based on an old approach**

A plan is being implemented for transfer of the spent fuel to a new dry storage facility under construction. It will provide a substantial improvement in the safe management of spent fuel, also from the point of view of fire safety. **Strengthening of the fire detection provisions to be considered in the transition phase.**

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Fire safety analysis

Fire safety analysis (FSA) (cf TS 02.3)

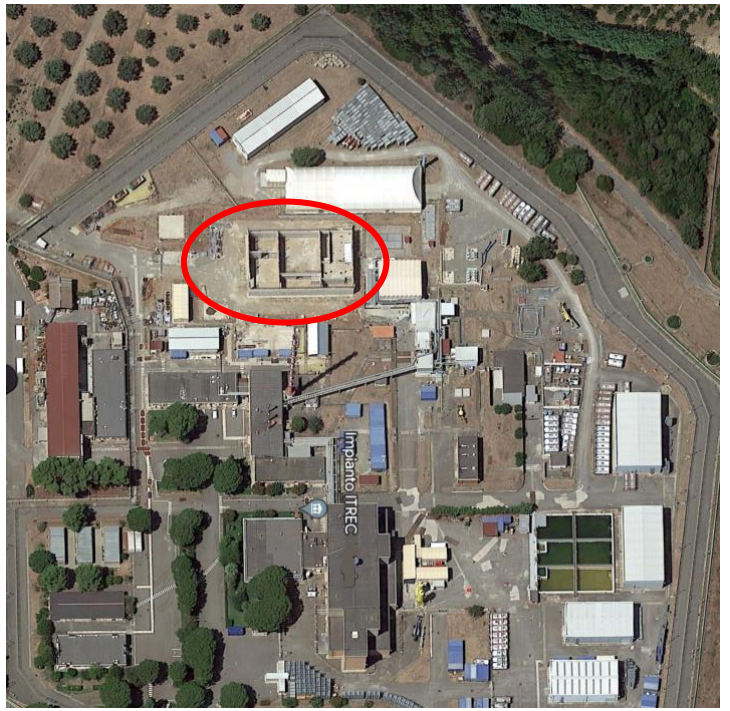
Deterministic analysis (Fire Hazard Analysis-FHA) according to the new regulation (DM 3 August 2015 Fire Prevention Code) and ISIN TG n.30 (Waste and Spent Fuel Storage Facilities)

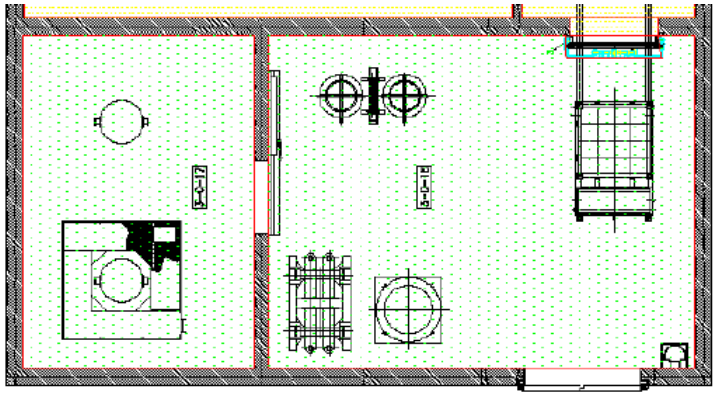
OBJECTIVES

Maintaining safety for workers public and environment

Spent fuel storage

DRY SF STORAGE AT ITREC UNDER CONSTRUCTION





DTC3 - area

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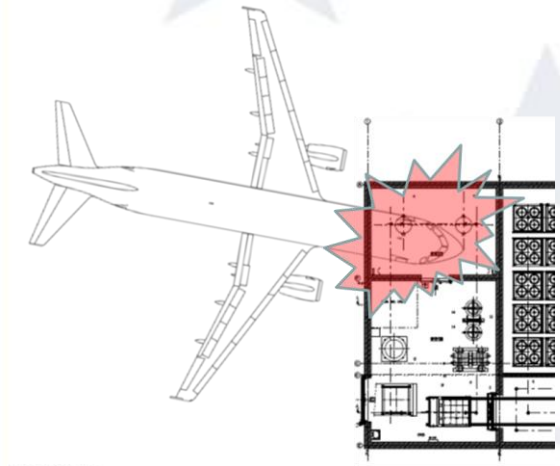
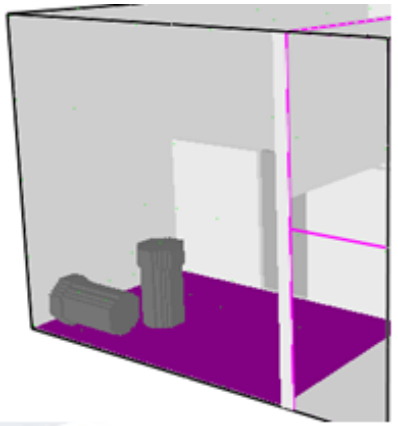
Fire safety analysis

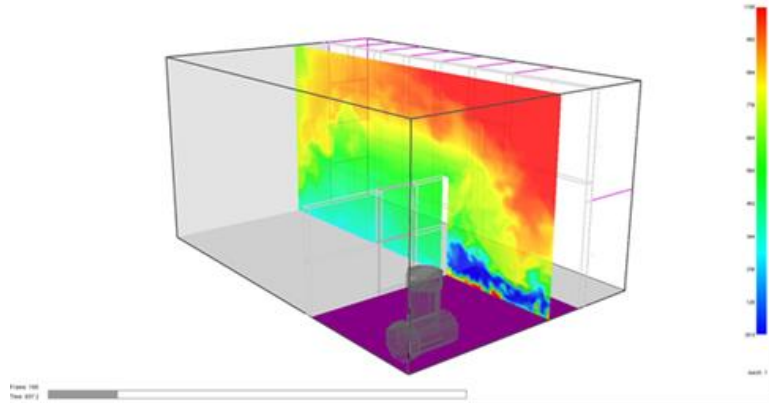
Fire safety analysis (FSA)
(cf TS 02.3)

