1. Defence in Depth (DiD): Regarding the level of fire DiD and the assumptions in the Fire Safety Analyses (FSA) the following questions arise:
a) Has the failure of the fire protection means (features such as structures, systems and equipment, but also human failures in active fire protection) been taken into account in the fire analysis for the safety demonstration of the Fire Protection structures, systems and components (SSCs)?
b) Is the single failure criterion considered in the fire analysis? If it is, on which regulatory basis and how is it considered?
c) Provide information on which combinations of fires and other events have been included in the fire analysis with their justification. Please refer to Appendix I of the IAEA SSG-64 to address possible combinations of events.
d) With regard to these combinations of fires with other events in the analysis, is the failure of the fire protection features (for detection or suppression) caused by combined hazards – such as earthquake and consequential fire or a fire occurring coincidentally with a long-lasting external flooding – considered? What are the qualification requirements ensuring their required function during and after these events?

According to the Lithuanian legal framework, probabilistic safety assessments are not required for decommissioning facilities (all spent nuclear fuel was removed from the Units1&2 INPP to SNFSF-2.), spent nuclear fuel storage facilities, or radioactive waste treatment and storage facilities. When analysing the fire risk of INPP facilities, a deterministic method was used.
According to the Lithuanian legal framework, single failure of fire protection means has been considered in the FHA (as part of SAR).
The SAR selects critical SSC and assesses the impact of their failure on safety, as well as on related SSC.
Existing barriers (organizational, technical) provide the required safety criteria during the time required for the arrival of fire rescue teams.

2. Applicability of PSA: According to the Technical Specifications of the TPR II, performance of Fire Probabilistic Safety Assessment is considered mandatory for NPPs. However, it would be useful to know if Fire PSA have been performed or are intended to be performed for the decommissioning facilities.

According to the Lithuanian legal framework, probabilistic safety assessments are not required for decommissioning facilities, spent nuclear fuel storage facilities, or radioactive waste treatment and storage facilities. When analyzing the fire risk of INPP facilities, a deterministic method was used.

3. Fire resistance/fire hazard rating: The fire resistance rating of fire compartments, or fire hazard level, is often determined based on the fire load density (MJ/m²) in every fire area or compartment accounting for both permanent and transient fire loads and potential ignition sources.
a) Provide details on the rationale followed.
b) Fire load criteria values may differ amongst facilities and countries depending on the regulatory framework. How are these respective criteria justified?
c) Are they justified knowing that fires in nuclear facilities are generally under-ventilated?

According to the Lithuanian legal framework (basic fire safety requirements), fire loads are determined into 3 categories (<600 MJ/m²; 600÷1200 MJ/m²; >1200 MJ/m²). Depending on the fire load category, requirements are established for the fire resistance class of structures and fire compartments.
According to the Lithuanian legal framework (requirements for fire protection of NI's SSC important to safety), the SAR must identify and evaluate all potential ignition sources.

To prevent the spread of fire, as well as reduce its negative consequences, fire localization systems are provided (fire shutdown, fire valves, etc.).

4. Qualification of cables: As far as qualified cables are available, in how far are they taken into account as fire load and fire source? How is the qualification of those cables been considered in the fire analysis and for what objective? In how far are protected cables (e.g., protected by protective coatings) considered as contributors to fire propagation in the analysis?

Electrical cables are rated as fire load. Electrical cables are coated with a fire-retardant coating (paste) that does not support combustion. Sealing of cable penetrations is also carried out in accordance with the requirements. The existing procedures at INPP provide for periodic inspection and repair of this fire protection coating and sealing.

5. Transient combustibles and decommissioning activities: In how far and how have risks from transient combustibles and decommissioning activities (ignition sources by e.g. hot works) been included in the fire analysis and what are the hypotheses related to their inclusion?

Constant fire loads are present in premises, buildings, and structures designed specifically for these purposes (with a design review) with appropriate fire protection systems.
The permanent (design) fire load is electrical equipment and cables, storage cabinets for flammable lubricants, etc. If temporary placement of materials/equipment is necessary, a special permit is issued, which analyzes the possibility of increasing the fire load, and also provides for compensatory measures. Periodic monitoring of fire conditions (including fire loads) is carried out by operational personnel, as well as fire service inspectors.

6. Direct fire effects: Are direct fire effects (by smoke, pressure, temperature, soot, etc.) onto SSC important to safety considered in fire the analysis? Some detailed information about the regulatory requirements applicable and the way such effects are taken into account regarding design/conception/construction/modifications would be appreciated.

According to the Lithuanian legal framework, the FHA (as part of SAR) must evaluate direct fire effects.

7. Electrical fires: Have electrically induced fires (including fires by high-energy arcing faults, HEAF) been considered in the fire analyses?

Performing FHA, only active electrical equipment (electric motors, pumps, etc.) are taken into account as ignition sources. Electrical cables are rated for fire load purposes only.

