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Report
Topical Peer Review 2023 Fire Protection Technical Specification for the National Assessment Reports

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Ad-hoc TPR II WG report to WENRA
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00
General requirements

00.1 Introduction

The general introduction has to be finalized after the rest of TS has been completed and discussed with ENSREG.

The European Union's Nuclear Safety Directive 2014/87/EURATOM (NSD) requires the member states to undertake, on a coordinated basis, topical peer reviews (TPR) every 6 years with the first starting in 2017. For each review the directive requires the following:

(a) a national assessment is performed, based on a specific topic related to nuclear safety of the relevant nuclear facilities[1] on their territory,
(b) all other member states, and the Commission as observer, are invited to peer review the national assessment referred to in point (a),
(c) appropriate follow-up measures are taken of relevant findings resulting from the peer review process,
(d) relevant reports are published on the above mentioned process and its main outcome when results are available.

The member states, acting through the European Nuclear Safety Regulators Group (ENSREG), have decided that the topic for the second topical peer review is fire safety.

The **objectives of the Topical Peer Review (TPR) process**, as agreed by ENSREG, are to:

- Enable participating countries to review their provisions for fire safety of nuclear installations, to identify good practices and to identify areas for improvement,
- Undertake a European peer review to share operating experience and identify common issues faced by member states,
- Provide an open and transparent framework for participating countries to develop appropriate follow-up measures to address areas for improvement.

Whilst these objectives were initially established for nuclear power plants (NPPs) specifically, the scope of the TPR has been extended to include research reactors (RRs), fuel cycle facilities (FCFs) and waste storage facilities (WSFs) at the same site and directly related to those installations, and these objectives apply equally to those.

The first stage of the peer review process is the **production of a national assessment report (NAR)** for each country participating in the Topical Peer Review, as required under item (a)

[1] In the frame of this Technical Peer Review, the terms installation used by the NSD and facility as often used by the IAEA are used interchangeably.

above. **This Technical Specification defines the structure and contents of the NARs to facilitate an effective peer review.** The other stages of the TPR are specified elsewhere (i.e. the Terms of Reference for TPR process).

The objectives of the NAR are to:

- describe the overall fire safety for the relevant installations in the scope of the TPR II including:
    - how coordinated sampling approach and graded approach have been applied for the installations in the scope,
    - implementation of the overall fire safety programme,
    - experience regarding fire safety activities,
- identify main strengths and potential good practices,
- identify areas for improvement and actions to address them,
- provide sufficient details according to a format which allows a meaningful peer review.

The format and content of the NAR are further described in Section 00.5.

A list of abbreviations used within this Technical Specification is included in Annex 3.

00.2 Topic for the review – fire safety

Fire is among the significant risks for many nuclear installations. Fires can occur at many locations in an installation and may be capable of challenging multiple structures, systems and components (SSCs) simultaneously and affect signalling and power supply of multiple systems, being a possible cause of common cause failures. A fire could also involve nuclear and/or radioactive materials and lead to the release and dispersion of these. In addition to being an independent event itself, fire can be induced by other hazards or events. It can also itself induce other internal hazards (e.g., flooding, explosion). For installations having radioactive waste in store, fire events could directly generate radioactive releases to the environment. The term 'fire safety', as used throughout the Technical Specification, is understood to relate only to nuclear safety. Other aspects of fire safety are not included.

None of the previous evaluations and benchmarks initiated after Fukushima covered fire safety, thus it's a subject that can lead to new insights. The regulations for fire safety are mature, resulting in a good reference for the review. It is also a topic that is relevant for every nuclear installation, subject to a graded approach.

There are different practices in implementation of fire protection among installations, which gives the opportunity to learn from each other and share experiences. Besides, as fire hazard is relevant in many other sectors besides nuclear, different practices might have developed in different participating countries resulting from how fire hazards are handled in general.

As a technical topic, fire safety has a strong relation to both design but also operation of nuclear installations. This means concrete questions and topics for review can be defined. The main safety benefits expected from the review of fire safety are:

- Increasing confidence of and participating countries in the adequacy and currency of their fire safety assessments,
- Identification whether fire safety can be improved,
- Contributing to develop harmonized approaches of fire safety across Europe on the basis of SRLs (Safety Reference Levels) implementation.

00.3 Scope of nuclear installations to be covered in the NAR

1. All installations under the NSD should be considered:
   - nuclear power plants (NPPs),
   - research reactors (RRs)[2],
   - spent fuel storage facilities,
   - enrichment plants,
   - nuclear fuel fabrication plants,
   - reprocessing plants,
   - storage facilities for radioactive waste that are on the same site and are directly related to the types of nuclear installations listed above.
2. In the present document enrichment plants, nuclear fuel fabrication plants, reprocessing plants are indicated with the term FCFs (see glossary in Annex 1). All stages in the lifecycle should be considered and the scope should cover installations under construction, under operation and under decommissioning. More precisely, the scope should include:
   - All nuclear installations that on 30th June 2022:
     - are operating or in a state of "care and maintenance",
     - are defueled or in the process of being decommissioned, where
       - the possibility of fire cannot be disregarded, and
       - any such fire could have the potential to develop into an incident,

[2] In line with the scope of the SRL for existing research reactors published in 2020, all research reactors independent of their type and thermal power with the exception of the critical, sub-critical assemblies, homogeneous zero-power reactors and accelerator driven systems are covered by the term "research reactor".

   - are under safe enclosure, excepting those from which all non-fixed radioactivity had been removed.

  For facilities whose stage will change between June 2022 and the date for the submission of the NAR, the NAR should detail if the information is related to the current stage of the facility and if and when this stage is expected to change (e.g. from operation to decommissioning).

- All nuclear installations for which construction permissions are granted by 30th June, 2022. For these it is expected that fire protection will have been considered in design assumptions. Thus, some detailed parts of this Technical Specification would generally not be applicable at the current stage of their lifetime.

Installations subject to the NSD which present a significant radiological risk to the people and the environment in case of fire should be included in the NAR. The significant radiological risk to the people and the environment relies either on a potential for causing radiation exposure or on a radiological inventory which can be spread in case of fire, directly or as result of impairment of safety systems, or the need to take protective actions and other response actions in case of fire event. This significant radiological risk can also be defined in the regulatory framework of the participant countries. In that case, the NAR should provide a description of the risk criteria or limits included in the regulatory framework.

This means for instance that installations at a late stage of decommissioning, when all free radioactivity has been removed, would be out of the scope. This is also the case for waste facilities for which the waste product can be regarded as fire resistant.

3. There is significant variability in the type, number, hazard and risk profiles of nuclear installations across participating countries.

   The NAR is expected to focus on installations with potential for significant radiological risks created or affected by fire, which are listed below:

   - nuclear power plants,
   - research reactors, two categories are considered:
     - **RRs with a higher risk profile**: RRs with a thermal power ≥ 1 MW_{th} as well as RRs with a thermal power < 1 MW_{th} and with an important additional risk,
     - **RRs with a lower risk profile**: RRs with a thermal power < 1 MW_{th}, which do not have any significant additional risk.

     For the first brief approximation of the risk profile, a threshold on thermal power is considered. Suitable value to define higher risk profile is thermal power of ≥ 1 MW_{th}. However, the thermal power itself may not be sufficient. For research reactors with a thermal power < 1 MW_{th}, additional significant characteristics should then be taken into account such as: radiological source term, location (proximity to population and/or proximity to other installations which can rise the external hazard), reactor specific features likely to affect safety (e.g., spent fuel storage areas, hot cells areas, high pressure systems, heating systems and the storage of flammables) and utilization of the reactor (experimental devices, tests, radioisotope production, reactor physics experiments). Further information may be found in Annex A of the WENRA SRL publication [2].

- fuel cycle facilities where fires have the potential to result in significant risks to workers, the public and/or the environment by impairing safety barriers,
- waste storage facilities in case of presence of combustible waste and/or non-fire resistant conditioned waste classified above VLLW, or where fires have the potential to result in significant radiological risks to workers, the public and/or the environment by impairing safety barriers,
- facilities under decommissioning in which the dismantling activities of contaminated/activated parts (structures, systems and components) are still to be completed, including waste storage facilities in these installations,
- any other facility for which fires may result in significant radiological risks to workers, the public and/or the environment.

4. As the scope of the TPR is wide, there is a need for selection amongst the installations, to preserve the feasibility and the quality of the exercise.

   In order to achieve this, there are three options:

   - grouping facilities with similar characteristics,
   - the coordinated sampling approach (for further description see Annex 4),
   - a combination of both.

   The NAR will have therefore to report information only about those selected installations, so-called candidate installations. It is not expected to provide information about other installations, so-called "represented installations". Insights from the TPR will be transferable to represented installations.

   The NAR will :
   - present the national selection of facilities,
   - develop the rationale to select these candidate installations. The rationale can include elements on similarities between candidate and represented facilities to show that information shared will be transferable to represented installations, it should also include the basis for the selected number of candidate facilities versus the overall number of qualifying installations… In particular, this rationale should explain how the list of candidate facilities allows identification of good practices and areas for improvement. The NAR will also list represented and excluded installations.

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00.4 WENRA Safety Reference Levels

The SRLs are agreed by the WENRA members. They reflect expected practices to be implemented in the WENRA member countries.

For **nuclear power plants**, WENRA has developed SRLs regarding fire safety, mainly within Issue SV “Internal hazards” of the WENRA SRL for Existing Reactors 2020 [1]. Issue SV has been recently developed (previously Issue S “Protection against internal fires” in 2014). Any additional requirements in Issue SV may not have been implemented in national regulatory frameworks.

For **research reactors**, WENRA has developed SRLs regarding fire safety, mainly within Issue S “Protection against internal fires” of the SRL document published in 2020 [2]. The WENRA SRLs for research reactors may not have yet been implemented in the national regulatory framework.

