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Summary of the Workshop on Practical Experience in preparing Periodic Safety Review using IAEA guidelines

Christiane Bruynooghe/Alexander Renev

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European Commission
Joint Research Centre
Institute for Energy

Contact information
Address: Alexander Renev, JRC-IE, Westerduinweg 3, NL-1755 ZG Petten
E-mail: Alexander.Renev@ec.europa.eu
Tel.: +31 224 56 54 19
Fax: +31 224 56 56 37

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http://ie.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

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1 Introduction

Upon suggestion of an EU utility (Electrabel, Belgium) JRC organised in December 2010 (1st and 2nd) a workshop with the aim of providing utilities in the EU the opportunity of sharing their experience for the preparation of Periodic Safety Reviews. Such reviews have to fulfil the expectation of national safety regulatory bodies, and due to this may differ in a great extend. However the EU directive of June 2009 on nuclear safety recognises the IAEA standards as the minimum to be reached in the EU nuclear power plants. This gives the IAEA guidelines a specific role: either some regulatory authorities ask the licensees to closely follow the IAEA guidelines and standards, or the specific national approach has to be compared to the minimum requirements as given by the IAEA.

The IAEA guidelines for preparing Periodic Safety Reviews are in the document IAEA Safety Guide NS-G-2.10 "Periodic Safety Review of Nuclear Power Plants" on the point to be superseded by the Draft D-426. It appeared however that the application of this safety guide may present some difficulties to the utility, more specifically as far as safety factors are concerned. This was the reason for organising the above mentioned workshop where participants could thoroughly discuss the identified issues and share approaches and solutions. A questionnaire was developed together with the utility Electrabel with the aim of organising the discussions and concentrating on difficult issues.

As a first priority this action addressed the utilities. However the participation of regulatory authorities (RA) was not excluded and the Dutch regulator participated to the workshop, while the French TSO participated through answering the questionnaire.

The first day (Dec 1st) was devoted to sharing the participants' experience in preparing periodic safety review and to the discussion of the questionnaire's results, while the 2nd day was concentrated to the discussion of 5 specific safety factors. The discussions on those factors were animated by participants who had experience of solutions or in the contrary of difficulties with those factors.

Feedback from the participants was positive. Especially the discussions of the 2nd day that prove to be very efficient in sharing good practices were positively ranked. Also the tight schedule of the workshop was appreciated. Here some appraisal:

> *I found the workshop to be a very positive experience, based on: (i) the opportunity to develop a number of contacts across different utilities, in order to share further information, (ii) some good discussions on issues/problems, (iii) a concise agenda, which kept the time/cost impact down to a minimum. I sense that a number of the participants (myself included) now need to develop contacts and exchange information, such as scoping documents, if we are going to take real benefit in sharing each others experience/approaches. This workshop helped create this opportunity.*
>
> *The workshop for me was positive in providing a platform to learn (from) other people. Especially the evening and day 2 were most fruitful. The minutes and the attendance of our regulator will help me in confirmation and trust of our project.*

2 Summary of Day 1

Dec 1st was devoted to presentations made by the participants. Mrs. Bruynooghe on behalf of the Unit Head Mr. Bièth welcomed all the participants and let them present themselves. The workshop scope was recalled, the agenda tuned, and the activities of the inviting organisation, JRC-IE Safety of Present Nuclear Reactors, were presented.

The second speaker Mr. Renev recalled the IAEA guidelines and TECDOCs in the area of PSR and how they can be helpful in preparing PSR. The new guideline document: Draft 426 was compared to the old one NS-G-2.10. Draft 426 will supersede NS-G-2.10. Presently some member states refer to NS-G-2.10 while other already refer to the Draft 426 for preparing and developing the PSR process. The participants briefly discussed their own experience in use of above documents.

The questionnaire (see Annex 1) was answered by all the participating organisation plus Iberdrola and IRSN (both not available for the workshop itself). The result has been analysed by JRC and presented by A. Renev. First the results corresponding to questions Q1 to Q9 were reviewed in the presentation. The main conclusions were the following:

- Most of those who answered use the IAEA documents, either fully or in some extend, in preparing and conducting the PSR.
- The majority of the responders use their own guide developing a specific approach or methodology for the PSR
- Most responders used external resources for the PSR assessment at least in some areas.
- More than half of responders use good practices in addition to the regulatory text having at the same time some flexibility in selection of scoping areas.
- Many of the responders use good practice derived from operating experience both internal and external, external reviews and reference documents like IAEA TECDOCs, NEA/CSNI documents etc.
- Most of the responders have among all PSR deliverables a final/summary/conclusion report.

There were found also some items to be discussed during the workshop like:

- What are examples of the PSR approaches and/or methodologies? Who did help in their development?
- What are the benefits in using good practices in PSR and how are they determined?
- What is the structure of the PSR deliverables? Why this particular structure is being used?