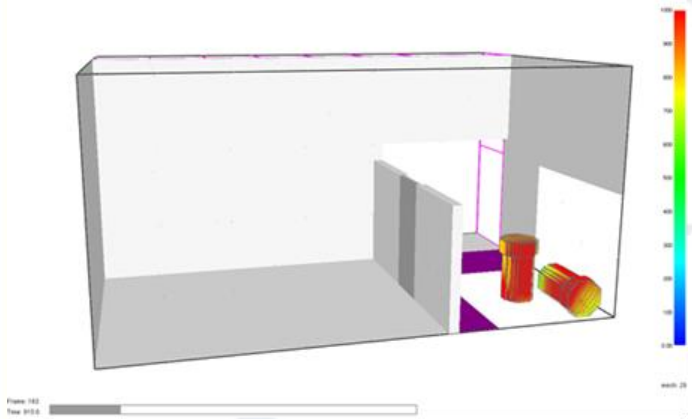
Spent fuel storage

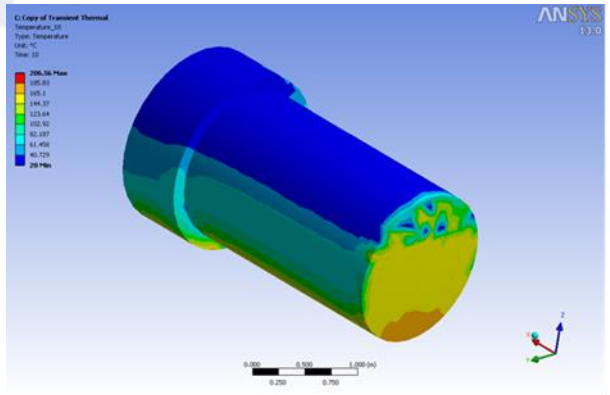
DRY SF STORAGE AT ITREC UNDER CONSTRUCTION

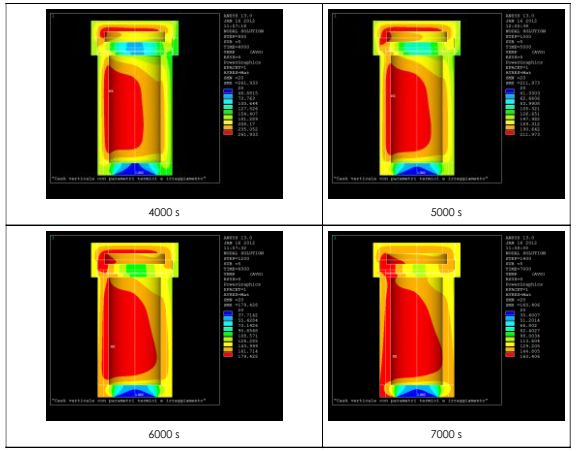












Specific fluid dynamic analysis performed to validate cask fire condition after **aircraft impact event** (modelled using FDS and Analysis calculation codes)

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Active fire protection

Fire detection (cf TS 03.2.1)

Spent fuel storage

DRY SF STORAGE AT ITREC UNDER CONSTRUCTION

ignition sources

Negligible

combustible material

Item	Area m²	specific fire load MJ/m²	specific fire load Kgw.eq/ m²
Cask storage	92	0	0
Equipment cask storage	172,2	6,46	0,35

Fire detection

Fire detection and alarm system
- in the cask storage facility
- In the outlet ventilation duct of the storage and maintenance cask area

Characteristics of detectors

Linear thermal detectors - Addressable

Others provisions

Fire buttons

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Active fire protection

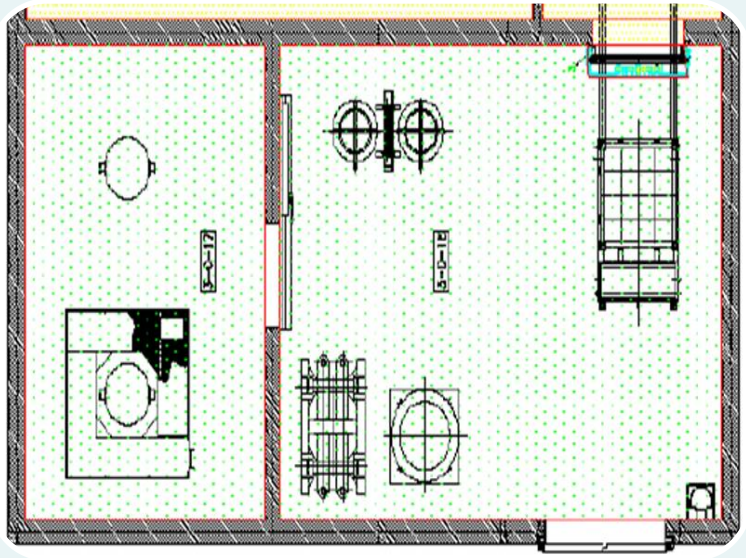
Fire suppression (cf TS 03.2.2)

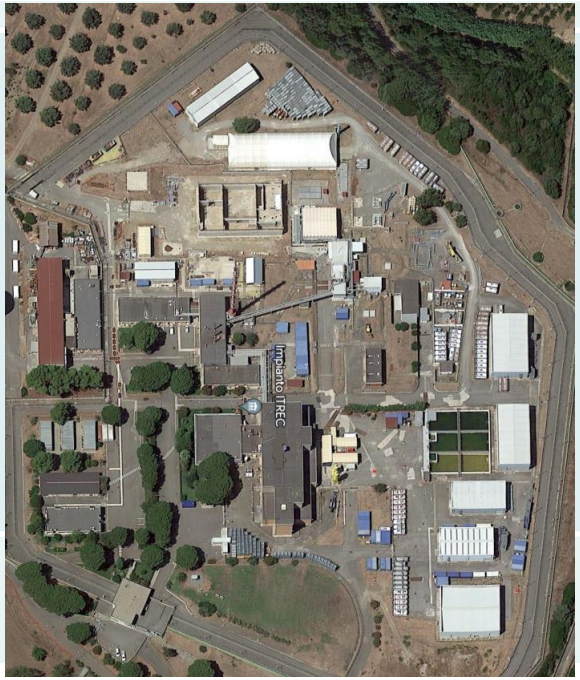
Spent fuel storage

DRY SF STORAGE AT ITREC UNDER CONSTRUCTION

Design approach

Based on Fire Hazard Analysis (FHA)





