



National Presentation of Lithuania

**Topical Peer Review II Country Review Workshop
'Fire Protection'**

30 September – 3 October 2024

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Presentation Outline

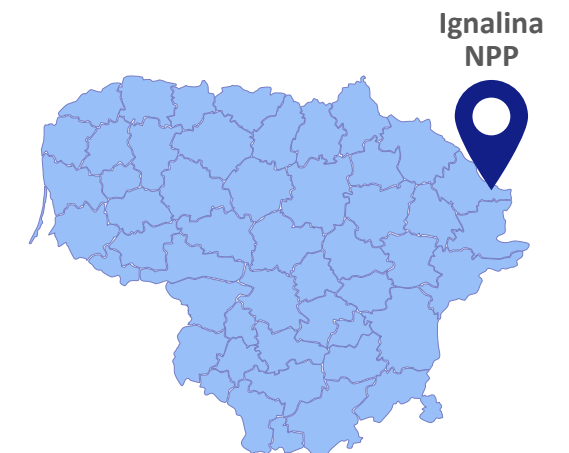
- Briefly about national nuclear programme
- List of candidate installations at Ignalina NPP site
- Regulation of nuclear installations
- Fire safety analysis and other important information of particular nuclear installations:
 - Spent nuclear fuel facilities
 - Waste facilities
 - Facilities under decommissioning
- Conclusions
- Areas of improvement



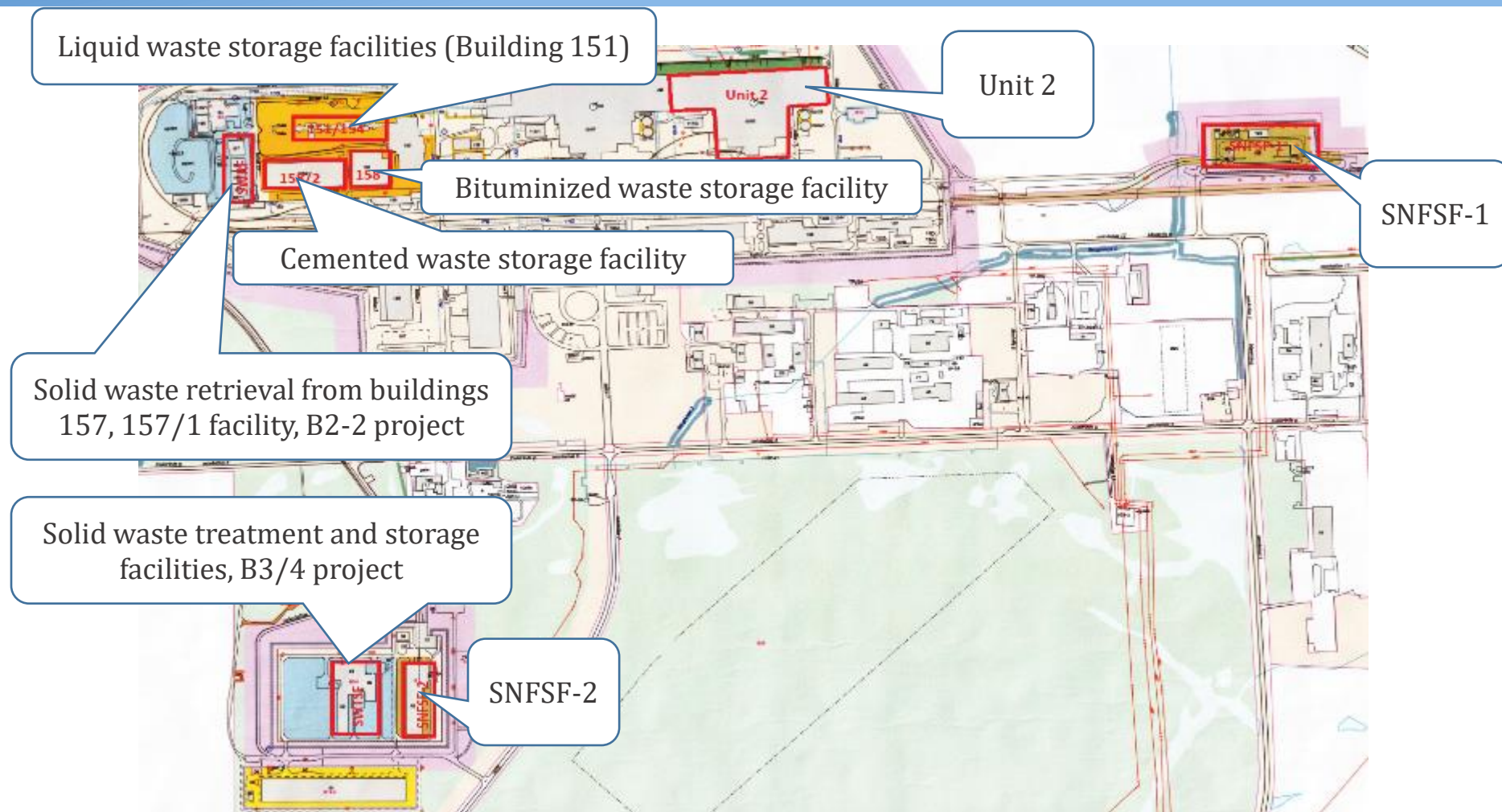
Briefly about national nuclear programme

