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REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM

(OSART)

MISSION

TO THE

PALUEL

NUCLEAR POWER PLANT

FRANCE

20 SEPTEMBER – 7 OCTOBER 2021

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/211/2021

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Paluel Nuclear Power Plant, France. It includes recommendations for improvements affecting operational safety for consideration by the responsible French authorities and identifies good practices for consideration by other nuclear power plants. Each recommendation, suggestion, and good practice is identified by a unique number to facilitate communication and tracking.

Any use of or reference to this report that may be made by the competent French organizations is solely their responsibility.

FOREWORD by the
Director General

The IAEA Operational Safety Review Team (OSART) programme assists Member States to enhance safe operation of nuclear power plants. Although good design, manufacture and construction are prerequisites, safety also depends on the ability of operating personnel and their conscientiousness in discharging their responsibilities. Through the OSART programme, the IAEA facilitates the exchange of knowledge and experience between team members who are drawn from different Member States, and plant personnel. It is intended that such advice and assistance should be used to enhance nuclear safety in all countries that operate nuclear power plants.

An OSART mission, carried out only at the request of the relevant Member State, is directed towards a review of items essential to operational safety. The mission can be tailored to the particular needs of a plant. A full scope review would cover eleven operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; operating experience feedback; radiation protection; chemistry; emergency planning and preparedness and accident management. Depending on individual needs, the OSART review can be directed to a few areas of special interest or cover the full range of review topics.

Essential features of the work of the OSART team members and their plant counterparts are the comparison of a plant's operational practices with best international practices and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Series documents, including the Safety Standards and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organization for achieving its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power plants.

An important aspect of the OSART review is the identification of areas that should be improved and the formulation of corresponding proposals. In developing its view, the OSART team discusses its findings with the operating organization and considers additional comments made by plant counterparts. Implementation of any recommendations or suggestions, after consideration by the operating organization and adaptation to particular conditions, is entirely discretionary.

An OSART mission is not a regulatory inspection to determine compliance with national safety requirements nor is it a substitute for an exhaustive assessment of a plant's overall safety status, a requirement normally placed on the respective power plant or utility by the regulatory body. Each review starts with the expectation that the plant meets the safety requirements of the country concerned. An OSART mission attempts neither to evaluate the overall safety of the plant nor to rank its safety performance against that of other plants reviewed. The review represents a `snapshot in time'; at any time after the completion of the mission care must be exercised when considering the conclusions drawn since programmes at nuclear power plants are constantly evolving and being enhanced. To infer judgements that were not intended would be a misinterpretation of this report.

The report that follows presents the conclusions of the OSART review, including good practices and proposals for enhanced operational safety, for consideration by the Member State and its competent authorities.

EXECUTIVE SUMMARY

This report describes the results of the OSART mission conducted for Paluel Nuclear Power Plant in France, from 20 September to 7 October 2021.

The purpose of an OSART mission is to review the operational safety performance of a nuclear power plant against the IAEA safety standards, make recommendations and suggestions for further improvement and identify good practices that can be shared with NPPs around the world.

This OSART mission reviewed eleven areas: Leadership and Management for Safety; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Preparedness and Response; Accident Management; and Long Term Operation.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader and the team was composed of experts from Belgium, Czech Republic, Canada, Hungary, the Netherlands, Ukraine, United Kingdom, the United States of America, and the IAEA staff members. The collective nuclear power experience of the team was 417 years.

The team identified 15 issues, resulting in four recommendations, and 11 suggestions. Nine good practices were also identified.

Several areas of good performance were noted:

- The plant management's establishment of a collaborative employee strategy to improve plant safety and performance.
- The development of a corrosion action plan to ensure equipment reliability as a part of a long-term operation programme.
- The establishment of so-called silent monitoring of emergency calls enabling medical staff to listen-in and be alerted to a possible medical emergency.

The most significant issues identified were:

- The plant leaders have not systematically ensured that plant staff are complying with requirements and standards for industrial safety and human performance in a rigorous and consistent manner.
- The plant work control process does not support the timely completion of preventive maintenance to ensure its safe and reliable operation.
- The plant operating experience programme does not always ensure that safety related events are adequately categorized, analysed, and have effective corrective actions to prevent recurrence.

Paluel NPP management expressed their commitment to address the issues identified and invited a follow up visit in about eighteen months to review the progress.

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INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of France, an IAEA Operational Safety Review Team (OSART) of international experts visited Paluel Nuclear Power Plant from 20 September to 7 October 2021. The purpose of the mission was to review operating practices in the areas of Leadership and Management for Safety; Training and qualification; Operations; Maintenance; Technical support; Operating Experience Feedback, Radiation Protection; Chemistry; Emergency Preparedness and Response; Accident Management; and Long Term Operation. In addition, an exchange of technical experience and knowledge took place between the experts and their plant counterparts on how the common goal of excellence in operational safety could be further pursued.

The Paluel OSART mission was 211th in the programme, which began in 1982. The team was composed of experts from Belgium, Czech Republic, Canada, Hungary, the Netherlands, Ukraine, United Kingdom, the United States of America, and IAEA staff members. The collective nuclear power experience of the team was 417 years.

Before visiting the plant, the team studied information provided by the IAEA and the Paluel Nuclear Power Plant to familiarize themselves with the plant's main features and operating performance, staff organization and responsibilities, and important programmes and procedures. During the mission, the team reviewed many of the plant's programmes and procedures in depth, examined indicators of the plant's performance, observed work in progress and held in-depth discussions with plant personnel.

Throughout the review, the exchange of information between the OSART experts and plant personnel was very open, professional and productive. Emphasis was placed on assessing the effectiveness of operational safety rather than simply the content of programmes. The conclusions of the OSART team were based on the plant's performance compared with the IAEA safety standards.

The following report is produced to summarize the findings in the review scope, according to the OSART Guidelines document. The text reflects only those areas where the team considers that a Recommendation, a Suggestion, an Encouragement, a Good Practice or a Good Performance is appropriate. In all other areas of the review scope, where the review did not reveal further safety conclusions at the time of the review, no text is included. This is reflected in the report by the omission of some paragraph numbers where no text is required.

MAIN CONCLUSIONS

The OSART team concluded that the managers of Paluel NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

- The plant management's establishment of a collaborative employee strategy to improve plant safety and performance.
- The development of a corrosion action plan to ensure equipment reliability as a part of a long-term operation programme.
- The establishment of so-called silent monitoring of emergency calls enabling medical staff to listen-in and be alerted to a possible medical emergency.

A number of proposals for improvements in operational safety were offered by the team. The most significant proposals include the following:

- The plant leaders have not systematically ensured that plant staff are complying with requirements and standards for industrial safety and human performance in a rigorous and consistent manner.

- The plant work control process does not support the timely completion to ensure its safe and reliable operation.
- The plant operating experience programme does not always ensure that safety related events are adequately categorized, analysed and have effective corrective actions to prevent recurrence.

Paluel NPP management expressed a determination to address the areas identified for improvement and indicated a willingness to accept a follow up visit in about eighteen months.

1. LEADERSHIP AND MANAGEMENT FOR SAFETY

1.1 ORGANISATION AND ADMINISTRATION

The plant management team has established a vision and strategy through which performance at the plant is improving. Plant management works in a collaborative manner with the workforce to create and implement strategies and improvement initiatives. The management team has also developed plant-specific leadership development projects which are in the process of being implemented. Collectively these efforts were recognized as a good practice.

A review of events, near-misses, and field observations identified weaknesses in worker behaviors related to industrial safety and effective use of human performance tools. While leader values and management programmes are established and clear, compliance with these has not been consistent and systematic. These weaknesses have contributed to injuries, near misses, and plant events. Worker understanding of and compliance in these important areas should be at the highest levels to ensure plant and personnel safety. The team made a recommendation in this area.

1.2. MANAGEMENT SYSTEM

Paluel management has collaborated with key contractors and the regional contractor's association (GIP-NO) to strengthen the safety performance of contractor groups working at the plant. Key contractors prepare "MQME (work quality) - Safety - Radiation Protection" action plans each year that are based on a comprehensive review of performance issues in the previous year. On an ongoing basis the Paluel Management Team engages with contractors in a variety of ways to monitor and provide feedback on their performance. This includes quarterly meetings with the regional contractor's association (GIP-NO), routine meetings with contractor management to establish a common understanding of performance challenges, conducting joint field visits to strengthen contractor oversight skills and check that actual performance is in line with standards, and conducting training to improve performance. The team has identified the level of collaboration between the plant, contractors, and the regional contractor's association to improve performance as a good performance.

The integrated management system is based on a common model utilized across the fleet. A review of these programmes indicate that they are generally in compliance with IAEA and industry standards. However, the team noted weaknesses in the execution of some key processes such as risk management and compliance with Technical Specifications that have challenged the effectiveness of these programmes which are important to safety. With regard to risk management, a review of plant events indicated that the staff is sometimes not providing the desired level of attention, thinking, and engagement to ensure that plant activities are performed properly and without impacting plant operation. With regard to Technical Specifications, it was noted that the plant staff needs to develop a more comprehensive understanding of the plant condition and configuration to identify applicable limiting conditions of operations and applicable actions. It was also noted that the tracking of action statements should be strengthened to ensure that desired efficiency arrives on specified times. The team made a suggestion in this area.

During the OSART it was noted that the plant has an effective working relationship with the regulator. Specifically, the senior management proactively engages regulatory counterparts, seeks their insights, and accepts their feedback in a positive way. Information and analysis provided to the regulator by the plant technical staff is typically thorough and comprehensive. Following a reportable event, the plant is required to report event facts to the regulator within 48 hours. The goal is 100% and actual compliance is 41%. In all cases, the ASN (the French regulatory body) was notified in advance of the due date and accepted the delay. The station is encouraged to strengthen their focus on the timely reporting of events.

The plant has an extensive programme to promote continuous improvement. For example, comprehensive reviews of macro-processes are performed annually, low-level events are trended and analyzed, periodic surveys of Nuclear Safety Culture are performed, and an annual diagnosis of Nuclear Safety is conducted. It was noted that the Safety Engineer (SE) meets daily with the Unit Shift Manager and provides an independent and critical review of threats to safety. In addition, the Nuclear Safety and QA Department (SSQ) conducts an independent verification of process effectiveness and performance deficiencies and is an integral part of the plant's performance monitoring system (nuclear safety group). These activities were recognized as areas of good performance.

1.9. SAFETY CULTURE

The team did not undertake a detailed safety culture assessment at the plant. However, the overall experience of the team was utilized to capture safety culture attributes, behaviours and practices which help to shape and define the safety culture at the plant. With respect to observed strengths, the team noted that the strongest characteristic was that safety is learning driven with a strong desire to learn from others to improve safety performance and understand the factors affecting sub-standard performance. The team also noted that an open working relationship existed between the plant and the regulatory body regarding the sharing of information and working together on the quality and comprehensiveness of the licensing requirements.

However, the team noted that some attributes could be strengthened to improve the overall safety culture and safety performance at the plant. The team observed that deviations from established standards and expectations contributed to operational events, human performance errors, industrial safety events, foreign material exclusion (FME) events and challenges, radiation work permit (RWP) compliance issues, and weakness in the conduct of field operator activities. The leadership safety culture initiatives have not yet been effective in communicating, checking understanding and reinforcing the individual's understanding of the impact of their actions on safety. This indicated that shortfalls exist in the following safety culture characteristic area: Leadership for safety is clear.

The team also noted that the plant had carried out nuclear safety surveys which resulted in the launch of a site level nuclear safety culture roadmap in 2019 and departmental nuclear safety culture roadmaps in 2021. These roadmaps are being used to further enhance the nuclear safety culture at the plant.

DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY FINDINGS

1.1. LEADERSHIP FOR SAFETY

1.1(a) Good Practice: Participatory management

A new plant project setting out the guiding principles for 2021-2025 was established with the assistance of an EDF department specializing in collective intelligence. The project includes a series of initiatives that involves line management and employees from EDF and the contractors. The project was unique in its 'bottom-up' versus 'top-down' design, and included the following.

- a digital questionnaire, which captured opinions on the diagnosis and corresponding solutions
- face-to-face workshops, which provided a forum for discussing ideas and solutions for working together better
- a digital platform, which aimed to challenge the content of the plant project

Over 500 employees played an active role in setting up the plant project.

In parallel, managers worked to define leadership traits for managers. This produced the following results:

- expectations for each management level (deputy plant manager, department manager, first-line manager, team leader) in relation to openness, commitment and legitimacy
- a leadership seminar on 19 March, 2021 produced an initial list of traits, which were then fine-tuned by a group of eight managers from each management level
- a final list of traits, presented in fun, user-friendly cards that foster communication and promote a sense of belonging

The Senior Management Committee for Managers (Senior Management Committee + department managers) prepared a "Predom" questionnaire to better understand individual and team behaviour/performance. The results of the questionnaire highlighted that good communication, exchanging views to better understand each other, was essential.

This approach has been rolled out to the management teams of some departments, including the Electrical-Mechanical Department, Modifications Department, and Technical and Nuclear Logistics Department.

Benefits**:** Every year, the plant conducts an internal communication survey with all employees. Following this initiative, for the first time, the employees identified management as the first source of information they sought for anything related to work. This greatly helps communication between management and employees.

1.1(1) Issue: The plant leaders have not systematically ensured that plant staff are complying with requirements and standards for industrial safety and human performance in a rigorous and consistent manner.