Internal

Internal hydrants (UNI 45)

Mobile fire extinguisher

Outside (ITREC site)

External hydrants (UNI 70)

Fire-fighting vehicle

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Conclusion

TS 01.3 and TS 04

Spent fuel storage

DRY SF STORAGE AT ITREC UNDER CONSTRUCTION

STRENGTHS

A **new fire hazard analysis has been conducted** as part of application documents submitted for construction approval, according to updated standards.

The design avails also of the **strong capabilities and qualification of storage casks** to withstand fires.

Specific fluid dynamic analysis performed to validate cask fire condition after aircraft impact event

Being a new facility under construction designed in accordance with current standards, there were no weaknesses.

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.3)

FHA, is conducted with the implementation of the prescriptive approach established by Ministerial Decree 10/03/1998 in which the standards and technical rules for fire prevention, impose compliance with minimum safety requirements identified in the same regulation.

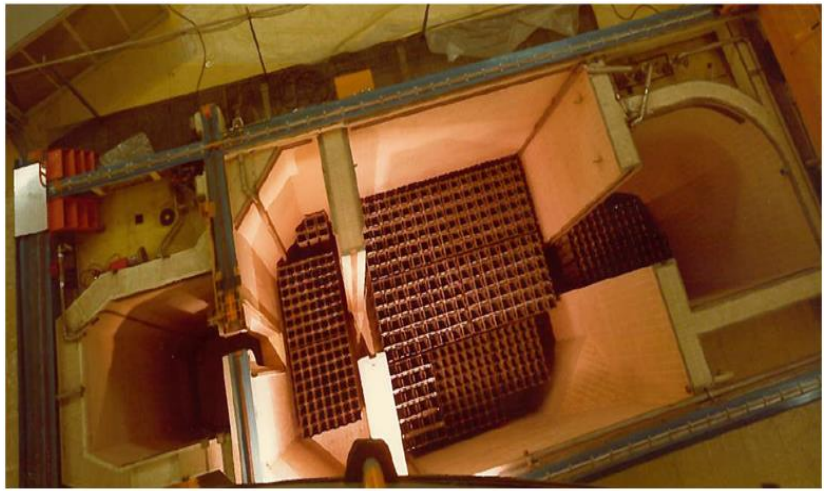
Updated according to Ministerial Decrees 1,2,3 September 2021

"Technical prescriptions for operation attached to the licence "- June 1995

OBJECTIVES

Maintaining safety for workers, public and environment

Spent fuel storage
AVOGADRO
Spent fuel pool



Avogadro spent fuel pool

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Active fire protection

Fire detection (cf TS 03.2.1)

Spent fuel storage
AVOGADRO
Spent fuel pool

ignition sources
NO presence of flames or sparks (e.g. from hot works), heat sources, equipment in which heat is produced,…

combustible material
Limited quantities

Fire detection
Fire detection and alarm system installed on the basis of conservative approach

Characteristics of detectors
Smoke detectors

Others provisions
Fire buttons

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Active fire protection

Fire suppression (cf TS 03.2.2)

Spent fuel storage
AVOGADRO
Spent fuel pool

Design approach

Defined on the basis of DM 10/03/98

Internal

Internal hydrants (UNI 45)

Manual fire extinguishers

Outside (AVOGADRO site)

External hydrants (UNI 70)

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Conclusion

TS 01.3 and TS 04

Spent fuel storage

AVOGADRO - Spent fuel pool

Strengths

- It is considered that, due to its age, the **spent fuel stored in the pool is quite old**. Even if the water pool cooling system is not redundant, there are large margin for decay heat removal performed by natural circulation.
- FSA periodically updated

Weaknesses

- The plant is rather old and the fire safety system was designed according to a **fire risk analysis based on an older approach**.

There is a programme to remove the spent fuel from the pool to be sent abroad for reprocessing

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Fire safety analysis

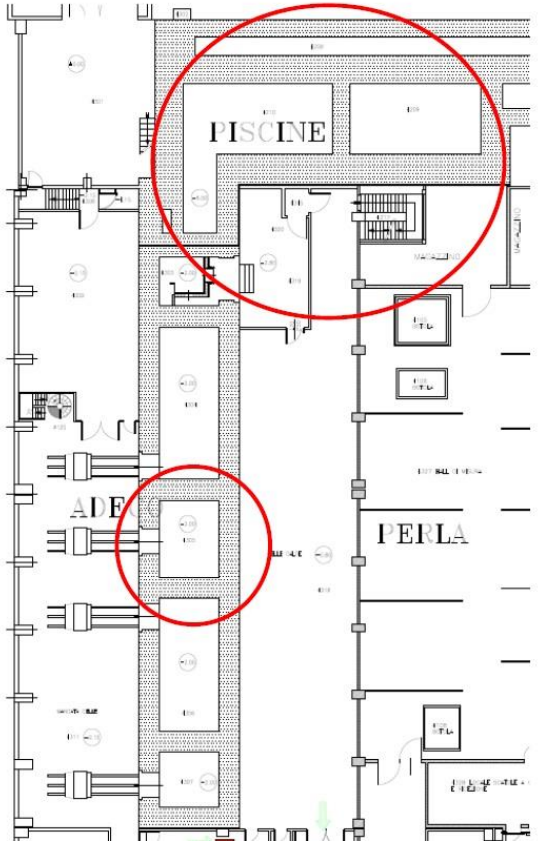
Fire safety analysis (FSA)
(cf TS 02.3)