8. Fire Brigade: How have the response times of the fire brigade (onsite, offsite brigades) been taken into account in the fire analysis? This question is more relevant in those installations that do not have a dedicated onsite fire brigade.

The FHA took into account the time of arrival of VFRS. In 2014, the VFRS was relocated to a different, more remote building (7 km away from Ignalina NPP). The estimated arrival time of firefighters and rescuers at the Ignalina NPP NIs for firefighting purposes is 6-7 minutes. To evaluate this change, a review of the Safety Analysis Reports was performed and confirmed that there was no negative impact of this change. Prompt detection and extinguishing of fire at an early stage is ensured by passive and active fire protection means.

9. Radiological consequences: Please provide description for:
   a) Methodology of assessment of the radiological consequences of a fire in the analysis and criteria and corresponding threshold values applicable in the success criteria.
   b) Radiological confinement measures during a fire.

According to the Lithuanian legal framework, the FHA (as part of SAR) must evaluate radiological consequences (Section Radiation exposure).
Permission to extinguish a fire for firefighters is issued by operational personnel after assessing the radiological situation in the fire zone.
Containment of the release of radioactive substances during a fire is ensured by fire localization systems (switching off ventilation, fire valves, etc.); measures are provided for collecting water after fire extinguishing.

10. Analytical methods:
a) For the installations that do not provide enough detail on the tools and models used in the fire analysis, please provide a more detailed description.
b) In cases where computational tools have been used within fire safety analyses, provide information on the sensitivity and uncertainty analyses carried out.

CFAST (Computational Fire Growth and Smoke Transport) Zone model:
Basis/scope: Estimating fire growth and smoke transport.
Input: Room configuration, heat release rate, fire growth constant, ventilation condition, ambient conditions, ceiling/roof/floor materials etc.
Output: Gas temperature, layer height, radiation, detector activation time, wall temperatures etc.
CFD (Computational Fluid Dynamics) models
If the zone model is decided not to be enough to evaluate the consequences a CFD-model can be used. This is a very complex computer model where the room is divided into small control volumes.
CFD model is appropriate to use when the:
I. Room is large.
II. Temperature differences between the gas layers are small.
III. Turbulence in the room is great.
The input to a CFD model is for example the heat release rate and the output from the model is the temperature in each of the control volumes and the smoke movement.
Field modelling using CFD:
Field modelling is often used in large or complex areas to calculate the gas temperature ad smoke movement in different areas of the room. Examples of CFD models are FLOW-3D (British Harwell Laboratory), JASMINE (British Fire Research Station), LES (NIST Building and Fire Research), and KAMELEON (Norwegian SINTEF NBL and Sandia National Laboratory), SOFIE (University of Lund).
Basis/scope: Estimating smoke movement and gas temperatures.
Input: Room configuration, obstructions, heat release rate, fire growth constant, ventilation condition, ambient conditions, etc.
Output: Temperature profiles, smoke movement etc.
Formulas/theory basis: Exchange of mass, momentum and energy between small control volumes (Navier-Stokes equation).
Application area/experiences: Can be used in all kinds of areas.
Limitations/assumptions: Dependent of each CFD model.
Validation made/required: Some experimental studies have been done.
Certification/users/experience: Input files demands expert knowledge.

11. Operating Experience: Provide a detailed description on if and how the operating experience from both (i) fires and (ii) other events (whether reportable or not) with degradation or failure of fire protection features in the installation analysed – and, as far as available, also from other nuclear installations – is considered in the analysis.

All fires at the Ignalina NPP NIs, including false alarms of the active fire protection system, are analysed by commissions appointed by the general director of the Ignalina NPP. Reports are sent to the Fire and Rescue Department under Ministry of the Interior and the VATESI, and the implementation of corrective measures is monitored.

12. Results and revisions of the Fire Safety Analyses and additional analyses: Please provide details about:
a) The process carried out to update the fire analysis.
b) Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for facilities under decommissioning in your country?
c) Some countries mention that a periodic safety review is performed for decommissioning facilities. It would be good to know more on the applicability and periods of performance of PSR for such facilities in your country in order to identify potential strengths.

The review of fire safety analysis is carried out within the framework of the PSR every ten year, including for nuclear facilities under decommissioning (for instance, for Unit 1 and Unit 2 of Ignalina NPP).

All relevant information about stress tests in Lithuania is published on the ENSREG webpage[1].

13. Strengths/weaknesses: In cases that no strengths and weaknesses have been explicitly mentioned in the NAR, please confirm that neither strengths nor weaknesses have been identified.

For each INPP NI, persons responsible for ensuring its fire safety are appointed.

Due to the natural aging of operating personnel, the company takes care of the timely training of reserve personnel important for ensuring fire safety.

[1] https://www.ensreg.eu/EU-Stress-Tests/Country-Specific-Reports/EU-Member-States/Lithuania