The Working Group on Waste and Decommissioning (WGWD) has developed SRL reports [3], [4] for the thematic areas: wa**ste and spent fuel storage, decommissioning, disposal and processing**. SRLs developed for waste and spent fuel storage as well as for decommissioning are applicable to the corresponding installations under the scope of this TPR II. The SRLs developed for nuclear power plants and research reactors in operation are addressed also to the spent fuel storage pools associated to these installations.

WENRA has not developed SRLs for **fuel cycle facilities**. Therefore, there is no equivalent set to the above for the expected practices relating to these facilities. In the absence of WENRA SRLs for fuel cycle facilities, a selection and interpretation of guidance and practices from other facilities’ SRLs and IAEA standards and guides has been developed to provide the framework for the NAR.

While all SRLs from Issue SV of the Safety Reference Levels for Existing Reactors 2020 and Issue S of the Safety Reference Levels for Existing Research Reactors are important to fire safety, for the TPR II specific SRLs are selected and used as a framework to perform the TPR II. The Technical Specification quotes the most relevant SRLs to be considered for the Topical Peer Review.

While the SRLs are considered as a framework for the TPR, the TPR is not meant to be a compliance check to SRLs.

00.5 Form and content of the NAR

The NAR will be provided by the nuclear regulator in the format and content described in this Technical Specification with significant input from the licensees.

Each participating country will prepare its NAR in English.

Attention should be given to types and detail of the information in order not to compromise Nuclear Security issues. The report will be published in the public domain.

The NAR shall not contain specific technical information, which have to be classified as export controlled “Technology” according to the Council Regulation for Dual-Use-Goods (EU 428/2009), i.e. manufacturing, developing and use of controlled technology or considered sensitive from a security point of view. The processes for licensing of such specific technical information would not be commensurate with the scope of the TPR.

To ensure the NARs can be used for an effective peer review process, the titles and numbering of the main sections of the NAR will be as follows:

1 General information

2 Fire safety analyses

3 Fire protection concept and its implementation

4 Overall assessment and general conclusions

5 References

A detailed contents list referring to the nuclear installations to be dealt with is presented in Annex 2. Each NAR should follow this template.

Annexes can be used to present detailed information if necessary. In addition, a preamble explaining the basis and goals of the NAR and/or an executive summary should be included.

Sections 01 to 03 of this Technical Specification describe the contents of the NAR and the sections within each chapter, with the numbering consistent with the list above.

Section 01 should describe the national requirements and guidance for fire safety, safety objectives and how the defence in depth principle has been implemented with respect to fire safety in nuclear installations.

Section 02 should describe the fire safety analyses performed for those nuclear installations in the scope.

Section 03 should provide information on the fire protection concept of the installations in the scope of the TPR and its implementation including the different aspects of defence in depth for fire safety: fire prevention, active fire protection and passive fire protection.

If a chapter of the report is not applicable to a particular participating country or to nuclear installations under scrutiny in the NAR, the NAR will still include the chapter, but just include the statement “not applicable” and a very short explanation.

Each participating country shall report on the whole scope of the national selection of nuclear installations in its country. This may include a significant variety in the type, number, hazard and risk profiles of nuclear installations across participating countries. Sub-sections in Annex 2 provide an overview of how each chapter should be structured. There may be a need to use a further level of sub-sections. These should be structured as follows:

- Issues common to all installations
    - further sub-sections grouping plants or licensees at the discretion of the participating country

Based on a graded approach, the **level of detail** within the NAR will be:

- consistent with the stage of the lifecycle. In particular, for those installations under construction it will be focused on the integration of fire safety in the design,
- related to the safety significance. In particular, for installations under decommissioning, the significance of the fire safety means in place will change over time, depending on the decreasing radiological risk.

01
General information

01.1 Nuclear installations identification

All nuclear installations that are operating or under construction as defined in Section 00.3 should be listed. The key parameters for each of them should be described with a clear statement concerning their inclusion or non-inclusion within the scope of the NAR. If necessary, this information can be presented in an annex to the report. Part of the NAR will be an extended description of the site, including all potential other installations located within.

The NAR should describe:

- information if these installations are operated by the same or by different licensees,
- commonly shared resources (e.g., electrical supplies, onsite fire brigade, common drills, etc.) between these installations,
- offsite resources needed in particular for successfully firefighting and mitigating the consequences to nuclear safety.

It is also important to provide a brief description of those installations in the direct vicinity of the site, which may affect the fire safety of the installations under consideration.

The key parameters should include for nuclear power plants and research reactors:

- Name,
- Licensee,
- Type of reactor,
- Thermal and electrical net power,
- Year of construction license (for reactors under construction),
- Year of the operating licence or first criticality (for operating reactors),
- Scheduled end of operation date (if any).

For waste storage facilities and fuel cycle facilities the key parameters should include:

- Name,
- Licensee,
- Type of facility,
- Year of first operation,
- Scheduled shutdown date (if any).

For facilities under decommissioning the key parameters should include:

- Name,

- Licensee,
- Type of facility,
- Year of end of operation,
- Year of authorization for decommissioning,
- Scheduled end of decommissioning operations date,
- Intended end state.

This covers at least for reactor facilities information on the phase of lifetime (construction, commissioning, operation, post-operation safe shutdown or other longer term shutdown, decommissioning) and the corresponding information on the fuel (in the reactor, in the spent fuel pool, other storage).

Research reactors generally operate at lower temperature and pressure levels than nuclear power plants based on the same technology type. Also, the radioactive inventory is usually lower within a research reactor. Nevertheless, all research reactors have to fulfil the three fundamental safety functions[3]. Where the regulatory framework considers a graded approach with respect to research reactors to meet these goals, a description of this approach should be provided.

For fuel cycle and waste storage facilities, a brief description of the plant process with a particular focus on the major specific risks potentially affected by fire should be provided. If a graded approach is applied to fuel cycle and waste storage facilities, this approach should be described and justified here.

Spent fuel storage pools associated to the operation of the nuclear power plants will be covered under the related section. The same also in the case where they are associated to research reactors and fuel cycle facilities (i.e. reprocessing), to the applicable extent. In the following sections the associated spent fuel pools are therefore also included when referring to NPPs, RRs and fuel cycle facilities. Spent fuel facilities for wet or dry storage used beyond the operation of the installations, including their decommissioning phase, or located outside them, will be covered in the specific sections devoted to dedicated spent fuel storage facilities.

For Facilities under decommissioning safe store conditions after end of operation as well as dismantling operation and waste treatment on the site should be described. Waste storage on the site will be dealt with in the dedicated section.

[3] see r[2]: […]
- *control of reactivity,*
- *removal of heat from the reactor core and from the spent fuel, and*
- *confinement of radioactive material.*

01.2 National regulatory framework

The NAR should include a brief overview of the regulatory system relevant to fire safety to allow understanding of requirements and guidance and their implementation related to the development and implementation of the overall fire safety regime. It should identify key regulatory documents and guidance as well as technical standards used domestically.

These consider provisions made as part of:

- the design and operation of those nuclear installations in the scope of the NAR,
- the safety assessment of these installations, including methods, data and analytical tools used.

The NAR should describe how international standards are used in developing the overall fire safety programme including:

- relevant WENRA Safety Reference Levels (SRLs),
- IAEA Safety Standards and other guidance, including the proven practices.

01.3 Improvements in fire safety as a result of experience feedback

In order to assess the suitability, effectiveness and reliability of fire protection means, operational experience feedback and other experience should be considered.

The NAR should describe:

- how fire safety has developed and improved in the installations based on lessons learned from internal and external events and other sources such as Periodic Safety Reviews, Safety Review Missions, maintenance, fire safety research and regulatory supervision
- how operational feedback of experience is shared amongst all relevant stakeholders.

01.4 Defence in depth principle and its application

The defence in depth is the basic principle to be applied in order to ensure also fire safety in nuclear installations. It is reflected in several WENRA SRLs.

Prevention, control and mitigation of fire hazards in any installation requires the examination of fires and their impact on items important to safety which should be protected to achieve the safety objectives. Consistent with the defence in depth principles, the corresponding fire protection means implemented aim at:

- Minimizing the likelihood of fires by

    - eliminating combustible materials and potential ignition sources to the extent practicable,
    - strict control of any such ignition sources by restricting their number and location, e.g. segregating ignition sources from combustible materials.
- Controlling and mitigating the fire by
    - timely detecting and extinguishing fires,
    - preventing the spread of fires.
- Mitigating secondary fire effects and maintaining safety functions identified as necessary in case of fire, including mitigation of the radiological consequences of the fire (protecting relevant SSCs against the effects of the fire hazard and limiting its consequences to achieve the safety objectives).

These protective means are therefore implemented and organized in different successive levels that should be as independent as practicable. Each level of defence against fire shall prevent the situation from deteriorating and moving to the next level as well as mitigate the consequences of the failure of the previous level.

In line with the concept of defence in depth, protection against fire is provided in general by ensuring the high quality and reliability of SSCs, by environmental qualification of these SSCs, by application of the principles of redundancy and diversity, and by physical separation, segregation, and design of appropriate barriers and other protective means.

Therefore, the design against the effects of fire is an iterative process. Identification of fire hazards at an early stage in the design is often used as a practical method to identify and prevent them. Adequate maintenance, control, and in-service inspections of SSCs need to be in place for timely detection of the occurrence of a fire and implementation of necessary corrective actions to ensure protection against the fire.

01.4.1 Nuclear power plants

WENRA SRL SV 5.2:The licensee shall implement the defence in depth concept for protection against internal hazards. This shall include provisions to prevent the occurrence of events induced by internal hazards, to detect these events and, if relevant, control and/or mitigate their consequences;

01.4.2 Research reactors

WENRA SRL S 1.1:. The licensee shall implement the defence in depth principle to fire protection, providing measures to prevent fires from starting, to detect and extinguish quickly any fires that do start and to prevent the spread of fires and their effects in or to any area that may affect safety.