The following presentations made by the participants addressed some of the items discussed in the questionnaire Q1 to Q9

Mr. Ordogh (Hungary) presented the experience on performing the PSR at Paks Nuclear Power Plant, making emphasis on organisation of the history, scope and the critical finding of the two PSRs held at the Paks NPP. The key points of the presentations were:

- The PSRs were prepared and conducted by mostly an in-house team and involvement of external technical support organizations was minimal.
- The first PSR report was considered as the starting basis for the task.
- The guideline developed for the tasks was very similar to the IAEA safety guide NS-G-2.10 with 14 safety factors.
- Identification of the detailed PSR requirements was left to the licensee.
- Based on the PSR results there were found 15 necessary modifications to the FSAR (Final Safety Analysis Report).

Mr. Lance from Electrabel, Belgium presented the Belgium experience in work organization during preparation and conduct of PSR.

Mr. Machacek explained the process of PSR organized in the Czech Republic. The key points were as following:

- Internal resources were mainly used for the PSR.
- External resources were only used for
    - Criteria and Methodology preparation,
    - Review of safety factor 10 – Administration and organization,
    - Review of safety factor 12 – Human factors,
    - Administrative help in safety factor reports preparation, and
    - Methodology for evaluation of Defence in Depth degradation resulting from identified deviations.
- The PSR is not a legislative requirement in the Czech Republic.
- No guidance is given in Czech technical documentation.

Jim Kershaw from EDF-Energy, UK, presented "Definition of the reference framework, rules for ranking amongst the weaknesses and/or the strengths", were highlighted among others:

- How the reference framework for the assessments is defined.
- Rules for ranking amongst the weaknesses and/or the strengths.
- Difference between existing and the new models of PSR, when safety assessments are becoming a continuous process shared with some modules of PSR, advantages of a continuous process was discussed regarding both the benefit for the safety level and for resources
- Implementation of the corrective actions: prioritisation issues (in term of time and of resources) also with regards with other improvements that are not derived from PSR but might be safety relevant.

Mr. Lance, Electrabel presented the Electrabel experience in reference framework. The key points of the presentation were as following:

- Reference framework is necessary in order to perform the assessment and to identify strengths and weaknesses.
- General reference framework is established from the regulation watch process.
- Review scope is equal to the regulations plus good practices getting from WANO, INPO and OSMIR databases plus found by assessors on their own.

Mr. Tudor from Cernavoda NPP, Romania explained how PSR was done at Cernavoda NPP stressing on:

- Structure of Cernavoda NPP PSR Documentation.
- Nuclear Safety Assessment Principles (NSAP) applicability to PSR Documents.
- Overview on NSAP Application.
- Review of NSAP against IAEA Safety Factors, INSAG Principles and WENRA Reference Levels.
- Relationship between PSR Main Report and the IAEA PSR Safety Factors.

Mr. Chukov from Kozloduy NPP shared his experience with Periodic Safety Review at Kozloduy NPP making stress on:

- Modernization programme at Kozloduy NPP.
- Preparation of PSR.
- Documentary outputs of PSR process.

Mrs. Bruynooghe made a presentation on behalf of the Mrs. Picot from IRSN, France who could not attend the workshop. In the presentation the French PWR Periodic Safety Review process

was explained. And this concluded the first half of the questionnaire review. The second part was devoted to sharing experience in global assessment.

Mr. Renev (JRC-IE) reported now the results of the analysis of the answers to the questionnaire from Q10 to Q18 (see the questionnaire in Annex 1). The main conclusions were as following:

- Majority of the responders stated they developed a methodology for determining the status of the SFs.
- According to use of ranking performed amongst the weaknesses and/or the strengths the opinions were shared almost half to half.
- Quite lot of responders (36%) did not provide clear answer to the question "Is there a comparison of the existing Postulated Initiating Events (PIE) against Gen III design PIE's?"
- The question "Is this just a gap identification or is an applicability analysis of the Gen III rules considered?" got equally "Yes", "No" and "No clear answer".
- Gen III PIE's were selected mostly referring to a preferred design (67%) not just considered as guidance.
- In assessing SF14 more frequently benchmarking against the others was used and/or comparison with previous periods of time as well as cost-benefit analysis.
- The majority of the responders interpret the proposed IAEA methodology as both process and results oriented and to achieve the review they used mostly comparison against relevant references, interviews and visiting the installation.
- To answer the questions on how to perform the global assessment in practice there must be clarified "what is the methodology of counterbalancing strengths and weaknesses" and provide some examples of counterbalancing and/or privileging.
- The main methods used for global assessment were "Probabilistic Safety Assessment", "deterministic approach", "defence-in-depth multiple criteria" and "cost/benefit".