During the review the team noted the following:

- The Industrial Safety Accident Rate indicator tracked in plant performance indicators (MP4, TF2) did not meet the established targets for 2019-2021. In addition, the current WANO Industrial Safety Accident Rate (ISAR) indicator for Paluel Plant is not meeting industry goals for all four units. While performance has improved over the last year, goals are still not being met.
- Shortcomings in industrial safety have contributed to several events and near misses:
    - Fatality during material handling when the load fell on the worker (March 14 2019)
    - Field operator burned by steam when flushing condensate (June 23 2019)
    - Electrical arc flash near miss (September 13 2019)
    - Several near miss rigging and lifting events (26 September 2019, 7 October 2020, 11 November 2020)
    - Several near misses and injuries due to dropped objects and falls (19 April 2019, 16 April 2019, 26 April 2019, 24 July 2019, 4 October 2019, 17 August 2020, 11 June 2020, 3 March 2020, 6 March 2020, 17 August 2020, 10 November 2020, and 20 April 2021)
- Several serious examples of non-compliance were observed by the OSART Team including two instances in which workers did not put on the required personal protective equipment (PPE) when accessing high voltage electrical panels (signage was posted next to the panels that identified the required PPE but was not followed by workers) and a worker that was positioned underneath a suspended load and then transported the load with a fork truck while the load was swinging.
- Additional observations by the OSART Team identified several examples of workers not wearing proper PPE and not identifying or correcting workplace hazards until identified by management.
- Observance of Paluel NPP managers in the field noted that managers may be overly focused on a specific job and not sensitive to hazards or other work performed in nearby areas.
- In 2021 there were three significant events caused by weaknesses in the effective utilization of human performance tools:
    - June 6, Operations, tagged wrong train for EDG Work, No Pre-Job-Brief (PJB) was conducted.
    - June 30, Operations, reactor trip due to Operations Tagging Error on Electrical Switchboard. No PJB was conducted
    - May 5, Operations, Operator opened the wrong electrical circuit breaker making ASG (Auxiliary Feed Water System) unavailable. Poor self-checking. (Potential Process Weakness that tagging does not require Independent Verification for Safety Systems).
- Operations Management has identified that Pre-Job Briefs are not being rigorously performed. It was also noted that utilization of human performance tools has been more challenging for field activities such as tagging and component manipulations.

- In 2020 there were three significant events caused by weaknesses in the effective utilization of human performance tools:
  - October 22, Testing Department did not comply with required Test Conditions, the expected one-minute stop prior to performing work was not completed.
  - July 13, Facility Maintenance, Scaffold built which blocked operator access to valve in PTR System (Reactor Cavity & SFP Cooling). Inadequate PJB.
  - March 5, Instrumentation and control (I&C) Maintenance, I&C workers caused five bar drop in reactor coolant pressure when calibrating pressurizer pressure regulator. Risk analysis was changed and workers were not aware of the change. No PJB with Operations conducted before activity performed.
- A review of station Operating Experience, field observations, and discussions with station management noted that the focus on high-risk activities is generally good. However, when the risk is perceived to be low, workers may be more willing to rationalize non-compliance with standards and take shortcuts. Contributing to this is some workers not fully understanding the purpose of rules, cultural challenges, and not recognizing the risks of performing work.
- Reviews by the OSART team noted that standards and expectations for industrial safety and human performance are well defined and consistent with industry standards. The performance gaps are mainly contributed to not complying with these standards.

If the plant staff does not strictly adhere to standards and expectations for industrial safety and human performance, there is an increased risk to plant and personnel safety.

Recommendation: Plant leaders should ensure that plant staff are complying with requirements and standards for industrial safety and human performance in a rigorous and consistent manner.

IAEA Bases:

SSR-2/2 (Rev.1)

4.35 Monitoring of safety performance shall include the monitoring of: personnel performance; attitudes to safety; response to infringements of safety; and violations of operational limits and conditions, operating procedures, regulations and licence conditions. The monitoring of plant conditions, activities and attitudes of personnel shall be supported by systematic walkdowns of the plant by the plant managers.

GSR Part 2

3.2. Managers at all levels in the organization, taking into account their duties, shall ensure that their leadership includes:

(a) Setting goals for safety that are consistent with the organization’s policy for safety, actively seeking information on safety performance within their area of responsibility and demonstrating commitment to improving safety performance;

(b) Development of individual and institutional values and expectations for safety throughout the organization by means of their decisions, statements and actions;

4.36. The organization shall make arrangements for ensuring that suppliers of items, products and services important to safety adhere to safety requirements and meet the organization’s expectations of safe conduct in their delivery.

SSG-72

3.2. The operating organization has the following main responsibilities:

(b) Establishing a safety policy, implementing operational policies and developing and applying safety performance standards…

3.5. As noted in para. 3.2(b), the operating organization is required to establish safety performance standards, and should effectively communicate these standards throughout the organization. All levels of management should promote and expect consistent adherence to these performance standards.

7.85. A suitable working environment should be provided and maintained so that work can be carried out safely and satisfactorily, without imposing unnecessary physical and psychological stress on personnel. Paragraph 4.29 of SSR-2/2 (Rev. 1) [1] states:

"Aspects of the working environment that influence human performance factors (such as workload or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel."

7.86. The operating organization should establish an appropriate programme for identifying such aspects of the working environment. Examples of things that should be considered in this programme include the following:

(a) The adequacy of the resources, support and supervision provided to manage and perform the work;

(b) The adequacy of lighting, access and operator aids;

(c) The adequacy of alarms, considering factors such as their number, position, grouping, colour coding and prioritizing for audibility;

(d) The frequency and clarity of communications;

(e) The availability of suitable tools and equipment;

(f) The duration of work time for personnel;

(g) The attention needed to be given to other factors, in particular for control room staff, including well-being, psychological and attitudinal problems, shift patterns and meal breaks;

(h) The availability of procedures that take into account human factor considerations.

GS-G-3.1

2.16. The actions of managers and supervisors or team leaders have a strong influence on the safety culture within the organization. These actions should promote good working practices and eliminate poor practices. Managers and supervisors or team leaders should maintain a presence in the workplace by carrying out tours, walkdowns of the facility and periodic observations of tasks with particular safety significance.

1.2(1) Issue: Weaknesses in the effective execution of some key processes such as risk management and compliance with Technical Specifications have challenged the effectiveness of programmes important to safety.

During the review the team noted the following:

– Risk Management

A review of significant events noted several examples in which the risk analysis was not comprehensive and did not consider the potential for adverse impacts. In each example, station analysis noted that deficiencies in the execution of Risk Management contributed to the event.

– On August 18 2021, Non-justified opening of two valves on the pressurizer.
– On November 5 2020, Dismantling of one of the turbine overspeed protections of the emergency water injection system at the primary pump seals during a painting activity.
– On January 14 2020, Deficient risk assessment combined with equipment failure, causing the flowrate of the auxiliary building ventilation system (DVN) to drop below 180 000 M3/h.
– On March 6 2019, Rise in the water level in Unit 4 essential service water (SEC) shaft train B due to human intervention on the isolation valve for the common inter-unit position.
– On June 19 2019, Loss of production of 66 days full production equivalent following pollution of the oil circuit of 6.6 kV emergency power supply diesel.

A review of the station response to WANO SOER 2015-02, 'Risk Management Challenges' was performed by the OSART Team. Paluel NPP internal reviews noted that only two of seven recommendations have been evaluated as Satisfactory (SAT). Most recommendation were Awaiting Implementation (AI) or had Further Action Required (FAR).

During an inspection in 2021, inspectors noted that projects do not sufficiently challenge the businesses on the identification and securing of risk activities and not all the risk control requirements are known to stakeholders.

The management process (MP3) performance indicator tracking the number of Significant Events due to defects in Risk Management is two, due to events in April 2021.

– Compliance with operating Technical Specifications (NCSTE):

Review of plant OE identified examples in which the plant did not identify and comply with operating Technical Specifications (NCSTE) and Action Statements:

- On January 27 2021, Action statements not followed for the Group 2 ICPA2 LCO following the unavailability of 2RRI188LP (Component Cooling Water system)
- On November 30 2020, Documents not correctly integrated into the Technical Specsifications for Units 1, 2 and 3
- On July 25 2020, Unit 4 taken into shutdown conditions as per action statement for group 1 LCO reference RPPR7. Given the time it took to complete troubleshooting and maintenance work, the action statement was breached
- On June 23 2020, Violation of an action statement for a group 2 LCO entered due to the malfunction of an I&C module. Repair times exceeded LCO action statement requirements.
- On December 4 2019, Breach of the action statement associated with the unavailability of the Train A auxiliary compressor for the compressed-air production system.

  - On July 17 2019, Repair deadline exceeded for a group 2 limiting condition for operation applied to the fire detection system
  - On June 29 2019, Noncompliance with the action statement for unplanned limiting conditions applied to the chilled water system for electrical rooms in units 1, 2 and 3.
  - On January 30 2019, Unavailability of the LOOP (loss of off-site power) alarms for four months.
- The plant performance indicator tracking the non-compliance with Technical Specifications (Number of NCSTEs) is one year-to-date which is the goal for all of 2021. Establishing a goal that accepts any non-compliances with Technical Specifications is not typical in the industry.
- During interviews with managers in the Independent Oversight Group (SSQ), they noted that identification and compliance with operating Technical Specifications (NCSTE) and Action Statements was a concern.

If the plant staff does not strengthen the execution of programmes for Risk Management, and compliance with Technical Specifications, operational safety might be compromised.

Suggestion: The plant should consider strengthening the effective execution of key processes such as risk management and compliance with Technical Specifications.

IAEA Bases:

SSR-2/2 (Rev.1)

4.14. A process shall be established to ensure that deviations from operational limits and conditions are documented and reported in an appropriate manner and that appropriate actions are taken in response. Responsibilities and lines of communication for responding to such deviations shall be clearly specified in writing

4.30. The operating organization shall encourage plant personnel to have a questioning attitude and to make appropriate and conservative decisions, so as to minimize risk and to maintain the plant in a safe condition.

Requirement 23: The operating organization shall establish and implement a programme to ensure that safety related risks associated with non-radiation-related hazards to personnel involved in activities at the plant are kept as low as reasonably achievable.

SSG 70:

9.1. The operating organization of the nuclear power plant has the prime responsibility for safety: see Requirement 1 of SSR-2/2 (Rev. 1) [1]. The operating organization is required to ensure compliance with OLCs: see Requirement 6 of SSR-2/2 (Rev. 1) [1].

9.6. The allocation of responsibilities for checking compliance with OLCs and operating procedures and for responding to deviations is required to be included in the management system: see paras 3.2(b) and 3.2(e) of SSR-2/2 (Rev. 1) [1].

9.11. The results of the surveillance programme to ensure compliance with OLCs (see Section 6) are required to be evaluated, recorded and retained: see para. 4.12 of SSR-2/2 (Rev. 1) [1]. Records of plant operation and demonstrations of compliance with OLCs and operating procedures should be made and kept in an appropriate archive (see also para. 4.52 of SSR-2/2 (Rev. 1) [1]. Deviations from OLCs are required to be reported and appropriate actions taken in response: see para. 4.14 of SSR-2/2 (Rev. 1) [1]. Reports of non-compliance should be investigated to ensure that corrective actions are implemented and to help prevent a reoccurrence of the non-compliance in future…

SSG-72:

5.11 Safety related activities should be properly planned to ensure that they can be carried out safely and effectively. Suitable and sufficient safety assessments of the potential risks arising from such activities are required: see para. 4.25 of SSR-2/2 (Rev. 1) [1]. The nature of the safety assessment will depend on the safety significance of the proposed activity, and the assessment may be qualitative or quantitative. The purpose of the safety assessment is to identify the acceptability of the proposed activity and the appropriate control measures that are necessary to ensure that protection and safety is optimized. The results of the safety assessment should be incorporated into work instructions or control documentation associated with the activity, for example, the documentation for the permit to work system.

7.66. The non-radiation-related safety programme should ensure that risks to personnel involved in plant activities are adequately controlled. The programme should include arrangements for the planning, organization, implementation, monitoring and review of appropriate preventive measures and protective measures. The operating organization should provide support, guidance and assistance for plant personnel in the area of non-radiation-related safety.

SSG-76:

7.10. Planning of work on plant systems and equipment important to safety should be coordinated to ensure that the plant remains in a safe condition at all times and in compliance with OLCs. Scheduling and planning should be used to prioritize the work so as to minimize the risk to safety.

GS-G-3.5:

3.15.The processes for implementing each policy and the structure within which the policy is implemented should be clear. Individuals should know which parts of the processes are relevant to them, so as to understand the major risks in the activities at the installation and how they are controlled.

3.16.In order to understand and implement policies at the installation, managers at all levels should have:

…

(d)An understanding of the risks within the manager's own area of responsibility;

…

5.65.In addition to the risk assessments carried out in the planning and control process, assessments of workplace risk (sometimes referred to as 'point of work' risk assessments) should be carried out for all activities performed by individuals at the installation or by contractors' personnel that may pose a particular risk of injury, harm or damage.

5.66.To carry out an adequate workplace risk assessment, the workplace should be visited and account should be taken of: the route for getting to and from the workplace; other work (including routine operations) being undertaken in the area; and any new requirements emanating from emergency arrangements, changes to procedures, training and supervision.

5.67.In recognition of differing types of risk, there are different types of workplace risk assessment that can be used and which should be documented and used as an input to work planning and control.

2. TRAINING AND QUALIFICATION

References in the text to plant training are intended to refer to plant-specific training. Some elements of the Systematic Approach to Training (SAT) are not sufficiently implemented to ensure the needed progression in staff competences and skills. Evaluation of the additional training identified by training committees is not systematically performed. Full competences for operation and maintenance of the emergency diesel generator (DUS) are not yet developed in the operating and maintenance departments. Several aspects of the plant-specific training process are not sufficiently robust to ensure the timely implementation and quality of the training programme. Across all performance indicators, there is no indicator on how training affects plant performance, such as the number of plant-specific training sessions identified as being delayed. The training department does not systematically use a method of learning from operating experience. This is left up to the decision of each trainer. During simulator scenarios, Main Control Room staff are evaluated individually, and not as a crew with instructors taking the role of senior operators, shift managers and field operators. The team made a recommendation in this area.

The plant has implemented a mock-up simulator facility to improve understanding of physical phenomena occurring during primary circuit transients, including mid-loop operation. Thanks to this mock-up, abnormal situations observed in the plant, such as incorrect vessel vent line-up, and water present in a vessel vent hose, have been better understood. Many nuclear plants in the French fleet have implemented this mock-up, which was developed by Paluel NPP. The team recognized this as a good performance.

The plant has implemented a system for monitoring registration for training sessions and optimizing attendance and fill rate of training sessions, thereby reducing the number of absent trainees. The training department sends weekly reminders to staff registered to training for the next eight weeks. Managers analyse this data in line with their own schedule of activities. Since the implementation of this new practice last year, the plant has decreased the absenteeism rate by a factor of 2. The team recognized this as a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.2 QUALIFICATION AND TRAINING OF PERSONNEL

2.2 (1) Issue: The plant specific training programme does not systematically ensure that personnel are provided with comprehensive training and evaluation to ensure safe plant operation and performance improvement.