01.4.3 Waste and spent fuel storage facilities

WENRA S-30: The licensee shall make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

The above SRLs apply to all above installations in the different stages of their life.

01.4.4 Fuel cycle facilities

For fuel cycle facilities, the above WENRA SRLs can be considered in the absence of fuel cycle facility-specific SRLs.

In this context, the IAEA Specific Safety Requirements SSR-4 [12] identify requirements on defence in depth in broad alignment with the WENRA SRLs. Requirement 10 states that the design of a nuclear fuel cycle facility shall apply the concept of defence in depth. The levels of defence in depth shall be independent as far as is practicable. IAEA SSR-4 also provides for fuel cycle facilities' expectations that Items important to safety shall be designed and located, subject to compliance with other safety requirements, so as to minimize the effects of fires and explosions, which could lead directly or indirectly to radiological consequences. IAEA SSR-4 [12], para 6.163 requires that internal fires shall not challenge redundant safety groups.

01.4.5 Content of the NAR

It is expected that a brief general description on how the defence in depth principles (i.e. in the WENRA SRLs) as presented in this section are met in each nuclear installation.

Section 03 of the NAR should describe how the defence in depth concept has been implemented with respect to fire safety in the nuclear installations, and that the impact of fire across the levels of defence in depth has been adequately considered. This includes adequate consideration to:

- prevent fires from starting, see Section 03.1,
- detect and extinguish quickly any fires that do start, see Section 03.2,

- prevent the spread of fires and their effects in or to any area that may affect safety, see Section 03.3.

In particular, the NAR should describe how the design and implementation of the fire protection concept meets the objectives with regards to independence, where applicable, of the different means discussed in Section 03.

02
Fire safety analyses

Fire safety analyses are an important part of a nuclear installation's safety demonstration.

The term fire safety analysis covers both, deterministic fire safety analyses such as a *Fire Hazard Analysis* (FHA) as well as probabilistic fire risk analysis (called *Fire PSA*). This approach is applied to NPPs and, where appropriate according to a graded approach, to research reactors and spent fuel storage facilities.

For waste storage, fuel cycle facilities and facilities under decommissioning, requirements for conducting fire safety analyses primarily refer to FHA. PSA as such is not currently applied to these installations.

However, in this context, it is important to note that IAEA SSR-4 [12], requirement 20 applies. This requirement states that *a comprehensive safety analysis shall be carried out in the design process for a nuclear fuel cycle facility. Systematic and recognized methods of deterministic analysis shall be used, complemented by probabilistic assessments where appropriate, in accordance with a graded approach. The purpose of the analysis shall be to ensure that the design provides an adequate level of safety and meets the required design acceptance criteria.*

02.1 Nuclear power plants

For nuclear power plants, there are requirements for conducting both, deterministic fire hazard analyses (FHA) and probabilistic fire risk assessment (Fire PSA). For nuclear power plants the focus should be on deterministic analyses in the TPR, but PSA should be covered at a general level.

WENRA SV 6.1: A fire hazard analysis shall be developed on a deterministic basis, covering at least :
- ***all plant operational states of normal operating and shutdown, a single fire and consequential spread;***
- ***any plant location where fixed or transient combustible material is present;***
- ***credible combinations (see RL E6.1) of fire and other events (including external hazards).***

The deterministic analysis shall be complemented by PSA in order to evaluate the fire protection arrangements and to identify risks caused by fires.

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear facility's safety demonstration, particularly for nuclear power plants and facilities where active processes are normally operated.

The following WENRA SRL has been developed to specifically correspond to the consideration of event combinations for nuclear power plants:

WENRA E 6.1: Credible combinations of individual events, including internal and external hazards, that could lead to anticipated operational occurrences or design basis accidents, shall be considered in the design. Deterministic and probabilistic assessment as well as engineering judgement can be used for the selection of the event combinations.

The NAR should provide to the extent practical and as far as required information on the scope of the fire analyses for the NPP including the spent fuel store, e.g., a deterministic fire hazard analysis (FHA), a probabilistic fire risk assessment (Fire PSA), the use of a combination of both, or others (e.g., engineering judgement). Concerning the deterministic analysis, the NAR should describe:

- the scope of the analysis including
  - different operational states,
  - scenarios analysed in the FHA and the technical elements used to justify that they are the most relevant (bounding scenarios),
  - event combinations (e.g. seismic events) considered in the analysis, including the rules and/or criteria applied to consider such event combinations,
- assumptions and methodologies applied to perform the analysis
  - guidance used, if applicable,
  - identification of the safety functions and related SSCs to be protected against fire,
  - consideration of the plant locations where permanent or transient combustible material is present, rules and justifications used to consider the absence of fire in specific situations,
  - consideration of on-site or off-site fire brigades,
  - general description of how uncertainties are considered,
- fire phenomena and their analysis:
  - methods, tools and data used for the quantification of direct (e.g., temperature, pressure, soot) and indirect fire effects (e.g. by fire suppression),
  - how the fire phenomena's complexity and the severity of the potential consequences are taken into account.

The following information should be provided with respect to Fire PSA in the NAR as far as applicable:

- the scope of the Fire PSA performed for the installation:
  - PSA levels of the study,
  - operational plant states included in the analysis,
  - analysis on reactor and/or spent fuel storages (spent fuel pools, etc.),
- the main results of the Fire PSA:
  - the most important accident sequences,
  - the contribution of the fire events to the overall PSA results.

The NAR should describe:

- the management of changes to and updates of the fire safety analyses in the context of Periodic Safety Reviews (PSRs) including their consideration at the plant,
- the most risk significant plant modifications (implemented and planned) based on fire safety analyses,
- the approach how the fire safety analyses are updated to reflect relevant modifications to the NPP.

02.2 Research reactors

For research reactors there are formal requirements for conducting deterministic fire hazard analyses (FHA). There are no formal requirements for a Fire PSA for research reactors, but for some researxh reactors with a higher risk profile a Fire PSA is however applied.

The following WENRA SRLs specifically correspond to fire safety analyses for research reactors:

WENRA S 3.1: A fire hazard analysis shall be carried out and kept updated to demonstrate that the fire safety objectives are met, that the fire design principles are satisfied, that the fire protection measures are appropriately designed and that any necessary administrative provisions are properly identified.

WENRA S 3.2: The fire hazard analysis shall be developed on a deterministic basis, covering at least:
- For all normal operating and shutdown states, a single fire and consequential spread, anywhere that there is fixed or transient combustible material;
- Consideration of credible combination of fire and other PIEs likely to occur independently of a fire ;
- fire hazards due to experiments.

WENRA S 3.3: The fire hazard analysis shall demonstrate how the possible consequential effects of fire and extinguishing systems operation have been taken into account

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear facility's safety demonstration, particularly for nuclear power plants and facilities where active processes are normally operated.

The WENRA SRL E 6.1 has been developed to specifically correspond to the consideration of event combinations for research reactors.

WENRA E 6.1: Credible combinations of individual events, including internal and external hazards, that could lead to anticipated operational occurrences or design basis accidents, shall be considered in the design. Deterministic assessment and probabilistic methods as well as engineering judgement can be used for the selection of the event combinations.

The NAR should provide to the extent practical and as far as required information on the scope of the fire analyses for the research reactors including the spent fuel store, e.g. a deterministic fire hazard analysis (FHA), or as a minimum, an engineering assessment (**for lower risk RRs**).

In line with Section 01.4, for any of these approaches, the following should be briefly summarised:

- the scope of the analysis including
  - different operational states,
  - scenarios analysed and the technical elements used to justify that they are the most relevant (bounding scenarios),
- event combinations (e.g. seismic events), if considered in the analysis, including the rules and/or criteria applied to consider such event combinations,
- assumptions and methodologies applied to perform the analysis
  - guidance used, if applicable,
  - identification of the safety functions and related SSCs to be protected against fire,
  - consideration of the research reactor locations where permanent or transient combustible material is present, rules and justifications used to consider the absence of fire in specific situations,
  - consideration of on-site or off-site fire brigades,
  - general description of how uncertainties are considered,
- fire phenomena and their analysis:
  - methods, tools and data used for the quantification of direct (e.g., temperature, pressure, soot) and indirect fire effects (e.g. by fire suppression),and their impact on nuclear safety[4],
  - how the fire phenomena's complexity and the severity of the potential consequences are taken into account.

The NAR should describe

- the management of changes to the fire safety analyses in the context of Periodic Safety Reviews (PSRs),
- the most risk significant research reactor modifications (implemented and planned) based on fire safety analyses,
- the approach how the fire safety analyses are updated to reflect relevant modifications to the research reactor.

For research reactors with a higher risk profile, if a PSA has been developed, the NAR should describe the scope and the main results of the PSA performed.

02.3 Fuel cycle facilities

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[4] The methods and tools applied for quantification of fire effects should be appropriate to the fire phenomena's complexity and the severity of the potential consequences.

WENRA SRLs have not yet been specifically developed regarding fire safety analyses for fuel cycle facilities.

The WENRA SRLs for other installations, e.g. SV 3.1, SV 3.2 and SV 3.3, should be considered proportionately in the NAR according to the graded approach. This can be the case when analyses are adapted from models and approaches used in other installations, and/or partly based on specific risk assessments or qualitative approaches / judgements.

WENRA SV 3.1: For all internal hazards that might affect SSCs important to safety, hazard assessments shall be performed using deterministic and, as far as practicable, probabilistic methods as well as engineering judgement. Assessment shall account for all individual hazard sources and corresponding direct and credible indirect effects.

WENRA SV 3.2: Internal hazard sources shall, as far as reasonably practicable, be removed or minimised until it can be shown that:
- the most severe physically possible impact is incapable of posing a threat to SSCs important to safety or
- the occurrence of an event induced by a hazard source is extremely unlikely with a high degree of confidence.

