European Nuclear Safety Regulators Group

Topical Peer Review II Country Review Workshop
‘Fire Protection’
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National Presentation of BULGARIA

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National Presentation Outline

List of candidate installations and their regulation

1. **NPP – unit 5 of the Kozloduy NPP**
2. **Dedicated spent fuel storage - Wet and Dry storage facilities for SNF at the Kozloduy NPP site**
3. **Waste - Storage facility for conditioned RAW at the Kozloduy NPP site**
4. **Decommissioning - unit 4 of the Kozloduy NPP**

The requirements of the national legislation related to ensuring the fire safety of nuclear facilities are regulated in:

- Act on the Safe Use of Nuclear Energy;
- Regulation on Ensuring the Safety of Nuclear Power Plants, 2016;
- Regulation on Ensuring the Safety in Spent Fuel Management, 2004;
- Regulation on Safety During Decommissioning of Nuclear Facilities, 2004;
- Regulation on Safe Management of Radioactive Waste, 2013;
- Regulatory Guide “Protection against internal fires in nuclear power plants“, RG 1/2023;
- Regulation No. Iz-1971 of 29.10.2009 on Construction and Technical Rules and Regulations for Ensuring Fire Safety;
- Regulation No. 8121z-647 on the Rules and Norms for Fire Safety During Operation of the Facilities;
- Other legislative documents and standards regulating fire safety.

Insurers activities:

- Inspection of the insurance risk of "Kozloduy NPP" EAD in 2023

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Deterministic Fire Safety Analyses**

  The fire hazard analyses (FHA) are made in accordance with the requirements of the Bulgarian regulatory framework, harmonised with the IAEA standards and WENRA Reference Levels in the area of fire protection. The analyses cover:

  – Fires and consequential spread for all plant operational states;
  – Fires, the spread of which is determined by the occurrence of dependent and multiple failures;
  – Performance of activities related to increased risk of generating fire as a result of human actions, including in the course of accident conditions;
  – States in which the fire impact endangers structures, systems and components (SSC) and safety functions;
  – Areas containing flammable material;
  – Possible combinations of fire and other events (including external hazards).

  The deterministic analysis is complemented by a Probabilistic Safety Assessment (PSA) in order to determine the effect of the fire protection measures and assess all relevant risks.

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Deterministic Fire Safety Analyses**

  The deterministic analysis takes into account the actual physical configuration and provision of SSCs and fire protection means. The analyses cover all steady states and transients considering:

  - Occurrence of a single fire and its development;
  - Assumptions for dependent failures in the areas affected by the fire;
  - Assumption for combined impact of a fire and other independent initiating events;
  - Design margins and margins related to the fire detection and alarm and fire suppression systems' reaction;
  - Effectiveness of the human actions included in internal and external procedures.

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Deterministic Fire Safety Analyses**

  The methodological approach of the analyses reflects the continuous improvement of Kozloduy NPP design (modernisation and design modifications related to minimization of the risk of fire spreading), taking into account:

  - **The systematic oversight of the activities;**
  - **The established procedures for inspections and tests;**
  - **The system for reporting the operational experience;**
  - **The results of studies and the identified weaknesses in the field of fire protection.**

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Deterministic Fire Safety Analyses**

  The scope of the deterministic analysis includes:

  - **Assessment of the structure and location of buildings and equipment in the scope of the fire zones and fire cells;**
  - **Available flammable materials in the fire zones;**
  - **Fire protection measures including fire detection and alarm systems;**
  - **Analysis of the areas with stored spent fuel;**
  - **Analysis of the possibility of single fire to influence the fulfilment of safe shutdown and fuel cooling functions or to result in uncontrolled release of radioactive material.**

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Deterministic Fire Safety Analyses**

  The deterministic analysis includes:

  - **Identification of equipment important to safety, and identification of the location of individual components in the fire zones;**
  - **Characterization of the combustible and explosive properties of the substance used, analysis of the probable ignition sources;**
  - **Analysis of expected fire development and possible consequences on equipment;**
  - **Determination of the fire-resistance rating of the boundaries of fire barriers and fire zones;**
  - **Determination of passive and active fire protection measures;**
  - **Identification of cases where additional separation or additional protection is required, particularly for common cause failures, so as to ensure the operation of safety systems during and after an anticipated fire;**
  - **Assessment of the indirect secondary consequences of the development of fires.**

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Fire PSA**

  The scope of the updated PSA level 1 includes an analysis of the current configuration of units 5 and 6 of Kozloduy NPP, taking into account all internal and external events and hazards specific to the site that individually or in combination could lead to nuclear fuel damage (including in the reactors and in spent fuel pools).

