ENSREG Second Topical Peer Review, Summary Report on First Stakeholder Meeting, 22 June 2021

On 22nd June 2021, ENSREG and the European Commission organised the first stakeholder meeting on the second Topical Peer Review (TPR), which was held online. TPR is a new requirement enshrined in the amended Nuclear Safety Directive of 2014 (NSD). It is a permanent mechanism for EU Member States to examine topics of importance to nuclear safety, to exchange experience and to identify opportunities to strengthen nuclear safety. This process takes place at least every six years.

The topic of the first TPR (2017-2019, TPR-1) was the ageing management of nuclear power reactors and large research reactors; the topic of the second TPR (2023-2024, TPR-2) is fire protection at nuclear installations.

This 'kick-off' event aimed at bringing together stakeholders at an early stage of the TPR-2 process. It was organized in two sessions, each followed by a panel discussion. In the panel discussions, comments and questions from the stakeholders including the public were addressed. The first session was to inform about the background and the objectives of the EU-wide TPR exercise. Various stakeholders expressed different views and expectations. Regarding general aspects, i.a. the need for avoidance of overlaps with regard to other peer reviews and for complementarity in terms of content and time was highlighted. Moreover, the need for clear guidance, concrete measures and full implementation thereof was expressed. The second session served to give a first opportunity for stakeholders interested in the topic to meet and exchange ideas on the technical issues of fire protection and fire-prevention at nuclear installations. Also, an overview of the scope of TPR-2 was given. Aspects to be examined included material/equipment and procedures/processes as well as human factors. Regarding the topic of fire-safety at nuclear installations, it was shown that already many sources, data, preparatory work are available and several projects ongoing (e.g. in IAEA, NEA).
With a total of 128 external participants, the event was well attended, including several participants from outside of the EU. More than 102 connections on the webcast were registered. During the panel discussions, the chat box counted 31 comments and questions. Those contributions, together with the views expressed by the different speakers help to further improve TPR-2.

It was important to have this meeting early in the process and to record the interest shown through the chatbox. In the next steps, factsheets will be issued in all EU languages to inform about the TPR. One proposal to strengthen public participation was to establish a standing focus group, to give feedback and views on present and future TPRs. This should be a balanced group, to also include people with specific knowledge about the respective topic. Various other documents like the technical specifications and process documents are being developed and will be submitted to a public consultation in 2022. There will be further opportunities during the peer review phase for the stakeholders to be involved in the peer review.

Closing the event, it was reminded that there is a more comprehensive process for stakeholder involvement for TPR-2 compared to TPR-1. Participants were invited to take up the possibilities to be involved. The process of topic selection has shown the consensus that fire protection is an important topic for nuclear safety. The European Commission attaches great importance to the TPR, not only because it is a legal

requirement under the NSD, but also to ensure that the TPR outcomes are meaningful and can add value to nuclear safety.

Annex: Detailed Report of the Meeting

Session 1: Background, objectives of the Topical peer review (TPR)

Andreas Molin (ENSREG member, Austria) the session Chair, welcomed participants and recalled that ENSREG has since its foundation placed great emphasis on transparency and public participation.

In her opening address, Marta Žiaková, the Chair of ENSREG (European Nuclear Safety Regulators Group), highlighted its role as an independent, expert advisory group to the European Commission. ENSREG promotes continuous improvements of nuclear safety facilitates the implementation of the Nuclear Safety Directive and the Waste Management Directive; improves cooperation between the Member States on nuclear safety and radioactive waste issues; improves overall transparency on nuclear safety and radioactive and spent fuel management; and advises on proposals for additional EU-wide provisions in these areas.

Jan Panek, Director for Nuclear Energy, Safety and ITER in DG Energy set the scene for the discussions, recapitulating the key elements from TPR-1 and the stress tests. He highlighted the multi-party character of the exercise, involving players at the national level, European level, and international level, as well as the input from civil society and NGO's. The TPR process, inspired by the post-Fukushima stress tests, establishes a regular EU-wide peer process, at least every 6 years, on a topic of safety significance. Besides the review involving licensees, regulators and experts, the process foresees public participation through public consultations, stakeholder meetings, and opportunities to pose questions during the review. The EU-level peer reviews, have promoted regulatory and technical cooperation, enabled tangible safety improvements, and sharing of good practices.