WENRA SV 3.3: The hazard assessment, applied methods and input data as well as the utilization of the results, including implementation of actions, shall be justified, documented and kept up to date.

IAEA SSR-4 [12], requirement 22 on analysis of fire and explosion should be considered. This requires that the potential for external and internal fires shall be analysed, and the related potential initiating events shall be identified for use in the safety analysis. It also states that specific controls required for fires shall be identified clearly. IAEA SSR-4 [12], paras. 6.77 to 6.79 outline the expectations on postulating initiating events, the consideration of common cause failure, the identification of appropriate limits on flammable materials, fire prevention, protection and control, fire extinguishing systems in the context of criticality hazards, and the availability of items important to safety.

IAEA Safety Guide SSG-5 “Safety of Conversion Facilities and Uranium Enrichment Facilities” [8], paras. 4.38 to 4.41 provide expectations on fire analyses for uranium conversion, gaseous diffusion and gas centrifuge enrichment facilities.

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear facility’s safety demonstration, particularly for nuclear power plants and facilities where active processes are normally operated.

The WENRA SRL E 6.1, developed to specifically correspond to the consideration of event combinations for nuclear power plants, might be considered as appropriate also for fuel cycle facilities, subject to a graded approach.

WENRA E 6.1: Credible combinations of individual events, including internal and external hazards, that could lead to anticipated operational occurrences or design basis accidents, shall be considered in the design. Deterministic and probabilistic assessment as well as engineering judgement can be used for the selection of the event combinations.

The fire safety analyses and/or assessments should provide justification of the adopted fire safety means to meet the applicable technical criteria for fuel cycle facilities. Based on the functional requirements associated with those SSCs to be protected, the licensee should therefore justify that the technical performance of the fire protection features ensures that the safety objectives will be met.

As outlined in IAEA SSG-64 [16], fires may not only occur as single (individual) events, but also in combination with other hazards (this is often referred to as 'combined hazards'). Expectations from SRL E 6.1 in this area are broadly transferable and should be considered.

According to the graded approach selected for fuel cycle facilities, the NAR should describe:

- the scope of the fire safety analyses, e.g. a deterministic fire hazard analysis (FHA), or others,
- the types of scenarios and phenomena considered, how it is justified that they are the most relevant (bounding scenarios).,
- the combinations of events considered in fire safety analysis and the rules/criteria applied to consider such event combinations,
- the methods, tools and data used for quantification of radioactive dispersion and release due to fire,
- the identification of the safety functions and related SSCs to be protected against fire,
- how the scenarios are characterised (key assumptions, models and methodologies),
- how plant locations where permanent or transient combustible material is present are considered, e.g. rules and justifications used to consider the absence of fire in specific situations,
- the management of changes to the fire safety analyses in the context of Periodic Safety Reviews (PSRs),
- the most risk significant plant modifications (implemented and planned) based on fire safety analyses.

02.4 Dedicated spent fuel storage facilities

The following WENRA SRL specifically corresponds to fire safety analysis for spent fuel storage facilities.

WENRA S-30: The licensee shall make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

Dedicated facilities for storage of spent fuel following NPPs/RRs and fuel cycle facilities operation are generally posing less demanding requirements in relation to the residual heat removal function. In case of dry spent fuel storage facilities safety is provided by passive systems such as the storage casks qualified to fire.

For these facilities a fire safety analysis has however to be conducted with an assessment of the fire hazard (FHA) on which basis all the adopted prevention and protection measures to be adopted are identified. This in order to adequately protect the structures hosting the spent fuel from potential fire events challenging their integrity and stability.

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear installation's safety demonstration, especially nuclear power plants and installations where active process are normally operated.

The WENRA SRL E 6.1 developed to specifically correspond to the consideration of event combinations for nuclear power plants is also applicable to the case of dedicated spent fuel storage facilities, subject to a graded approach.

The following information should be provided in the NAR, subject to graded approach, if applicable for specific type of spent fuel storage facility:

- the requirements on the scope, assumptions and methodologies applied to perform the fire hazard analysis,
- the prevention and protection measures to be adopted as result of the fire hazard analysis,
- event combinations to be considered,
- how the performance levels are achieved through the adopted design and layout,
- assessment of radiological impact following a fire event, as postulated in the safety analysis of the installation, in relation to the safety and radiological objectives.

02.5 Waste storage facilities

The following WENRA SRL specifically corresponds to fire safety analysis for waste storage facilities.

WENRA S-30: The licensee shall make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

Dedicated facilities for storage of waste are in general characterised as quite simple facilities where no active processes are required to maintain safety. Such facilities are generally inherently robust, and safety is provided by means of passive safety functions. For these facilities fire safety is primarily related to prevention of radioactive releases from waste involved in a fire rather than to protect SSCs from fire effects. The fire safety analyses for such facilities are not required to be unduly sophisticated unless stored waste / waste packages as such are flammable.

The dire safety analysis should include an assessment of the fire hazard on which basis all the adopted prevention and protection measures to be adopted are identified.

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear installation's safety demonstration, especially nuclear power plants and installations where active process are normally operated.

The following WENRA SRL has been developed to specifically correspond to the consideration of event combinations for nuclear power plants.

WENRA E 6.1: Credible combinations of individual events, including internal and external hazards, that could lead to anticipated operational occurrences or design basis accidents, shall be considered in the design. Deterministic and probabilistic assessment as well as engineering judgement can be used for the selection of the event combinations.

For some waste storage facilities, the above SRL might be considered as appropriate, subject to a graded approach.

The following information should be provided in the NAR, subject to graded approach:

- the requirements on the scope, assumptions and methodologies applied to perform the fire safety analysis, including the fire hazard assessment,
- the prevention and protection measures to be adopted as result of the fire hazard analysis,
- event combinations considered in the fire safety analysis,
- assessment of radiological impact following a postulated fire event and the adequacy of the performance levels in relation to the safety and radiological objectives,
- how the performance levels are achieved through the adopted design and layout.

02.6 Facilities under decommissioning

The following WENRA SRL developed for waste storage facilities applies also to facilities under decommissioning.

WENRA S-30: The licensee shall make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

For facilities under decommissioning fire safety is primarily related to prevent radioactive releases from contaminated parts, waste temporarily in storage in buffer areas before being transferred to dedicated storage facilities or under treatment on site. It may also be necessary to protect from fire effects a limited number of still relevant SSCs. The fire safety analyses for such facilities are therefore not required to be unduly sophisticated unless highly contaminated parts or flammable waste in temporary storage are involved.

The fire safety analysis should include an assessment of the fire hazard based on which all the prevention and protection means to be adopted are identified.

Following the Fukushima nuclear accidents, consideration of event combinations including fire has been recognised as a key part of some nuclear facility's safety demonstration, particularly for nuclear power plants and facilities where active processes are normally operated.

Expectations from SRL E 6.1 on credible combinations of individual events are transferable to the case of Facilities under decommissioning and should be considered, according to a graded approach.

The NAR should describe, subject to a graded approach:

- the requirements on the scope, assumptions and methodologies applied to perform the fire safety analysis, including the fire hazard assessment,
- the prevention and protection measures to be adopted to the different decommissioning activities according to the results of the fire hazard analysis,
- event combinations considered in the fire safety analysis, if any,
- assessment of radiological impact following a postulated fire event and the adequacy of the performance levels in relation to the safety and radiological objectives,
- how the performance levels are achieved through the adopted design and layout.

2.7 Licensee's experience of fire safety analyses

The NAR should describe the licensee's experience on the fire safety analyses. The NAR should identify strengths and weaknesses in this area and the actions to address them. Lessons learnt from events, reviews, OSART, INSARR and/or equivalent should be presented.

2.8 Regulator's assessment and conclusions on fire safety analyses

The regulator should report:

- its assessment of fire safety analyses described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

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The regulator should also present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the relevance of those fire safety analyses.
The conclusions on the adequacy of the licensee's fire safety analyses should be presented.

03
Fire protection concept and its implementation

This section contains the elements of the fire protection concepts applied for the installations in the scope of the TPR covering the three levels of defence in depth with regard to fire safety and their implementation in the installations according to Section 01.3.

03.1 Fire prevention

Preventing fires from starting is the first level of defence in depth with respect to fire safety, see Section 01.4.

The WENRA SRLs as well as other applicable standards, e.g. from IAEA, require that several measures are taken to minimize the likelihood of internal fires. These typically concern:

- fire loads (minimization and segregation of fixed and transient combustibles to the extent practical; location, spatial distribution and properties of combustibles, etc.),
- ignition sources (in particular, minimization of potential ignition sources to the extent practical, a strict control of any ignition sources and segregation of them from fire loads, management of hot work, etc.), and
- oxygen (reduction of oxygen concentration, inert gas atmosphere, etc.).

The general aspects to be considered for fire prevention are the same for all reactor installations, regardless of their power, and in principle also the same for other installations in the scope of the TPR. The extent, level of detail and effort used by the licensee for the reporting should be adequate depending on the potential risks of the installation.

The following WENRA SRL specifically corresponds to fire prevention in NPPs.

> ***WENRA SV 6.11: In order to prevent fires, procedures shall be established to control and minimize the amount of combustibles and the potential ignition sources. In order to ensure the operability of the fire protection measures, procedures shall be established and implemented. They shall include examination, inspection, maintenance and testing of fire barriers, fire detection, alarm features and extinguishing systems.***

The following WENRA SRLs specifically correspond to fire prevention in research reactors.

> ***WENRA S 2.3: Buildings that contain equipment that is important to safety shall be subdivided into compartments that segregate such items from fire loads and segregate redundant or diverse trains of a safety system from each other. When a***

fire compartment approach is not practicable, fire cells shall be used, providing a balance between passive and active means, as justified by fire hazard analysis.

WENRA S 2.4: Buildings that contain radioactive materials that could cause radioactive releases in case of fire shall be designed to minimize such releases.