- **Ignalina NPP:**

- The only nuclear power plant in Lithuania
- Unit 1 and Unit 2, both with RBMK-1500 type reactors, water-cooled, thermal neutron with graphite moderators, pressure-tube type boiling water reactors
- Unit 1: operated 1983-2004
- Unit 2: operated 1987-2009
- **Both Units are permanently** shutdown since 2004 and 2009 respectively
- All spent fuel from both Units' storage pools were removed to spent nuclear fuel storage facility in April 2022



List of candidate installations at the Ignalina NPP site



Regulation of candidate installations

Regulatory bodies for fire safety:

- **Fire and Rescue Department (non-nuclear):**

- Inspections (3-4 per year; cover different buildings) and site visits to familiarize with facilities;
- Drills between INPP staff and Public Fire Service (~10 per year; cover all INPP shifts);
- Annual assessment of access roads to water sources and hydrant inspections;
- Regulatory evaluation and agreement of INPP decisions related with fire safety.



Priešgaisrinės apsaugos ir
gelbėjimo departamentas
prie Vidaus reikalų ministerijos



- **State Nuclear Power Safety Inspectorate (VATESI) (nuclear)**

- Sets requirements for the protection against fires of SSCs important to safety of NI and monitors their implementation;
- Inspections (annual; cover different topics and facilities);
- Regulatory review (for instance, Periodic Safety Review Reports, modifications)





Fire safety analysis and other important information of particular nuclear installations



Fire safety analysis

General information

- 98 - CONSTOR®RBMK-1500 type casks.
- 20 - CASTOR®RBMK-1500 type casks.
- SNFSF-1 is fully loaded.

The main assumptions from deterministic safety analysis:

- There are no combustible materials to sustain a fire in casks area (building 192): all components of the structure are made of metal and concrete. Thus, a fire at SNFSF-1 is a highly unlikely event.
- Both type of casks can withstand a fire with a flame temperature of 600°C for 1 hour and 800°C for 0,5 hour and remain sealed after the such fire.
- Local fires can be contained and extinguished using primary firefighting equipment.
- The Public Fire Service is located 8 km away from Ignalina NPP. The estimated arrival time of firefighters and rescuers at the Ignalina NPP facilities for firefighting purposes is 15-20 minutes.



Active fire protection

Fire detection

- In all auxiliary buildings fire alarm system is installed, from which the signal is transmitted to the Ignalina NPP Shift Supervisor room.

Fire suppression

- There are 2 fire hydrants on the site and 2 accessible fire hydrants near the territory of SNFSF-1.
- Portable carbon dioxide fire extinguishers are also available on site.
- Fire extinguisher storage box with fire-fighting tools and sand.