The team noted following:

- During chemistry staff training on emergency scenarios, it was recognized that chemistry staff is responsible for dose assessment during emergencies at Paluel NPP. However, such competences are not referenced in the SAT for chemical staff.
- A list of competences for Tagging Supervisor (DSE) does not include a role of Shift Supervisor. However, based on the crew organization during accidents, the Tagging supervisor can take on the role of Shift Supervisor.
- ‘Evaluation’ is one of several phases in the Systematic Approach to Training (SAT). However, evaluations of the additional training identified by the training committees are not systematically performed.
- A first line manager in the electrical/mechanical maintenance department provided a competence map showing that competences (level 2 and 3) for mechanical maintenance of the emergency diesel generator (DUS) were not developed in 2021, and even in 2022 the plant will not reach the minimum requirements for the needed competences, despite the DUS being in operation since March 2020.
- To date, 61% of the Main Control Room (MCR) staff have initial training in the classroom and on the simulator on how to operate the DUS, and 39% of the MCR staff have refresher training (EOP).
- To date, 90% of field operators have received training related to the DUS (APE RFLE 245). Only two electrical and two mechanical technicians have participated in testing and maintenance activities with the vendor of the equipment. It is expected that training for the rest of the technicians will be done through coaching. However, no plan is available at the moment.
- Root Cause Analysis (RCA) training is not referenced in the list of personnel competences and training needs for Safety Engineers, even though they perform and review the quality of RCAs.
- The Systematic Approach to Training requires consistency, efficiency and management of training materials and results. However, the plant catalogue of local training is under development at Paluel NPP.
- Once per year training managers of all EDF plants discuss operating experience related to competences to be included in the training plan for the next year (only two events are identified). International operating experience is not reviewed.
- The Training department does not regularly participate in the meeting dedicated to plant events. They are invited to the meeting when investigation of significant events is presented. The training department is not obliged to systematically use a method of learning from events by including the significant events in the training sessions. This is left to the decision of each trainer. At the Level 1 training committee, only operating experience related to competences is discussed.

- Training related to multi-unit accidents includes only two units and is organized every year. However, the plant does not ensure that different crews are part of the exercise. The same situation applies to the safety engineer.
- Training and evaluation scenarios do not include combined events, for example fire and other accidents in the same unit. This kind of scenario was only trained once on the simulator (preliminary training) when it was recognized that crew members have problems with their roles. It was not repeated or included in the next training plan. Additionally, in the accident scenarios Safety Engineer and Tagging Supervisor (DSE) can replace the Shift Supervisor (CED) and Shift Manager (CE) without receiving appropriate training.
- In simulator scenarios, Operators, Senior Operator, Shift Supervisor and Shift Managers are evaluated separately, they are not evaluated as a crew. In the reviewed simulator training of the Shift Supervisor and Shift Manager, instructors act as Senior Operator and field operators. During training of the Senior Operator, instructors take the roles of Shift Manager and field operators.
- Field operators do not systematically participate in simulator training to measure a time to deploy equipment.
- The Level 1 training committee prepares a list of actions based on events related to competences, observations, and additional requests for training. Currently there are 112 open actions, 2/3 are delayed (mostly from instrumentation, electrical maintenance, environment). The report from the Level 1 committee does not include information on the priority of the actions. The Level 1 committee report includes some feedback on training. However there is no detailed information on how effective it was, and if it will be repeated.
- The Level 2 training committee can change the priority of implementation of the proposed actions from the level 1 training committee. However, there are no criteria how to do that. The Level 2 training committee report includes proposed training/activities, without information on the priority of the actions.
- The plant has several indicators related to training committee activities. However, the number of delayed activities is not a performance indicator.
- Results of instructor assessment and gaps in simulator training (FAP report), are reported to the Level 2 training committee. However, no action is identified with the aim of improving operators' performance.
- Field Operators' evaluation does not include several levels of competences to ensure better organization of their work and to identify progress in field operator performance.

Without effective training, safe plant operation as well as plant performance may be compromised.

Suggestion: The plant should consider enhancing its plant specific training programme to ensure that personnel are provided with comprehensive training and evaluation to ensure safe plant operation and performance improvement.

IAEA Bases:

SSR-2/2 (Rev. 1)

4.17. Suitably qualified personnel shall be selected and shall be given the necessary training and instruction to enable them to perform their duties correctly for different operational states of the plant and in accident conditions, in accordance with the appropriate procedures.

4.18 The management of the operating organization shall be responsible for the qualification and the competence of plant staff. Managers shall participate in determining the needs for training and in ensuring that operating experience is taken into account in the training. Managers and supervisors shall ensure that production needs do not unduly interfere with the conduct of the training programme.

4.20. Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel (including, if necessary, external support organizations, including contractors). The content of each programme shall be based on a systematic approach. Training programmes shall promote attitudes that help to ensure that safety issues receive the attention that they warrant.

4.21. The training programmes shall be assessed and improved by means of periodic review. In addition, a system shall be put in place for the timely modification and updating of the training facilities, computer models, simulators and materials to ensure that they adequately reflect current plant conditions and operating policy, and that any differences are justified.

4.22. Operating experience at the plant, as well as relevant experience at other plants, shall be appropriately incorporated into the training programme. It shall be ensured that training is conducted on the root cause(s) of the events and on the determination and implementation of corrective actions to make their recurrence less likely.

SSG-75

2.17 When selecting candidates to work as control room operators or as other personnel who might have to respond to an emergency, their ability to work together as a team in such conditions should be considered. In the allocation of staff to particular teams, the likely personal interactions should be taken into account.

3.1…The criteria for competence and qualification should be established in such a way as to ensure that the competences are appropriate to the tasks and activities to be performed.

4.2. The operating organization should formulate an overall training policy. This policy should describe the commitment of the operating organization and managers to the training of personnel, and acknowledge the essential role of training in the safe and reliable operation and maintenance of the plant.

4.4. A training plan should be prepared on the basis of the long term needs and goals of the plant. This plan should be reviewed periodically in order to ensure that it is consistent with current (and future) needs and goals. Factors that should be taken into account in the review of the training plan include feedback of operating experience; significant modifications to the plant or to the operating organization; changes in regulatory requirements; changes in the national education system; fluctuations in staffing and specific staffing problems ….

4.14. A systematic approach to training should be used for personnel. The systematic approach provides a logical progression, from identification of the competences necessary for performing a job, to the development and implementation of training towards achieving these competences, and to the subsequent evaluation of this training.

4.19. Representative simulator facilities are required to be available, and these should be used for the training of control room operators, shift supervisors, responsible managers and technical support personnel. With regard to simulator training, consideration should be given to the following:

…

(f) Training should be conducted using a shift team concept to develop team skills, good communication and co-ordination habits and trust in the application of plant procedures;

(g) Individual and team assessments should be based on predetermined performance criteria;

…

5.27 Field operators should receive training commensurate with their duties and responsibilities. The main objectives of this training should be to develop and maintain adequate knowledge and skills to ensure that they are able to perform the following tasks:

(a) Monitor performance and status of plant equipment, and recognize any deviations from normal conditions, including any non-compliance with the foreign material exclusion programme;

(b) Conduct operations in a safe and reliable manner, without causing unacceptable risks to the plant;

(c) Detect and properly respond to plant conditions with the goal of preventing or, at minimum, of mitigating unanticipated plant transients;

(d) Implement the emergency operating procedures and severe accident management guidelines outside the main control room.

5.38 Training instructors should thoroughly understand all aspects of the contents of the training programmes and the relationship between these contents and plant operation. In addition, the instructors should be familiar with methods of adult learning and a systematic approach to training, and should have the necessary skills to assess the progress made by trainees.

SSG-54

2.107. Results from exercises and drills should be systematically evaluated to provide feedback for the improvement of the training programme and, if applicable, the procedures and guidelines, as well as the organizational aspects of accident management.

2.108. If, within the operating organization, the transfer of authority to direct the accident management actions is considered during an accident, it should be verified that the person to whom authority will be transferred has the required background to efficiently discharge such authority.

3.114 ….Training should cover severe accidents occurring simultaneously at more than one unit and severe accidents occurring in different reactor operating states. Training should consider unconventional line-ups of the plant equipment, the use of non-permanent equipment (e.g. diesel power generators, pumps) and repair of the equipment.

3. OPERATIONS

3.4. CONDUCT OF OPERATIONS

The plant operational requirements and practices to support reliable and safe operations are not fully followed and verified during control room activities. Reactivity changes were not always carried out with sufficient rigor, and dilution of boron concentrations were made without peer check or supervision.

There is no plant expectation for Main Control Room (MCR) operators to familiarise themselves with newly issued procedure changes before starting duty. Temporary operating procedures on all four units were not fully countersigned by personnel, despite the fact that the personnel concerned had been on several shifts since the procedures were issued. The team made a suggestion that the plant should consider improving operational requirements and practices to enhance safe and reliable operations.

The operations personnel do not always identify and report field deficiencies and equipment status in a timely manner to ensure that they can be effectively addressed. The company has well-defined rules for maintaining cleanliness, housekeeping and use of temporary storage. However, there was an acceptance of low housekeeping standards in some areas and equipment deficiencies were not always identified or reported by field operators. The team observed several unreported equipment deficiencies and inappropriate housekeeping in the field. The team made a suggestion in this area.

Return-to-shift training days are practiced before the shift starts its duty cycle. They are prepared and led by job-role leads within the Operations Department. The objective is to prepare personnel, before they return to shift, for the activities they will be required to carry out. This is designed to give workers the time to familiarize themselves with procedures, instructions and risk assessments, so that they are ready to implement them at the appropriate time during the upcoming week on-shift. This is seen as a good performance.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

Plant firefighting personnel have initial training and refresher training. The local civil firefighting groups receive site-based processes training. The use of the backup fire team which consists of highly trained firefighting personnel from the plant's additional departments enhance the plant's firefighting capabilities. This is seen as a good performance.

DETAILED OPERATIONS FINDINGS

3.4. CONDUCT OF OPERATIONS

3.4. (1) Issue: The plant operational requirements and practices to support reliable and safe operations are not fully followed and verified during control room activities.

During the review, the team noted the following:

Reactivity Control:

- In Unit 2, no peer check was applied when the reactor operator started to dilute the boron in the primary circuit at approximately 20% reactor power, following a power reduction from rated power.
- There is no plant expectation to apply a peer check during primary circuit dilution of boron after significant automatic power reduction.
- In Unit 1, a reactor operator diluted the boron in the primary circuit to increase the average primary temperature by 0,1 ºC and went to the left part of the MCR to make a phone call. The reactivity change was not monitored continuously after the dilution.
- In Unit 2, a reactor operator diluted the boron in the primary circuit to increase the average primary temperature by 0.1 ºC without any communication with the leading operator (USS). During the primary circuit dilution there was no peer check and procedure use. The whole activity was not supervised.
- There is no plant expectation to use an operating procedure in case of small primary circuit dilutions for the purpose of varying the reactor temperature by less than 1ºC.
- During simulator training, while performing a planned unit power decrease from 25% to 8% power level no peer check was applied.
- Plant expectations regarding the use of peer check do not apply to situations in which a Control Room Operator triggers a planned unit power decrease.

Control of Operational Documentation:

- There is no plant expectation for MCR Operators to familiarise themselves with newly issued procedure changes before starting duty.
- In Unit 1, two out of eight temporary operating procedures were not fully countersigned by personnel including operators and the Shift Manager, even though they have been on several shifts since the procedures were issued. One was issued in August 2021 and the other in September 2021. One of the temporary procedures concerned a safety-related system (station blackout diesel generator).
- In Unit 2, two out of 10 temporary operating procedures were not fully countersigned by personnel, despite the fact that they have been on shift several times since the procedures were issued. One of the temporary procedures concerned a safety-related system (reactor coolant pump).
- In Unit 3, six out of nine temporary operating procedures were not fully countersigned by shift personnel, despite the fact that they have been on shift several times since the procedures were issued. One of the temporary procedures was issued in November 2020. One of the temporary procedures concerned a safety-related system (station blackout diesel generator).
- In Unit 4, two out of 10 temporary operating procedures were not fully countersigned by shift personnel, despite the fact that they have been on shift several times since the

procedures were issued. One of the temporary procedures was issued in June 2021, the other in August 2021. One of the temporary procedures concerned a safety-related system (station blackout diesel generator).

- In Unit 1, one out of eight temporary operating procedures were not labelled on the operational board despite plant expectation.
- A handwritten procedure on 1KLI004AR which had not been subject to quality assurance was observed in the main control room.

Without fully established operational requirements and practices, the plant could experience an increase in errors during operational activities.

Suggestion: The plant should consider improving control room activities to ensure operational requirements and practices are followed and verified to support reliable and safe operations.

IAEA Bases:

SSR-2/2 (Rev.1)

7.20. The operating organization shall be responsible for establishing a safe reactivity management programme under a strong management system for quality. Decisions on, and the planning, evaluation, conduct and control of, all operations or modifications involving the fuel that are liable to affect reactivity control shall be undertaken by using approved procedures and respecting predefined operational limits for the core.

7.21. A comprehensive core monitoring programme shall be established to ensure that core parameters are monitored, analysed for trends and evaluated to detect abnormal behaviour; to ensure that actual core performance is consistent with core design requirements; and to ensure that the values of key operating parameters are recorded and retained in a logical, consistent and retrievable manner.

7.22. Reactivity manipulations shall be made in a deliberate and carefully controlled manner to ensure that the reactor is maintained within prescribed operational limits and conditions and that the desired response is achieved.

7.5. A system shall be established to administer and control an effective operator aids programme. The control system for operator aids shall prevent the use of non-authorized operator aids and of any other non-authorized materials such as instructions or labels of any kind on the equipment, local panels, boards and measurement devices within the work areas. The control system for operator aids shall be used to ensure that operator aids contain correct information and that they are updated, periodically reviewed and approved.

SSG-76

2.13. Operating personnel should maintain the reactor and its supporting systems within the bounds of approved equipment alignments. As stated in para. 4.26 of SSR-2/2 (Rev. 1) [1]:

“All activities important to safety shall be carried out in accordance with written procedures to ensure that the plant is operated within the established operational limits and conditions. (…)”

2.14. The nuclear power plant should be maintained in a safe condition by deliberate monitoring and control to ensure that fundamental safety functions (e.g. control of reactivity, removal of heat from the reactor and from the fuel store, confinement of radioactive material) are fulfilled at all stages of the lifetime of the nuclear power plant, including decommissioning. Requirements on decommissioning are established in IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities [12]. Further recommendations are provided in IAEA Safety

Standards Series No. SSG-47, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities [13].