Petteri Tiippana, Director Gen of STUK, Finland talked about his experience of TPR-1 as Chair of the TPR-1 Board. He presented some aspects of the experience of the 1st topical peer review, the importance of the topic selection and relevance for nuclear facilities, the need to allow enough time for the process, and preparing guidance for the peer review experts. He highlighted the importance of the self-assessment produced by licensees and regulators. The peer review complements that assessment, and through the findings of the peer review and delivery of the national action plan, safety improvements can be achieved. There are numerous achievements from TPR-1, but also challenges have to be recognised.

Sylvie Cadet-Mercier, ASN France, and Chair of the TPR-2 Board, provided an overview of the different stages of the process, scope and goals of TPR-2 to allow an in-depth examination of safety significant topics. The TPR Board is responsible for providing the main orientations. Since fire protection is relevant to all facilities, the scope will cover nuclear power plants (NPPs), enrichment plants, reprocessing plants, research reactor facilities, spent fuel storage facilities, as well as storage facilities for radioactive waste related to these installations. It will cover all stages of the lifecycle. The review will follow the defence-in-depth approach including measures to prevent fires from starting, measures to detect, extinguish, prevent the spread of fires and their effects on nuclear safety. The process involves a national assessment according to technical specifications prepared by WENRA, a peer review (desktop-review, workshop, preparation of reports), and a final follow-up phase.

Patrick Majerus, ENSREG Member Luxembourg and ENSREG WG3 Chair presented proposals for further stakeholder involvement engagement in the TPR process, taking account of lessons from TPR-1. The aim is to better inform about the TPR activities, and secondly to seek more active engagement of stakeholders who could contribute to improving the process in the longer term. The first part includes the production of information factsheets aimed to better describe and help to inform about the TPR process. The second aim is to foster more continuity in stakeholder involvement throughout the peer review process, and collect relevant contributions.

Panel discussion on the value of European peer reviews

- Petteri Tiippana, Director General, STUK, Finland
- Roger Lundmark, Chairperson, ENISS (European Nuclear Installations Safety Standards)
- Jan Haverkamp, Vice President, Nuclear Transparency Watch
- Massimo Garribba, Deputy Director General, DG ENER, European Commission

Each panellist started with an introductory remark:

- Petteri Tiippana said TPR is a significant tool for regulators, and for licensees as well. It is a fairly novel approach to select a topic, discuss nationally, regionally, and even globally, with the aim to evaluate safety and to identify improvements. It also allows to study good practices from other countries. Outcomes are sent to WENRA and IAEA to help improve standards.

- Roger Lundmark described that ENISS represents a group of licensees joining forces together for nuclear safety. TPRs offer an opportunity for benchmarking, sharing of experience, and provide confidence in the completeness and adequacy of the practices. He insisted on the importance to ensure complementarity of the various peer reviews, having in mind the resources available. ENISS emphasized that safety significance relates to the design and manufacturing of the different plants. It is important to reinforce communication, and have clarity about the expectations. Strengthened guidance on structure and layout of the national reports would be welcome. One focus point is on a common understanding and alignment: Clear assessment criteria should be set in advance and endorsed amongst the peer reviewers, and country delegations should include experts from licensees. The reviewed parties need to understand and accept the review findings.

- Jan Haverkamp remarked that the TPR mechanism is in principle a very positive innovation. Both the post-Fukushima EU stress tests and TPR-1 were qualitatively much better than international reviews – since the scope was wider, there were opportunities for stakeholder participation, and there was more transparency. However, the aim of transparency is not to create more credibility or buy-in of the industry, but rather to improve the quality of the outcome. Greenpeace's review of the outcome of the post-Fukushima national action plans showed that many outputs consisted of studies, and actions were delayed or not fully implemented. The TPR-1 exercise on ageing management was very technical and came out with minimal outcome. He set the challenge whether TPR-2 on fire

protection would see regulators and licensee think the unthinkable, and whether it will lead to real measures.

