GENERAL QUESTIONS TO THE COUNTRIES

Thematic: FIRE SAFETY ANALYSIS (FSA)

Answers provide references to a section (§) or page (p) in the NAR. In some cases a generic reference to the NAR is given where a certain topic and the associated questions are treated. Where necessary further information is provided.

Type of installation: Research Reactors (RRs)

General questions: The experts of the Fire Safety Analysis group, after their analysis of the National Assessment Reports, consider necessary to transfer to all countries the following questions. If this information has already been provided somewhere in the NAR, the country may simply answer providing the section and the page number(s) of the NAR where the answer is found.

1. *Fire safety objectives*: Not clearly stated. In particular, clarification is requested regarding the purpose of the deterministic fire risk assessment: has it been carried out with the purpose of protecting the lives of operators or of preventing nuclear accidents?

Both objectives are considered, as the Belgian regulation on well-being at work also requires a fire risk analysis to demonstrate personnel safety.

Both analyses (fire - nuclear safety) are essentially decoupled as is also mentioned in the excel table with the answers to similar questions

2. *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 FSA for the safety demonstration of the fire protection structures, systems and components (SSCs)?
    Not directly since the reactor design is considered robust against fire event (see above)
    b) Both in the deterministic and probabilistic FSA, under which assumptions is this failure considered: full burnout in the fire area and failure of all SSC therein, functions of failure probability for the different SSCs, no damage due to the fire?
    Probabilistic FSA is not required for research reactors and has not been carried out.
    Deterministic FSA: see §2.2.2
    c) Under these considerations, do you consider your Fire PSA (if applicable) conservative or realistic?
    Probabilistic FSA is not required for research reactors and has not been carried out.
    d) Could you provide (in case a Fire PSA is performed) results in terms of CDF / LRF / LERF?
    Probabilistic FSA is not required for research reactors and has not been carried out.
    e) Is the single failure criterion considered in the fire analysis? If it is, on which regulatory basis and how is it considered?
    No, not in the FSA. The safety studies, that cover fire related incidents, SFC is considered.
    f) Are the spurious actuation of signals by a fire and the false operation of fire protection SCCs considered in the fire analyses? In what way?
    §1.2.1.1: Fire protection systems shall be designed and installed such that their operation in the event of real fire, as well as their spurious operation, inadvertent start-up or failure

does not prevent the structures, systems and components from completing their safety functions.

g) 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.
IAEA SSG-64 applies to NPPs not research reactors.
§1.2.1.1: the FHA cover credible combinations with other initiating events.

h) 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?
No

i) Consideration of the different Plant Operational States (POSs) or of the operative status and modes in the deterministic FSA.
§1.2.1.1: The deterministic fire hazard analysis covers the operational conditions and normal shutdown conditions of the facility

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.
   In the NAR §2.2.2. it is mentioned that the fire load is based on the nature and actual amount of burnable material and on the flammability (i.e. book vs. paper bin).
   b) Fire load criteria values may differ amongst facilities and countries depending on the regulatory framework. How are these respective criteria justified?
   At SCK CEN the same criteria are used in all facilities.
   c) Are they justified knowing that fires in nuclear facilities are generally under-ventilated?
   The fire suppression strategies are developed in line with the risk and the boundary conditions of the area to be protected.

4. *Transient combustibles and ignition sources*: In how far and how have transient combustibles and ignition sources (by e.g. hot works) been included in the fire analysis and what are the hypotheses related to their inclusion?
   See §3.1.2.2. These have not been included in the general fire analysis – instead the general fire analysis impact on the extent to which hot works or mobile fire loads are allowed and whether or not this requires additional fire analysis.

5. *Direct fire effects*: Are direct fire effects (by smoke, pressure, temperature, soot, etc.) onto SSC important to safety considered in the fire 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.
   Regulations, see §1.2.2, generally refer to “effects and possible consequences of fire” covering in principle all direct and indirect effects.

6. *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.

SCK CEN has a dedicated on-site fire brigade so response times are sufficiently short.

7. *Radiological consequences of fires*: Please provide more details about the methods of addressing the radiological consequences of the fires in the fire analysis and the radiological criteria of acceptance and the corresponding threshold values applicable.
   See: Safety Generic Position (fgov.be) and TR SD.

8. *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.
   c) The use of calculation tools is growing. What are your review processes to identify the needs and advantages/disadvantages of adopting such tools? What are the outcomes of these prospects?
   d) How are you facing to this (understanding of the corresponding studies by the stakeholders)?

See §2.2.2. The method followed is simple and does not need specific computational tools.

9. *Management of temporary modifications and their impact on fire safety*: A lot of temporary modifications are implemented at research reactors for performing experiments. These temporary modifications for experiments may increase fire loads in compartments, limit access to compartments or buildings, or even impact sequences of fire events if any. Could you please specify:
   a) Are, and how are the modifications (including those for incorporation of new experimental devices, launching new laboratories, etc.) considered in the fire safety analysis and the periodic safety review (PSR) updates?
   b) Is any fire safety analysis/assessment of temporary modification for experiments conducted before implementation (to assess the impact on the fire safety of the reactor)?
   c) Updates of the FSA and PSR: criteria and periodicity for their review.
   d) Sources to derive new modifications: FSA and PSR and their updates, operating experience, new regulation, etc.

See §2.2.3 and p83.

10. *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 fire analysis.

See §3.4.2

11. *Additional analyses*: 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 research reactors in your country? Please provide details.

The stresstest was carried out for all Belgian class I nuclear facilities. It included the DEC scenario of an aircraft crash with kerosine fire as well as, where relevant, external (bush)fire.

12. *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.

See §2.2.4.