2.22. Paragraph 4.19 of SSR-2/2 (Rev. 1) [1] states:

"A suitable training programme shall be established and maintained for the training of personnel before their assignment to safety related duties. The training programme shall include provision for periodic confirmation of the competence of personnel and for refresher training on a regular basis. The refresher training shall also include retraining provision for personnel who have had extended absences from their authorized duties. The training shall emphasize the importance of safety in all aspects of plant operation and shall promote safety culture."

Additional training or briefings should be provided for operations important to safety or for infrequent operations (including operations that are performed less frequently because of improved operational performance, e.g. startup of the plant). Changes to regulations and procedures, modifications to plant equipment and changes to the organizational structure should be addressed in continuing training. Special training should be provided on internal events and external events relevant to the safety of the plant.

4.27. A controlled copy of all operating procedures should be available in the main control room. Controlled copies of selected procedures should be located at other locations within the plant where these procedures are used (or will be used in appropriate situations), for example, in the supplementary control room. Administrative controls should be put in place to ensure that only valid operating procedures are in use and that outdated procedures are not used by mistake. The plant procedures should be kept in such a way as to ensure their immediate availability. Operating personnel should take special care when new procedures are introduced and used for the first time.

5.26. The management of the operations department should be involved in the planning, evaluation and conduct of all operations affecting the fuel while under the supervision of the department (i.e. not only during operation of the reactor). The level of involvement of the management should correspond to the degree of responsibility that the operations department has for the safe operation of the plant and to the degree of responsibility assigned to shift personnel under the supervision of the shift supervisor. Further recommendations on operations relating to reactivity are provided in SSG-73 [6].

5.27. Decisions on operations that might result in changes of reactivity should be such that the reactor is maintained within the core operational limits with adequate margins. This should also provide the basis for safety in anticipated transient operational conditions. The importance of maintaining margins to core operational limits should be a part of the management's expectations for operating within established limits.

5.28. Paragraph 7.22 of SSR-2/2 (Rev. 1) [1] states:

"Reactivity manipulations shall be made in a deliberate and carefully controlled manner to ensure that the reactor is maintained within prescribed operational limits and conditions and that the desired response is achieved."

These manipulations should include appropriate time intervals between reactivity changes during which time the reactor is monitored to verify the response.

5.29. Planned reactivity changes are required to be performed in accordance with approved procedures: see para. 7.20 of SSR-2/2 (Rev. 1) [1]. Reactivity manipulations should only be performed with the explicit permission of the shift supervisor. The shift supervisor should monitor the reactivity and the plant evolution, and the reactor operators should be free from other duties and free from distractions while planned reactivity changes are performed.

5.30. Any planned major changes to the reactor power or to any other operations relating to reactivity should be initiated only after a pre-job briefing on the expected effects of the change. Before any major change is made, any conflicts in procedures should be resolved and possible distractions from work or contingency action should be discussed.

5.31. Self-assessment and error prevention tools, such as the ‘stop, think, act, review’ methodology and peer checking (see also paras 5.70 and 5.71) should be used during reactivity manipulations. Effective and appropriate control should be established over activities performed by other plant personnel (e.g. chemistry technicians or instrumentation and control technicians) that could affect reactivity or the removal of residual heat.

6.16. Operator aids should be placed in close proximity to where they are expected to be used and posted operator aids should not obscure instruments or controls.

3.4 (2) Issue: The plant personnel undertaking operator rounds do not always identify and report deficiencies and adverse conditions to improve the safe and reliable operation of plant systems and components.

During the review, the team noted the following field observations:

- A field operator did not identify inadequate lighting in the main cooling pump house areas adjacent to the Unit 4 main cooling water pump access pathway. Several unidentified cables and temporary pipework from an unused sump drainage pump were also not identified as tripping hazards. This was repeated when a turbine hall field operator accepted poor lighting conditions within Turbine 3 basement pipe tunnel. Also overlooked was temporary power cables causing a tripping hazard in a walkway on Turbine 3 Instrument room.
- Field operators conducting rounds do not always report deficiencies in laydown storage contents, plant identification labelling, oil and water leaks. Unit 2 Turbine Building oil leak under 2APP turbine feed water pump was observed. In Auxiliary Building El 7.74 of Safety Systems RIS 052 PO, an oil leak was observed. The labels of 3GCT334VL turbine by-pass valve were unreadable and the valve body was rusty. During shift rounds several leaks were being managed with appropriate leak management but no defect labels were applied to the plant.
- Field operators were observed during plant rounds to take readings on their mobile devices without checking adjacent plant for industrial safety issues and substandard housekeeping issues.
- During plant rounds in the field, turbine hall and the main cooling water plant, the operator's use of human performance (HU) tools (point, touch, verbalize) were not always carried out to ensure correct application of their duties.
- At the field operators shift handover 3-way communication was not used and the handover was very brief so that the accurate information of plant status was not conveyed.
- The application and use of the department's Operations Fundamentals (monitor plant parameters and status attentively) were not always evident during field operator rounds.
- The required competences for field operators include supervision of scaffolding. However, during interviews with field operators it was reported that they do not have competences for implementing that task, even though there is an expectation in the Operations department for them to do that. There is a recognized need to repeat training for field operators on risks related to installation of scaffolding near safety related equipment.

Without the consistent application of Operator Fundamentals, along with timely identification and reporting of all deficiencies, risks could accumulate, which could cause adverse events.

Suggestion: The plant should consider enhancing the identification and reporting of deficiencies and adverse conditions during field operator rounds to enhance safe and reliable operations of plant systems and components.

IAEA Bases:

SSG-76

SHIFT ROUNDS

4.40. Operating personnel who are assigned the task of conducting shift rounds should be made responsible for verifying that operating equipment and standby equipment operate within normal parameters. They should take note of any equipment that is deteriorating and of factors that might affect environmental conditions, such as water leaks, oil leaks, broken light bulbs and changes in building temperature or the quality of the air.

4.41. Any problems with equipment that is observed during shift rounds should be promptly reported to the control room personnel and corrective action should be initiated. Factors that should typically be noted and reported include:

(a) Deterioration in material conditions of any kind, including corrosion, leakage from components, accumulation of boric acid, excessive vibration, unfamiliar noise, inadequate labelling, foreign bodies and deficiencies necessitating maintenance or other action;

(b) Any issues associated with the operability and calibration status of measurement and recording devices and alarms on local panels throughout the plant, and their readiness for actuating or recording;

(d) Indications of deviations from good housekeeping, for example: the condition of components, sumps, thermal insulation and painting; obstructions; unusual smells, posting of signs and directions in rooms; posting of routes and lighting; and posting and status of doors;

TOOLS FOR PREVENTING HUMAN ERROR

5.70. Appropriate training that focus on anticipating and preventing human errors before they become the cause of events should be provided for the conduct of operations at nuclear power plants.

4. MAINTENANCE

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The plant has developed a product to test metal surfaces for imperfections or damages. It is used for leak tightness inspection on industrial valves.

4.6. MATERIAL CONDITION

The plant has implemented a foreign material exclusion (FME) programme to prevent foreign materials being introduced into the plant systems and components. However, the team observed several deviations, for example in the protection of the reactor and spent fuel pool area against intrusion of foreign material. Furthermore, an increasing trend of deviations related to the foreign material risk was identified in the first half year of 2021. The team suggests that the plant should consider reinforcing its FME programme.

4.7. WORK CONTROL

The team identified that the on-line plant work control process does not always support the timely completion of preventive maintenance, surveillance activities and the effectiveness of maintenance. In 2019 the plant started to reduce the preventive maintenance backlog. However, at the end of July 2021 there were 2776 activities delayed, 106 of them were safety related.

During the review the team noted that, following a turbine trip, a delay of maintenance activities caused a subsequent delay to the restarting of the turbine. Further, the work control indicators had not met the expected target value and the plant is not using some indicators to evaluate the work control process (for example: Week + 1 indicator and rework indicator). The team made a recommendation that the plant should improve the work control process.

4.8 SPARE PARTS AND MATERIALS

The team noted that preventive maintenance activities on the spare parts at the local storage are not carried out. Several maintenance activities were postponed beyond their due date, due to missing or late delivery of spare parts. The team encourages the plant to consider implementing preventive maintenance activities on spare parts in the local storage, and to reduce the delay of activities by on time delivery of spare parts.

DETAILED MAINTENANCE FINDINGS

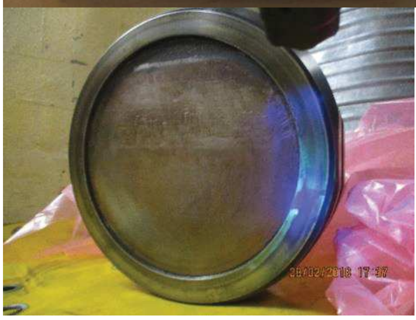
4.2. MAINTENANCE FACILITIES AND EQUIPMENT

4.2(a) Good practice: Fluo Kit – Checking Kit for Leak Tightness of Industrial Valves.

Description:

The product is used for surface testing on valves.

The kit comprises a Fluo-pen-type applicator and an ultraviolet (UV) lamp. The applicator is such that the liquid does not dry and, combined with a simple cloth, enables the plant to ensure a fine layer of fluo is applied on the surface. The UV lamp makes improper fitting of valves, or damage on machined surfaces, easy visible.



Context: the checks on the seating faces are carried out at each internal visit for the valve, meaning between 300 and 500 uses per maintenance outage or VP (around a hundred times on a refueling outage or ASR).

Results achieved:

Replacement of the formed used tool for the checks on seating faces/valve tightness of industrial valves by a fluo kit. The fluo kit was developed by an employee at the Paluel NPP and is now used in all NPPs in the fleet.

Potential applications on another equipment or area of expertise:

Applicable in all NPPs.

4.6. MATERIAL CONDITION

4.6 (1) Issue: The plant foreign material exclusion (FME) programme is not strictly implemented to prevent foreign materials being introduced into the plant safety related systems and components.

The team noted the following:

- Several deviations in the protection of the spent fuel pool against foreign material in Unit 1, 3 and 4:
  - Several openings in the pink foreign material exclusion (FME) barrier.
  - Pink FME barrier fixed on the wrong side of the fence around the pool.
  - Small metal wire found near the FME zone.
  - Missing parts from anchoring points in the FME zone.
  - Small particles of plastic and dirt behind the FME zone.
- Trend in FME findings (reference trend report first half year 2021). 'FME risk highlighted as a significant weakness in the first half of the year 2021 and confirmed by several incidents with important impact'.
- Post-Fukushima test water storage tanks were stored without FME covers on inlet and outlet flanges.
- It was noted that the workshop practice was not to install FME covers when work was stopped during breaks or at the end of the day.
- In February 2021, a 19-size spanner was found inside the reactor pressure vessel, after having remained inside the vessel for at least one cycle.
- On 2 September 2021, broken glass was found in the FME zone area around the spent fuel pool of Unit 2 (C000320314). Some pieces were found at the edge of the pool.

Without strict adherence to the FME requirements, especially around the spent fuel pool, foreign material intrusions could cause equipment damage or material contamination, resulting in a nuclear safety, radiation and/or equipment reliability risk.

Suggestion: The plant should consider strictly implementing its FME programme to prevent foreign materials being introduced into plant safety related systems and components.

IAEA Bases:

SSR-2/2 (Rev.1)

7.11. An exclusion programme for foreign objects shall be implemented and monitored, and suitable arrangements shall be made for locking, tagging or otherwise securing isolation points for systems or components to ensure safety.

SSG-73

3.11. The areas for the handling and storage of fresh fuel should be maintained under appropriate environmental conditions (in respect of humidity, temperature and clean air) and controlled at all times to exclude chemical contaminants and foreign materials.

4.2 The steps necessary to assemble fresh fuel and to prepare it for use in the reactor, including any arrangements for holding it in intermediate storage, should be specified in the refueling plans.

Only fuel that meets the requirements established in para. 7.18 of SSR-2/2 (Rev. 1) [1] may be loaded into the reactor core. Checks should be carried out to confirm that the fuel has been assembled correctly. In all fuel handling and maintenance activities, it should be ensured as far as possible that no foreign material is introduced into the reactor: see paras 4.25-4.27.

4.5 Although handling procedures may be simpler when a reactor is being loaded for the first time (i.e. because the fuel and core components have not yet been irradiated), the refueling plans and the quality management programme should still be followed. Checks should be carried out before fresh fuel is loaded into the refueling machine or the core, to ensure that all equipment, materials and dummy or test fuel assemblies used for commissioning have been removed. Precautions should also be taken to prevent foreign materials from entering the reactor core (see paras 4.25-4.27). Dummy or test fuel assemblies should be clearly distinguishable, even when in the core. Procedures should be followed to ensure that all unnecessary material has been removed from the reactor vessel before it is closed. Further recommendations on the first loading of fuel are provided in IAEA Safety Standards Series No. SSG-28, Commissioning of Nuclear Power Plants [20].

4.21 For reactors that are refueled off-load, the prerequisites for ensuring that a critical configuration is not formed during fuel loading, such as nuclear startup instrumentation and protection system interlocks, should be checked before and, as appropriate, during the loading process. This is particularly important during the first core loading. This is also applicable to the shutdown period after maintenance for reactors that are refueled on-load. Further recommendations on these prerequisites are provided in SSG-28 [20].

4.27 The necessary clean working conditions should be created at places where fuel handling or fuel repair operations are in progress, to prevent foreign material from entering any opened cavities. This should be accomplished by taking only necessary materials into the foreign material exclusion zone, maintaining positive control of all such materials, and then removing them from the area as soon as possible. An ‘empty pockets’ policy10 should be implemented for work in close proximity to the spent fuel pool or open reactor vessel cavity. All materials and tools entering the foreign material exclusion zone should be logged in and out using a tool and material control log. All items and materials should be removed from the foreign material exclusion zones at the end of each shift, unless approved and documented to do otherwise. Activities that could generate debris should be avoided as much as possible within foreign material exclusion zones. Where these activities cannot be avoided, appropriate arrangements should be made to capture any debris generated.

4.7. WORK CONTROL

4.7 (1) Issue: The plant work control process does not support the timely completion of preventive maintenance to ensure its safe and reliable operation.