Spent fuel storage

SNFSF-2

Fire safety analysis

- 190 new-type casks for INPP RBMK-1500 type reactor spent fuel (incl. damaged SF).
- CONSTOR®RBMK-1500 type casks can withstand a fire with a flame temperature of 600°C for 1 hour and 800°C for 0,5 hour and remain sealed after the such fire.
- The following fire scenarios in FHA were analyzed:
 - Fire in the train (most penalizing scenario);
 - Fire in the truck;
 - Fire in the cranes;
 - Fire in cables;
 - External fires.
- FHA demonstrated that in all fire scenarios in the spent nuclear fuel containers storage and handling area would last no longer than one hour, or be localized in time and ensure the invulnerability of the spent nuclear fuel container.
- Fire works, such as welding of CONSTOR container lids, are no longer carried out.
- The active operating phase of SNFSF-2 was over in 2022 (the last container with spent nuclear fuel was placed in storage).



New-type
CONSTOR®RBMK1500/
M2 cask

Capacity: 91 assemblies

Diameter: 2.63 m

Empty cask weight: 91 t

Loaded cask weight: 118 t

Spent fuel storage

Active fire protection

Fire detection

- SNFSF-2 cask area is under round-the-clock supervision of INPP operational staff.
- Addressable fire alarm system (photoelectric smoke detectors) is installed, from which the signal is transmitted to the Ignalina NPP Shift Supervisor room.

Fire suppression

- Powder and carbon dioxide extinguishers – for train, truck and for cask area.
- There is a metal fighting enclosure containing sand box, 2 fire fighting shovels, two carbon dioxide extinguishers and non combustible textile.
- External fire hydrants, dry pipe (to connect fire trucks), wheeled-type and portable fire extinguishers (powder and carbon dioxide).

SNFSF-2



- The SWTSF is a reinforced concrete building equipped with all necessary auxiliary facilities. SWTSF consists of waste reception, waste sorting and size reduction, incineration system, high force compaction of waste, containerization of waste, grouting of short-lived and waste storage.
- Different scenarios in FHA were analyzed (e.g. cranes, handling systems, cabling and electrical equipment fires and etc.).
- The FHA showed, that the resistance of building structures (walls and doors), where safety important and other equipment is located, is sufficient to be able to resist possible fires even without human intervention (i.e. without taking any fire fighting actions).
- The most part of fire load in different premises (accesses, staircases, personnel locks, shafts, etc.) is due to cabling. All the cabling equipment used in SWTSF has fire resistant coating.