- Massimo Garribba recalled the experience of the post-Fukushima stress tests. In the beginning, there was scepticism about the idea in the industry, amongst regulators and even NGOs. However, the stress tests provided a unique, collaborative opportunity to compare practices and identify reasonably practicable improvements. This was the inspiration behind the TPR mechanism, designed to be flexible based on a chosen topic of safety importance. The Directive guarantees a high level of transparency in the exercise, but he expressed regret that public participation in TPR-1 was not as high as wanted. We have seen that the stress tests methodology has been adopted outside EU – in Armenia, Belarus. The topic of the first TPR was pertinent, but the realisation could have been improved. There are also a number of ingredients that are important for the TPR - openness and cooperation, bringing together regulators and licensees, a willingness to be self-critical and to learn from each other. there is need to balance the resources needed and ensure an appropriate timetable. However, the resulting recommendations have to be challenging. He stressed that transparency of reporting is a key element as well as adequate follow up of the findings and recommendations. He recalled that some actions of the EU stress tests are still outstanding. The ENSREG process to regularly follow up implementation is valuable.

During the panel discussions comments and questions received through the chat function were replied to, as follows:

- Concerning the experience of TPR-1 and changes to TPR-2, there was agreement on a need for earlier expert nomination and development of guidance. For TPR-2 it is anticipated to increase the time for the self-assessment and the desktop review, and more time will be allocated to develop the report.

- Switzerland, Ukraine and Norway had participated voluntarily in TPR-1. For EU Member States, participation is mandatory. Observer countries of ENSREG will be invited to participate in TPR-2.

- Some comments were made on nuclear emergency preparedness and response, as well as on nuclear liability and insurance, neither of which were covered by the stress tests. It was pointed out that EP&R matters are dealt with under the BSS, but that nuclear liability and is treated in a different part of the Euratom Treaty and is not part of specific EU legislation.

- It has been agreed that international peer reviews should be used as much as possible, but one should be careful not to overlap. A peer review provides a snapshot – but it is not a comprehensive safety review. It is true that some actions from earlier reviews have still not been implemented, but countries have to prioritise due to other areas of significance. TPR-1 showed that for NPPs ageing management programmes exist, and are implemented in line with IAEA standards and WENRA reference levels.

- In response to a suggestion that licensees should be involved in the peer review itself, it was noted that licensee input was important to improve the efficiency

and effectiveness of the process but independence of the review and its outcomes has to be guaranteed.

- Concerning a comment that the TPR and its criteria only ensure the level of status quo and it does not result in improvements, it was replied that regulators and ENSREG/WENRA are committed to continuous improvement. Whether outcomes are marginal or bigger – that may vary on the situation. The findings in TPR-1 were not revolutionary but evolutionary.

Session 2: 'Fire protection' – The topic for TPR-2

The afternoon session which looked at the choice of fire protection as a topic and information on operating experience at nuclear installations was chaired by Michael Huebel, Head of Unit – Radiation Protection and Nuclear Safety, Directorate D, DG ENER.

In her presentation, Gila Stoppa, Chair of WENRA RHWG, discussed the process for selecting the topic of TPR-2, and the reasons for the choice of 'fire protection'. Starting from a long list of candidate topics, a shortlist of topics was arrived at following a scoring process in which member countries took account of selection criteria presented by WG1 as well as their own interest. After a process of elimination, a shortlist of 4 potential topics was approved by WENRA for submission to ENSREG. Amongst the reasons for the choice of 'fire protection', is the fact that fire is a significant risk to all nuclear installations. It is also an area where reasonably practicable improvements are possible and there is room for harmonization. There is a large experience feedback on fire related events, and it may provide useful operating experience. Issues that could be considered in the review are internal hazards caused by fires, how fire hazards analysis addresses different causal events, and implementation of compartmentalisation and segregation means.

Kai Weidenbrück, Vice-chair of TPR-2 Board, presented WENRA's development of the TPR-2 technical specifications. An ad-hoc working group of WENRA is currently working on the technical specifications, and a template and guidance for the national assessment reports. The scope is expected to cover the installations covered by the NSD. The ad-hoc group comprises 20 persons from 13 WENRA countries, and covers WENRA working groups for power reactors, research reactors, waste and decommissioning, and includes experts for fuel cycle facilities. The technical specifications will follow a logical order related to fire protection, taking account of the defence-in-depth approach and recently published WENRA reference levels. The thematic areas being considered are: Experience and research feedback and major modifications, fire prevention, active fire protection, passive fire protection, and fire-hazard analysis (for NPPs and large RRs). The timetable foresees stakeholder involvement during the summer, and preliminary presentation to ENSREG in November.