  The updated PSA Level 1 study covers:

  • All possible operating states – full power, low power and shut down

  • The full spectrum of internal initiating events (including internal fires, internal floods) and possible external hazards (natural and human induced)

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Fire PSA**

  Internal Fire PSA is a probabilistic analysis of fire events caused by sources that are within the site boundaries and their potential impact on the nuclear safety of the plant. Using probabilistic models, this PSA examines:

  • the possibility of fire in specific locations of the unit;

  • the detection, extinguishing and spread of the fire;

  • the effect of fire on safety-related equipment (components, as well as associated instrumentation and control, and power cables);

  • the possibility of damage to this equipment, and in case of severe fires, to the integrity of the structures (walls, ceilings, columns, etc.);

  • the impact of accidental equipment failures and human error.

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Fire PSA**

  The assessment of the risk of internal fires during power operation includes the result of the analysis of 40 fire zones and cells and fire scenarios from 8 groups of initiating events identified for them.

  The estimate for reactor core damage frequency in power operation, obtained as the sum of the results of individual fire zones and cells, is insignificantly different for the two units and is:

  - **4.54E-07 1/y for unit 5**
  - **4.49E-07 1/y for unit 6**

Fire safety analysis (FSA)
(cf TS 02.1)

NPP

- **Fire PSA**

The total core damage frequency during power operation is:

- **8.14E-7 1/y for unit 5;**
- **8.03E-7 1/y for unit 6.**

The analysis of the results shows that (for both units):

- **the contribution of the internal initiating events constitutes about 60% of the total frequency, the next contribution being the seismic effects with about 22%;**
- **internal fire risk accounts for 10% of the total core damage frequency per unit, with turbine hall fires being the dominant factor;**
- **external hazards account for 8% of the total core damage rate per unit, and internal flooding accounts for 2%;**
- **the share of the other internal events is negligibly small.**

The risk of internal fires during the operation of units 5 and 6 of the Kozloduy NPP is mainly determined by the occurrence of internal fires during full power operation (about 56% contribution to the final result). The contribution of the low power and shut down states is about 13%. The contribution of fuel damage in the spent fuel pool is about 31%, which shows that it should not be underestimated.

Fire detection (cf TS 03.2.1)

NPP

Fire detection

The fire alarm systems are built on a modular principle, latest generation system with microprocessor control and interactive addressing of the fire alarm sensors. This technology makes it possible to accurately determine the location of the fire in case of an event - the specific number of the activated fire detector, the room in which it is located and the fire zone to which it belongs are displayed. Also, if necessary, the fire alarm system provides information about actuated output signals of the fire automation to activate the controlled fire extinguishing and ventilation systems and fire dampers.

Fire detection (cf TS 03.2.1)

NPP

Fire detection

The approach adopted tt units 5 and 6 is to use fire alarm equipment compatible with respect to data transmission. The installed fire alarm stations use the same communication protocol.

This approach allows the information from fire alarm networks of Reactor Buildings of units 5 and 6, diesel generator rooms, engine rooms, additional diesel generators and shared site facilities to be unified and directed to common communication portals.

All fire alarm centers are connected in a common FCnet network with a loop topology.

The information flow is directed to a visualization system from which the control and management of the fire alarm equipment at the site is carried out.

Fire detection (cf TS 03.2.1)

NPP

Strategy for the location of the detectors

At Kozloduy NPP a "full coverage" approach has been adopted, excluding rooms with wet processes and no combustible load (for example, bathrooms and toilets) in accordance with national requirements. The installation of fire detectors complies with the requirements laid down in item 6.4. from standard CEN/TS 54-14.

Possibility of fire detection has been ensured in hard-to-reach places where special solutions are required - for example, aspiration systems for smoke detection, thermal cables, linear fire detectors, sensors for work in explosive premises.

The factors influencing the choice of the type of fire detectors are:

- Regulatory requirements;
- Combustible materials in the area covered by the fire detectors;
- The room configuration, in particular the ceiling;
- Impact of other systems in the room where the fire detector is located - for example, heat sources and impact of the room ventilation;
- The environmental conditions in which the fire detectors will work.