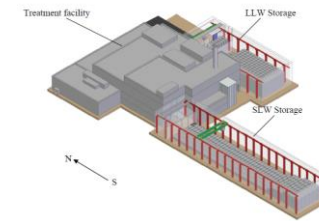


Figure 3.3-3: Layout of the facilities



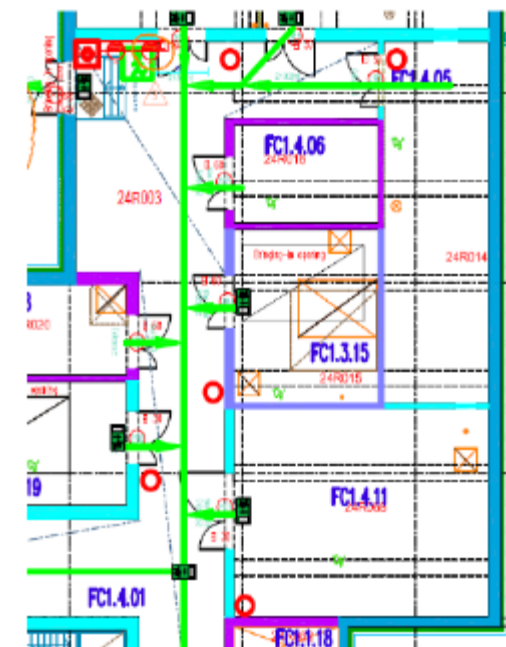
Fire detection and fire suppression

- All the premises of SWTSF are equipped with fire detectors for fast fire detection (smoke or flame, which were chosen to be the most suitable for specific location; for the sake of reliability at least 2 detectors are used in one compartment).
- Portable fire extinguishers located near the entrances to the compartments. SWTSF is also equipped with internal cocks and external fire hydrants for water fire-fighting.
- The extinguishing system design was defined taking into account the fire load category of each room, the continuous presence of personnel, and the identification of the combustible/flammable and potentially radioactive materials inside each room.
- Personnel working in SWTSF understands all hazards and are well trained for fire-fighting before Public Fire Service will arrive. Operational Staff are trained in how to handle and use self-contained breathing apparatus (Self-Contained Breathing Apparatus (SCBA)).
- Signals about fires in SWTSF to Public Fire Service are transmitted by calling Emergency Response Center by phone number 112. Arrival time of Visaginas Public Fire Service to the facility is about 15-20 minutes. Ignalina NPP Shift Supervisor - key person who is responsible for firefighting arrangements before Public Fire Service comes to the Ignalina NPP Site.



Compartmentation

- SWTSF is divided into fire compartments and sub-compartments.
- Fire dampers are used in ventilation system, therefore proper separation of fire departments is ensured.
- Design and SAR:
 - Fire scenarios were analyzed in different fire compartments with evaluation of fire loads;
 - Fire resistance of walls and doors were evaluated.
- Due to properties of surroundings and a provision of fire compartments and sub-compartments, fire dampers in ventilation system, fires will be local, no fire spread to other rooms/structures is expected. The analysis also showed that the resistance of building structures (walls and doors) is sufficient to be able to resist possible fires even without human intervention (i.e. without taking any fire fighting actions).



Fire sub-compartment of Emission control room 24R014 (top view)



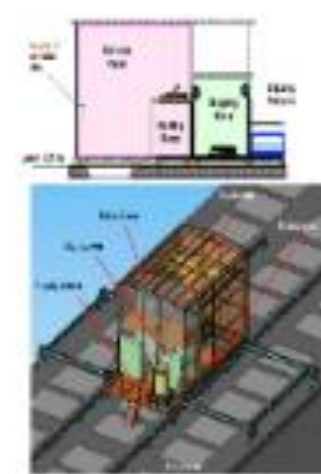
11 pav. Priešgaisrinis vožtuvas

Emergency fire exercise during commissioning of SWTSF

- Smoke generator was used during emergency fire exercise with the aim:
 - To test the smoke removing system;
 - To create as much as possible realistic conditions.

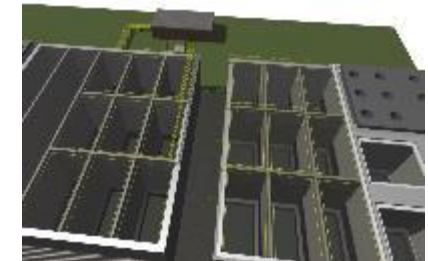
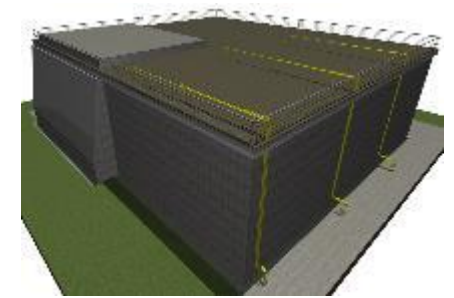


- Solid waste retrieval Unit 2 (RU2) uses to retrieve, pre-sort and pack waste from buildings 157 and 157/1 into containers G1 and G2. RU2 is a mobile unit located on the top of the waste storage building. The unit is able to move in 2 directions due to rails system mounted on the top of the waste storage building.
- RU3 uses to retrieve not-combustible waste from compartments 1 and 4 of building 157 into container G3. RU3 is a fixed shed structure, located on the top of the waste storage building. All waste retrieval and packaging, operations are remotely controlled from the Control Building.
- Different fire scenarios in FHA were analyzed (Fire in the shipping room; Fire in the retrieval room; Fire in the ventilation unit; Fire in the technical room; Fire during transportation of waste).
- Fire detection in the waste storage of buildings 157, 157/1 and RU2, RU3 is able to detect a fire and the fire alarm system of the fire detection system will immediately inform the staff 24 hours a day on duty at Ignalina NPP. Ignalina NPP Shift Supervisor is responsible for firefighting arrangements and immediately informs about fires to the Public Fire Service.
- The evaluation showed that the portable powder and carbon dioxide extinguishers as well as gas extinguisher system are sufficient to extinguish possible fires.