There were found also some items to be discussed during the workshop like:

- What are examples of a bad and a good proportion between manpower/paperwork and plant improvements?
- What are good practical examples on communication at the stage of delivery of the PSR reports and at the stage of compiling the review?
- What are the problems in assessment of safety culture?
- What kind of organizational measures are deduced from the Global Assessment (GA) to constitute the Integrated Implementation Plan?

Mr. Mertens from Electrabel presented questions raised in his organization in relation with the Global Assessment. He highlighted:

- Current situation with global assessment in Electrabel.
- Preliminary methodology, and
- Open questions.

Mr. Tenschert, Switzerland made the participants familiar with methods used for global PSR assessment in Periodic Safety Review at NPP Beznau.

Then Mr. Minarcik presented experiences of Bohunice V2 NPP in Periodic Safety Review focusing on Global Assessment, such as:

- Basic review methodology.
- Interaction between Review Areas (in fact between objects and elements of Review Areas).
- Safety significance ranking.
- Integrated Corrective Action Plan Implementation.
- Conclusive Assessment within PSR Summary Report.

Mr. Harti from Fortum, Finland presented “Actions deduced from the Global Assessment and constitution to Integrated Implementation Plan (IIP)”, focusing on:

- Global assessment, including interactions between safety factors, individual shortcomings and corrective actions and/or safety improvements, including compensatory measures.
- Preparation of the program of corrective actions and/or safety improvements.
- Post-review activities.

Mr. Te Lintello from EPZ, Borssele made the participants familiar with periodic safety review in his company emphasizing:

- Agreement with the Regulator.
- PSR scope.
- Risk assessment.

After all of these presentations there was a joint discussion on significant experiences with the method in use (main findings, difficulties, lessons learned, good practice to share…) where all the participants provided their input. Then participants decided upon the safety factors selected for specific focus for the next day with appointment of discussion facilitators who prepared questions for future discussion.

3 Summary of Day 2

Dec 2nd started with a presentation of A. Duchac on "Long Term Operation organization in Europe and related international programs and frames" and after this was mainly devoted to exchange of experience in relation with specific safety factors (SF) as shown in the table below that was prepared with the participants the day before. Roughly one hour was devoted to each safety factor of the table.

	Discussion facilitator	
SF1 & SF4	Jim Kershaw	SF1: Plant Design; SF4: Ageing
SF5	Ray Ashley	SF5: Deterministic safety analysis
SF12	Kris Mertens	SF12: Human factors
SF8 & SF9	Benoît Lance	SF8: Safety Performances; SF9: Use of experience from other plants and research findings
SF2	Jaromir Machacek	SF2: Actual condition of systems, structures and components

SF1:

Objective: The objective of this safety factor is to review and determine the adequacy of the design of the NPP and its documentation in an assessment against current national, international standards, requirements and practices.

Questions selected for further discussion:

- Do you have a process in place that does this on a continuous basis or do you do this as a one off PSR exercise?
- How far does your list of SSCs important to safety go, do you identify and assess every component of a system, e.g. cables?
- Do you have any outlying systems where you have to apply alternate approaches, e.g. radwaste?
- How do you review the cumulative impact of minor modifications or temporary modifications?
- Any other questions?

Discussed approaches:

- The utility has a team looking for inconsistencies (mainly design versus reality). If an inconsistency is identified the team checks against technical and national standards. This corresponds to a global approach providing a way for learning from PSR and not being lost in the details.
- Evolution toward a continuous process has been discussed: upgrade on a continuous basis the NPP's documentation, put it in front of the regulation or standards evolution. The continuity in the process is triggered by system evolution (refurbishment) or by regulation evolution. Design evolution (due to modifications) might not be reviewed on a continuous basis; in such case backlog is accumulated. PSR is a good opportunity to review all this. However the heavy work load generated might come in competition with other tasks that could have higher safety implication. These considerations are triggering the choice of going as much as possible toward a continuous process.
- The list of SSC to be considered is generally limited to the safety relevant systems and one layer below (ex: valves to and from those systems, Control-Command of those systems etc…). The lowest detail level (ex: cable) is generally not considered. However it can be the case if LTO is part of the review.
- Modifications are considered if they have an impact on the licence (GV, fuel enrichment, power etc…) and if they have an impact on the safety report. The classification is made with the RA (regulatory authority). Modifications correspond to a living safety case. Of relevance for the SF1 is the fact that in several cases modifications are adopted and implemented before an update of the documentation. This may lead to an important backlog difficult to hold on when the PSR has to be prepared. It is a typical case where a continuous approach, if not already implemented, should be favoured. It might be preferable to adapt the documentation before the modifications are implemented.
- To the question of the cumulative impact of minor modifications which alone have no impact on the safety report it was suggested that they should be part of the life safety case. To this aim PSA can help.
- Modifications are either proposed by the utility or required by the Regulatory Authority (RA) because the design is 10-30years old or the perception toward some safety cases is changed. For detail issues the process should be continuous.
- SF1 review was considered to be more process oriented than entering into all details of the design documentation. It was suggested to use this PSR exercise for being one step ahead of the RA, anticipating what could be requested.