- **Strategy for the location of the detectors**

Item 6.5. of the standard CEN/TS 54-14 "Fire alarm systems. Part 14: Guidelines for planning, design, installation, commissioning, use and maintenance" sets requirements about the installation of fire detectors regarding:

- Minimum distance from walls and distance between two adjacent fire detectors;

- Location of manual fire detectors;

- Installation height as a function of the protected area;

All installed fire detectors have to comply with the relevant part of the CEN/TS 54-14 standard.

- **Characteristics of detectors**

In the initial design of Kozloduy NPP conventional (non-addressable) fire alarm systems were planned and implemented. With the development of technologies, in 2002 a decision was made for modernization and to switch to interactive addressable fire alarm systems. The project was developed and implemented in accordance with the national legislation and European standards in force in the area at that time.

The type of fire detectors selected is such that they will provide the earliest reliable alarm signal under the environmental conditions in which they are installed. The final choice depends on the specific circumstances - in some cases multi-sensor fire detectors are used in other the use of two or more types of fire detectors is more appropriate.

- **Characteristics of detectors**

By moving to high-end addressable fire alarm systems, a number of advantages are achieved:

- Indication of the exact location of fire - up to a detector level;

- Circular topology of the fire detectors that provides a two-sided power supply to the fire detector line – that is, a single fault in the cable line (interruption or short circuit) would not result in the loss of power to the fire detectors.

- Fire detectors have short-circuit isolators with the help of which they locate/eliminate the damaged cable section. The fire detectors retain their functionality as the fire detector topology changes from a contour to a beam structure.

- **Characteristics of detectors**

- Extended possibilities for initiation of control signals to other systems (fire extinguishing systems, fire dampers, ventilation systems, etc.) by logic according to the needs of the design.

- Possibility of unification in a common network of individual fire alarm systems (FDAS) and thus integration of the entire information flow about the status of fire alarm systems to common terminals through which operators monitor the status of the protected equipment.

Fire suppression (cf TS 03.2.2)

NPP

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics**

In accordance with the FHA, the premises with increased combustible load, its quantity, the type of combustible materials, their location in the premises and facilities are determined. The fires are divided into four classes, which can be determined by the nature of combustible substances and materials in accordance with EN 2 "Classification of fires". Taking into account the class of the fire, the location of the equipment in the premises, the type of combustible materials, the presence of specific electronic equipment, the presence of waterproofing and drainage systems in the premises, the requirements of the current standards in Bulgaria are applied.

Effective fire prevention and fire extinguishing measures, including a combination of automatic fire extinguishing systems, as well as creating conditions for manual fire extinguishing, are applied to protect the facilities important for safety at the NPP.

Fire suppression (cf TS 03.2.2)

NPP

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics**

In accordance with the regulatory requirements and the type of protected equipment, the following fire extinguishing systems have been implemented:

- Stationary systems with dispersed water, for cable rooms and rooms of oil systems located in containment that are important to safety.
- Stationary water fire extinguishing system in the conventional part, non-system premises and external fire water supply on the site.
- Volumetric gas fire extinguishing systems, based on FM200 extinguishing agent, for rooms with electrical control equipment for safety systems.
- Volumetric gas fire extinguishing system based on extinguishing agent CO2, for RAW storage facilities shafts.

Automatic fire extinguishing is carried out after two different sensors (smoke and thermal) from the fire alarm system of the relevant room are activated, and via output relays of the fire alarm station control signals are sent to open the adjacent electrical valves for the protected room and start the main fire pumps.

Fire suppression (cf TS 03.2.2)

NPP

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics**

  Stationary automatic water fire extinguishing systems are provided for the cable rooms of the safety systems. They are with open nozzles and are self-contained for each unit and are designed to be independent for each of the three trains. Each system consists of a tank, a pump, a system of pipes and valves. The water supply to the tank is from two sources - from the fire protection pipeline and from service water.

  Automatic water fire extinguishing systems with dispersed water have been built in the diesel generator stations. Such systems are provided for the rooms with increased combustible load like the fuel-lubrication system of the diesel generator, as well as the oil and diesel fuel storage tanks. For fire protection, sprayed (pulverized) water is used as a fire extinguishing agent. Water is sprayed using open nozzles mounted on stationary fire extinguishing installations.