WENRA S 5.1: In order to prevent fires, procedures shall be established to control and minimize the amount of combustible materials and minimize the potential ignition sources that may affect items important to safety. In order to ensure the operability of the fire protection measures, procedures shall be established and implemented. They shall include inspection, maintenance and testing of fire barriers, fire detection and extinguishing systems.

Further relevant aspects corresponding to fire prevention are specified in WENRA SRL S2.2 for research reactors.

WENRA S 2.2: Buildings that contain SSCs important to safety shall be suitably* fire resistant.

****In accordance with the results of the fire hazard analysis.***

The following SRL developed for NPPs applies to waste storage facilities on the same site and to dedicated spent fuel storage facilities to facilities under decommissioning.

WENRA SV 6.11: In order to prevent fires, procedures shall be established to control and minimize the amount of combustibles and the potential ignition sources.

In addition, the following SRLs related to waste storage facilities and to dedicated spent fuel storage facilities apply.

WENRA S-26: The licensee shall establish operational limits and conditions (OLCs) in order to maintain the storage facility and waste and spent fuel packages or unpackaged spent fuel elements in a safe state during facility operation.

WENRA S-27: The defined OLCs (see S-26) shall consider, in particular, and as appropriate:

- ***(…)***
- ***potential aspects of gas generation from waste or spent fuel, in particular the hazards of fire ignition, explosion, waste and spent fuel package or unpackaged spent fuel element deformations and radiation protection aspects;***
- ***(…).***

For fuel cycle facilities, although expectations could be read across from other installations´ SRLs, providing the appropriate safety goals and functions are considered. As an example, SSCs in fuel cycle facilities should be designed and located to minimize the frequency and the effects of fire, to maintain capability for confinement of radioactive material and for criticality prevention.

The expectations for NAR content covering fire prevention provided previously in this chapter should be considered for fuel cycle facilities proportionately. Depending on the facilities, for example, the NAR should consider fire prevention in the context of static / dynamic containment operation, protection of filtration systems and other fuel cycle facility-specific issues would be valuable.

The NAR should therefore describe for all installations in the scope of the TPR to the extent practical:

- the process in the installation´s design for minimizing the likelihood of fire, with due regard to the characteristics of radioactive waste in storages.
- the fire prevention means including specific needs due to the installation´s operation and processes (flammable liquids, pyrophoric materials, optimized layout of buffer zones for temporary waste storage, etc.),
- in accordance with the fire analysis considerations, the procedures for management and control of
  - fire loads and ignition sources (e.g., minimization and segregation of fixed and transient combustibles to the extent practical), and
  - “hot work” to handle maintenance or other work (e.g., experiments in research reactors, decommissioning operations, daily start and stoppage of dismantling works in installations under decommissioning) where there are risks of fire ignition.

03.2 Active fire protection

Detecting and extinguishing quickly those fires which do start, thus limiting the damage is the second level of defence in depth with respect to nuclear fire safety and covered by the term “active fire protection”, see Section 01.4.

Following detection, the fire has to be extinguished and the facility has to be put into a safe condition.

03.2.1 Fire detection and alarm

The following WENRA SRLs correspond to fire detection and alarm in nuclear power plants.

> ***WENRA SV 6.8: Fire detection and alarm features, with detailed annunciation of the location of a fire to the control room personnel, shall be installed at the plant and their adequacy shall be supported by results of the fire hazard assessment. These features shall be provided with non-interruptible emergency power supplies and failures of the cable connections shall be announced to the main control room.***

The following WENRA SRL corresponds to fire detection and alarm in research reactors.

> ***WENRA S 4.1: Each fire compartment or fire cell shall be equipped with fire detection and alarm features, with detailed annunciation for the control room staff of the location of a fire. These features shall be provided with non-interruptible emergency power supplies and appropriate fire resistant supply cables.***

WENRA SRL SV 6.8 developed for nuclear power plants can be applied to, waste storage facilities, dedicated spent fuel storage facilities and facilities under decommissioning based on the results of the fire safety hazard developed, according to a graded approach, considering both dismantling and/or waste treatment activities as well as activities to ensure safe store of specific portions of the installations.

WENRA SRLs have not yet been developed specifically for fire detection and alarm issues in fuel cycle facilities. IAEA SSR-4[12], requirement 22 (analysis of fire and explosion) and para. 6.77 expect the analysis to cover all means of fire prevention and control including fire detection and extinguishing. Para. 8.9 expects demonstration of systems for fire detection and control during commissioning. IAEA SSG-5 [8] expects that all rooms with both fire loads and significant amounts of fissile and/or toxic chemical material should be equipped with fire detection and alarms (except where the permanent presence of operators is sufficient). Para. 4.56 expects that to fulfil requirements of SSR-4 [12], para. 6.28 an emergency power supply should be provided for fire detection and alarm systems.

Subject to the graded approach selected for the different installations, the NAR should describe:

- the fire detection and alarm provisions (including subordinate systems to the extent applicable) to identify and notify occupants and fire emergency responders of any fire as needed according to the fire safety analysis (for reactor installations also including information to the control room, including systems' key features / technology and locations covered, and their emergency power and cable failure arrangements). For fuel cycle facilities, this should include a description of the balance between automated and manual detection and alarm provisions at the installation.
- to the extent practical, the approaches to assure that the systems are capable to withstand the relevant ambient / hazard conditions,
- to the extent practical, how independency between fire detection systems of adjacent compartments is achieved and maintained under hazard conditions,
- alternative arrangements applied when temporary works require fire detection to be disabled locally or globally,
- specifically for fuel cycle facilities, which and how fire detection systems (and/or other systems such as filter clogging detection and alarms, etc.) initiate operations on the confinement function in case of fire to limit radioactive releases.

03.2.2 Fire suppression

Following detection, the fire has to be extinguished and the installation has to be put into a safe condition.

The following WENRA SRLs correspond to fire extinguishing in nuclear power plants.

WENRA SV 6.9: Suitable fire extinguishing features shall be in place according to the fire hazard assessment. They shall be designed and located such that their rupture, spurious or inadvertent operation does not inadmissibly impair the SSCs important to safety.

WENRA SV 6.10: The fire water distribution network for fire hydrants outside buildings and the internal standpipes shall provide adequate coverage of all plant areas. The coverage shall be justified by the fire hazard assessment.

The following WENRA SRLs correspond to fire extinguishing in research reactors.

WENRA S 4.2: Fixed or mobile, automated or manual extinguishing systems shall be installed. They shall be designed and located so that their rupture, spurious or inadvertent operation does not significantly impair the capability of SSCs important to safety to carry out their safety functions.

WENRA S 4.3: The distribution loop for fire hydrants outside building and the internal standpipes shall provide adequate coverage of areas of the research reactor relevant to safety. The coverage shall be justified by the fire hazard analysis.

WENRA SRLs SV 6.9 and SV 6.10 developed for NPPs apply to facilities under decommissioning, waste storage facilities, dedicated spent fuel storage facilities and fuel cycle facilities based on the results of the fire safety analysis developed.

For fuel cycle facilities it should be noted that, as highlighted in IAEA SSR-4 [12], para. 6.79, fire extinguishing systems shall be demonstrated not to increase the criticality risk. For example, the use of water in certain areas may be prohibited or subject to specific authorisation procedures.

Subject to the graded approach selected for the different installations, the NAR should describe

- the approaches applied in the selection, design and location of fire extinguishing systems, according to the relevant fire hazard challenges to the SSCs important to safety and any related potential releases,
- key design characteristics of the fire extinguishing provisions including to the extent applicable seismic resistance, how the use of water may be excluded in certain areas, how adequate capacity and coverage of the water distribution network in all relevant plant areas is achieved, etc.),
- how harmful effects of inadvertent operation are taken into account and system reliability is assured,

- how secondary hazards from actuation or rupture of fire extinguishing systems (flooding, challenges to radiological containment, criticality, stored waste etc.) have been considered in the safety demonstration and operational arrangements,
- the balance between fixed fire extinguishing and manual firefighting that may be applied at the installation. This should include accessibility considerations during manual firefighting.
- specifically for research reactors and, if relevant for other installations: active fire protection specific to experiments if these are different than for other parts of the installation.

03.2.3 Administrative and organisational fire protection issues

The administrative and organisational aspects of fire safety are important considerations in addition to design provisions. Specifically, fire protection can significantly rely on organisational and administrative arrangements.

The following WENRA SRLs correspond to administrative and organisational fire protection issues in NPPs.

WENRA SV 5.10: Adequate organisational arrangements, including minimum staffing levels, equipment, fitness for duty, skills and training, and procedures shall be in place to ensure safety, as identified by the hazard assessment.

WENRA SV 6.11: In order to prevent fires, procedures shall be established to control and minimize the amount of combustibles and the potential ignition sources. In order to ensure the operability of the fire protection measures, procedures shall be established and implemented. They shall include examination, inspection, maintenance and testing of fire barriers, fire detection, alarm features and extinguishing systems.

WENRA SV 6.12: Written procedures that clearly define the responsibility and actions of staff in responding to any fire in the plant shall be in place and kept up to date. A firefighting strategy shall be developed, kept up-to date, and appropriate training provided, to cover each area in which a fire might affect SSCs important to safety.

WENRA SV 6.13: If plant internal firefighting capability is supported by offsite resources, there shall be proper coordination between the plant personnel and the offsite response group, in order to ensure that the latter is familiar with the hazards of the

The following WENRA SRLs correspond to administrative and organisational fire protection issues in research reactors.

WENRA S 5.1: In order to prevent fires, procedures shall be established to control and minimize the amount of combustible materials and minimize the potential ignition sources that may affect items important to safety. In order to ensure the operability of the fire protection measures, procedures shall be established and implemented.

They shall include inspection, maintenance and testing of fire barriers, fire detection and extinguishing systems.