SF4:

Objective: The objective of the review is to determine whether ageing of System Structures & Components (SCCs) is being effectively managed, so that the required safety functions are maintained, and whether an effective ageing management programme is in place for designed life time and if it is planned, for long term operation.

- Does your PSR claim an effective Ageing Management (AM) program, with processes in place to ensure plant is monitored and risk is managed on appropriate timescale or do you get drawn into providing a specific AM review with commitments and/or design solutions within the PSR?
- Are there any specific technical challenges that you face with an AM programme, e.g. qualification of new control and instrumentation / micro processor equipment to demonstrate appropriate levels of reliability?
- How do you manage uncertainty in station closure dates with respect to ALARP decisions?
- Any other questions?

- In screening the AM generally the RA does not want only to get demonstration of the process in place, but wants to see the exact situation: evaluation of the aging state and of the planned measured. This is also generally part of a PLiM programme considering how long the plant is to be operating.
- Such a review applies to all classified systems: 1, 2 and 3 and for the structures. Non safety systems having an impact on the safety systems are included

- If LTO is considered the RA wants to see the effect of the AM on the LTO. In cases where application for LTO is prepared before PSR, PSR only needs to carry out a gap analysis.
- Technical challenges faced typically cover obsolete items among them part of the instrumentation.

SF5:

Objectives: To determine to what extent the existing deterministic safety analysis (DSA) remains valid when considering: the actual plant conditions; the current safety standards and knowledge.
The current state of the DSA should be reviewed for the completeness of the set of postulated initiating events and for its scope, methods and assumptions.
The review of the DSA should determine whether the actual plant design is capable of meeting the prescribed regulatory limits for radiation doses and radioactive releases resulting from postulated accidents. If the safety concept of the plant design differs from current practice, any advantages or disadvantages inherent in that safety concept should be recognized.In addition, the review should also identify any weakness related to the application of the defence in depth concept.

- Postulated Initiating Events (PIE) includes Anticipated Operational Occurrence (AOO), Design Basis Accidents (DBA) and Beyond design basis accident (BDBA).
- Reference-lists for PIEs, BDBAs, Safety Analysis?
- Including considerations for Plant Operating States? How far?
- How to apply the Single Failure Criterion? Impact on classification?
- How to combine PSA results and classification of PIEs ?
- Other issues?

- Models: Modelling in usage is accepted by the RA. In some instances both utilities and RA have the same softwares. The operator's reaction can be validated using NRC documents or situation in a simulator environment. Deterministic studies can provide conservative analysis and Best-Estimate Plus Uncertainties (BEPU) analysis. The operator's reaction can be validated using NRC documents or situation in a simulator environment.
- PIEs: Evolution in the selection of the single failure criteria may have an impact on the system classification. DBA can evolve since the writing of the SAR (ex of primary loop flow asymmetry after GV tube plugging). Event(s) can be selected as bounding postulated initiating event(s) to represent a group of events. Plant condition takes into consideration the modification as included in the documentation: No walk down is carried out.
- Link to PSA: On how to combine PSA results and classification of PIEs the Canadian example was given. Also the cavity flooding is an example (DSA) that can reduce CDF to a Gen III (EPR) level.
- Others: Comparison with Gen III may prove to be difficult: the safety class limits are not systematically the same (ex EPR and Gen II PWR). It can however be used for demonstrating strong points in the plant design.
- Crucial statement: All items considered under this SF require hypothesis that need to be fixed in agreement with the RA.

SF12:

The objective of the review of human factors (HF) is to determine the status of the various human factors that may affect the safe operation of the nuclear plant.

- Overlapping with SF 10 (Organisation & Administration)?
- Legal framework is limited
- Which yardstick for assessment?

- Legal framework is limited: rely on good practices. But evolution in HF practice is difficult to estimate in 10 years of time.
- Human factors that can affect the safe operation of the plant: limited to operation or is maintenance to be included?
- Operators can be checked if they can perform a task in a given time. Usually done in simulator environment. Is this acceptable since it is different from a real environment? In TECDOC 1643 Korean example on the use of simulator for assessing HF is given.
- Maintenance tasks are not considered under the same aspect, but programs for improving the quality control of maintenance work are currently implemented at NPPs.

- In connection to SF10: living document to forecast the adequate numbers of qualified staff according to function and required qualification is developed in several utilities.
- WANO review also covers SF10 and 12. The question was raised if the WANO review results could be used though they are of confidential nature. The opinion was defended that the NPP itself is owner of these results and can use them for further assessments.
- Outsourcing: SF10 deals with process: management of contractors, while SF12 deals with people: behaviour of the personnel contracted.
- Example was given where SF12 is included in the Global Assessment, where systematic approach to training is developed, and where HF are considered for maintenance. It was found that PSA could help for improving safety for maintenance planning and procedure.