Deterministic analysis
(Fire Hazard Analysis-FHA)
according to the new regulation
(DM 3 August 2015 Fire Prevention Code)

OBJECTIVES
Maintaining safety for workers, public and environment

Spent fuel storage

W&D SF STORAGE AT ESSOR JRC Ispra



Spent Fuel Pool (Wet Spent fuel storage)

TSA- Transit Safe Area
(Dry Spent fuel storage)

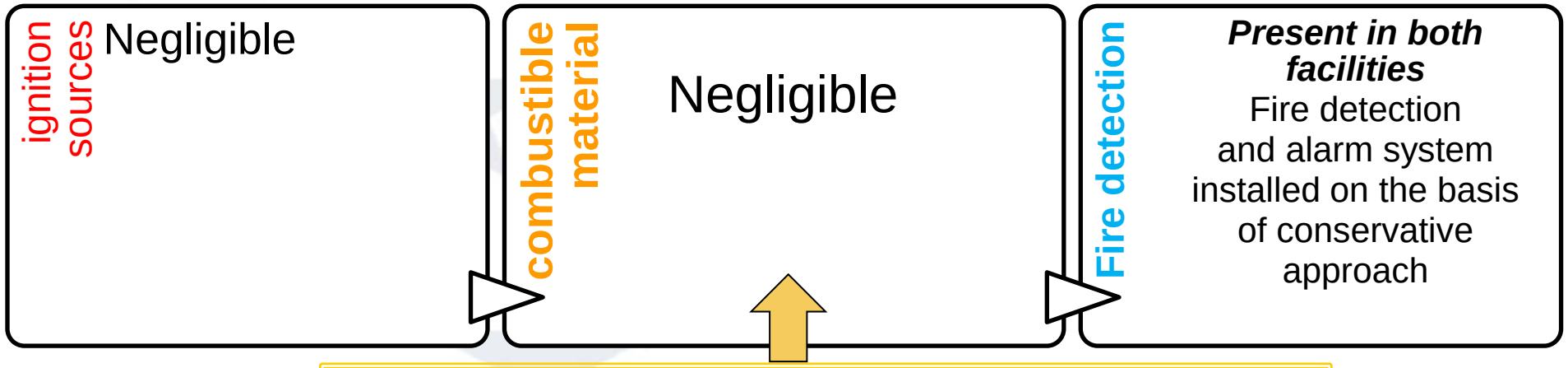
Ispettorato Nazionale per la Sicurezza Nucleare e la Radioprotezione

Active fire protection

Fire detection (cf TS 03.2.1)

Spent fuel storage

W&D SF STORAGE AT ESSOR JRC Ispra



- *Inside TSA facility* no combustible material present
- *Inside Spent fuel pool* combustible materials are significantly limited (fire risk mitigation operational procedures)

Action are in progress through the reduction of the existing fire load in all controlled areas by removing the electrical cables and electrical system components no longer live.

Characteristics of detectors

Fire and smoke detectors + Heat detectors (in the pool)

Others provisions

Fire buttons + Closed-circuit camera system

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Active fire protection

Fire suppression (cf TS 03.2.2)

Spent fuel storage
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Design approach

Fire Hazard Analysis (FHA)

Internal

Mobile fire extinguisher

Automatic gas extinguisher (Powder and CO2)

Hydrants (UNI 45)*

Outside (JRC site)

External hydrants (UNI 110/90/70)

Each fire alarm situation is managed directly by the Fire Brigades on site (24/7)
(*) in adjacent premises to the classified area

Conclusion

TS 01.3 and TS 04

Spent fuel storage

W&D SF STORAGE AT ESSOR JRC Ispra

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Dry storage (TSA)

STRENGTHS

A **new fire hazard analysis has been conducted** as part of application documents submitted for construction approval, according to updated standards.

Wet storage (pool)

STRENGTHS

The residual decay heat does not require an active heat removal (fuel unloaded more than 20 yrs ago)

WEAKNESSES

The pool fire safety system was designed according to fire hazard analysis based on the original final safety report, approved for operation. No major changes occurred so far.

There is however a plan for the transfer of spent fuel into the TSA dry storage facility.

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WASTE STORAGE FACILITIES

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WASTE STORAGE FACILITIES GENERAL

Candidate Waste Storage Facilities assessed in the TPR II are those present in some of the sites of the Italian Installations under Decommissioning or in Safe Store (with preliminary decommissioning operations on going)

For some of these facilities a **substantial refurbishment** programme has been conducted **in the recent years or is on going**. In particular:

- **TRINO NPP (Decommissioning)**: The **D1 and D2** Storage facilities will be **demolished and reconstructed**;
- **EUREX Site (in Safe Store)**:
  - The old storage facility 2300 is going to be dismissed and all the wastes are transferred to the new **D2 facility** in operation;
  - a storage facility for IL liquid wastes (**NPS**);
- **Casaccia Research Centre**: **the OPEC-2** new storage facility (for alfa contaminated waste coming from IPU Plant currently in Safe Store)

The following part of the presentation will focus only the waste storage facilities of new construction

Fire safety analysis (FSA)
(cf TS 02.4)

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Waste
STORAGE FACILITIES

D2 (Trino NPP); D2 (EUREX FCF); OPEC-2

- Deterministic FSA ➔ FHA
- Objectives

  Identify the technical and management solutions aimed at achieving the primary objectives of fire protection, which are:

  a) safety of human life,

  b) protection of people (protection of workers and the possible impact on public),

  c) protection of property and the environment.