WENRA S 6.1: The licensee shall implement adequate arrangements for controlling and ensuring fire safety, as identified by the fire hazard analysis.

WENRA S 6.2: Written emergency procedures that clearly define the responsibility and actions of site personnel in responding to any fire in the research reactor shall be established and kept up to date. A fire fighting strategy shall be developed, kept up-to date, and trained for, to cover each area in which a fire might affect items important to safety and protection of radioactive materials.

WENRA S 6.3: When reliance for manual fire fighting capability is placed on an offsite resource, there shall be proper coordination between the licensee's response group and the off-site response group, in order to ensure that the latter is familiar with the hazards of the research reactor.

The administrative and organisational aspects of fire safety are important considerations in addition to design provisions and physical measures. They are relevant also for waste storage facilities, dedicated spent fuel storage facilities and facilities under decommissioning. For waste storage facilities, as the fire events represent the prevailing risk for an unexpected release of radioactivity, administrative and organizational measures are important components to be reflected in emergency plans. For facilities under decommissioning, fire protection can significantly rely on organisational and administrative arrangements.

For example, temporary fire detection and suppression means may need to be deployed during hot works. Similarly, fire detection and suppression means may be unavailable or suspended and increasing reliance may be placed on administrative procedures, especially when the area is left unattended

WENRA SRLs SV 5.10, SV 6.11, SV 6.12 and SV 6.13 correspond to administrative and organisational fire protection issues in NPPs. SRLs covering similar administrative and organisational fire protection issues in research reactors are also available and could be considered for fuel cycle facilities where it is proportionate to do so. IAEA SSR-4 [12], para. 9.44 outlines IAEA expectations for fuel cycle facilities that "*specific training and drills for operating personnel, internal and external firefighters and other personnel relevant for emergency response shall be provided relevant to their assigned response functions in the event of a fire or explosion at the facility*" (see requirement 25 of GSR Part 7 [6]). The extent of the fitness for duty, skills, training and retraining programmes shall be in accordance with the potential hazards of the facility and its processes. IAEA SSR-4 [12], para 9.109 to 9.115 provide requirements for fuel cycle facilities on the expected licensee arrangements for ensuring fire safety.

Subject to the graded approach selected for the installations in the scope of the TPR, the NAR should briefly describe as appropriate:

- the firefighting strategies, how they are assured (written procedures, training provision, frequency of emergency exercises, key learning from past events, exercises, etc., to the extent practical) and how they are kept up-to date, in order to adequately fight any fire that might affect SSCs important to safety,

- written procedures in place clearly defining responsibility and actions of staff in responding to any fire in the installation and how they are kept up to date,
- administrative measures to ensure the operability of the fire protection measures over the lifetime of the installation including inspection, maintenance and periodic testing procedures (for research reactors only for those with a higher risk profile),
- firefighting capability, responsibilities and organisation (such as onsite plant internal fire brigade, organisation between onsite and offsite firefighters, etc.)[5], including
  - criteria for deploying onsite and offsite firefighting resources,
  - how coordination is achieved between the plant personnel and the offsite resources, if the plant internal firefighting capability is supported by offsite resources,
  - how it is ensured that the firefighting resources are familiar with the hazards of the plant, and adequate time for security control is provided,
- safety culture and how the above are reinforced through emergency training, drills and exercises,
- type and contents of firefighting documentation available to onsite and offsite firefighting resources,
- specific provisions for firefighting situations with loss of access routes
  - to the installation within the site boundary, and
  - with loss of access routes to the site.

Emphasis is expected on how the administrative measures above may be adapted to address specific considerations such as contamination, irradiation and criticality constraints.

03.3 Passive fire protection

Preventing the spread of those fires which have not been extinguished, thus minimizing their effects on essential plant functions is the third level of defence according to the defence in depth principles of nuclear fire safety and covered by the term “passive fire protection”, see Section 01.4.

The third level of the defence in depth concept is to assume both that fire extinguishing systems fail and that the firefighters do not respond quickly enough which causes fire development. Objectives of this level are to prevent the spread of fires and to limit the quantity of radioactive material involved in the fire. This shall minimize effects and consequences of fires not extinguished, particularly to avoid common cause failures and possible cliff-edge effects.

[5] This includes prioritisation of the different responsibilities of onsite firefighting resources if these resources are expected to also carry out other work.

03.3.1 Prevention of fire spreading (barriers)

The following WENRA SRL corresponds to the prevention of fire spreading through fire barriers in nuclear power plants by passive fire protection means.

> ***WENRA SV 6.5: Use of a fire compartment approach is preferred. The fire resistance rating of the fire barriers of the fire compartment shall be sufficiently high so that the total combustion of the fire load in the compartment can occur without breaching the barriers taking into account the fire hazard analysis. If a fire compartment [1] approach is not practicable, fire cells shall be used and duly justified by the fire hazard analysis. For fire barrier resistance assessment oxygen availability within and oxygen supply to the fire compartment shall be conservatively considered and justified.***

The following WENRA SRL corresponds to the prevention of fire spreading through fire barriers in research reactors by passive fire protection means.

> ***WENRA S 2.3: Buildings that contain equipment that is important to safety shall be subdivided into compartments that segregate such items from fire loads and segregate redundant or diverse trains of a safety system from each other. When a fire compartment approach is not practicable, fire cells shall be used, providing a balance between passive and active means, as justified by fire hazard analysis.***

WENRA SRL SV 6.5 for nuclear power plants applies also to waste storage facilities, dedicated spent fuel storage facilities and nuclear facilities under decommissioning according to the results of the fire hazard analysis.

WENRA SRLS have not yet been developed specifically with respect to prevention of fire spreading for fuel cycle facilities.

WENRA SRLs SV 6.5 and S 2.3 above correspond to the prevention of fire spreading through fire barriers in nuclear power plants and research reactors by passive fire protection means and should be considered for fuel cycle facilities where transferable. The interpretation and provision of fire compartmentation in fuel cycle facilities should be commensurate with the fire and radiological risks associated with the facilities.

Subject to the graded approach selected for the installations in the scope of the TPR, the NAR should briefly describe as appropriate:

- how the fire barriers forming fire compartment or fire cell boundaries are determined including the improvements made over the lifetime of the installation (e.g. to retain structural / mechanical integrity, to ensure delivery of the confinement function).,
- how it is ensured that the expected fire resistance and stability ratings are fulfilled
- measures taken to prevent spreading of fire, smoke and contamination between adjacent fire compartments / cells (HVAC systems, combustible free areas, etc).,
- how access routes for firefighting are maintained, and

- the process for justification that the fire barriers remain efficient under temporary and permanent evolution of the fire loads, operations increasing fire load and/or ignition sources (maintenance, modifications, etc.).
- specifically for research reactors with a lower risk profile and facilities under decommissioning: a global description of the fire compartments and/or fire cells, fire barriers, other means to prevent or delay the spreading of fire, use of self-fire extinguishing and/or fire resistant components (connecting doors) and materials, already existing in the installation and consider applicable to protect against fire during experimental work or decommissioning activities.
- the fire compartments and/or cells formed and a description of fire barriers and other means to prevent or delay the spreading of fire, use of self-fire extinguishing and/or fire-resistant components (connecting doors) and materials.

03.3.2 Ventilation systems

In the event of fire, changes in pressure and temperature can disrupt the circulation of air and give rise to uncontrolled transfers of radioactive material within the installation and eventually to the environment. Furthermore, a fire can damage filters and ventilation ducts and facilitate the transport of radioactive aerosols within the installation and/or to the environment.

The management of ventilation systems in case of fire therefore requires consideration. Objectives are to avoid the spreading of the fire and the risks associated with pyrolytic gases, smoke and other unburned material, and to facilitate intervention and control of fire consequences in the concerned areas, especially in terms of confinement. These objectives should be analysed in some specific areas to demonstrate that they do not unacceptably conflict with other safety requirements (e.g., keeping depressurisation, atmosphere circulation patterns, radiological confinement (filters), etc.).

Ventilation issues strongly depend on the operation and processes in a nuclear installation and therefore should be considered in the NAR.

The following WENRA SRLs correspond specifically to ventilation systems in nuclear power plants.

WENRA SV 6.6: Ventilation systems shall be arranged such that each fire compartment fulfils its segregation purpose in case of fire and designed such that the ventilation of other fire compartments which contain other trains of the safety system is maintained as far as required to fulfil their safety functions.

WENRA SV 6.7: If parts of the ventilation systems (such as connecting ducts, fan rooms and filters) are located outside fire compartments they shall have a fire resistance consistent with the fire hazard analyses or be capable of isolation from fire effects by appropriately rated fire dampers.

The following WENRA SRLs correspond specifically to ventilation systems in research reactors within the scope of the NAR:

> ***WENRA S 4.4: Ventilation systems shall be arranged such that each fire compartment fully fulfils its segregation purpose in case of fire.***
>
> ***WENRA S 4.5: Parts of ventilation systems (such as connecting ducts, fan rooms and filters) that are located outside fire compartments shall have the same fire resistance as the compartment or be capable of isolation from it by appropriately rated fire dampers.***

WENRA SRLs have not yet been developed specifically with respect to issues concerning ventilation systems for facilities under decommissioning, waste storage facilities, dedicated spent fuel storage facilities and fuel cycle facilities. Ventilation considerations are however significant for the confinement of radioactive materials in the event of fires.

WENRA SRLs SV 6.6 and SV 6.7 correspond to preventing fire spreading through ventilation systems in NPPs by passive fire protection means and can be interpreted in the context of the fire compartmentation that may be practicable and the provision of safety measures as redundant safety groups in these facilities.

WENRA SRL S2.4 can also be considered helpful to tackle this consideration in the context of fuel cycle facilities. This SRL expects that buildings that contain radioactive materials that could cause radioactive releases in case of fire shall be designed to minimize such releases.