SF8:

The objective of the review of safety performance is to determine the safety performance of the NPP and its trends from records of operating experience.

- SF 8 observations give rise to several questions which finally makes the scope greater than initially foreseen
- Pay attention to define a clear border with SF 9 (Operation Experience Feedback - OEF), what does not seem to be adequately delimited in DS 426 and experience reported through TECDOC 1643
- Experience to share?

- Radiation protection is not a specific safety factor but can be trapped in SF8
- Trend analysis can be performed based on the IAEA-TECDOC-1141 (Operational safety performance indicators for nuclear power plants).
- Are the monitoring tools appropriate? Benchmark on international basis could be helpful to undertake corrective actions: use of KPI tools?
- Are the low level events, near misses included? Which system for reporting near misses?

SF9:

The objective of the review of the use of experience from other plants and research findings is to determine whether there is adequate feedback of safety experience from other nuclear power plants, sometime from non nuclear power plants and the findings of research.

- How do other operators perform their PSR (NS-G 2.10) (aim of the workshop)?
- What to find more than OSART or WANO audit?
- What are the main lessons learned from external events: INPO/WANO - Significant Operating Experience Report (SOER), safety evaluation report (SER), International Reporting System for Operating Experience (IRS), NRC Generic Letters, Recommendations, Expert and Working Groups - Framatome Owner's Group (FROG), Pressurized Water Reactor Owners Group (PWROG), Candu Owner Group (COG) etc...?
- How did operators manage with?
- How can we access to this information? Exchange visits?
- How do you assess the efficiency of corrective actions?
- Remark (TECDOC 1643) : OEF normally adequate, whereas it is not the case for research findings.

- It was recommended that the NPP performs this assessment on its own not relying only on external audits like OSART or WANO to do the job. This assessment should adopt an ALARP approach.
- SF9 requires not only Operating Experience Feedback (OEF) but also input from research findings. Example of the Candu Owner Group (COG) was given, where the utilities fees are used for funding research projects. Also the OECD/NEA/CSNI (Committee for the Safety of Nuclear Installations) and the IAEA regularly launch research projects gathering nuclear stakeholders at large (regulatory body, industry, research organisations). The research topics can be specific (i.e. a specific OEF event like Forsmark) or generic (ex: ageing in metal components). Also JRC has an action devoted to OEF (Clearinghouse). This action gathers the RAs of the nuclear EU member states who annually decide upon a work program. In this frame specific events have been studied beyond the mere description of the event itself (Shika, Forsmark). One of the major point of these

studies is to analyse how countries in which the event didn't took place, responded to that event. Also so-called topical studies are carried out: fuel failure events, maintenance events etc… Once approved by the Clearinghouse Board the reports are posted to the IAEA's IRS site which is accessible to the utilities.

- It was found important to put in place a good process at the plant for following the safety implementation. The example was given of the performance monitoring carried out by 10 people in the licensee's headquarters for 2 plants and one contact point in each plant department.

SF2:

Objective: The objective of the review is to determine the actual condition of SSCs important to safety and whether it is adequate for them to meet their design requirements until at least the next PSR. In addition, the review should confirm that the condition of SSCs is properly documented, including the on-going programs of maintenance, surveillance and in-service inspection, as applicable

- How do you obtain the stand back safety case review of the plant condition, e.g. that it is appropriately aligned to the safety case requirements?
- Any other questions?

Practical example of the SF2 review was given and discussed. In the given example SF2 was considered as the poorest SF in the PSR.

- List of SSCs important to safety: their classification and information about their integrity are available. They are registered; the list is updated yearly and approved by the RA. The corresponding review is process oriented; no evaluation of the completeness is carried out.
- Information on the existing or anticipated obsolescence of any SSCs important to safety is gathered in a similar way than for SF4 where SF4 is more process oriented and SF2 more equipment oriented.
- Process and records in place for tests demonstrating the functional capability and results of inspection are reviewed (process oriented), but the testing procedure is not.
- Maintenance records are checked both as a process oriented review and results (availability of records).
- Description of present condition of SSCs important to safety: declaration that actual condition of each SSC important for safety is known. Declaration that actual condition of each SSC important for safety matches design requirements. In this case questions were raised if declarations from the field specialist can be enough. This seems to touch the HF field (evolution and availability of this staff in the long term) and seems not enough for the reporting needs of the NPP in the long term.
- Other discussed points were: modifications from design have to be taken into account and possibly are triggering an update of the FSAR.
- It was mentioned the necessity to compare the FSAR to the exact situation at the plant through walk-down.
- If the process is good (QA behind) there is no necessity to check the details.
- Are supports to safety relevant systems considered in the list of safety relevant systems? Usually they are part of In-Service Inspection (ISI) programs.