Fire detection and fire suppression

- Smoke detectors are installed in the RU2 and RU3 retrieval area and in the extract ventilation system duct (4 detectors are installed in the duct), there are 4 temperature detectors also installed in the extract ventilation system duct.
- There are several cameras installed in the RU2 and RU3 for supervision of operations.
- There is fire detection system in the waste storage compartments. In case of fire in the waste compartment, the fire detection system is used to detect fire inside the compartments (additionally fire can be detected by operators visually - via cameras in RU2). The alarm of the existing fire detection system is connected to the control room at Ignalina NPP.
- New facilities (RU2/3) are connected to the existing waste storage buildings and due to this fire protection (extinguishing with CO₂) systems of the existing waste storage buildings was slightly modified. The modification was performed due to the reason, that pipelines were interfered with the installation of RU2/3.
- There are in RU2 and RU3 4 CO₂ and 2 powder extinguishers.
- Waste storage buildings 157 and 157/1 are equipped with fire detection and extinguishing systems. Fire extinguishing agent is carbon dioxide gas. A gas supply facility is located in auxiliary buildings 163, 163/1. According to the project the station is designed for fire extinguishing in one of unprotected vaults. 100% of carbon dioxide is reserved.

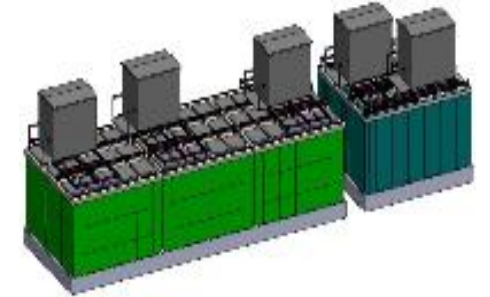
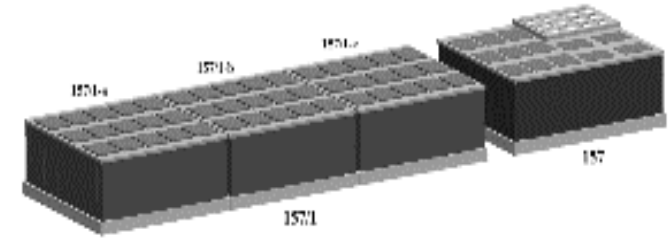


**General view of buildings
No 157, 157/1 with fire
extinguishing system pipelines**

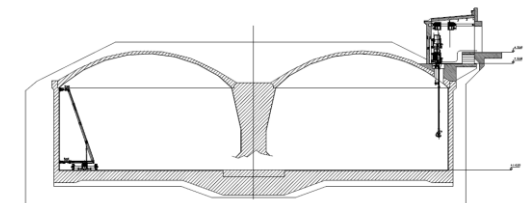
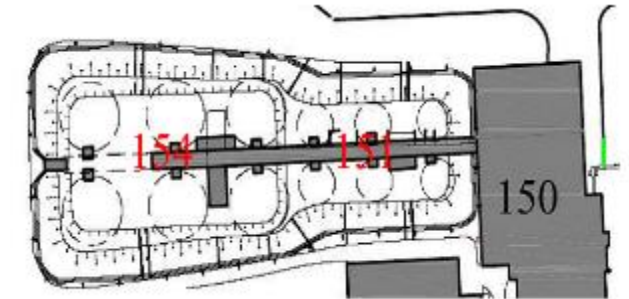


Compartmentation

- Solid waste storage buildings 157, 157/1 are divided into fire compartments.
- If fire is detected in the Solid waste retrieval from buildings 157, 157/1 facility, all the operations will be stopped – sliding hatch and the docking station will be remotely closed, ventilation system will be switched off and operator will leave retrieval unit.