Kazufumi Nagashima of IAEA, presented the IAEA safety standards for fire protection, and described the review missions. The many IAEA standards covering nuclear power plants are established under two specific requirements. One defines the functional requirements in terms of design, and the other for commissioning and operations phase, under the codes SSR-2/1 and SSR-2/2 respectively. In addition, there are five safety guides which provide recommendations on fire safety in design and safety assessment aspects, and operational aspects. The specific safety guide on protection against internal

and external hazards in the Operation of NPPs (NS-G-2.1) is currently being revised (as DS503). A clear segregation is made with the new design guide SSG-64 on Protection against internal hazards in the Design of NPPs. The revision of NS-G-2.1 is aimed at covering wider range of hazards and their combination in line with the Vienna Declaration on Nuclear Safety. Operating experience gained from events shows that fire continues to be an important risk contributor amongst other hazards. The draft is still subject to change, but it reflects the experience of IAEA Member States, such as interfaces with security, awareness of hot work and importance of ventilation, and more realistic assumptions when relying on external firefighting service. Provisions have been added to address other hazards, particularly flooding by fire extinguishing water, and external fires. It is expected to be published in 2022 or 2023. The new guide, SSG-64 "Protection against Internal Hazards in the Design of NPPs, adopts a unified approach to all internal hazards, with fire being covered extensively. Defence-in-depth is used as an underlying principle when considering protection against internal hazards, and specific recommendations for fire hazard analysis are provided. The deterministic safety analysis is covered by SSG-2 (Rev.1), whilst probabilistic safety assessment is covered by SSG-3 and SSG-4. IAEA has been providing OSART missions, a service to review the operational safety of nuclear power plants, for almost 40 years. As of 2020, more than 200 missions have been conducted to provide international independent assessments against IAEA safety standards. IAEA publishes highlights every three years, summarizing the results and trends of the OSART reviews, describing common issues such as control of combustibles, integrity of fire compartments, and arrangements for hot works (covered in the more detail in the next presentation). Recently IAEA has issued a technical document, TECDOC-1944 on fire protection in NPPs. This summarizes the experience of the Member States, in terms of both design and operation. It covers the design of passive and active protection systems, fire risk analysis, and operational aspects such as fire prevention measures and fire-fighting. It also discusses the good practices identified in recent OSART missions.

Miguel Peinador from the Joint Research Centre (JRC) made a presentation on recent events and operating experience related to fire hazards at NPPs to provide context to the TPR topic based on actual issues observed in the field as opposed to programmatic ones. The sources of information include fire events in the last ten years or so reported by NPP operators, relevant findings from international peer reviews, as well as a literature review. In the IAEA/NEA IRS database, there were 39 reports related to fire (5% of the total). Most of the reported events were rated INES 0 or 1. Additional events were linked to flooding caused by fire protection systems. Some representative examples of fire events in the database include: a high-energy arc flash in a cabinet causing damage to another safety related system; delayed confirmation of fire on a coolant pump; inadequate separation of cables; inadequate management of the response to a fire in a cabinet that caused loss of feedwater; arc flash in a cubicle due to foreign conductive material causing worker injury and damage to a compliant fire door; and non-compliant fire barriers. Examples of findings from OSART missions related to: inadequate control of ignition sources or combustible materials; inadequate design, installation, or maintenance of fire barriers; inadequate drills or training of on-site fire services; and organisational issues leading to delays in fire response. A cross-reference of these events against the WENRA safety reference levels (SRLs) on fire protection (SV1-SV6) shows that the SRLs can serve as a framework to cover relevant operational experience. However, a different question is whether the SRLs provide a sufficiently detailed basis to support the TPR or whether additional guidance should be considered. In the context

of limited time and resources devoted to the TPR, past operating experience provides an indication of the areas that should be retained in the scope.