General: the question was raised if some documents could be exchanged. Main discussion dealt with the format and content of the Basis Document, Safety Factor Report, Global Assessment Report and the PSR Final Report. Several participants indicated that the documents are in principle in the public domain but this corresponds to the fact that they are kept by the RA which is a public body. Often the top level documents (without the technical references or details) are possible to share. Also the feedbacks from the RA are often in the public domain. The workshop provided the necessary discussion forum preliminary to any further exchanges of documents among the participants.

4 Conclusion

The workshop fulfilled its target: providing to EU utilities a platform for exchanging experiences, difficulties and solutions in relation with the preparation of Periodic Safety Reviews. Such reviews are gaining in importance in the frame of long term operation of nuclear power plants. LTO is considered in several EU countries as a decision combining economical advantage of electricity production, CO2 reduction and alternative to the future advanced nuclear energy electricity generation that will not be available before 2050.

The question was raised among the participants if some documents could be exchanged. Main discussion dealt with the format and content of the Basis Document, Safety Factor Report, Global Assessment Report and the PSR Final Report. Several participants indicated that the documents are in principle in the public domain but this corresponds to the fact that they are kept by the Regulatory Authority (RA) which is a public body. Often the top level documents (without the technical references or details) are possible to share. Also the feedbacks from the RA are often in the public domain. The workshop provided the necessary discussion forum preliminary to any further exchanges of documents among the participants and was judged by the participants as a very effective way for initiating such exchanges. As such it is a contribution to promoting harmonisation in the approaches related to nuclear safety in the EU.

Annexe 1

Questionnaire:

Survey on Practical application of IAEA NSG.2.10, Safety Guide

"*Periodic Safety Review of Nuclear Power Plants*"

in the EU Member States

Since operation of the first generation of commercial nuclear power plants started in the 1950s there have been substantial developments in safety standards and practices, and in technology, resulting from new scientific and technical knowledge, better analytical methods and lessons learned from operating experience.

Operational nuclear power plants in many states are subject to both routine and special safety reviews. These safety reviews are generally not comprehensive and do not always take account of improvements in safety standards and operating practices, the cumulative effects of plant ageing, modifications, the feedback of operating experience, and developments in science and technology. Consequently, the concept of **Periodic Safety Reviews (PSR)** has been developed as a method that is complementary to the existing types of reviews

In many member states in the EU, Periodic Safety Reviews (PSR) have been introduced as part of the regulatory system.

The objective of a Periodic Safety Review (PSR**)** is to determine by means of a comprehensive assessment of an existing nuclear power plant the extent to which the plant conforms to current international safety standards and practices; the extent to which the licensing basis remains valid; the adequacy of the arrangements that are in place to maintain plant safety until the next PSR or the end of plant lifetime; and the safety improvements to be implemented to resolve the safety issues that have been identified.

In 2003 the IAEA developed the **Safety Guide (NSG.2.10) "Periodic Safety Review of Nuclear Power Plants**. The purpose of this Safety Guide is to provide recommendations and guidance on the conduct of a PSR for an existing nuclear power plant. However according to exchanges and discussions to which JRC-IE participated recently the application of this safety guide may present some difficulties to the utility, more specifically as far as safety factors are concerned.

To better understand the way this Safety Guide is used by different utilities, JRC-IE SPNR (Safety of Present Nuclear Reactors unit) is collecting information and experiences on **practical application** of **IAEA NSG.2.10** in the EU Member States.

To facilitate information collection and usage, a questionnaire has been developed. JRC-IE SPNR solicits your support by answering a number of questions regarding approaches and methodologies being used by your organization for Periodic Safety Review of Nuclear Power Plants.

This questionnaire concentrates especially on the practical application of IAEA NSG.2.10, Safety Guide:

- **Part A** of the questionnaire covers the regulatory requirements and practices and is addressed primarily to the regulators. Licensees can use it to indicate what requirements are issued to them by their regulatory body.
- **Part B** covers the descriptions and experiences obtained in the development and application of Periodic Safety Reviews for Nuclear Power Plants. This part is addressed primarily to licensees. Regulatory bodies can also use it to inform on tools they use on their side for assessing the PSR.

Given the difficulties associated with establishing a set of questions that properly fit each individual case, the questionnaire has to be interpreted in a flexible manner so as to obtain the most accurate and clear description of every intended item, while keeping in mind the necessary effort to, later on, provide information on fairly uniform basis. Your anticipated assistance in completing this short questionnaire is appreciated.

It is intended to call a workshop in the late 2010 that would provide the opportunity for the participants to thoroughly discuss the identified issues and to share approaches and solutions. At the workshop the answers to the questionnaire will be presented. Such a workshop would concentrate on a reduced set of safety factors identified as the most challenging when preparing the PSR along NSG 2.10.