- A deterministic fire event for each compartment is assumed and analyzed with conservative assumptions (e.g no intervention of fire protection systems) to verify the associated radiological impact to the population

Fire safety analysis (FSA)
(cf TS 02.4)

Waste
STORAGE FACILITIES

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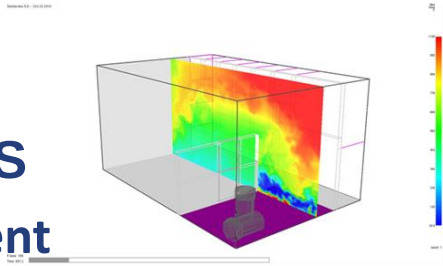
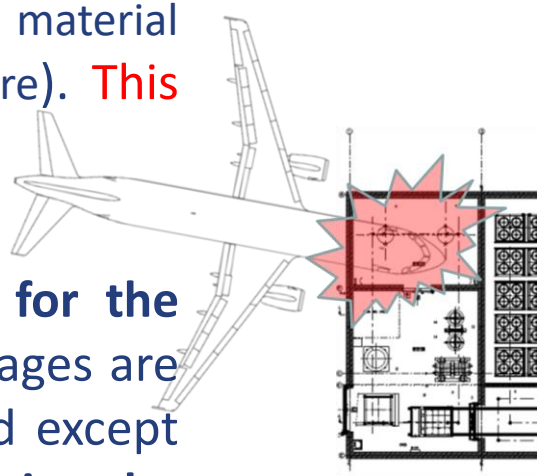
D2 (Trino NPP); D2 (EUREX FCF); OPEC-2



COMBINATION OF EVENTS - MOST PENALISING SCENARIOS

- According to Technical Guide 30, the analysis an **aircraft impact event** has been conducted as BDBA scenario (**What-if approach**) in order to verify **compliance with the radiological objectives for workers and population** (wastes directly impacted by the aircraft losing all the material contained into the waste drums subsequently involved into the fire). This approach is applied to all new waste storage facilities;



- A structural seismic design and qualification is **requested for the structures** of the facility **and for racks** where the waste packages are placed. The fire-fighting systems are not seismically qualified except for the requirement to maintain the capacity to **retain the extinguishing agent**. In the case of a subsequent fire development and complete failure of the fire protection system**, the off-site radiological objectives have however to be met**.

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.4)

Waste
STORAGE FACILITIES

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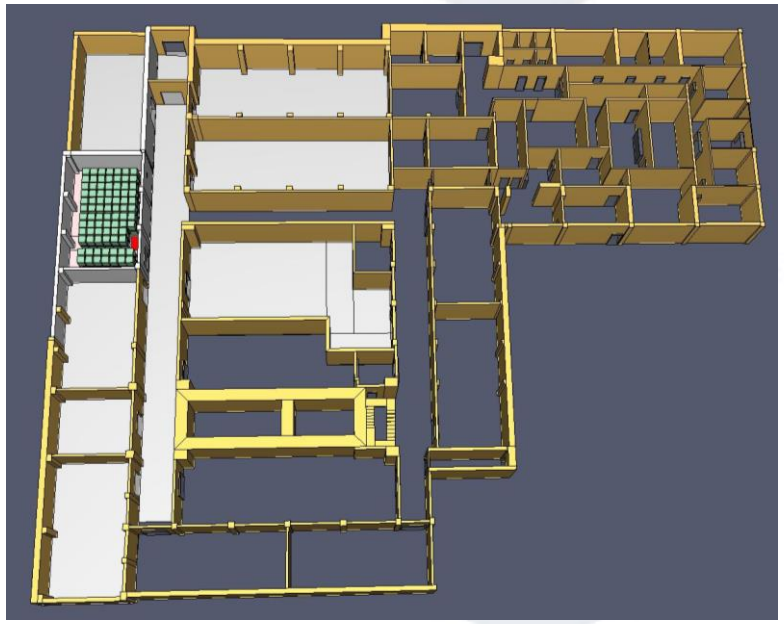
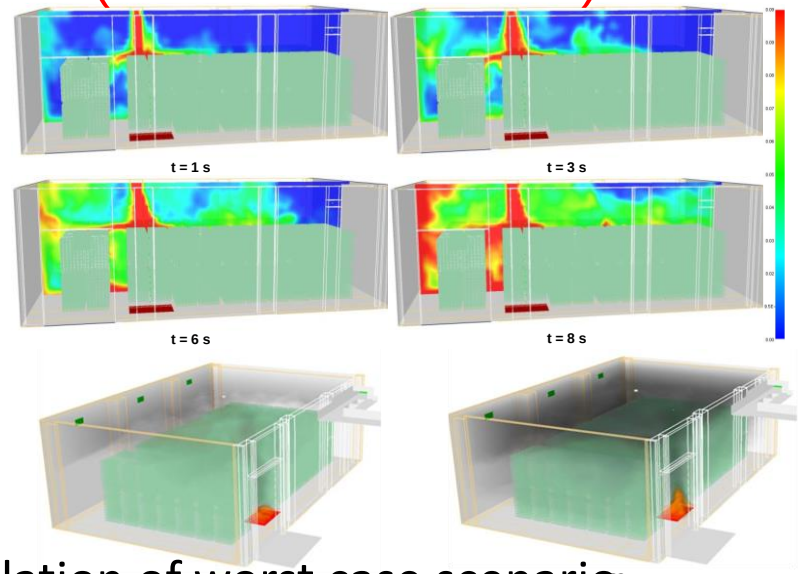
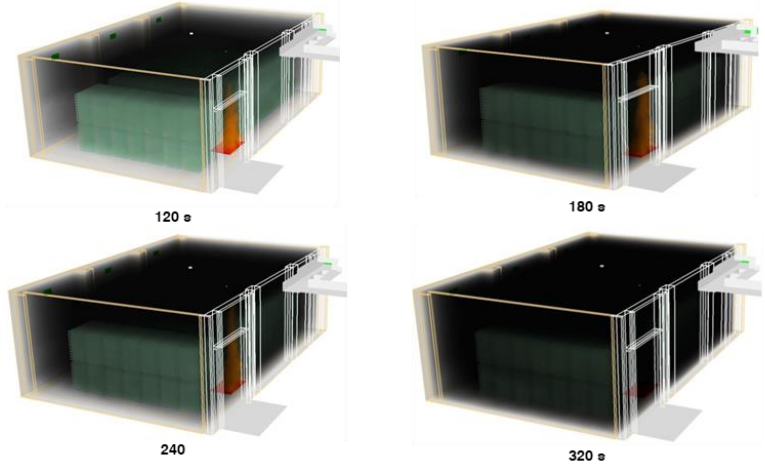
Fluid dynamics analysis (Computational Fluid Dynamics simulation) of the fire event in the absence of firefighting systems (worst case scenario)





CFD simulation of worst case scenario.