The team noted the following:

- In 2019 the plant started to reduce the preventive maintenance backlog. However, at the end of July 2021, for the three maintenance departments were 2776 activities delayed, 106 of them are safety related.
- On 29 September 2021 a scheduled surveillance test activity had to be cancelled due to an incomplete risk assessment.
- During the OSART review there was a turbine trip on Unit 4 and a subsequent delay in restarting the turbine due to instrumentation and control (I&C) workers not being available for 12 hours.
- A specific procedure for replacing a control device, resulting in an 11-hour delay, was not developed for the current plant conditions (control device 3CET306RG).
- The performance indicator on actual execution of scheduled work 'week -1' indicator was one of the lowest in the EDF fleet in June and July 2021. The performance indicator on evaluation of the process 'week +1' (provides data on the reasons why work is not executed) is not efficiently used in the plant. During the connection of a temporary power supply, the team observed that the workers were not confident in doing the job. After three hours the job (normally lasting 30 minutes) was not finished. A contributing factor was that a plant walk-down to prepare the workers was not performed. Furthermore, the scheduling of human resources well in advance was not done due to the amount of unexpected events in the department.
- The rework indicator is not used to measure the effectiveness of maintenance.
- The performance indicator, for requests to order spare parts to corporate department, has a target value from 72%. The current value of the plant indicator is below the target (63%).

Without effective use of a current work control process, delay in preventive maintenance and surveillance activities could have impact on the availability and reliability of safety related equipment.

Recommendation: The plant should take measures to improve the work control process to ensure the timely completion of preventive maintenance and the effectiveness of the maintenance to ensure its safe and reliable operation.

IAEA Bases:

SSR-2/2 (Rev.1) Requirement 31

8.10. The work control system shall ensure that plant equipment is released from service for maintenance, testing, surveillance or inspection only with the authorization of designated operations department staff and in compliance with the operational limits and conditions. The work control system shall also ensure that permission to return equipment to service following maintenance, testing, surveillance and inspection is given by the operating personnel. Such permission shall be given only after the completion of a documented check that the new plant configuration is within the established operational limits and conditions and, where appropriate, after functional tests have been performed.

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2.9. The approach to preventive maintenance activities for SSCs important to safety should include the following elements:

(a) A systematic evaluation of the purpose and functions of each SSC, to determine the relevant safety requirements and the necessary maintenance activities;

(b) A focus on long term maintenance objectives, and the establishment of a proactive (as opposed to a reactive) maintenance programme;

(c) A reliability centered approach to maintenance;

(d) Planning and scheduling of maintenance that are derived from the objectives of the overall maintenance programme.

2.10. A systematic evaluation should be undertaken to establish which maintenance tasks are to be performed, on which SSCs, and at what intervals, in order to optimize the use of resources allocated for maintenance and to ensure the safety and availability of the plant. In addition to maintenance based on a pre-determined time interval, the maintenance activities should also be undertaken on the basis of the condition of SSCs, in order to ensure their ability to perform their safety functions. This approach should be used in establishing a preventive maintenance programme and for optimization of the ongoing maintenance programme. Condition monitoring should also be used to determine where unnecessary maintenance work and failures induced by errors in maintenance can be avoided. If a probabilistic safety assessment has been performed, its results should be taken into account.

8.4. Preventive maintenance should be of such a frequency and scope to ensure that the reliability and functionality of SSCs important to safety remain in accordance with the design assumptions and intent. Preventive maintenance should also ensure that the safety of the plant has not been adversely affected since the commencement of operation.

8.6. In establishing the frequency and extent of preventive maintenance, the following aspects should also be considered:

(a) The recommendations of designers and vendors;

(b) The results of condition monitoring;

(c) The opportunities for on-line maintenance based on deterministic and risk analysis considerations;

(d) The need to keep radiation doses as low as reasonably achievable.

5. TECHNICAL SUPPORT

5.3 PROGRAMME FOR LONG-TERM OPERATION

The corrosion action plan at Paluel NPP is a dedicated project organization at the plant level, with monthly steering committee reviews, and progress indicators. It is based on a research and development programme to cope with corrosion phenomena, in order to ensure equipment reliability as part of the long-term operation programme of the plant. In addition, it proposes an integrated prioritization and multiannual planning of the implementation of innovative design solutions in relation to equipment potentially affected by corrosion phenomena.

The results obtained show that more than 80% of findings related to corrosion problems on items important to safety were solved according to the corrosion action plan. The team recognized these actions as a good practice.

5.7. PLANT MODIFICATION SYSTEM

Temporary modifications are divided between temporary modifications (MTI) and specific provisions and means (DMP). While the roles and responsibilities for managing temporary modifications are clearly defined among the plant staff and at the corporate level, the current plant process, procedures and practices are not sufficient to limit the number and duration of temporary modifications. There were 171 safety related temporary modifications the oldest of which was from 1985 and plant procedures do not specify a time limit for temporary modifications. The plant should strengthen the arrangements for temporary modifications in order to minimize the potential cumulative safety significance of temporary modifications. The team made a recommendation in this area.

DETAILED TECHNICAL SUPPORT FINDINGS

5.3(a). Good practice: Corrosion action plan.

Area: Long Term operation

Objectives sought (nuclear safety performance / in relation to the WNO) - Challenges:

- Prioritize refurbishment resulting from corrosion findings on safety related SSC, and especially on safety diesel generators, and on safety equipment in water pumping station;
- Build an integrated and prioritized overview of all corrosion findings, to extend the scope of refurbishment action plan to all SSC affected by corrosion phenomena;
- Implementation of a dedicated project organization at plant level, with monthly steering committee meetings, and indicators of progress.

Description: The strategy of the corrosion action plan is managed by a multi-year planning and covers all of the concerned equipment: pumping station, emergency diesel generators, ventilation systems, common equipment and facilities, transformers, pipings (instrument and service compressed air distribution systems, nuclear island vent and drain system), auxiliary boilers, etc.

Action plan development led the plant to find innovative solutions:

- Design and implementation of 'plug & play' air dryer system in the Pumping Station, which reduces corrosion kinetics by a factor of three.

Air dryer system *View before vs. after implementation in Pumping Station*

- Installation of movable covers along the trash rakes to limit dissemination of saline air in the rooms and improve quality of air for workers
- Installation of special water repellent grease ends protective covers protecting bolted assembly against humidity and shocks.

- Replacing of steel slabs by composite slabs: replacing with this new material guarantees sustainable mechanical resistance, improves handling safety.

– Painting of switchyard with resin for blocking corrosion by isolating the material from background air and flows of water

Results achieved / results sought:

– Treatment of more than 87% of corrosion findings on the 8 Diesel Generators achieved in 2021, in compliance with time schedule and deadlines.
– Refurbishment of priority rooms in Pumping Station (rooms containing equipment important for safety) issued at almost 80%, in accordance with time schedule milestones of the roadmap.
– Design and implementation of ”plug & play” air dryer system in Pumping Station, which reduces corrosion kinetics by a factor of three.

5.7 (1) Issue: The plant process, procedures and practices to manage modifications do not ensure that temporary modifications are limited in time and in number to minimize cumulative safety significance.

During the review the team noted the following:

- In the plant database, there are a total of 228 temporary modifications (MTI) in progress in the four units plus common equipment at the site as follows, 13 for common site equipment, 55 for Unit 1, 54 for Unit 2, 48 for Unit 3 and 58 for Unit 4. 171 on them are on safety related equipment.
- A time limit is not specified in the plant procedures for the removal of temporary modifications or for their conversion into permanent modifications.
- The procedure to deploy a new temporary modification explicitly requests an analysis of nuclear safety, industrial safety, radiation protection, environment and production. However, it does not request a safety assessment of the cumulative impact of all temporary modifications, or a review of the safety assessment if temporary modifications are in place longer than planned or if a new time limit should be specified.

Examples of current temporary modifications on safety related plant systems and components:

- Four temporary modifications from 1985, related to electrical jumper wires on the frame of the unit alarm relay processing system (KCO). Three in Unit 1 (1KCOAH4CQ, 1KCOAN4CQ, 1KCOBJ3CQ) and one in Unit 2 (2KCOAN4CQ). The proposed date for resolution is 2026, after the 4th Periodic Safety Review.
- Eight temporary modifications from 2018 (3KCOAX2CQ), 2019, (1KCOAX2CQ, 4KCOAX2CQ, 4KCOBX2CQ) and 2020 (2KCOBX2CQ, 1KCOBX2CQ, 2KCOAX2CQ, 3KCOBX2CQ) related to electrical jumper wires on the frame of the diesel unit alarm relay processing system (KCO).
- One temporary modification on unit alarm relay processing system (KCO) from 1992 (4KCOAW4CQ) related to temporary trip point settings for adjusting valve stroking times (TEU147VV). The deadline for closing this modification was during the 3rd Periodic Safety Review of Unit 4 in 2019.
- 17 temporary modifications related to the in-core instrumentation system (RIC), particularly one since 2016, which is systematically redeployed (MTI052AU), relating to the switching of thermocouples to ensure the availability of the core cooling monitors.
- Seven temporary modifications on the ventilation systems. Four on the control room ventilation system since 2018 (1DVC171HU, 2DVC171HU, 3DVC171HU) and since 2019 (4DVC171HU). One on the fuel building ventilation system (3DVK191MT) since 2018. Two on the electrical building ventilation system for battery rooms (1DVZ101ZV, 1DVZ102ZV) from 2018. The deadline for closing the last two temporary modifications was during the 3rd Periodic Safety Review of Unit 1 in 2016.
- Nine temporary modifications on the emergency diesel generators from 2018 (3LHP000SYST, 3LHQ000SYST) and from 2019 (1LHP760ZI, 1LHQ760VA, 1LHQ760ZI, 2LHQ760VA, 2LHQ760ZI, 4LHQ760VA, 4LHQ760ZI), one in the gas turbine generator (0LHT020FF) from 2019.
- 24 temporary modifications related to the fire protection system from 2018 to 2021. Those from 2018 and 2019 are on the fire protection water pumps for Unit 1 (1JPD011PO and 1JPD012PO) and Unit 3 (3JPD011PO and 3JPD012PO).

- One temporary modification since 2018 to allow measurement of the mechanical stresses on efforts in the stem of valve 1LLS012VV.
- In addition, there are currently 37 temporary modifications implemented in the four units which are dependent on the normal operation mode (DMP-type temporary modifications). Among them, there are two particularly long lasting temporary modifications:
- Temporary modification during reactor operation (DMP GEX 50) for protection of the generator due to potential loss of instrumentation and control cabinet KCOAM5CQ. This temporary modification has been installed during reactor operation since 2006, following OEF from Saint-Alban NPP (DT220), to ensure the operation of protections during turbine trip following a defect in the stator cooling water system. A permanent modification related to this temporary modification depends on the endorsement by the corporate level.
- Temporary modification during reactor operation (DMP 1SEC001SYST) to prevent alarms relating to the unavailability of pump 1SEC202PO, due to repair. This temporary modification has been installed since 6 November 2020.

System for managing temporary modifications:

- Temporary modification label in place relating to 1RGL401AR/B10, 1RGL401AR/B12 and 1RGL401AR/B14 (1MTI RGL051, control rod system) since 2012, closed in 2016 but still in place.
- Temporary modification on the 1ASG031PO (DT 716022, auxiliary feedwater system) relating to the external filtering of tank 1ASG313BA, was recorded in the system but not in the field anymore.

Without adequate processes, procedures and practices to minimize the number and limit the duration of temporary modifications, an additional burden for maintence and operators occurs and plant safety could be compromised.

Recommendation: The plant should enhance its processes, procedures and practices to manage temporary modifications to limit their number and duration to minimize the cumulative safety significance.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 11. Management of modifications

The operating organization shall establish and implement a programme to manage modifications.

4.41 Temporary modifications shall be limited in time and number to minimize the cumulative safety significance. Temporary modifications shall be clearly identified at their location and at any relevant control position. The operating organization shall establish a formal system for informing relevant personnel in good time of temporary modifications and of their consequences for the operation and safety of the plant.

SSG-71

6.1 Modifications that are implemented for a limited period of time should be treated as temporary modifications. Examples of temporary modifications are temporary bypass lines, electrical jumper wires, lifted electrical leads, temporary trip point settings, temporary blind flanges and temporary defeats of interlocks. Temporary modifications also include temporary construction and installations used for maintaining the design basis configuration of the plant in unanticipated situations. In some cases, temporary modifications can be made as an intermediate stage in making permanent modifications.

6.4 Paragraph 4.41 of SSR-2/2 (Rev. 1) [1] states that “temporary modifications shall be limited in time and number to minimize the cumulative safety significance.” To achieve this, any opportunity should be taken to remove temporary modifications as soon as possible, in particular during outages.

6.5 As noted in para. 6.4, a time limit is required to be specified for the removal of temporary modifications or for their conversion into permanent modifications. Justification should be provided if a temporary modification persists longer than its agreed duration and a new time limit should be specified.

6.6 Documents such as drawings and procedures relating to a temporary modification should be clearly marked showing the presence of the modification, i.e., until the modification is removed or changed to a permanent modification.

6.8 In the safety assessment and review of all proposed modifications (temporary and permanent), any existing temporary modifications and the cumulative safety significance of the proposed change should also be considered.

6.9 The operating organization should regularly review temporary modifications and decide whether they are still needed. The review should check that associated operating procedures, instructions and drawings and operator aids conform to the approved configuration. The status of temporary modifications should be periodically reported (typically at monthly intervals) to the plant manager. Those that are considered to be needed permanently should be converted in a timely manner in accordance with the established procedure.

6.11 An appropriate procedure should be established to control temporary modifications on the plant. The following should be included in this procedure:

…

(c) The control of documentation — such as operating flowsheets, operating manuals, maintenance manuals, emergency procedures — to ensure that this documentation reflects temporary modifications and that the plant continues to be operated and maintained safely while the modification is in place;

…

(g) The procedures for setting a time limit on temporary modifications and the procedure to extend this time limit, if necessary;

(h) Checks to ensure the reinstatement of the plant configuration, and communication with personnel when a modification is removed.

6. OPERATING EXPERIENCE FEEDBACK

6.5. ANALYSIS

The plant has a programme in place to investigate issues. However, safety relevant events are not always analysed according to the expectations. The scope of root cause analyses is often too narrow to ensure that all root causes are correctly identified. Corrective actions are often of a soft nature. Corrective actions involving external organisations often do not include a check of the results and of the associated timing. There is no systematic effectiveness review of corrective actions to prevent recurrence in root cause analyses, and the team noted a number of repeat events. The categorization of events to define the depth of analysis needed, is at times not commensurate with their actual or potential safety significance. Therefore, the team recommended that safety related events are always adequately categorized, analysed and have effective corrective actions to prevent recurrence.

6.6. TRENDING AND REVIEW

The plant has developed a tool which assesses findings of the managers in the field programme and identifies adverse trends in a timely manner. Trends are then used to adapt the focus of the managers in the field programme for the next period. The team considers this as a good performance.