Survey on issues related to the Practical Application of IAEA NSG.2.10, Safety Guide "Periodic Safety Review of Nuclear Power Plants"

Part A .BACKGROUND INFORMATION ON REGULATORY REQUIREMENTS AND PRACTICES. The aim of these questions is to collect information on regulatory requirements and practices in different countries. This part is addressed primarily to the regulators
Regulatory organization identification and contact person (e-mail-address)
1. Are there regulatory requirements of any sort regarding Periodic Safety Review (PSR) for the utility?
2. Are there special requirements for Periodic Safety Review (PSR) using IAEA NSG.2.10, Safety Guide as a reference? **If yes, status and content of requirements (describe here or attach documents)**
3. Does the regulatory body assess the Periodic Safety Review (PSR) performed by the utility? **If yes, description of the approaches, methods and criteria used in assessment, or description of regulatory actions in relation to Periodic Safety Review (PSR)**
If you want to attach documents or refer to material situated elsewhere, as requirements or regulatory guides found in www-pages, please list the material here:

Part B. -INFORMATION ON SPECIFIC DEVELOPMENTS, APPROACHES, TOOLS

AND METHODOLOGIES REGARDING PREPARATION of PERIODIC SAFETY REVIEW (PSR)

The aim of these questions is to collect information on systematic approaches and methods used by organizations in nuclear industry as tools for **Periodic Safety Review (PSR)** especially methods for practical application of IAEA NSG 2.10.

This questionnaire is to be filled primarily by licensee or utility informing about tools and methods used in their own organization, but also by consultant, research institution, specialist developing such tools, or by regulator describing tools used in regulatory organization**.**

It is easier to answer, if you read first all questions!

There are several sub-questions, part of which may be irrelevant in your case, ignore those!

Organisation, address and contact person (e-mail address)

4. Do you use IAEA NS-G-2.10 for the preparation of the Periodic Safety Review?

5. Do you use another guide?

6. Do you develop a specific approach or methodology for the Periodic Safety Review (PSR)? If yes, please provide a brief description of the approach (about 200 words).

7. Do you use external resources for the PSR assessment (consultants, WANO TSM, IAEA audit mission …) or do you restrict to self-assessments?

Achieving a review requires first to have a reference framework against which you may compare the actual status, in order to determine strengths and weaknesses.

8. **How do you define the reference framework for the assessments?**

9. **Do you restrict to regulatory texts or do you also consider good practices / performances?**

10. **Do you have some choice about the selection of the regulatory texts or are the regulatory texts selected and required from the Safety Authority?**

11. **How are determined good practices / performances? (Good practices coming from OSART or other audits in different countries, some other Operating Experience Feedback?)**

12. **What is the concrete form of the PSR deliverables (number of report, distribution, layout, volume …)?**

13. **Regarding the Safety Factors as defined in the IAEA NSG 2.10 Safety Guide, do you develop a specific methodology for determining the status (strengths and weaknesses) of the Safety Factors?**

Please illustrate your answer at this question by giving examples concerning the following SF :

a. **SF 2 (Actual condition of systems, structures and components)**

b. **SF7 (hazard analysis)**

c. **SF 8 (safety performances)**

d. SF 9 (Use of experience from other plants and research findings)

e. SF12 (Human factors)

The objective will be to have a deeper exchange about the Safety Factors addressed with this question, during the workshop. The here above SF were chosen in account of specific questioning. Should you wish to address another SF, please develop hereunder.

14. Is there a ranking performed amongst the weaknesses and/or the strengths?

Questions about some specific Safety Factors.

15. SF5 (deterministic safety analysis): is there a comparison of the existing Postulated Initiating Events (PIE) against Gen III design PIE's? Is this comparison just an identification of the gaps or is an applicability analysis considered? How are the Gen III PIE's selected? (Preferred design, guidance)?

16. SF14 (radiological impact on the environment): How do you assess that a practice or a result is ALARA (issue of subjectivity)?

17. How do you interpret the proposed IAEA methodology? (This question may be asked / particularized for each Safety factor)

a. Do you consider that it is a process-oriented review (i.e. assessment of the process related to the Safety Factor), a results-oriented review (i.e. assessment of the results obtained by the existing processes) or both?

b. How do you achieve the review? Use of comparison against relevant references, interviews of personnel, benchmarking with other utilities, visit of the installations, others?

IAEA NSG-2.10 specifies that the PSR exercise ends up with a global assessment, wherein all 14 SF are gathered and assessed together, balancing both strengths and weaknesses.