Fire suppression (cf TS 03.2.2)

NPP

- **Strategy for the selection of the location of the fire extinguishing systems and their characteristics**

The following assessment principles laid down in EN 15004 "Stationary fire extinguishing installations. Installations for extinguishing with gaseous substances" were taken into account for the selection of extinguishing agent:

- minimal impact on the environment and minimal global warming potential;
- minimal impact on people's health and safety;
- sufficient fire-extinguishing properties suitable for the corresponding class of fires and protected equipment;
- compatibility of the protected equipment with the chemical and extinguishing properties of the selected gas (based on volumetric protection of premises);
- availability of reliable manufacturers or sales representatives in Europe of the extinguishing agent and system components at least until 2060.

Two main groups of agents are used in such fire extinguishing systems. These are inert gases and chemical/synthetic agents.

Compartmentation (cf TS 03.3.1)

NPP

- **Methods for determining suitable fire barriers**

During the design, the general industrial construction and technical rules and standards for ensuring fire safety of the buildings are laid down. In parallel, a Deterministic analysis of the fire hazard was carried out. The purpose of this analysis was to determine the adequacy of the planned fire protection system for units 5 and 6 of the Kozloduy NPP. The approach was used to limit spreading of the fire by defining fire zones and cells.

The categorization of buildings, areas and departments is based on safety objectives. For this purpose any room with installed equipment that has safety functions is defined as a fire zone.

Kozloduy NPP uses fire containment approach – the fire zone is completely enclosed by fire barriers that have a minimum fire resistance of 90 minutes. The definition of fire resistance rating of 90 minutes for fire zone barriers is based on international codes and standards and on international experience.

- **Methods for determining suitable fire barriers**

After the fire barriers in the buildings had been identified they were assessed in the Fire Hazard Analyses and Probabilistic Fire Hazard Assessment. Based on the thermal loads in the premises, the complete combustion of the combustible materials is simulated in the fire risk analysis to determine the impact times on the fire barriers.

Quantitative assessment methods:

- **(1) CFAST simulation model - it consists of a two-level zone model to analyze smoke movement, gas concentration and heat transfer. CFAST considers fire size as a function of time to be set by the user.**
- **(2) TEMPW simulation model - it is a "post-fire model" used to analyze the heat transfer, the pressure in the closed fire zone and the concentration of gas in the complex system of fire zones. TEMPW makes it possible to calculate the amount of heat released in the event of a fire and its distribution throughout the system of fire zones and heat sinks.**

Compartmentation (cf TS 03.3.1)

NPP

- **Compensatory fire protection measures in cases where the use of ‘state-of-the-art’ compartmentation is not possible**

When separation of fire zones is not appropriate fire cells are created. Using the fire effect approach, the trains of the safety systems and other elements important to safety are not necessarily separated by fire-resistant partitions, but the effect of the fire is limited by combination of distance and means of protection like active extinguishing system or passive means. This combination is designed so that the fire does not spread and the protected elements are not affected by the fire.

Fire cells are created for the following cases:

- **when it is not possible to separate redundant equipment into different fire zones;**
- **when with common areas for extinguishing in the different rooms, these rooms are treated such as individual fire cells;**
- **in the presence of main access routes, if establishment of a fire zone is not necessary.**

Ventilation management (cf TS 03.3.2)

NPP

- **Maintenance of fire dampers**

  As part of the modernization program of the Kozloduy NPP, fire dampers have been installed on the air ducts of the ventilation systems. In accordance with the requirements of the regulatory documents, all boundaries of fire zones must have a fire resistance of 90 minutes, therefore in all places where air ducts cross the border of a fire zone, fire dampers with fire resistance of 90 minutes are installed.

  Planned maintenance and functional tests of fire dampers and control and signaling panels are done according to approved schedules. If defects are detected between outages the repairs are done when and if it’s possible.

Ventilation management (cf TS 03.3.2)

NPP

- **Maintenance of fire dampers**

  The periodicity of the tests is in accordance with the manual for technical support of the manufacturer of the fire dampers, the requirements for the system to which they belong and the technical specifications of the units:

  - Tests of fire dampers belonging to safety systems are carried out monthly.

  - Tests of fire dampers for the premises with gas fire extinguishing are carried out every quarter.