Test of fire resistant overpack.



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Active fire protection

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

Waste

STORAGE FACILITIES

D2 (Trino NPP); D2 (EUREX FCF); OPEC-2

FIRE DETECTORS

For **D2-Eurex** and **OPEC-2** Waste storage facilities the system consists of:

- ❑ automatic fire detectors;
- ❑ manual glass break fire call points;
- ❑ visual and sound alarm devices.

For the new **D2-Trino** (under contraction) waste storage facility, the **independence of the fire detection system**, in different areas, is achieved by the **compartmentalization** provided by the **walls**.

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Active fire protection

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

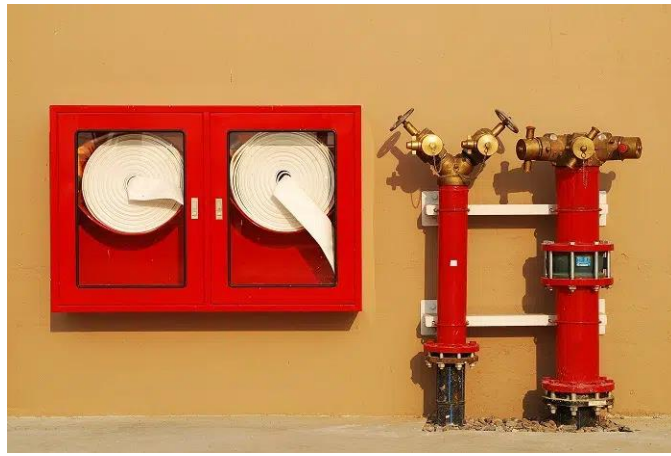
Waste

STORAGE FACILITIES

D2 (Trino NPP); D2 (EUREX FCF); OPEC-2

LOCATION OF THE FIRE EXTINGUISHING SYSTEMS

- Hydrants are **located in the nearby** of waste storage facilities to be used in case of fire;
- According to the results of the fire hazard analysis, the **D2-Trino** storage facilities is not provided with a specific fire suppression system;
- For **D2-Eurex** and **OPEC-2**, the fire extinguishing systems are **manually operated** by the intervention of the control room operator after acknowledge and check of the signal coming from the detection system;
- For **D2-Eurex** the **Water deluge sprinklers** extinguishers are located in **each waste storage fire compartment**;
- For **OPEC-2**, the fire extinguishing systems is a **gaseous suppression** type using an extinguishing agent.



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Active fire protection

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

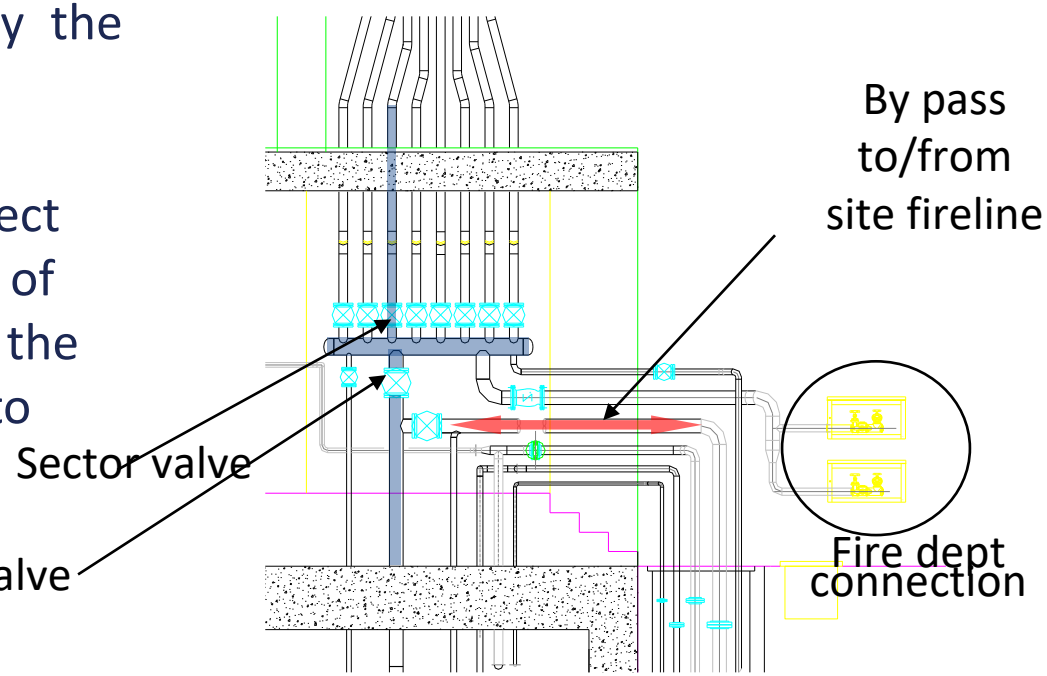
Waste

STORAGE FACILITIES

D2 (Trino NPP); D2 (EUREX FCF); OPEC-2

POTENTIAL HARMFUL EFFECTS

- Potential harmful effects from the spurious/inadverted activation of the sprinkler extinguishing system or the external Hydrants are prevented by the **manual activation** of the systems;
- A drainage system is provided to collect into dedicate tanks the water in case of activation (requested or spurious) of the existing firefighting systems, as also to avoid any potential spread of contamination.