Marina Rowekamp from GRS and chair of the OECD/NEA FIRE database project described fire events in NPPs and operating experience collected in the database. Since the late 1990's there has been interest to collect data on fire events in a consistent, comprehensive way and over the long term, given that fire events are relatively infrequent, to be able to draw meaningful conclusions about the different causes and to draw lessons about prevention and mitigation. The current phase of the project has 14 member countries from Europe, Asia and North America. The project collects fire events experience by international exchange, analyses them to understand their causes in order to derive approaches to prevent or mitigate them, contributes to prevention policies through development of indicators for risk-informed and performance-based inspections, and records fire events characteristics to facilitate fire risk analysis.
The database covers more than 550 events, in different reactor types, representative of more than 9700 reactor-years operation. Data is collected systematically to generate generic fire frequencies for different reactor types and plant operational states for PSA use, including different locations and room types, and operational modes. About two-thirds of events are associated with operations, and one-third in low-power or shutdown modes, with fewer cases in construction. The major apparent causes can be summarised as electrical overheating (34% human error), mechanical overheating (25% human error), high energy arcing faults (26% human error), hot work (100% human error). In operations mode, of three categories of root causes, the most common were equipment related (78%), human actions (29%), procedural (14%), whereas for low-power and shutdown modes the corresponding rates were equipment (27%), human (19%) and procedural (6%). Event combinations of fire with other hazards is also studied. Some of these did not affect plant safety, but are significant precursors. Operational experience shows the importance of high energy arcing faults (HEAF) as an important phenomenon for causing fires, and their non-negligible contribution even in a unit that has stopped commercial operation. The data can be used for assessment by regulators, looking at fires as single events or as combined events with other events or hazards that could have consequential effects. Events could have a common cause, or could occur independently, or sequentially. She gave the example of a long duration flood on site which hampered response to a fire that had occurred independently. In the recent past there has been a strong emphasis on observations from such combinations. There is work to improve models for fire simulations, covering real scenarios.
For generating generic fire frequencies, Member countries report systematically on occurrences, with corresponding plant data to ensure a complete history of event data. PSA activities are done in different manner, sometimes starting with occurrence frequencies based on buildings or room types e.g. cable rooms, process rooms or switchgear room, ventilation rooms (compartment approach). Other countries collect data based on component types. For specific cases, generic frequencies can be calculated. Differences between operations and low-power or shutdown modes can be compared. The data on a component basis shows that high-energy arc fault plays an important role. Information on cables is not so easy compared other components and is the subject of on-going work. In terms of apparent causes, data shows a link with mechanical issues, and an association with human factors. Amongst root causes, the majority of events in operations are equipment failures, but human factors and procedures are non-negligible. Event combinations of fire with other hazards generally did not affect plant safety but can be significant precursors. In the future, the aim is to extend the database

to larger research and demonstration reactors, and collect data from decommissioning units, and extending database to inspection and maintenance data.

Panel discussion on the topic of fire-safety at nuclear installations

- Raquel Velasco, ANAV/ENISS
- Roger Millis, EDF Energy, Nuclear Industry Fire Safety Coordinating Committee
- + previous speakers.

The 2 panellists that had not given a presentation started with an introductory remark:

- Raquel Velasco of ANAV presented the views of ENISS licensees on fire safety at nuclear installations. ENISS has formed a fire safety task force group for this TPR. In view of the nuclear safety significance of fire safety, licensees apply the continuous improvement principle. Goals, standards and expectations are defined, communicated and monitored on-site. The importance of education, training and drills to support safety culture was emphasized. Improvements in design, processes and human performance, are based on research findings and evaluation of operating experience. It is important to be connected to national and international operating experience feedback channels with appropriate integration in the internal organisational system. Licensees follow and support research projects to improve fire safety. Some licensees are members of international R&D fora, and some host own in-house research facilities. Developments in computer codes will support risk evaluation, and support design and operational optimisation especially for new designs. Further improvements are triggered by changes in European and international standards. Whilst current arrangements are working smoothly, some improvements could further support its efficiency and practice. Using the risk informed approach allows to focus on the most important aspects. Management of transitions between lifecycle changes which involve changing risks, needs more attention. It is important to use a graded approach, for example in the decommissioning phase. Use of industrial standards would give licensees more flexibility to use different equipment but would need some harmonisation of standards. Enhanced risk analysis making use of actual equipment reliability data would be the preferred option. In the view of ENISS, rather than focusing on design matters, the TPR-2 could support the industry through identifying good practices in operational experience, methodologies for evaluation, transition between lifecycle stages, progress in risk analysis, and application of risk-informed and performance based approaches, fire protection leadership and management, and the harmonisation and flexible use of different standards.