  - The tests of all other fire dampers from the system for limiting the spread of fire through the ventilation ducts are carried out once a year during the annual outage.

Conclusion

Regarding nuclear reactors Kozloduy NPP adequately applies the concept of defense in depth to protect against internal hazards. This includes preventing events caused by internal hazards from occurring, detecting these events, controlling and/or mitigating their consequences.

The fire hazard analysis for Kozloduy NPP was prepared on the basis of deterministic approach according to the national requirements in the field of fire protection, harmonized with the specific guidelines of the IAEA and the WENRA reference levels.

The fire hazard analysis model is a detailed, integrated and realistic model of the nuclear units, including the procedures and actions of operational and professional fire protection service personnel at the site for a wide range of initiating events and hazards, external and internal fires, the combination of extreme climate conditions and the consideration of seismic hazards specific to the NPP site.

- **Conclusion**

The Fire Safety Program includes maintenance, testing, monitoring and inspections, as well as hazard management processes such as:

- **administrative procedures for fire hazard control;**
- **inclusion of firefighting equipment in the scope of the aging management process - physical and technological;**
- **hazard mitigation and response equipment monitoring programs;**
- **fire risk management.**

Fire hazards are taken into account when planning and conducting inspections.

Conclusion

The oversight carried out by Nuclear Regulatory Agency and the General Directorate "Fire Safety and Protection of the Population" of the Ministry of Internal Affairs contributes to maintaining a high level of fire protection by the licensee "Kozloduy NPP" EAD.

The licensee's open policy for systematic application of good international practices through active participation in safety inspections by the IAEA and WANO, and the application of lifetime management measures to the components of the fire safety program should be noted as strengths.

Activities that are not fully completed at the time of the TPR are the FHA update (regarding Pool-type Spent Fuel Storage Facility) commented on in the national report and the ongoing replacement of equipment in connection with the obsolescent equipment replacement program.

Fire safety analysis (FSA)
(cf TS 02.3)

Spent fuel storage

- **Focus on**

According to the Safety Analysis Report (SAR) of the Pool-type Spent Fuel Storage Facility (PSFSF) it is necessary to analyse only the consequences of a fire in the switchgear room, as a representative to a fire in the electrical and I&C equipment rooms. The main consequences of a fire in this room are:

• Loss of power;

• Loss of control and remote control systems.

Various measures to prevent the occurrence and spread of fires are discussed in the SAR of the Dry Spent Fuel Storage Facility (DSFSF). In the building, fire sources are limited to a few areas where the construction allows fires to be extinguished without spreading.

Fire detection (cf TS 03.2.1)

Spent fuel storage

Fire detection

The Pool-type Spent Fuel Storage Facility and the Dry Spent Fuel Storage Facility use fire alarm equipment, compatible with the fire alarm equipment of the NPP units in terms of data transmission. The installed fire alarm stations use the same communication protocol. The equipment is built on a modular principle, with microprocessor control and interactive addressing of the fire alarm sensors. This technology makes it possible to accurately determine the location of the fire. In case of an event, the specific number of the activated fire detector, the room in which it is located and the fire zone to which it belongs are recorded. Also, if necessary, the fire alarm system provides information about triggered outputs of the fire automation to activate the controlled ventilation systems.

- **Fire detection**

The fire alarm sensors are intelligent, interactive, addressable with high operational reliability, guaranteeing safe and early fire detection. The sensors have decentralized intelligence, automatic self-diagnosis function, CPU Fault mode, alarm and operation memory, alarm indicator, software addressing, working status indication. Each sensor is equipped with a built-in isolator and allows a parallel indicator to be connected to it.

Sensors automatically compensate for changing levels of atmospheric pressure, air humidity, smoke concentration in accordance with their working principle. They have a high immunity against false alarms by evaluating at a certain time against various sensor criteria. Alarm patterns not typical for fires are removed by using a special filter with algorithms.

Fire suppression (cf TS 03.2.2)

Spent fuel storage

- **Fire suppression**

  According to national legislation for closed warehouses for the storage of noncombustible materials a fire extinguishing installation is not required, and none has been built.

  Fire extinguishers are deployed for the initial extinguishing of fires, according to the current regulatory requirements. Their location and type are regulated in the internal instructions for PSFSF and DSFSF.