- **Building 151** contains 6 tanks, each with a volume of 1500 m³, and they are intended for collecting sewage water (2 tanks), collecting water from special washers (1 tank) and collecting sediment from ion exchange resin and perlite pulp (2 tanks).
- The foundation of the connecting corridor is made of monolithic reinforced concrete slabs with thicknesses of 1000 mm and 600 mm. The foundations under the columns are also monolithic reinforced concrete.
- All the tanks are underground.
- The following fire scenarios in FHA were analyzed:
 - Internal fires;
 - External fires.
- In the framework of PSR 2018 FHA for Liquid Waste Storage Facilities (LWSF) was not performed. Under regulatory requirement the licensee prepared and submitted LWSF FHA to VATESI in 2020. It was confirmed that the summary conclusions presented by FHA are acceptable.

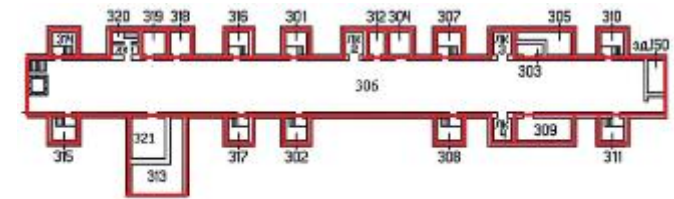


Fire detection and fire suppression

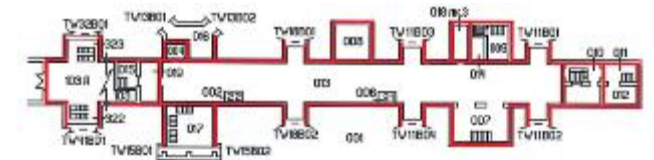
- Conventional fire alarm system with photoelectric and linear smoke detectors.
- For extinguishing potential fires in Building 151 powder or carbon dioxide portable extinguishers can be used. There is also an internal fire pipelines and external hydrants.

Compartmentation

- The building 151 is divided into fire compartments. The fire resistance of all structures of the building is at least 45 minutes.



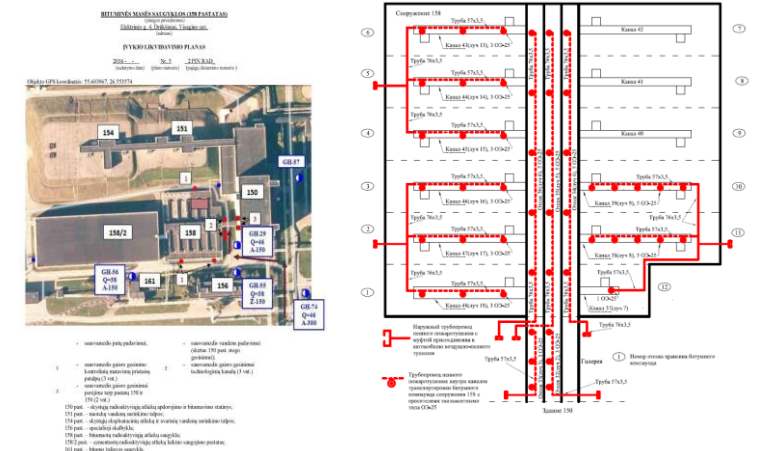
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27 pav. 151/154 statinio gaisriniai skyriai (parodytas -1,20 m lygis)

- **Bituminized radioactive waste storage facility (Building 158)** - surface type, prefabricated monolithic reinforced concrete structure.
- **Building 158** - divided into 12 compartments by internal partitions, including 11 compartments with a volume of 2500 m³ each and one compartment with a volume of 1000 m³.
- Ignalina NPP has not been carried out LRW's bitumen since 2015 - the Ignalina NPP no longer conducts active activities with combustible material - bitumen. The "passive" operation of the storage facility is being carried out.
- The following fire scenarios in FHA were analyzed:
 - Fire in the canyon;
 - Fire in the service room;
 - Fire in the room of control-measurement devices.