6.9. REVIEWING THE EFFECTIVENESS OF THE OPERATING EXPERIENCE PROGRAMME

The plant operating experience (OE) programme is spread over different processes, coordinated by different departments and uses separate tools and databases. There is no overall performance indicator covering the overall OE programme. There is no joint self-assessment reviewing the different parts of the programme. This fragmented organisation makes it difficult for managers to obtain a global vision of the health of the OE programme at the plant. The team therefore encourages the plant to consider improving the oversight of the health of the OE programme.

DETAILED OPERATING EXPERIENCE FEEDBACK FINDINGS

6.5. INVESTIGATION

6.5(1) Issue: The plant operating experience programme does not always ensure that safety related events are adequately categorized, analysed and have effective corrective actions to prevent recurrence.

The team noted the following, in terms of quality of root cause analyses:

The scope of root cause analysis (RCA) is often too narrow to ensure that the correct root cause(s) are identified. Examples include: (RES402921, RES200821, RES303819, RES000521, RES001521):

- In November 2020, a 192 mSv skin dose contamination occurred during work in the fuel transfer compartment (INES level 1 event - RER4000320). The report does not explain whether the plate blocking the opening to the orange/red RP area is locked in a normal situation. It does not explain when and by whom the access plate was opened. It does not assess the miscommunication between the supervisor and the RP department that led the supervisor to wrongly give approval to start the work. It does not explain why the sensor (suspected to be the cause of the contamination) removed from the orange zone was not checked for radioactivity and was not put in a bag as expected.
- In February 2021, a 19-size spanner was found inside the reactor pressure vessel (RES402921), after having remained inside the vessel for at least one cycle. The report does not include information that the TV inspection performed before the cycle was less comprehensive than the one after the cycle, which could explain why it did not enable the spanner to be detected before refuelling. The RCA concludes that the foreign object originated from the upper floors (steam generator level) without substantiating this, and without explaining why it could not originate from the existing foreign material exclusion zone at reactor platform level.
- In November 2019, oxide deposits (crud) were found on numerous fuel elements, three of which showed fuel cladding degradation (RES200821). The 'five whys' method in the RCA was stopped too early because the international OE on how to prevent this phenomenon was not identified, and therefore the root cause is incorrect. The insufficient use of international OE is not addressed by any corrective action. The only corrective action resulting from the RCA report is to perform more analyses to check whether unloaded fuel could be reused in the future. The assessment of the safety significance of the event does not include the actual impact of 665 man.mSv on the collective dose and the reactor power limitation of 93% Pnom applied during the next cycle.
- In September 2019, a reactor trip occurred following water intake clogging (RES303819). The 'five whys' method stopped too early, and therefore the root cause is incorrect. The assessment of the extent of cause and condition did not lead to additional considerations of different types of ingress in the report, and therefore the plant response to this particular event is restricted to ingress of transparent jellyfish only. In January 2021, two reactor trips occurred following water intake clogging (RES000521). One of the root cause analyses indicates that only ingress of seaweed was considered in a procedure. This indicates that the scope of earlier analyses was too narrow. The assessment of the extent of cause and condition still did not led to additional considerations of different types of ingress in the report, and therefore the plant response to this particular event was narrowed to ingress of small fishes only. One of the corrective actions is to sign an agreement with a fishing company to perform preventive fishing in case of exceptional events. However, the report does not explain on which basis the preventive fishing will be triggered (what alert system

is in place). Penly NPP (50km away on the same coast) had in 2013 one, and in 2020 two water intake clogging events due to similar biologic organisms (small fish). The latter two are not indicated in the RCA report. Paluel had also one similar event (small fish) in 2016. This past similar OE has not prevented recurrence. On 23 September 2021, a turbine tripped due to water intake clogging by small fishes. An event report was drafted (category 3 – for actions, but no causal analysis or no formal challenging of previous causal analyses). The report concludes that the origin is known and addressed. However, this new occurrence shows that previous corrective actions were not effective to prevent the recurrence. The plant has a process to review the health of the heat sink. However, a degrading trend in reactor trips caused by water intake clogging can be observed over the last decade: there were three trips in the last two years and none before.

- On 4 April 2021, a fire occurred on the main transformer and led to reactor trip (RES001521). This is a repeat event as a similar event happened in Cattenom NPP in 2013. A modification of the fire protection of the transformer had been decided but delayed. The ‘five whys’ method stopped too early, and therefore some root causes are incorrect (corrective actions not timely implemented).
- RCAs often state an incorrect or incomplete assessment of the actual or potential consequence on nuclear and radiation safety. (RES402921, RER4000320, RES303819, RES000521, RES400819, RES200821).
- RCAs often do not assess the robustness of some significant inefficient barriers and this leads to missed opportunities to strengthen the barriers. (RES402921, RER4000320, RES303819, RES400819, RER4000320).
- RCAs include a search for similar past events. However, the procedure and guide does not include a definition of what is a similar/repeat event. At times, the search for past similar OE in RCAs does not identify important relevant events. When past similar events are identified, their corrective actions are rarely used to define more effective corrective actions in the new report. (RER4000320, RES303819, RES000521).
- RCAs at times do not assess or do not correctly assess the possible extent of cause or condition of the event analysed. (RES402921, RER4000320, RES303819, RES000521).
- RCA reports do not indicate the strategy for CARP effectiveness reviews. The RCA guide does not give guidance on effectiveness reviews of corrective actions to prevent recurrence.
- There are often methodological mistakes in the RCA, such as: some causal factors being actually events, not causal factors; Event and Causal Factors Chart too short and incomplete; ‘five whys’ method stopped too early and therefore real root cause not identified. (RES402921, RER4000320, RES303819, RES000521, RES200821).
- The plant does not use probabilistic risk assessment to assess the actual and potential safety significance (CDF) of significant events. This is done using a deterministic analysis in the RCA.
- There is no formal causal analysis (RCA/ACA) performed for adverse trends identified.
- A category 1 event (reportable) occurred on 14 September 2021 for which formal interviews (by trained interviewers) were not started until eight days afterwards. Another category 1 event (reportable) occurred on 12 September 2021 for which formal interviews were not started until 10 days afterwards. This delay could lead to loss or degradation of information necessary for understanding the event. According to a RCA author and a RCA validator interviewed, the main difficulty when performing an RCA at the plant is to establish the facts, in particular during some interviews.

– The corporate engineering support function (UNIE) assesses the depth of certain event investigations and has encouraged the plant to improve.

In terms of definition of effective corrective actions to prevent recurrence:

– Out of 27 corrective actions defined to address root causes in 11 recent RCAs, 26 are of a soft nature (96%) and only one is a hardware modification (that was already planned before the event). These soft actions typically include one-shot training, briefings, document modifications or additional analyses to be performed.

– CAs involving external actors often do not include a check of the results and of the associated timing.

– During the last annual review of the process covering RCAs, one performance indicator was used to assess the quality of RCAs (based on feedback from EdF corporate). This indicator was indicated as green (good) in the last report, even though there was no actual corporate feedback since three years before.

– A number of significant events are repeat events or events with similar past events. This calls into question the effectiveness of some of the past corrective actions. (RES303819, RES000521, RES400819, RES001521).

In terms of categorization of events to define the depth of analysis needed:

– The plant has an OE categorization system for non-equipment issues, in which category one is investigated using RCA, category 2 using ACA, category 3 leads to action(s), and category 4 is kept for trending. There are no clear screening criteria related to nuclear and radiation safety to decide whether to perform an ACA (category 2 events): the decision is left to the screening committee.

– On 17 January 2019, an electrical fire started in a room adjacent to the MCR (C0000027176). It was categorized as category 3 only (no causal analysis).

– On 3 June 2021, presence of flames was observed at the exhaust of the 4 DUS emergency diesel generator during a periodic test (C00000297547). This event was categorized as category 4 only.

– According to the procedure, fires have to be investigated using an RCA only if they are high intensity fires involving fire spread of significant duration before their extinction. Fully developed intense fires impacting their whole initial volume but not spreading to the rest of the installation, do not need to be investigated using a RCA, whatever their location.

– In November 2020, spent fuel pool cooling was briefly lost due to lack of procedure adherence. This event was initially categorized in category 4, then challenged 48 days later and finally recategorized in category 1. This challenges the robustness of the categorization process.

– Equipment issues, when not additionally recorded in CAMELEON, are only treated either through the work management system, or through ‘GRP’ problem-resolution working groups. GRPs are focused on immediate resolution of the issue (troubleshooting) and do not use any formalized event analysis technique (such as RCA or ACA or underlying tools). They consist of a series of meetings where the issue is discussed.

– A GRP was created on 22 September 2021 to solve a leak identified on the cylinders of the emergency diesel generator 1LHQ-001MO. GRP minutes conclude that the cause of the leak is unknown. No extent of condition is mentioned. Similar leaks were observed in 2018. There is no final event report on this event.

- A GRP was created on 21 July 2021 to solve a problem of a high temperature detected on emergency diesel generator 1LHP-001MO. There is no trace of any technical meeting held within the GRP. There is no information at all about investigations conducted (if any), or about causes or corrective actions.
- A GRP was created on 22 July 2021 to solve a leak tightness issue with a valve on the SAR compressed air system. The analysis concludes that past OE on the same issue had not been taken into account.
- A GRP was created on 08 February 2021 to solve an issue on the in-core instrumentation system. There is no investigation of the causes indicated in the minutes, and the failed part was simply replaced. No extent of cause is mentioned.
- 40% of GRPs created during the 2021 outage of Unit 1 have not been formalised in a final event report.
- External OE (events from other plants) is pre-screened at corporate level and the result is sent to the plant for action or information. Of the around 370 events from other plants received at the plant per year, only about 2,3% are OE from plants outside France. Not any action was actually taken as a result of OE from outside France in 2020 and 2021.

Without safety significant events being adequately categorized and analysed, and without having effective corrective actions, events can reoccur.

Recommendation: The plant should improve its operating experience programme to ensure that safety related events are always adequately categorized, analysed and have effective corrective actions to prevent recurrence.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 24: Feedback of operating experience

The operating organization shall establish an operating experience programme to learn from events at the plant and events in the nuclear industry and other industries worldwide.

5.27. The operating organization shall establish and implement a programme to report, collect, screen, analyse, trend, document and communicate operating experience at the plant in a systematic way.

5.28. Events with safety implications shall be investigated in accordance with their actual or potential significance. Events with significant implications for safety shall be investigated to identify their direct and root causes, including causes relating to equipment design, operation and maintenance, or to human and organizational factors.

5.29. Information on operating experience shall be examined by competent persons for any precursors to, or trends in, adverse conditions for safety, so that any necessary corrective actions can be taken before serious conditions arise.

5.30. As a result of the investigation of events, clear recommendations shall be developed for the responsible managers, who shall take appropriate corrective actions in due time to avoid any recurrence of the events. Corrective actions shall be prioritized, scheduled and effectively implemented and shall be reviewed for their effectiveness.

SSG-50

2.21. Management should ensure that records of the operating experience programme are maintained, easily retrievable and retained for an appropriate period (for the life of the installation, if necessary).

2.31. In order to apply a graded approach to operating experience, identified issues should be screened in a timely manner to evaluate their significance on the basis of their actual or potential consequences for safety.

2.33. Screening criteria should include the actual or potential consequences of reported issues for nuclear safety, radiation protection, protection of the environment and non-radiation-related safety.

2.39. The results from the screening of all operating experience (internal and external) should be recorded and may be used for evaluation in subsequent self-assessments, periodic safety assessments or peer reviews.

2.41. The operating organization should implement procedures with criteria specifying the type of investigation that is appropriate for any category of event. The type of investigation should be commensurate with the actual or potential consequences of an event and the likelihood of its recurrence. Events should be investigated using appropriate analysis techniques.

2.42. The level of investigation and analysis applied should be commensurate with the significance of the event. For example:

(a) In the case of an event with the potential to provide major lessons (e.g. an event with severe actual or potential consequences, or significant consequences and a high likelihood of repetition), a formal root cause analysis, tailored to the type of event, should be performed. The root cause analysis should be conducted by a team with appropriate skills and knowledge relevant to the nature of the event.

(b) For an event providing fewer and/or less important lessons (e.g. an event with moderate actual or potential consequences), the apparent causes should be identified and corrected.

(c) Adverse trends, including those consisting of minor issues, should be reviewed for safety significance and, when necessary, investigated using appropriate techniques to identify causes and generic implications.

2.46. The investigation should be started as soon as practicable, consistent with maintaining the safety of the installation, to ensure that important information is not lost, invalidated or removed.

2.47. In the case of events for which root cause analysis is necessary, the analysis should document the following:

(a) The complete event sequence (what happened, including how the event developed);

(c) An assessment of the safety significance (what could have happened);

(f) A strategy for the determination of effectiveness of the corrective actions;

(g) An evaluation of the extent to which similar conditions are present in other structures, systems and components or processes at the installation, or in human performance in the organization (‘extent of condition’);

(h) An evaluation of the extent to which similar specific root or underlying causes could affect the safety of other structures, systems and components or processes at the installation, or in human performance in the organization (‘extent of cause’);

(i) An evaluation of the potential for common cause failures or common mode failures.

2.48. If a previous similar event is found to have occurred at the installation, then the corrective actions taken should be reviewed to identify why the event recurred and to identify more effective corrective or preventive actions.

2.57. An appropriate review should be conducted in response to identified adverse trends. The level of analysis in the review should be based on the safety significance of the events or issues and the nature and speed of the changes that constitute the trend. For significant trends, root cause analysis should be conducted.

2.65. The effectiveness of major corrective actions should be reviewed after their completion.

7. RADIATION PROTECTION

7.3 RADIATION WORK CONTROL

The plant has a system to plan radiologically hazardous work. For low-risk radiological work, radiation work permits level 0 or level 1 are issued by the radiation protection trained work coordinator of the department which will perform the activity. For higher risk radiological work, the work preparation requires involvement of the radiation protection department which then issues the radiation work permit. However, the team observed incorrect behaviors with respect to the use of level 0 and/or level 1 radiation work permits. Furthermore, several events have occurred in the past 2.5 years, when work has been performed in orange areas without using the appropriate higher risk radiological work permit. The team made a suggestion in this area.

7.4 CONTROL OF OCCUPATIONAL EXPOSURE

The plant has implemented the ‘Safety Challenge’ initiative to promote risk prevention in a positive manner with contractors working in the plant. Activities are observed by a team with radiation protection experts as well as contractors’ representatives. A form is used for the observations. Bonus points or penalty points can be gained based on the score of the contractor on general performance indicators. The winners receive gifts. The team considers this a good performance.