- Roger Millis, Head of Industrial and Fire Safety at EDF Energy, UK, described the work of the Nuclear Industry Fire Safety Coordinating Committee. It is a national forum bringing together licensees from different fuel cycle facilities, operating and decommissioning, but also includes representatives of regulators, fire response services, insurers, research establishments and consultants in fire safety. It provides a consolidated industry view on relevant issues such as the development of national standards, through its range of experience spanning fire engineering, fire safety management and prevention, and fire response. It also allows sharing of operating experience across the nuclear industry for learning

and developing good practice. The areas of focus which would most benefit the industry from this peer review, would be a focus on operational aspects rather than historical design, good practices in operational practicalities of fire safety management, cross functional management of conflicting demands (e.g. between safety and security), good practices in moving from operations to decommissioning activities, and good practices in fire safety management indicators (other than fire events).

During the panel discussions comments and questions received through the chat function were replied to, as follows:

- In reply to a question about the differences and overlaps between different peer reviews, it was indicated that while there may be some partial overlaps, IAEA does not have a peer review service that specifically addresses fire protection. OSART is an operational review of NPPs and does not cover design aspects. It provides a snapshot based the IAEA safety standards. Design and PSA aspects may be covered by technical safety reviews (TSRs), but these are not only addressing fire protection.

- The IAEA conducts reviews at the request of a Member State. The reports are therefore addressed to the Member State. The IAEA review also include experts from outside Europe. The IAEA is further willing to support ENSREG for the TPR activities, to provide experts or as an observer, or to provide comments to scoping documents.

- Responding to questions on the scope it was indicated that as per the Directive, it will include storage facilities that are on-site and directly related to the installation. Concerning NPPs that have been in decommissioning for a long period, these are included as long as fire risks cannot be disregarded and can cause a radioactive risk. Research reactors would be included, based on a graded approach. So far it has not been decided if the TPR will look only at fire extinguishing, or also at the impacts of a fire. According to the defence in depth approach, it should cover fire prevention, fire detection, fire extinguishing and mitigation of consequences.

- In relation to the identification of good practices it was said that a distinction should be made between a 'benchmarking exercise' which is principally about identifying and sharing good practices, and a peer review which additionally looks at gaps and issues for improvement. Experience has shown that some peer reviews can have a tendency to focus on programmatic aspects, because it is easier to manage with limited time and resources, but it very important that peer reviews also take account of the realities and feedback from the field. It has been proposed that the 3 presentations on operational experience of this session, should be taken into account for the development of the technical scope of the TPR on fire protection.

- Cable fires are very important. Using observations coming from testing different materials and ageing effects, improvements can be found on the reliable functioning of cables.

- On how to feed operating experience into the TPR-2 process, since the reality of the plant is very important especially for fire protection, one way to take this into account could be to include in the national assessment report inputs from events and inspections from fire protection. For TPR, regulators in Europe are well placed to access all the operating experience that is available, not only the databases, but also the results of inspections. This would be very representative of operating experience in Europe.

- In reply to the question on examples of good practice that could be highlighted, the case of hot-work fires was mentioned, where thanks to a focus on rigorous procedures and controls, these have been almost eradicated.

- The importance of including the human performance aspect in the peer review was pointed out. It is expected that human factors would be covered in the description of management, process and structures.

- Concerning whether a graded approach would be applied to define the thematic and depth of the peer review, it was indicated that a graded approach will be used for the technical specifications, not only between the different types of installations, but also for the different lifecycle phases, distinguishing between operations and decommissioning.

All presentations and a video recording of this event are available at this site:

- https://www.ensreg.eu/eu-topical-peer-reviews