Subject to the graded approach selected for the installations in the scope of the TPR, the NAR should briefly describe for areas of the installation equipped with ventilation systems, as appropriate:

- how the ventilation systems are designed in order to not compromise building compartmentation and to maintain access routes for firefighting,
- [not for research reactors with a lower risk profile] how the ventilation systems in fire compartments separating redundant trains of a safety system are designed such that a fire in one compartment will not propagate to another, including fire effects such as loss of ventilation in a compartment of another redundant train, and
- [not for research reactors with a lower risk profile] in case that a ventilation system serves more than one fire compartment, the provisions that are in place to maintain segregation between fire compartments to prevent the spread of fire, dangerous fire by-products, and other hazardous (e.g., asphyxiant, combustible, corrosive, toxic and/or radioactive) substances, if any, to other fire compartments,
- [not for research reactors with a lower risk profile] the fire resistance rating of ventilation systems, and any possibilities to isolate the fire compartment penetrations by suitably rated fire dampers (automatically where appropriate),
- means available to prevent the spread of fire,

- specifically for fuel cycle facilities: confinement provisions used in case of fire (static or/and dynamic confinement and the strategy regarding the maintenance of dynamic confinement considering the risk of fire propagation through ventilation systems.

3.4 Licensee's experience of the implementation of fire protection concept

The NAR should describe the licensee's experience on the implementation of the fire protection concept. The NAR should identify strengths and weaknesses in this area and the actions to address them. Lessons learnt from events, OSART, INSARR and/or equivalent should be presented.

3.5 Regulator's assessment and conclusions on fire protection concept

The regulator should report:

- its assessment of the fire protection concept described in this chapter;
- its experience from inspection on the implementation of the fire protection concent and assessment as part of its regulatory oversight;

The regulator should also present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the fire protection concept.
The regulator's conclusions on the adequacy of the licensee's fire protection concept and its implementation should be presented.

04 Overall assessment and general conclusions

The conclusions on the adequacy of the licensee’s overall fire safety approach should be presented.

This information can be grouped by the licensee and/or the type of installation.

The regulator should also report its general conclusions, bringing together the outcomes of the review in the national assessment report. This should identify areas for improvement or potential good practices that have been identified in the earlier parts and any actions that result from an overview evaluation of the self-assessment.

References

1 WENRA: Report Safety Reference Levels for Existing Reactors Revision 2020, 17th February 2021.

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4 WENRA WGWD: Report Decommissioning Safety Reference Levels - Version 2.2, 22 April 2015.

5 International Atomic Energy Agency (IAEA): Fire Safety in the Operation of Nuclear Power Plants, Safety Guide No. NS-G-2.1, IAEA Safety Standards Series, Vienna, Austria, 2000.

6 International Atomic Energy Agency (IAEA): The Operating Organization for Nuclear Power Plants, Safety Guide, IAEA Safety Standards Series No. NS-G-2.4, Vienna, Austria, 2001.

7 International Atomic Energy Agency (IAEA): IAEA/NEA Fuel Incident Notification and Analysis System (FINAS) Guidelines, IAEA Services Series 14, Vienna, Austria, September 2005.

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16 International Atomic Energy Agency (IAEA): Protection against Internal Hazards in the Design of Nuclear Power Plants, Specific Safety Guide, IAEA Safety Standards Series No. SSG-64, Vienna, Austria, August 2021.

17 National Fire Protection Association (NFPA): NFPA 97: Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances, 2003 Edition, Quincy, MA, USA, 2003.

18 OECD Nuclear Energy Agency: FIRE (Fire Incidents Records Exchange) Database Project: OECD/NEA FIRE Coding Guideline (OECD/NEA FIRE-CG 2019:01), Paris, France, October 2020.

Annex 1

Glossary

A glossary of terms internationally used in the context of nuclear fire safety or of this TPR is provided in this section. The NAR should follow this terminology in order to avoid misinterpretations.

Barrier (from IAEA Glossary 2018 [15]): A physical obstruction that prevents or inhibits the movement of people, radionuclides or some other phenomenon (e.g., fire), or provides shielding against radiation ().

Conversion Facilities (from [AEA Glossary 2018 [15] and IAEA SSG-5 [8])**:** Facilities used to generate uranium hexafluoride [from uranium concentrate]. Generally, in a conversion facility or an enrichment facility, only natural uranium or LEU that has a 235U concentration of no more than 6% is processed. Typical process routes are outlined in Annex I of IAEA SSG-5 [8].

Criticality (from IAEA Glossary 2018 [15]): The state of a nuclear chain reacting medium when the chain reaction is just self-sustaining (or critical), i.e. when the reactivity is zero. Often used, slightly more loosely, to refer to states in which the reactivity is greater than zero).

Criticality accident (from IAEA Glossary 2018 [15]): an accidental release of energy as a result of unintentionally producing a criticality in a facility in which fissile material is used. A criticality accident is also possible for fissile material in storage or in transport.

Event (from IAEA Glossary 2018 [15]): In the context of the reporting and *analysis* of *events*, an *event* is any occurrence unintended by the *operator*, including operating error, equipment *failure* or other mishap, and deliberate action on the part of others, the consequences or potential consequences of which are not negligible from the point of view of *protection and safety.*

Fire (from OECD/NEA FIRE Database [18]): A fire is defined as follows:
- A process of combustion characterized by the emission of heat accompanied by (open) flame or smoke or both,
- Rapid combustion spreading in an uncontrolled manner in time and space.

Fire barrier element (from IAEA SSG-64 [16]): Elements of the fire barrier, e.g., walls, ceilings, floors, doors, dampers, penetration seals.
Explanatory remark: Some elements are purely passive, such as walls, floors, or ceilings. However, elements with active functions, such as fire doors, fire or smoke dampers, etc., are also fire barrier elements.

Fire cell (from IAEA NS-G-2.1 [5]): Fire cells are separate areas in which redundant items important to safety are located. Since fire cells may not be completely surrounded by fire barriers, spreading of fire between cells should be prevented by other protection measures. These means include the following:

(a) The limitation of combustible materials,

(b) The separation of equipment by distance, without intervening combustible materials,

(c) The provision of local passive qualified fire protection such as fire shields or cable wrap;,

(d) The provision of fire detection and extinguishing systems.

Fire compartment (from IAEA SSG-64 [16] and formerly [NS-G-1.7]): A fire compartment is a building or part of a building that is completely surrounded by fire resistant barriers: all walls, the floor and the ceiling. The fire resistance rating of the barriers should be sufficiently high that total combustion of the fire load in the compartment can occur (i.e. total burnout) without breaching the fire barriers. (from IAEA SSG-64 [16]).

Fire Hazard Analysis (FHA) (from OECD/NEA FIRE Database [18] and IAEA SSG-64 [16]): An analysis to evaluate potential fire hazards and appropriate fire protection means to mitigate the effects of fire in any plant location). According to [[16], a FHA is a deterministic analysis and needs to formally meet specific requirements provided there.

Fire load (from OECD/NEA FIRE Database [18] and IAEA SSG-64 [16]): The heat of combustion of the combustibles. The fire load [MJ] is calculated as product of mass of combustibles and corresponding calorific value.

Fire load distribution (spatial) (from IAEA SSG-64 [16]): Distribution of different combustibles over a given space; it can be distinguished between uniformly distributed fire load, non-uniformly distributed fire load, point fire load.

Fire prevention (from OECD/NEA FIRE Database [18] and description in IAEA SSG-64 [16]): Preventing the occurrence of any fire

Fire protection feature (from OECD/NEA FIRE Database [18] and IAEA SSG-64 [16]): Structural elements (passive such as walls, floors, ceilings, beams, and active such as doors, hatches, dampers, etc.) and technical equipment (fire detection and alarm systems and equipment, fire extinguishing systems and equipment, including their extinguishing media supplies)

Fire protection means (from OECD/NEA FIRE Database [18]): Active and passive means to protect a target against effects from fires.

Fire protection measure from OECD/NEA FIRE Database [18]): Active means covering also human actions and procedures for protecting a target against the effects of fire.

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Nuclear Regulators Association

Fire resistance (from [16]): The fire resistance of fire barriers is characterized by stability, integrity and insulation under fire conditions.

Fire safety analysis (adapted from IAEA Glossary 2018 [15]): Evaluation of the potential fire hazards associated with the operation of a facility or the conduct of an activity.

- The fire safety analysis is part of the overall fire safety assessment; that is, it is part of the systematic process that is carried out throughout the design process (and throughout the lifetime of the facility or the activity) to ensure that all the relevant safety requirements are met by the proposed (or actual) design.
- Fire safety analysis is often used interchangeably with fire safety assessment. In the context of this Technical Specification they comprise the analyses and assessments undertaken for the evaluation of fire safety.
- The term fire safety analysis covers both, deterministic fire safety analyses such as a *Fire Hazard Analysis* (FHA) as well as a probabilistic fire risk analysis (so-called Fire PSA).

Fire source: The component where the fire originated from, including the combustibles and the corresponding ignition source.

Fire suppression (from NFPA 97 Glossary [17] and OECD/NEA FIRE Database [18]): The sum of all the work done to extinguish a fire from the time of its discovery.

Fitness for duty (from IAEA NS-G-2.4[6]): An individual's suitability for duty, addressing adequate physical and mental fitness and aspects such as the illicit use of drugs or tobacco and alcohol abuse, in consonance with national regulations.

Fuel cycle facilities (from AEA SSR-4 [12] and IAEA/NEA Fuel Incident Notification and Analysis System (FINAS) Guidelines [7]): Nuclear fuel cycle facilities are nuclear facilities, other than nuclear power plants, research reactors and critical assemblies, in which nuclear material and radioactive material are processed, handled, stored and prepared for disposal, in quantities or concentrations that pose potential hazards to personnel, the public and the environment. Nuclear fuel cycle facilities include facilities for:

(a) mining and processing of uranium and thorium ores,

(b) conversion and enrichment of uranium,

(c) reconversion and fabrication of nuclear fuels of all types,

(d) interim storage of fissile material and fertile material before and after irradiation,

(e) production of nuclear energy for power, research and other purposes,

(f) reprocessing of spent nuclear fuel and breeder materials from thermal reactors and fast reactors,

(g) associated waste conditioning, effluent treatment and facilities for interim storage of waste that allow for retrieval of the waste for later disposal,

(h) separation of radionuclides from irradiated thorium and uranium,

(i) related research and development.