Bituminized waste storage facility (Building 158)

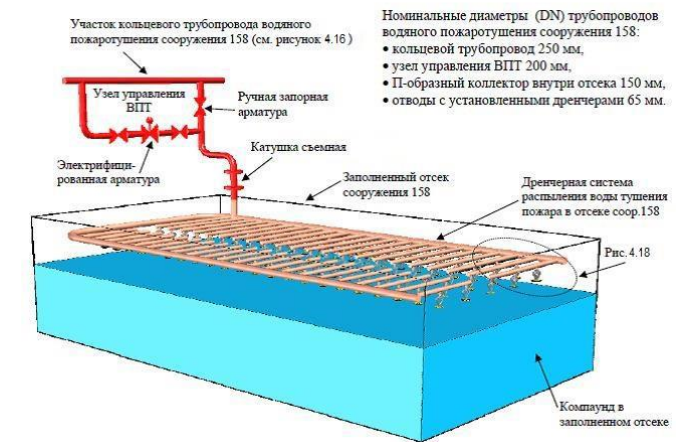
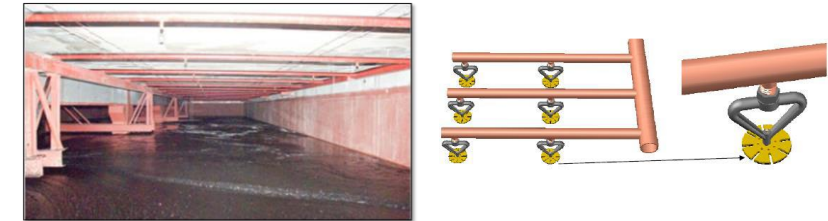


Fire detection and fire suppression

- Conventional fire alarm system with rate-of rise temperature detectors. Two line of detectors in each canyon are used: one is working and the second is in reserve.
- Continuous monitoring of building 158 with video cameras, which allows for the detection of emerging smoke through canyon ventilation chimneys and taking appropriate measures in case of a fire.
- Fire protection system of bituminous compound storage facility compartments is intended for fire-fighting while spraying water through drenchers.
- Pipelines of the subsystem for water supply to building 158 are located in the service room above control units and are filled with water under pressure. Each canyon has one feed pipeline, which is divided into two separate half-loops with drenchers.
- There is also an additional way of extinguishing bitumen canyons by supplying water or foam directly to the canyons through ventilation chimneys.

Compartmentation

- Building is divided into fire compartments: canyons (each canyon is a separate fire compartment); communication (technological) channels; rooms for control and measurement devices (each room is a separate fire compartment); service room.



Temperatūros pakeičio jutiklis DPTC-038



Gaisrinis temperatūrinis jutiklis HPI-103

- Temporary storage building 158/2 of the cemented radioactive waste - for storage of containers filled with eight drums of cemented waste and containers loaded with irradiated graphite rings and sleeves, which are placed in metallic 200 l drums).
- Building 158/2 is a reinforced concrete building.
- Loading, unloading and transportation of containers in the storage is done by the remotely controlled electrically driven bridge crane with a loading capacity of 10 t.

FHA fire scenarios:

- Truck fire in Bld. 158/2;
- Fire outside building 158/2.
- Fire resistance of building structures is sufficient to withstand the possible calculated fire of the truck.



Fire detection and fire suppression

- Fire detection system with 20 photoelectric smoke detectors is installed in all building areas capable of detecting potential fires.
- Powder fire extinguishers (two) and carbon dioxide (nine) can be used for primary fire extinguishing.
- Foam and water can be used to extinguish a heavy vehicle fire.
- For extinguishing of the roof area there are allocated two fire ladders and two dry pipes. Each of the pipes are equipped with a connection for the hose at level 0.00 m and at the roof level.
- Water can be supplied by using Visaginas PFS firemen trucks and/or by the external hydrant. Fire hydrants in Ignalina NPP territory are operational during winter time also.