18. In practice, how do you perform the global assessment, based upon strengths and

weaknesses of different natures (Organization, design, software, studies …)? **19. Which method do you use for the global assessment (cost / benefit, defense in depth multi-criteria, PSA …)?**
20. Significant experiences with the method in use (main findings, difficulties, lessons learned…)
21. Which types of actions are deduced from the Global Assessment and constitute the Integrated Implementation Plan (IIP)?
If you want to attach documents or refer to material situated elsewhere, as in **www-pages, please list the material here:**

Annexe 2

List of participants

	Country	First name	Surname	E-mail
1	AXPO	Jens	Tenschert	Jens.Tenschert@axpo.ch
2	Cernavoda NPP	Eduard Catalin	Tudor	Catalin.Tudor@cne.ro
3	CEZ	Jaromir	Machacek	jaromir.machacek@cez.cz
4	EDF-UK	Jim	Kershaw	jim.kershaw@edf-energy.com
5	Electrabel	Benoit	Lance	Benoit.Lance@electrabel.com
6	Electrabel	Kris	Mertens	Kris.Mertens@electrabel.com
7	Electrabel	Deborah	Rozan	deborah.rozan@electrabel.com
8	EPZ	Hans	Te Lintelo	j.te.lintelo@epz.nl
9	EPZ	Hugo	Reyners	h.reyniers@epz.nl
10	Fortum	Mika	Harti	Mika.Harti@fortum.com
11	JRC-IE	Christane	Bruynooghe	Christiane.Bruynooghe@ec.europa.eu
12	JRC-IE	Alexander	Duchac	Alexander.Duchac@ec.europa.eu
13	JRC-IE	Alexander	Renev	Alexander.Renev@ec.europa.eu
14	Kozloduy NPP	Ilko	Chukov	IAChukov@npp.bg
15	MINVROM NL	Lutz	Lindhors	lutz.lindhorst@minvrom.nl
16	NRG	Wim	Van der Mheen	vandermheen@nrg.eu
17	SOM System Kft.	Miklos	Ordogh	miklos.ordogh@somsystem.hu
18	SE-ENEL	Radovan	Minarcik	minarcik.radovan@ebo.seas.sk
19	Tractebel	Ray	Ashley	ray.ashley@gdfsuez.com
20	Tractebel	Anna-Maria	Deer	anna-maria.deer@gdfsuez.com

Annexe 3

List of the presentations

	Name	Company	Presentation
1	C. Bruynooghe	JRC-IE	Presentation of the inviting organization
2	A. Renev	JRC-IE	Use of IAEA documents in PSR preparation
3	A. Renev	JRC-IE	Results of the questionnaire for Q1 to Q9
4	M. Ordogh	SOM System Kft.	Experiences on performing the PSR in the Paks Nuclear Facilities
5	B. Lance	Electrabel	Q4 – Work organization.
6	J. Machacek	CEZ	Practical Experience in preparing Periodic Safety Review in CR
7	J. Kershaw	EDF-UK	Definition of the reference framework, rules for ranking amongst the weaknesses and/or
8	B. Lance	Electrabel	Q5-8 – Reference framework
9	E.C. Tudor	Cernavoda NPP	Periodic Safety Review at Cernavoda NPP
10	I. Chukov	Kozloduy NPP	Experience with Periodic Safety Review (PSR) at Kozloduy NPP
11	C. Bruynooghe (On behalf of IRSN)	JRC-IE	French PWR Periodic Safety Review process.
12	A. Renev	JRC-IE	Results of the questionnaire for Q10 to Q18
13	K. Mertens	Electrabel	Q15-Q16: Questions raised in relation with the Global Assessment.
14	J. Tenschert	AXPO	Periodic Safety Review in NPP Beznau. Methods used for global PSR assessment
15	R. Minarcik	SE-ENEL	Periodic Safety Review experiences Bohunice V2 NPP
16	M. Harti	Fortum	Actions deduced from the Global Assessment and constitution to Integrated Implementation
17	H. Te Lintelo	EPZ	10EVA13 Periodic Safety Review
18	A. Duchac	JRC-IE	Long Term Operation organization in Europe and related international programs and frames
19	R. Ashley	Tractebel	Experience with SF-5 review. Deterministic Safety Analysis
20	K. Mertens	Electrabel	SF09 – use of experience from other plants and research findings

European Commission

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Abstract

This EUR report describes summary and conclusions of the workshop on periodic safety reviews conducted at NPPs in different European countries. Application of the existed IAEA safety guideline on this matter provides some difficulties for utilities. At the same time many utilities use this document as well as the draft of its new edition as a basis for such activities. Upon suggestion of an EU utility JRC organised a workshop to provide opportunity for EU utilities to share their experience in preparation and conduct of Periodic Safety Reviews. The workshop gave the necessary discussion forum preliminary to any further exchanges of documents among the participants and was judged by the participants as a very effective way for initiating such exchanges. As such it is a contribution to promoting harmonisation in the approaches related to nuclear safety in the EU.

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