- **Conclusion**

  The PSFSF and DSFSF buildings do not contain combustible materials.

  The use of combustible materials outside the storage area in the receiving area is minimized by not storing materials and equipment that could pose a fire hazard.

  In the administrative area, where there are materials and equipment that could be a fire hazard, the fire load is minimized as far as possible. In addition, the administrative area is separated from the receiving area and the storage area by a technical fire barrier with 1 hour fire resistance.

  The electrical cables used are noncombustible and they do not emit poisonous smoke.

  Backup generators and their fuel tanks are located at a distance from the PSFSF and DSFSF main buildings.

Fire safety analysis

Fire safety analysis (FSA)
(cf TS 02.4)

Waste

- **Focus on**
  - **The fire safety analysis for the Storage Facility for Conditioned RAW (SFCRAW) is conducted within the Updated Safety Analysis Report of State Enterprise "Radioactive Waste" Kozloduy;**
  - **The main conclusion of the Updated SAR is that a fire in the waste storage facility is possible from a short circuit in the electrical circuits of the transport and technological equipment and cranes, and it is assumed that such an event will not affect the protective barriers, especially since SFCRAW does not store combustible substances and materials that help spread the fire.**

Active fire protection

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

Waste

- There are no combustible materials in the Storage Facility SFCRAW, the building structure and items stored therein are mainly made from reinforced concrete and the fire load is assumed to be 0 (zero).
- In accordance with the national legislation, construction of automated fire-extinguishing and fire-alarm systems is not required for closed storage facilities for storage of non-combustible materials.

Active fire protection

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

Waste

- **The following requirements were followed during the design and construction of the fire alarm system of SFCRAW:**
  - **to detect a fire at an early stage, to obtain accurate information about the place of its occurrence;**
  - **to use a loop (circular) structure;**
  - **to monitor for short circuit or mechanical failure in a convenient manner;**
  - **general information from the system to be received in the Command Room and the information to be stored locally in the receiving station;**
  - **to be provided with non-interruptible electrical power supply;**
  - **control of the ventilation installation should take place at signal 1 of 1;**
  - **the risk of fire when determining the protected area of the fire detectors should be chosen depending on the importance for the protected equipment;**
  - **information is transferred to the Regional Service Fire Safety and Protection of the Population (RSFSPP) - Kozloduy NPP;**
  - **the maximum number of points in one circuit should be 127 pieces, as separators (isolator) are provided at intervals of 32 points in case of short circuit.**

Active fire protection

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

Waste

- SFCRAW does not have fire-extinguishing system as it’s not required by the national legislation.
- Fire-extinguishers for initial fire extinguishing are deployed according to the current regulatory requirements. The location and tag number thereof are regulated in the List of tag numbers of firefighting equipment for initial extinguishing and location, and the corresponding Process Diagram.

- **The fire-protection concept in the SFCRAW design is based on the implementation of measures to reduce the risk of fire, namely:**
  - **physical separation of the systems;**
  - **protection of personnel in case of fire;**
  - **protection of the equipment from fire;**
  - **early detection of fire;**
  - **timely extinguishing of fire.**

- **The entire SFCRAW building is one firefighting sector, detached from the adjacent buildings and premises by means of firewalls. Openings in the firewall do not exceed 10% of its area. The doors and covers protecting the openings have a minimum fire resistance of 90 minutes. The doors are self-closing.**

TS 02.6, TS 03.2, TS 03.3

Decommissioning

- The fire safety analysis methods are based on the “Report on safety analysis during the decommissioning of units 3 and 4 of the Kozloduy NPP”, developed in 2015 on the basis of the planned activities and in connection with obtaining a decommissioning license.
- A large part of the hazards are also inherent in the operation of the nuclear units, therefore the design decisions like passive fire protection, supplemented by the operating instructions and other administrative measures, ensure the first level of defence in depth.
- The required fire resistance limits of fire walls, partitions, air ducts, doors, corridors, and staircases have been ensured.