Compartmentation

- The building comprises a fire compartment sufficiently separated from neighbouring buildings by walls and distance.
- The evaluated fire resistances show that the “weakest” constructional elements are the roof elements. Despite that, they still can resist fires at least for one hour.
- Ventilation systems in Bld. 158/2 are not rated for high temperatures/smoke extraction, in case of fire they will be switched off.



Decommissioning

Towards decommissioning

- Unit 2 Buildings 101/2 are protected by automatic fire alarm (linear, photoelectric and ionization smoke detectors) and stationary water fire suppression (138 sections) systems. Fire extinguishers - water, powder, CO₂, foam.
- At both Units the oil systems and communications of main RBMK-1500 equipment were dismantled. This circumstance made it possible to refuse a foam firefighting system.
- The safety justification of decommissioning projects cover the topic of fire safety assurance. Appropriate measures are implemented following the performed assessment of dismantling and cutting technologies, such as the installation of mobile smoke extraction and filtration systems, an implement additionally of fire fighting equipment in workplaces, etc.
- Administrative measures regarding hot works:
 - INPP internal procedure related with permissions for hot works was amended (the additional sharp note „Hot works“ was added to permission; after hot works staff on duty is obliged to visit of such working areas for some time to monitor the existing condition in order to make sure that there is no fire or smoke.
 - Storage areas for gas cylinders are securely installed and their safety is reasonable. Their accounting is constantly carried out.
- The Shift Supervisor is a key person responsible for firefighting arrangements on INPP site before Public Fire Service comes to the Ignalina NPP Site.

Ignalina NPP Unit 2



Updates and improvements

- No updates and improvements resulting from PSR, FSA and OPEX since NAR production.

The following strengths related to fire protection have been reported in the NAR for all facilities:

- Fire safety adequacy at Ignalina NPP NIs is continually maintained by Integrated Management System and strengthening of organizational Safety Culture. A fire safety assurance management process has been implemented taking into account organizational and technical measures.
- Periodic inspections on fire safety are performed by VATESI at nuclear installations (NIs) in accordance with annual plans, based on five-year inspection program and they address both the organizational issues and technical aspects. VATESI also has resident inspectors at the Ignalina NPP site, who conduct regular walkdowns across the site and supervise as well as how fire safety is ensured in the NIs.



Reduction of fire risks

- Both spent fuel storage facilities are fully loaded and no activities with casks (e. g. lid welding, transportation, transfer) are provided.
- Since 2015 waste bituminization process at INPP was stopped, the building of fresh bitumen storage was demolished and no activities with bituminized waste are provided in Bituminized Waste Storage Facility.
- Most of the systems (turbines, generators, main circulation pumps, diesel generators, etc.) that used oil have already been dismantled.

Important information

- Part of the external piping of the fire extinguishing system was changed to plastic, which increased the reliability of the system.
- All operational staff are practically trained in how to use fire extinguishers, some employees are trained in how to handle and use self-contained breathing apparatus (Self-Contained Breathing Apparatus (SCBA)).
- A periodic fire safety assessment of all NIs has been carried out and planned for next periods.
- WENRA SRLs are binding, as they are transfer to national (legally binding) nuclear safety requirements (the question from peer review).
- Licensee has an ageing management program for all NIs, which covers fire protection system components.

The measures to improve fire detection

- Installations of additional equipment that will allow remote monitoring from INPP main control room the situation in SNFSF-1 under round-the-clock supervision.

The measures to improve the reliability of fire detectors

- Implementation of solutions to improve the reliability of fire detectors that are working in hard conditions (for instance, high radiation, humidity) in Solid waste treatment and storage facilities (B3/4 project) and Solid waste storage buildings 157, 157/1.

Fire dampers: the need to have standardized inspection and functionality testing procedure for all relevant nuclear installations

- Fire dampers must be visually inspected on site for actuation condition and such method shall be properly addressed in relevant Ignalina NPP operating and maintenance procedures.

Management of ignition sources and control of fire loads

- A need to add provisions related with new types of ignition sources (for instance, lithium-ion batteries) and control of fire loads to national nuclear safety requirements.



Thank you
[questions | discussion]