7.6 RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The plant has accredited all effluent monitoring sampling systems and monitoring equipment against ISO 17025. The plant is the first French EDF plant that showed a 100% on the EDF corporate performance indicators for gaseous and aqueous emissions. The team considers this a good performance.

DETAILED RADIATION PROTECTION FINDINGS

7.3 RADIATION WORK CONTROL

7.3(1) Issue: Plant personnel are not always protected from internal and/or external exposure greater than the forecast to ensure their safety.

During the review, the team noted the following:

– More than one Radiation Work Permit (RWP) can be scanned when entering the Radiation Controlled Area (RCA) of a unit. Should different doses or dose-rates be specified on the different RWPs, personnel dose and dose rate alarms could be less conservative.
– Low risk RWP's level 0 and 1 (up to 10 manmSv collective dose, up to 2 mSv/h dose rate, contamination < 400 Bq/cm2) are issued by Radiation Protection (RP) trained work coordinators of the departments and do not have to be presented to RP staff before starting the work.
– All the active neutron dosimeters have a pre-set dose alarm setting of 0.2 mSv and a dose rate alarm setting of 1.6 mSv/h. However, the RWP that was used during a walkdown only allowed a maximum total dose of 0.007 mSv and a maximum neutron dose rate of 0.050 mSv/h.
– In Unit 3 RCA, two persons who had replaced fuses in the RCA had used a RWP which was valid for a year, but which had been signed on that day. However, they had not performed the obligatory radiation pre-job brief before entering the RCA and had therefore not ticked the boxes on the RWP.
– In Unit 3, a field operator of the operations department worked on a general level 0 or level 1 RWP, which was valid for a year. The field operator did neither carry his RWP, nor knew his daily dose limit or participated in the obligatory pre-job briefing when the RWP was issued.
– Several events have occurred in the past 2.5 years, when work has been performed in orange areas without using the appropriate higher level RWP.
– In November 2020, two workers used a level 1 RWP for an activity in the transfer channel of the Unit 3 fuel storage building, which was an orange area at the time and required a higher level RWP. One of the workers received a skin dose of 192 mSv due to a Co60 particle on his ear, the other worker became internally contaminated with an effective dose < 0.1 mSv.
– In April 2019, two workers entered the RCA of Unit 4 using a level 0 and level 1 RWP. They started an activity in an orange area without the appropriate RWP because they scanned at a wrong terminal.
– In May 2019, checks on two level gauges in an orange area had to be performed. An orange zone RWP was issued for the work on one gauge. The personnel misinterpreted the RWP and also used it for the work on the second gauge. The local dose rate in the room with the second gauge (3.52 mSv/h) was higher than the maximum dose rate allowed by the RWP (2.5 mSv/h).

Without compliance with the requirements in radiation work permits for low-risk radiation work, personnel could be exposed to unplanned internal and/or external exposure.

Suggestion: The plant should consider enhancing compliance with the requirements in radiation work permits for low-risk radiation work, to always protect personnel from internal and/or external exposure greater than the forecast.

IAEA Bases:

GSR part 3

3.94. Employers, registrants and licensees, in consultation with workers, or through their representatives where appropriate:

(d) Shall ensure that any work in which workers are or could be subject to occupational exposure is adequately supervised and shall take all reasonable steps to ensure that the rules, procedures, and measures for protection and safety are observed;

Requirement 8: Performance of safety related activities

The operating organization shall ensure that safety related activities are adequately analyzed and controlled to ensure that the risks associated with harmful effects of ionizing radiation are kept as low as reasonably achievable.

4.25. All routine and non-routine operational activities shall be assessed for potential risks associated with harmful effects of ionizing radiation. The level of assessment and control shall depend on the safety significance of the task.

5.11. The radiation protection programme shall ensure that for all operational states, doses due to exposure to ionizing radiation at the plant or doses due to any planned radioactive releases (discharges) from the plant are kept below authorized limits and are as low as reasonably achievable.

GSG7

3.94. When work is to be conducted during which significant radiation levels or contamination levels might be encountered, or when the work is complex (involving several groups of workers and numerous activities), advance work planning is one of the most important means of achieving optimization of protection and safety. The radiation protection officer should take part in the planning of the work and should advise on the conditions under which work can be undertaken in controlled areas. …

3.96. For each task that needs special radiological precautions to be taken, a radiation work permit should normally be prepared. The radiation work permit is issued by the persons in charge of the planning of the operations, in collaboration with the radiation protection officer….

8. CHEMISTRY

8.2. CHEMISTRY PROGRAMME

The plant uses indicators based on measuring the dose rate from the primary circuit to evaluate the success of chemistry control. These measurements, although performed to a sufficient extent, do not provide complete information on which specific radionuclides generate the source term for the collective dose. A more precise optimization of the primary circuit chemistry is not possible without knowing what are the deposits on the primary circuit over a long period. Monitoring by in-situ gamma spectroscopy using germanium detector provides an improved method for the identification of radionuclides build in primary circuit surfaces. The team made a suggestion in this area.

The power plant observed the formation of cruds and increased collective dose after the replacement of the steam generators on Unit 2. The power plant has taken additional measures to eliminate this problem, consisting of increased coolant cleaning, monitoring of the metal content in the coolant, zinc injection and operation of the unit at base load. The team encourages the plant to consider all available options including the consideration of passivation of steam generators in order to prevent a reoccurance.

8.5 LABORATORIES AND MEASUREMENTS

The plant performs monthly pH meter calibration of the steam generators blow down water. They use customized pots created with a 3D printer that allow calibration of the pH meter without interrupting the flow on the activity measurement chains (KRT), located on the same lines. This modification completely eliminates the risk of a group 1 event which could occur if the flow to the primary to secondary leak monitor is interrupted. The team has recognized this as a good practice.

The plant uses the ‘MERLIN’ laboratory software, for planning all the measurements to be made by the laboratory at the required frequency. The ‘MERLIN’ software is also used to plan the half-yearly check of the documentation at all workplaces. This helps to keep chemistry documentation up-to-date. The team recognized as a good performance.

DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY PROGRAMME

8.2(1) Issue: The plant chemistry programme does not use available techniques to monitor and control build-up of activated corrosion products in order to reduce the source term and the collective dose.

During the review, the team noted the following:

- The plant does not use regular in-situ gamma spectrometric measurement of activated corrosion products that plate on the inner surfaces of primary loops. The plant is missing an opportunity to analyse the cause of the growth or decline of the source term (for example sub-optimal chemistry or intrusion of impurities such as Ag, Ni or Sb).
- The chemistry group does not have an indicator for evaluation and control of build-up of specific activated corrosion products on primary system surfaces. The plant uses only gross gamma measurements for evaluation of the source term. Without such an indicator, feedback on the efficiency of primary chemistry control is missing, and the process of activated corrosion product build-up, followed by source term increase, is not under optimal control.

Without using all possible tools to monitor and control build-up of activated corrosion products, improvement of the source term and collective dose minimization is reduced, and feedback on primary chemistry control effectiveness is incomplete.

Suggestion: The plant should consider all possible enhancing tools in the chemistry programme to monitor, and control activated corrosion product build-up in order to improve reduction of the source term and the collective dose.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 29: Chemistry programme

7.13. The chemistry programme shall be developed prior to normal operation and shall be in place during the commissioning programme. The chemistry programme shall provide the necessary information and assistance for chemistry and radiochemistry for ensuring safe operation, long term integrity of structures, systems and components, and minimization of radiation levels.

SSG-13

3.4 (b) The primary water chemistry regime is appropriately selected, with account taken of its potential impact on: (i) uniform corrosion and stress corrosion cracking of circuit materials, (ii) fuel cladding corrosion, (iii) activation and transport of corrosion products, (iv) dose rates, (v) crud induced power shifts and (vi) crud induced localized corrosion.

5.1. The optimization of radiation exposures through an appropriate chemistry regime results in: (a) Continuous reduction, over time, of dose rates in the plant;

5.7. The primary water chemistry programme applied should effectively control and minimize the buildup of radioactive material from the transport and accumulation of fission products and activated corrosion products on the internal surfaces of the systems.

5.18. Once the plant is constructed and is in operation, chemistry control, through an appropriate water chemistry regime, should be the main technique used by the operator to reduce the rate of buildup of radioactive material. Adequate control of water chemistry parameters during normal operation and for shutdown, startup and standby processes should be established and implemented to minimize the release, transport and deposition of activated corrosion products throughout the fuel cycle. During shutdown, the concentration of corrosion products may increase considerably and the directions of transport may also change, resulting in deposition on out-of-core surfaces. This can result in elevated dose rates and occupational radiation exposures during outage and possibly in radioactive hot spots.

8.5(a) Good Practice: pH meters calibration

Every month, a pH-meter calibration is carried out on the steam generators blow down line. The risk analysis reveals a potential for a group 1 event during this activity. In fact, during this procedure the arrival of water is cut which can cause a lack of flow on the activity measurement chains (KRT), located on the same lines.

A customized pots with a 3D printer was created so that the electrodes of the pH meter do not come into contact with the standard solution for calibration. There is no need to stop the water supply to calibrate the unit. This completely eliminates the risk of a group 1 event.

Benefits: Since the implementation of this modification, the Group 1 safety event risk is removed

BEFORE	AFTER
risk of group 1 safety event	eliminates the risk of a group 1 safety event
stressful activity	less stressful activity

9. EMERGENCY PREPAREDNESS AND RESPONSE

9.1. ORGANIZATION AND FUNCTIONS

The hazard assessment for emergency preparedness (EP) is based on deterministic studies. These studies are documented in the Final Safety Analysis Report and integrated in the Emergency Plan. Corporate Organization has also prepared an internal event probabilistic safety assessment (PSA) for the 1300 MWe class, which is deemed to apply to the Paluel NPP units. However, the external event PSA for the Paluel site will only be completed in 2025. The plant is encouraged to incorporate the hazard assessment for external events into the emergency plan, and to share with plant personnel the potential consequences for nuclear safety of the initiating events that contribute the most to the core melt frequency.

9.2. EMERGENCY RESPONSE

When an emergency call comes into the control room to report an emergency situation, the nurse on duty at the medical centre is dialled-in for silent listening to the call. This allows the nurse to respond more quickly to medical emergencies. The team has recognized this as a good practice.

9.3. EMERGENCY PREPAREDNESS

To avoid triggering false alerts, the plant has devised several measures: using a separate console for training the duty officer that issues the recall message to the Emergency Response Organization (ERO), using a training phone number that allows the emergency director to practice navigating the menu of options for sending a voice message to off-site authorities, and numbering the plant units TR11 to TR14 instead of TR1 to TR4 to avoid confusion with the real units. The team has recognized this as a good practice.

Since 2018, the plant has included in its exercise programme a wider range of accident scenarios to ensure that every emergency procedure is tested in exercise situations. Many situations that had not been included in the exercise programme were tested, such as severe accident management guidelines (SAMG), two units in emergency situations, contamination on site, medical emergency in the radiation controlled area (RCA), relocation of main control room (MCR) personnel to the emergency control room, distribution of iodine tablets to the personnel. However, the team noted that the current objectives of each exercise are process based, such as checking which steps were completed and which decisions were made. The team has identified a suggestion to further improve the exercise programme by adopting performance based objectives in the evaluation process.

The Command Post for maintenance (PCM) is currently not shielded against radiological contamination hazard. The plant is encouraged to have plans to relocate this command post during a radiological emergency, until the new shielded facility that has been planned is built on site.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

9.2(a) Good Practice: Silent monitoring of emergency calls

When a person at the plant detects an event that requires emergency intervention (fire, medical emergency or injury), they dial 18 to reach the main control room of the unit. This call also rings the nurse on duty at the medical center and simultaneously lights up an indicator on the wall that shows from which unit the call originated. The nurse listens silently to the call and determines if it is a medical emergency, in which case he/she will immediately go to the unit to give first aid to the victim. Meanwhile, the control room calls the off-site medical responders to request assistance on site.

Benefit: By monitoring the emergency calls to the main control room, the nurse on duty minimizes the delay for assistance to the victims. In those instances where intervention is required promptly, this can save lives.


9.3(a) Good Practice: Measures to prevent a false alert during an exercise

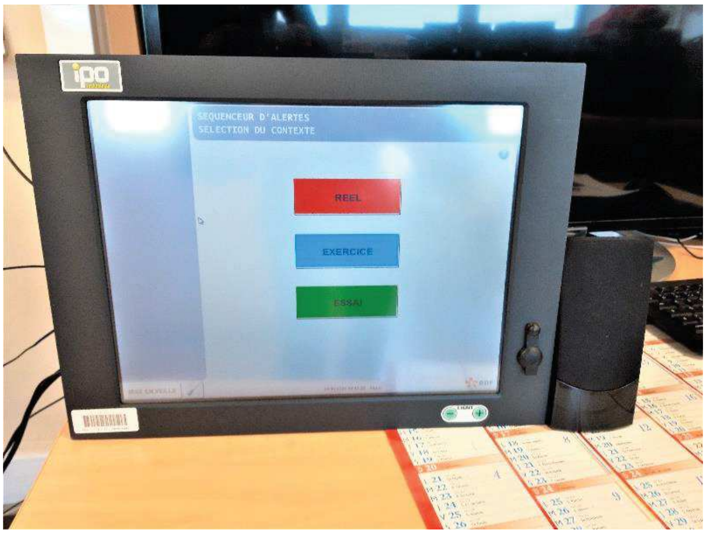
The plant organizes emergency exercises that involve the participation of corporate, off-site authorities, off-site fire-fighters and off-site medical services. During these exercises, several messages are sent to these external organizations.

In many countries, there have been examples of false alerts that have been triggered during training, exercises and tests.

To avoid triggering false alerts, the plant has devised several measures:

- There are two separate consoles for issuing a recall message to the ERO: a real console that sends the recall message, and a practice console that is used for training. The practice console is in a training room, not at the duty officer desk.
- There is a training phone number that allows the emergency director to practice navigating the menu of options for sending a voice message to off-site authorities without actually sending a false alert message.
- During an exercise, the units are numbered TR11 to TR14 instead of TR1 to TR4. As a result, if a message was intercepted or misinterpreted, it would be clear that the real units are not in accident condition.

Benefit: There have been no instances of false alerts triggered during training, tests, and exercises. The plant personnel can gain proficiency in the tools that are used during an emergency without worrying about triggering a false alert.