- **Management of fire loads and sources of fire during ‘hot works’ is carried out by the already built fire-alarm and fire-extinguishing system that meets the following requirements:**
  - **to detect a fire at an early stage, to obtain accurate information about the place of its occurrence;**
  - **to use a loop (circular) structure;**
  - **to monitor for short circuit or mechanical failure in a convenient manner;**
  - **general information from the system to be received in the Command Room and the information to be stored locally in the receiving station;**
  - **to be provided with non-interruptible electrical power supply;**
  - **information is transferred to the Regional Service Fire Safety and Protection of the Population (RSFSPP) - Kozloduy NPP**

- **Conclusion**

– **the Fire Alarm and Extinguishing Station was upgraded to accommodate the upcoming dismantling activities.**
– **from 2021 to 2023, 50% of the fire-extinguishers for initial fire extinguishing were replaced with new ones.**
– **workplaces were equipped with new fire-extinguishers and fire blankets.**
– **with regard to the forthcoming renewal of Decommissioning License of Units 3&4 in 2025, a periodic safety review, including a review of the fire safety, will be carried out.**

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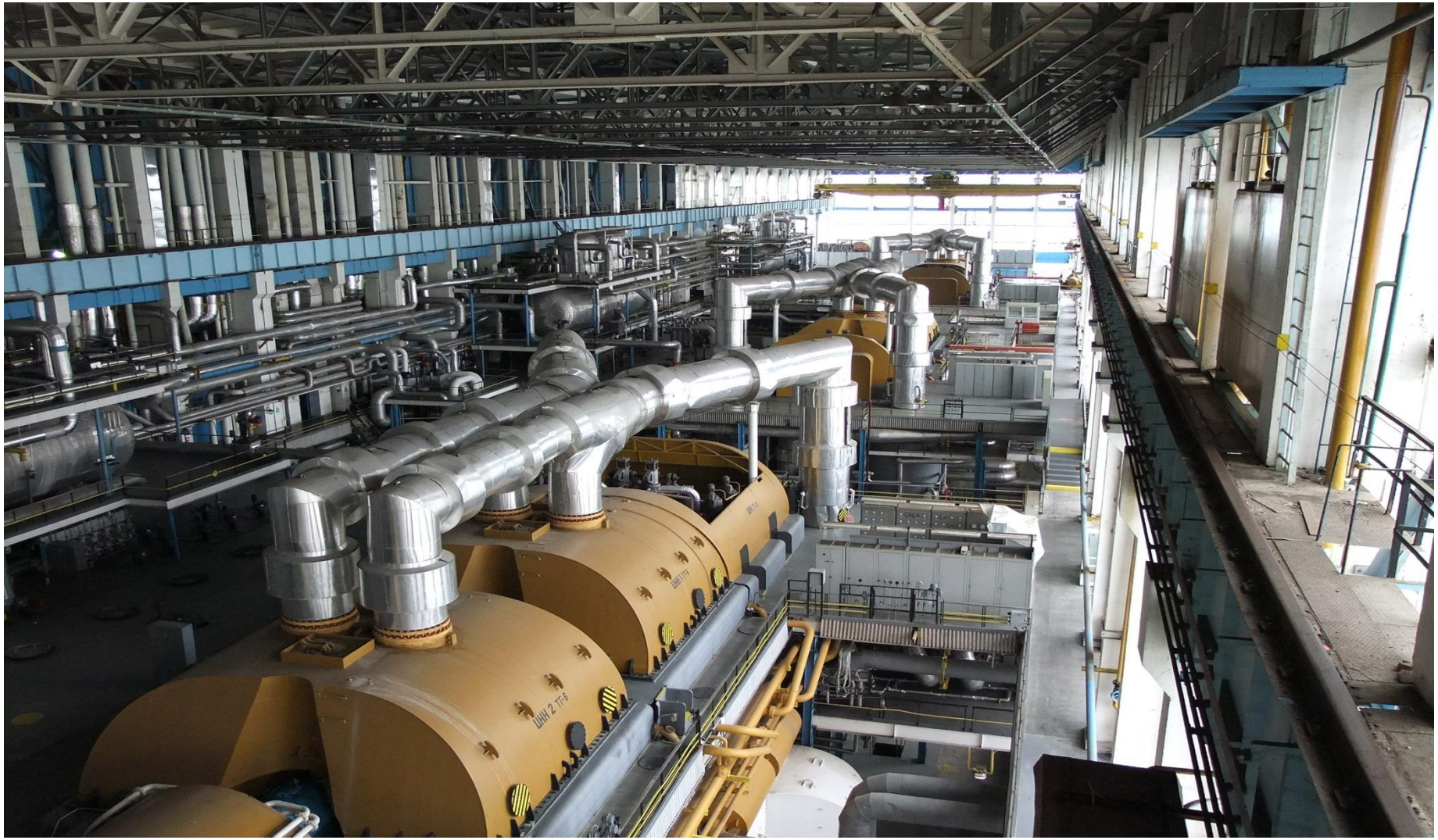
View of the Turbine Hall - then