Consistently with the article 3 of the NSD, the above mentioned facilities (a), (d) and (i) are not included in the scope of the TPR. From the facilities mentioned in (g), only interim waste storage facilities are included in the scope of the TPR since they are directly related to installations included in the scope of the TPR.

Ignition (from NFPA 97 Glossary[17] and OECD/NEA FIRE Database [18]): The initiation of combustion evidenced by glow, flame, detonation, or explosion, either sustained or transient; the moment when a fire first occurs.

Ignition source (from NFPA 97 Glossary [17] and OECD/NEA FIRE Database [18]): Any item or substance capable of an energy release of type and magnitude sufficient to ignite any flammable mixture of gases or vapours that could occur at the site (e).

Incident (from IAEA Glossary 2018 [15]): Any unintended event, including operating errors, equipment failures, initiating events, accident precursors, near misses or other mishaps, or unauthorized act, malicious or non-malicious, the consequences or potential consequences of which are not negligible from the point of view of protection and safety.

Item important to safety (from IAEA Glossary 2018 [15]): An item that is part of a safety group and/or whose malfunction or failure could lead to radiation exposure of the site personnel or members of the public. Items important to safety include:

- Those structures, systems and components whose malfunction or failure could lead to undue radiation exposure of site personnel or members of the public,
- Those structures, systems and components that prevent anticipated operational occurrences from leading to accident conditions,
- Safety features (for design extension conditions),
- Those features that are provided to mitigate the consequences of malfunction or failure of structures, systems and components.

Reprocessing (from IAEA Glossary 2018 [15]): A process or operation, the purpose of which is to extract radioactive isotopes from spent fuel for further use.

Safety groups (from IAEA Glossary 2018 [15]): The assembly of equipment designated to perform all actions required for a particular initiating event to ensure that the limits specified in the design basis for anticipated operational occurrences and design basis accidents are not exceeded.

Site (area) (adapted from [WENRA SRL 2020]): The geographical area that contains an authorized nuclear facility. It is enclosed by a physical barrier to prevent unauthorized access and the management of the authorized facility can exercise direct authority over it (in accordance with IAEA SSR-3 [11], IAEA SSG-64 [16] and the IAEA Safety Glossary [15]).

Uranium Enrichment Facilities: Facilities used to increase the ratio of U-235 isotope to others in order to produce fuel for nuclear reactors. At present, enrichment facilities use either the gaseous diffusion process or the gas centrifuge process, both of which require prior conversion of uranium oxide into a fluoride - see conversion facilities. Typical process routes for enrichment facilities are outlined in Annex II of IAEA SSG-5 [8].

Annex 2

Detailed contents list for the NARs (Template)

Annex 3

Abbreviations used in this specification

FCF	fuel cycle facility
FHA	fire hazard analysis
NAR	national assessment report
NPP	nuclear power plant
PSR	periodic safety review
PSA	probabilistic safety analyses
RR	research reactor
TPR	technical peer review
V&V	validation and verification
VLLW	very low level waste
WGWD	working group on waste and decommissioning

Annex 4

Description of the coordinated sampling approach

The “TPR coordinated sample” has been prepared through the combination of national selections of installations, proposed by the regulators. The TPR coordinated sample has been reviewed by the Board of the TPR and approved by ENSREG prior to the beginning of the TPR.

The approach to develop the coordinated sample is presented in the diagram below.

The NAR will present the national selection of candidate facilities along with the rationale to select them. The NAR will also list the represented facilities.

National selections have been made following the recommendations below:

- The national selection should include at least one facility of each category adressed by the NSD, if present in the participating country and likely to present a significant radiological risk in case of fire.
- The sample shall be representative of the various types of installations and technologies.
- candidate facilities should be selected considering similarities with regard to the fire safety concept implemented.

Qualifying installations are installations in the scope of the NSD which present a significant radiological risk for people and the environment in case of fire (see Section 00.3).

The process involved the development of national lists of ‘candidate installations’ from the regulators’ master list of all qualifying installations.

The term ‘candidate installations’ refers to installations that will be reported on in the individual NARs.

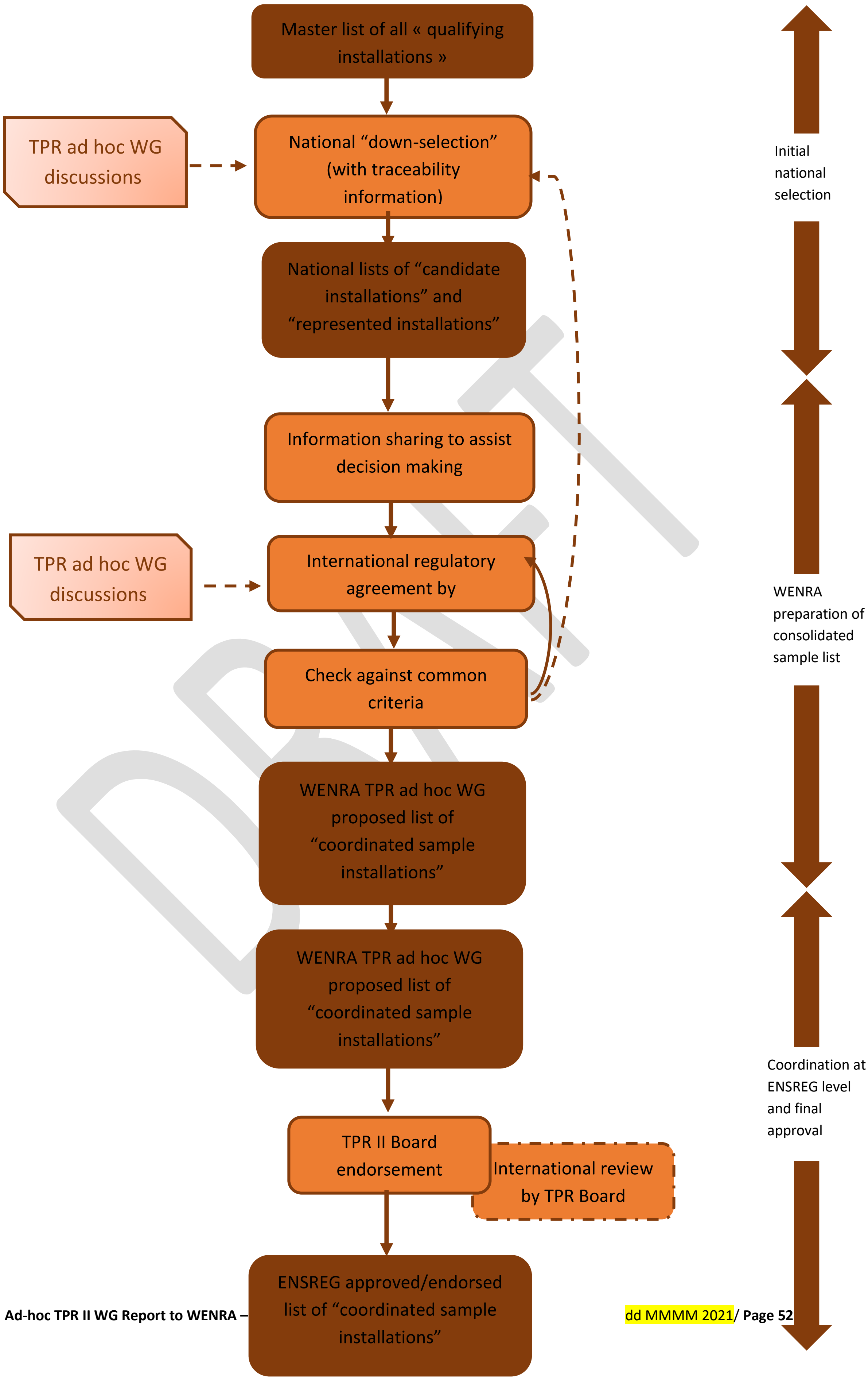
Candidate facilities should be selected in order to allow the identification of good practices and areas for improvement. Thus it is important to balance the selection.

The initial selection was then refined through iterative exchanges in the WENRA TPR working group. The iterations were guided by the following set of criteria:

- Ensuring that the various types of installations and technologies (within each installation type) are represented.

- Ensuring that, in grouping installations within each type, due account was taken of the potential fire safety hazard and risks (including the inventory and state / mobility of the radioactive substances) and the variability in the type of fire safety approaches implemented (i.e. selected installations will be representative of implemented similar approaches).
- Ensuring that the final list of candidate installations presented to the TPR board would result in all ‘represented’ installations (i.e. installations not reported in the NARs) receiving transferable insights from those reported.
- Ensuring that all participating countries are involved proportionately to their nuclear estate in scope of TPR.

The list of proposed candidate installations was reviewed and endorsed by the Board of the TPR and approved by ENSREG prior to the beginning of the TPR.


Master list of all « qualifying installations »
TPR ad hoc WG discussions
National "down-selection" (with traceability information)
National lists of "candidate installations" and "represented installations"
Information sharing to assist decision making
TPR ad hoc WG discussions
International regulatory agreement by
Check against common criteria
WENRA TPR ad hoc WG proposed list of "coordinated sample installations"
WENRA TPR ad hoc WG proposed list of "coordinated sample installations"
TPR II Board endorsement
International review by TPR Board
ENSREG approved/endorsed list of "coordinated sample installations"
Initial national selection
WENRA preparation of consolidated sample list
Coordination at ENSREG level and final approval