Compartmentation (cf TS 03.3.1)

Waste

STORAGE FACILITIES

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D2 (EUREX FCF); OPEC-2

- The **D2-Eurex and OPEC-2** are divided into a series of compartments to separate the **different risk areas**.
- The waste storages consist of **compartments with fire resistance** characteristics for **not less than 2 hours** in case of fire.
- The **ventilation ducts crossing the structures that delimit compartments**, are equipped with **at least one damper** installed at the crossings, with the **same fire resistance of the structure** they pass through, automatically and directly **operated by smoke detectors** and **thermofusible elements**.

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D2 (Trino NPP)

- Due to radiation protection requirements, the **wall** of the **D2-Trino** is **thicker than normally required** from a fire safety point of view;
- The **spreading of fire** inside the waste storage facility is limited by the **wall thickness** and by keeping areas in the surrounding free of combustible materials.
- The **ventilation** system is **not required** because **only conditioned waste** will be stored in the facility;

Conclusion

TS 01.3 and TS 04

Waste

STORAGE FACILITIES

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D2 (Trino NPP); D2 (EUREX FCF); OPEC-2

IMPROVEMENTS

- For all these waste storage facilities recently enter into operation (D2-Eurex and OPEC-2) or under construction (D2-Trino), the design is compliant with the current standards and therefore represents a significant improvement also for the fire protection systems.

STRENGTHS

- The facilities are protected from the harmful effects of extinguishing water by drainage systems and collection tanks, also to prevent the possible release of contaminants to the environment;
- Deterministic analysis based on a "What-if" methodology related to an airplane crash with fire development is conducted in the framework of the licence process to verify the compliance with the established radiological objectives.

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Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.4)

Waste
EUREX NPS

- FHA developed according to the national legislation;
- NPS rooms are to be considered as areas with "**Zero Fire Load**", except for the **battery room**;
- The NPS is a **bunkered** structure able to **resist to an aircraft impact** and to the consequent fire development.

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STRATEGY FOR LOCATION OF DETECTORS

The functions of the NPS Fire Detection System have been considered as follows:

- **quickly detect** a possible fire;
- alert the operator for **any manual** action;
- the detection system is designed to protect all NPS rooms and allow the **automatic closure** of air outlet dampers (before and after HEPA filters).

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FIRE DETECTORS

- **Linear thermal** detectors ➔ rooms with potential presence of **aeriform** contamination (equipped with addressing module);
- **Optical smoke** detectors ➔ for other rooms (equipped with addressing module);
- **H2 gas** detector in the **battery room**.
- In case of fire **detection unavailability** the following provisions are applied:
  - All the operations in the NPS areas affected by fire detection unavailability **must be stopped** and ISIN must be informed;
  - In operational accessible NPS areas affected by fire detection unavailability, **alternative measures** must be put in place (e.g. fire watch periodical surveillance).

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LOCATION OF THE FIRE EXTINGUISHING SYSTEMS

- **Inside the NPS building**, because of the very low specific load fire, there are **no automatic extinguishing systems** and **no water hydrants**. **Only portable** fire extinguishers CO2 are provided.

- **Portable fire extinguishers** CO2 are installed in the **accessible rooms**:
  - Fan room (two fire extinguishers);
  - Electrical panels room (two fire extinguishers);
  - Other rooms (one fire extinguisher) It is also planned the installation of other two external hydrants, connected to the firefighting existing network of the site.

POTENTIAL HARMFUL EFFECTS

- Not envisaged

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- Almost **all areas** have been **classified** as **“zero fire load”**, so the criteria for confinement and separation of the rooms envelop those for fire protection;
- **Safety-critical redundant components** are sufficiently **separated** so that potential damage is limited to a single redundancy;
- **Every tank cell** is **separated from the others** and areas where a fire may occur have fire-resistant separation respect to others areas;
- The **batteries room** has the highest specific load fire and it is **equipped with a separate ventilation system**; any fire remains contained in the room and does not spread to adjacent rooms or to other plant rooms.

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STRENGTH

- NPS storage facility is a bunkered building which has been designed considering severe accidents including external aircraft crash;

WEAKNESS

- No weaknesses related to fire protection were identified in the NAR.

IMPROVEMENTS

- In order **to reduce the hazard** posed by the high level liquid waste, **a new conditioning facility** called CEMEX is under construction.

The CEMEX design contains a detailed Fire Hazard Analysis and entails Fire Protection Concept compliant with applicable WENRA Safety reference levels.

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INSTALLATIONS UNDER DECOMMISSIONING

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Decommissioning

GENERAL

- According to ISIN TG 31, in the framework of the application for decommissioning authorization, operators have to provide a **'Fire Prevention and Protection Programme'**.
- It contains the Fire Hazard Assessment guidelines for the definition of fire prevention and protection measures for each operation relevant to nuclear safety and radiation protection during decommissioning.