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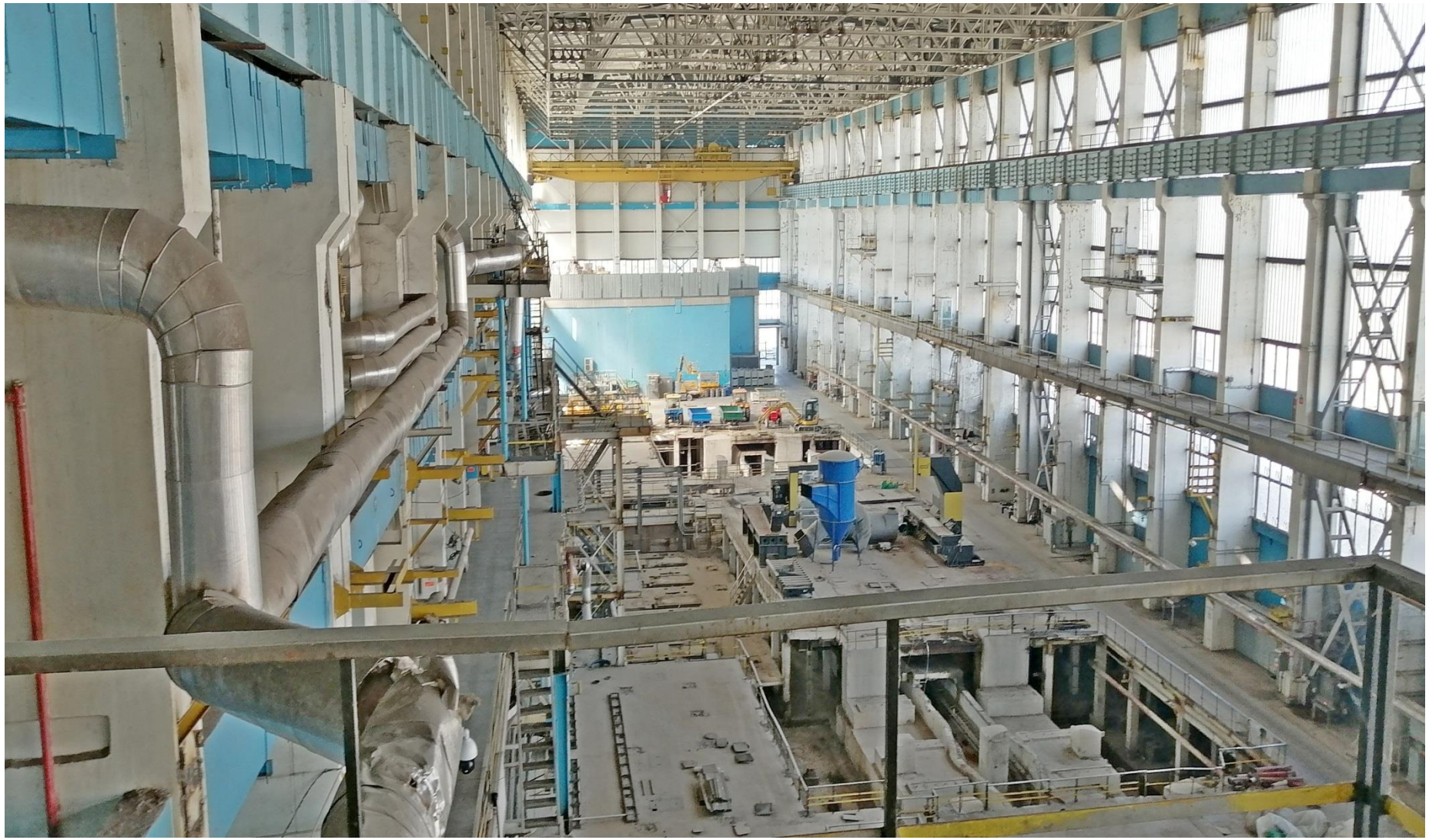
View of the Turbine Hall - now



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