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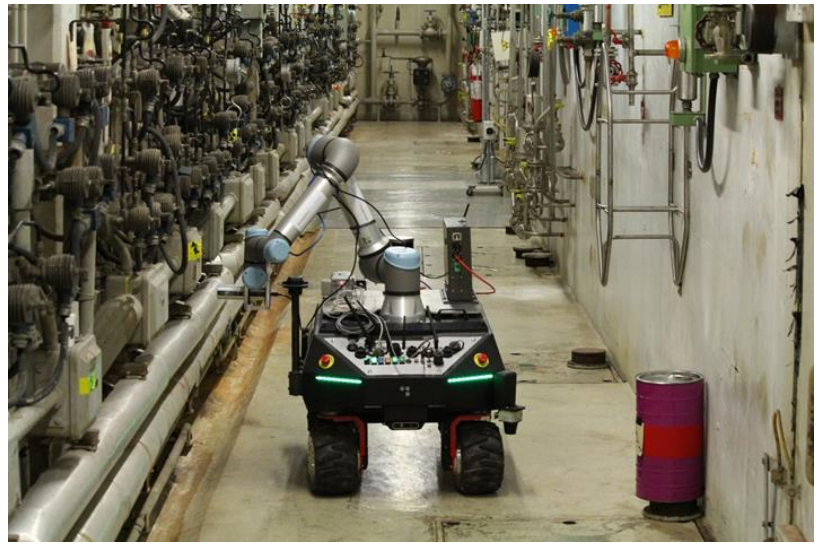
Towards decommissioning

TS 02.6, TS 03.2, TS 03.3

Decommissioning

GENERAL

- For **each relevant operation or plant modification**, to be performed during decommissioning, a **specific Fire Safety Analysis** and the related interventions on the Fire Protection System have **to be submitted for approval** by the Nuclear Regulatory Authority and the Fire Authority.
- Therefore, the fire protection system **is kept up to date** in line with the decommissioning operations progress.
- Moreover, **prescriptions** included in the projects approvals, provide specific provision to **regulate the management of fire loads** and **ignition sources**.



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Conclusion

TS 01.3 and TS 04

Decommissioning

LATINA NPP

STRENGTHS

- Fire Safety Analysis are well established and strictly based on the current configuration of the plant;
- Prevention and protection programme is approved by Regulatory Authority prior any decommissioning activity;

WEAKNESSES

- Latina NPP plant was built in the late 50's. Some buildings reflect design concepts uncompliant with current fire protection criteria. The oldest facilities lack of ventilation systems and adequate compartmentation and revamping activities have not been carried out because of their upcoming dismantling. Nevertheless, decommissioning activities are designed by including means to address any residual risk, taking into account the updated normative requirements.

IMPROVEMENTS

- Recent revamping of the fire detection system has increased the number of detectors for each building.
- A new water supply reservoir of the fire extinguishing system has been recently installed.

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Conclusion

TS 01.3 and TS 04

Decommissioning

TRINO NPP

STRENGTHS

- Relevant systems for decommissioning operations **(e.g., ventilation systems in the reactor building)** have been refurbished, **also taking into account fire safety** requirements;
- The whole fire protection system is **periodically assessed by the Fire Authority** and its availability and rating are evaluated. If the system does not ensure minimal fire safety requirements, it must be renewed;

WEAKNESSES

- No weaknesses reported

IMPROVEMENTS

- In relation to the conduct of decommissioning operation the fire water low pressure extinguishing system was refurbished.

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Decommissioning

EUREX FCF

WEAKNESSES

- EUREX plant was built in the **60's**. There is **no real compartmentation**, according to current fire protection certification of the plant. However, the facility is divided into sections and rooms, separated from each other by doors, and **each section has an own ventilation system**;

- Critical issues related to EUREX systems, which date back to the time of the construction of the facility, concern the **updating and modifications of protection measures in compliance with technical guide n. 31**. They can be addressed during the **ongoing process to grant the decommissioning license**.

IMPROVEMENTS

- In the perspective of the decommissioning operation a new water supply system was realized.

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STRENGTHS

- High **autonomy in terms of prompt intervention** operational capability by **own on-site fire brigades emergency Centre**, for both research activities and for the management of nuclear installations;
- The systems and components, although not in line with current technology, are **continuously maintained** to ensure their proper functioning;

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WEAKNESSES

- In relation to the upcoming decommissioning activities, **some interventions** envisaged by the Fire Risk Evaluation **are being implemented**, e.g.:
  - Installation of smoke detectors inside ventilation channels,
  - Replacement, where applicable, of existing channels with others classified as fire resistant;

- The **renewal of fire protection provisions** in the perspective of decommissioning, in compliance with technical guide n. 31, will be addressed in the ongoing process to grant the decommissioning license.

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IMPROVEMENTS

- In order to eliminate the emergency generator (building 84a) and related diesel storage tanks located in building 84a, a **new dedicated power supply** is being developed;
- Some improvements have recently been carried out on **the outer ring of the hydrant network**;
- The **removal of out of service items** (e.g. electrical cables and components) within the **Controlled Zones** has begun.

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Consideration on the proposed findings

Deletion of AGP on Installations under decommissioning

- ~~*the availability of firefighting team beyond worker's hour and the short intervention time.*~~

It is proposed to reconsider the AGP for ESSOR Research Reactor under decommissioning at the JRC of Ispra, taking into account the following and on the bases of a graded approach:

- **there is on the site a permanent fire-fighting team: 6 firefighters available during working hours, 4 firefighters outside working hours, with 24/7 coverage;**
- the following equipment is available: 1 fire truck and 1 ambulance, with an additional truck and ambulance as backups;
- the response time is less than 10 minutes (fire station located 1 km from the RR);
- **all staff are trained and qualified** in Nuclear, Biological, Chemical, and Radiological (NBCR) response;
- the research reactor is **in safe conservation**, awaiting for decommissioning license, with **small quantities of spent fuel in wet and dry storage**;
- **the extension of the research reactor site is much smaller compared to a NPP**;

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Consideration on the proposed findings (cont'd)

- The internal firefighting staff and equipment is sufficient to manage **design-basis accident scenarios**. Specific **agreements with the Italian Fire Brigade** are also in place to address beyond-design-basis accident scenarios

- The site has also the **availability of a medical and decontamination service** that can serve as a first line of response in case of **contamination/injuries of operator staff or firefighters**. The service is present during working hours with at least 1 Authorized practitioner, 1 emergency doctor, 1 nurse, 1 radiotoxicologic lab technician. The service is complemented by the Whole Body Counter facility and Radiotoxicologic lab on site.

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

National Presentation of Italy

Thanks for the attention