9.3. EMERGENCY PREPAREDNESS

9.3(1) Issue: The plant exercise programme is not sufficiently comprehensive to evaluate all emergency response functions and ensure the effectiveness of the emergency response organization.

During the review, the team noted the following:

- Exercise planning to ensure that all emergency response functions are tested over several years is not performance based. Performance based objectives such as: identifying, notifying and activating, taking mitigating action, taking urgent protective action, providing information and issuing instructions and warnings to the public, protecting emergency workers are not included in the exercise planning process.
- The evaluation reports prepared after exercises contain an evaluation of the process, such as which steps were completed, and which decisions were made. However, the reports do not assess if the organization achieved the overall expected result or mission.
- The emergency preparedness team that organizes the emergency exercises has not received the support of other departments at the plant to help prepare scenarios and evaluate the response to specific situations such as:
  - emergency exposure situations
  - public dose assessment
  - using operational intervention levels

  As a result, due to the lack of external support from other departments in the plant, no exercises with emergency exposure situations, or exercises requiring prompt public protective actions (‘phase reflex’) triggered by the plant have been conducted at the plant.
- There was no plant exercise utilizing pre-established operational intervention levels for initiating the different parts of an emergency plan.
- Self-evaluation during the debriefing after an exercise was not comprehensive. As an example, after an exercise to deploy a mobile pump to the feed water tank on September 27, the participants identified only one issue. The team identified several more:
  - High winds were closing the doors of the container holding the pumps while the personnel were trying to unload them.
  - The ramp used to roll down the pump from the container was jammed in its holding bracket and could not be released. A ramp from the next container was used instead.
  - The personnel did not connect the fuel tank to the pump engine.
- The diesel fuel tanks for mobile pumps are stored empty. The procedure is to fill them before use, but this has not yet been tested in exercises.

Without a comprehensive exercise programme, the plant may not evaluate all emergency response functions to ensure the effectiveness of the emergency response organization.

Suggestion: The plant should consider enhancing the exercise programme to evaluate all emergency response functions and ensure the effectiveness of the emergency response organization.

IAEA Bases:

GSR Part 7

Requirement 25: Training, drills and exercises for emergency preparedness and response

6.30. Exercise programmes shall be developed and implemented to ensure that all specified functions required to be performed for emergency response, all organizational interfaces for facilities in category I, II or III, and the national level programmes for category IV or V are tested at suitable intervals. These programmes shall include the participation in some exercises of, as appropriate and feasible, all the organizations concerned, people who are potentially affected, and representatives of news media. The exercises shall be systematically evaluated (see para. 4.10(h)) and some exercises shall be evaluated by the regulatory body. Programmes shall be subject to review and revision in the light of experience gained (see paras 6.36 and 6.38).

Requirement 5: Protection strategy for a nuclear or radiological emergency

4.28. Development of a protection strategy shall include, but shall not be limited to, the following:

(4) Once the protection strategy has been justified and optimized and a set of national generic criteria has been developed, pre-established operational criteria (conditions on the site, emergency action levels (EALs) and operational intervention levels (OILs)) for initiating the different parts of an emergency plan and for taking protective actions and other response actions shall be derived from the generic criteria13. Arrangements shall be established in advance to revise these operational criteria, as appropriate, in the course of a nuclear or radiological emergency, with account taken of the prevailing conditions as they evolve.

EPR EXERCISE 2005

7.3.5. How to evaluate performance

A performance-based evaluation focuses on results, not process. It is based on response objectives and response time objectives (see Appendix X of [2] for details). It answers the question: was the response objective achieved and in what time it was achieved?

7.3.6. Exercise report

It should include observations, grades, deficiency classifications and, where pertinent, recommendations. The report should contain sufficient details to permit the evaluated organization to use the report to commence rectification of problems.

7.3.7. Assessment of deficiencies

Deficiencies or weaknesses that are identified by the evaluation should be classified in terms of their impact on response performance. The purpose of this classification scheme is to help prioritize follow-up actions and to establish a target schedule for improvements.

EPR METHOD 2003

2.1.6. Functions and Infrastructure

FUNCTIONS

- Establishing emergency management and operations (A1 elements)
- Identifying, notifying and activating (A2 elements)
- Taking mitigatory action (A3 elements)
- Taking urgent protective action (A4 elements)
- Providing information and issuing instructions and warnings to the public (A5 elements)
- Protecting emergency workers (A6 elements)
- Assessing the initial phase (A7 elements)
- Managing the medical response (A8 elements)

- Keeping the public informed (A9 elements)
- Taking agricultural countermeasures, countermeasures against ingestion and longer- term protective action (A10 elements)
- Mitigating the non-radiological consequences of the emergency response (A11 elements)
- Conducting recovery operations (A12 elements)

10. ACCIDENT MANAGEMENT

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

The team identified that the plant accident management programme does not fully consider all aspects of concurrent multiple unit severe accidents. An emergency response organisation was put in place to deal with multiple unit incidents, and the plant has enhanced its external support through the permanent presence of the corporate response team (FARN), and through engagement with the neighbouring nuclear power plants. However, the Severe Accident Management (SAM) guidelines do not provide all the necessary information on how to cope with concurrent multiple unit severe accidents. The plant has not carried out and not planned any exercises that cover concurrent severe accidents on more than one unit. The time-critical mitigation actions are not sufficient to ensure an effective response for concurrent severe accidents. The team made a suggestion in this area.

The team identified that the SAM programme does not use feedback on adverse meteorological conditions from SAM training and exercises. The team observed that during a debriefing of a SAM exercise, the adverse effects of strong wind and rain which affected SAM activities were not clearly identified. The exercise record did not contain any description of the weather and temperature and consequently it was not possible to determine if exercises had been carried out under a range of environmental conditions, such as high wind, heavy rainfall, etc. The team encourages the plant to make further use of the input from SAM training to enhance the SAM programme against external hazards.

10.4. DEVELOPMENT OF PROCEDURES AND GUIDELINES

The plant has developed a guideline document (C0) which explains how to read the emergency operational procedures and the Severe Accident Management Guideline (GIAG). The procedures and the Guideline used for SAM actions follow a standardized format such as direction of arrows and color codes. The plant also developed a detailed information sheet (FPSSQ) to summarize the major aspects of the newly installed Post-Fukushima Diesel Generator (DUS) in a user-friendly frequent-question-and-answer format. These arrangements are beneficial in guiding responders to perform appropriate actions. The team considered this as a good performance.

10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

The corporate response team FARN based approximately 5km from the Paluel site carries out a realistic exercise to deploy mitigating equipment. In the exercise, the FARN team members are required to simulate the SAM actions in darkness with various obstacles imitating debris and layout of the plant, wearing radiation protective equipment with black-out filter (frosted vinyl piece to worsen the visibility) on the visor of the chemical-cartridge respirators, in various scenarios with different objectives. When the FARN team members come out of the simulated accident site, they are asked to brief the next team that will be deployed, they draw a map of the site, pointing out obstacles and dangers. This exercise enhances the ability of personnel to mitigate an accident under high stress and adverse conditions. The team considered this as a good performance.

The plant is going beyond the provision of mobile water supply and emergency generators which is rather widespread worldwide, by additionally having mobile air compressors available. The goal of these mobile compressors is to re-pressurize the safety-related compressed air system at the plant in case of accident. The team considers this is as a good practice.

DETAILED ACCIDENT MANAGEMENT FINDINGS

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

10.2(1) Issue: The plant accident management programme does not fully consider all aspects of concurrent multiple unit severe accidents.

During the review, the team noted the following:

- An emergency response procedure, PUI-SACA was put in place to deal with multiple unit incidents, and the plant has enhanced its external support through the permanent presence of the corporate FARN (Nuclear Emergency Response Task Force) off site and through engagement with the neighbouring nuclear power plants. However, multiple unit concurrent severe accidents are not fully considered in the baseline for severe accident management (SAM).
- The SAM guidelines do not provide all the necessary information on how to cope with concurrent multiple unit severe accidents.
- The accessibility estimates for local SAM actions do not consider concurrent severe accidents. In the event of a single severe accident in a unit, dose estimates are produced for the neighbouring units. However, the accessibility and habitability for the required SAM actions during concurrent severe accidents have not been evaluated.
- In 2020, an exercise was carried out on the Paluel site involving two units, but with only one of the units facing severe accident conditions. This exercise did not include a specific action plan to improve the plant's capability for concurrent severe accidents. The plant has not carried out and not planned any exercises that cover concurrent severe accidents on more than one unit.
  - The plant has estimated the number of personnel members required for the time-critical mitigation actions, assuming that a severe accident sequence occurs simultaneously in four units. However, these actions are not sufficient to ensure an effective response for concurrent severe accidents:
  - Time to deploy equipment is not measured as an indicator to compare the expectation in the annual training of the mitigation actions for field operators.
- Regarding equipment used for the time-critical actions, only one piece of equipment is available for each unit. The plant relies on the use of the equipment designated to other units in case of failure.
- Some hazards are expected to be incorporated into the probabilistic safety assessment prepared for the coming periodic safety review to address the vulnerabilities against extreme external hazards which may cause a multiple unit severe accident. However, the dependencies of equipment and organizational factors in multiple unit severe accidents are not fully assessed.

Without considering concurrent multiple unit severe accidents, some time-critical mitigation actions may not be performed in a prompt and effective manner.

Suggestion: The plant should consider further enhancing its severe accident management programme to include all aspects of concurrent multiple unit severe accidents.

IAEA Bases:

SSR-2/2 (Rev. 1)

Requirement 19. Accident management programme

The operating organization shall establish, and shall periodically review and as necessary revise, an accident management programme.

5.8A. For a multi-unit nuclear power plant site, concurrent accidents affecting all units shall be considered in the accident management programme. Trained and experienced personnel, equipment, supplies and external support shall be made available for coping with concurrent accidents. Potential interactions between units shall be considered in the accident management programme.

SSG-54

2.65. For a multiple unit nuclear power plant site, the accident management programme is required to consider concurrent accidents affecting multiple units, in accordance with para. 5.8A of SSR-2/2 (Rev. 1) [6].

2.66. Accident management guidance should include the equipment and supporting procedures necessary to respond to accidents that might affect multiple units on the same site and last for extended periods of time. Personnel should have adequate skills to use such equipment and implement supporting procedures, and adequate staffing plans should be developed for emergency response at sites with multiple units.

2.67. Some events, especially natural hazards, may result in similar challenges to all units on the site. Therefore, staffing plans should take into account situations in which multiple units at the same site have been affected simultaneously and some plant personnel have been temporarily or permanently incapacitated.

2.68. In the case of multiple unit sites with shared safety related equipment or systems, the possible continued use of a unit that has not been affected should be taken into account in the accident management guidance. Predefined criteria should be established to decide whether the operating units at the same site should be shut down in the event of a severe accident.

2.73. The accident management guidance should address the possibility that more than one unit, or all units, might be affected concurrently by simultaneous accidents, including the possibility that damage will propagate from one unit to another or that damage to one unit will be caused by actions taken at another unit.

2.74. When installing equipment (both permanent and non-permanent equipment) for use in severe accident management, consideration should be given to the possibility of severe accidents occurring simultaneously at more than one unit.

2.94. For multiple unit sites, the on-site emergency plan should include the necessary interfaces between the various parts of the overall on-site emergency response organization responsible for different units. Emergency directors for each unit may be assigned to decide on the appropriate actions at specific units. In this case, an overall emergency director should also be assigned to coordinate activities and priorities among all affected units on the site. Decision making responsibilities should be clearly defined. If there are different operating organizations at a given site, appropriate arrangements should be established for the coordination of emergency response operations, including accident management measures, among those organizations.

3.3. Severe accident sequences should be identified and analyzed using a combination of engineering judgement, deterministic methods and probabilistic methods. Sequences for which practicable severe accident management guidance can be implemented should be identified. Acceptable severe accident management guidance should be based on best estimate assumptions, methods and analytical criteria. Activities for developing severe accident management guidance should take into account the following:

[…] (e) For multiple unit sites, consideration of the use of available means and/or support from other units on the site, provided that the safe operation of those units is not compromised.

3.66. Validation should be performed under conditions that realistically simulate the conditions present during an emergency and should include simulation of other response actions, hazardous work conditions, time constraints and stress. Special attention should be paid to the use of portable and mobile equipment, when such use is considered, and for multiple unit sites, to the practicality of using backup equipment that could be provided by other units.

3.106. All phenomena (e.g. thermohydraulic and structural phenomena) important for the assessment of challenges to the integrity of barriers against releases of radioactive material, as well as for the assessment of the source term, should be addressed. For a multiple unit nuclear power plant site, concurrent accidents affecting all units should be analyzed.

10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

10.5(a) Good Practice: Use of lessons learned from OE on availability of mobile compressors for supplementing safety related needs (pneumatic actuators, regulation, etc) in extreme external hazard scenarios.

To take into account lessons learned from the earthquake and tsunami devastation at Fukushima Daiichi nuclear power plant, the robustness of the plant has been increased by making mobile equipment available in a timely manner in case of station blackout, loss of ultimate heat sink or more generally when the existing plant safety systems are jeopardized by an unexpected scenario.

This mobile equipment is stored at a safe distance from the plant, and can be transported on site in a short time, by road, flat bottom boat or helicopter. The plant is going beyond the provision of mobile water supply and emergency generators which is rather widespread worldwide, by additionally having mobile air compressors available.

The goal of these mobile compressors is to re-pressurize the safety-related compressed air system at the plant in case of accident. This system enables actuation of key pneumatic valves, and will avoid having to actuate them manually in a radioactive environment (which could lead to a significant dose to workers). It would allow the use of the compressed air system even if electrical power cannot be timely restored.

Standard cables of a comfortable length are available with the compressors and would allow the quick connection points installed on site to be reached. Frequent exercises have been conducted both at the plant and in a dismantled facility used as a training centre, to test deployment, connection and operation.

The equipment weights 770 kg, and is about 2 x 1.1 x 1.8 m wide. It delivers a pressure of 7 bar with an air flow capacity of 48 m3/h and can operate at full power with an autonomous fuel tank for 10 hours, after which it would be refilled from a larger tank.

12. LONG TERM OPERATION

12.1. GENERAL

In preparation for the fourth ten-year outage, the plant initiated the use of drones to carry out an expert assessment of material condition in certain areas: for example civil engineering structures. The plant also uses drones for expert appraisals in various environments such as confined areas. As an additional benefit of this innovation, the drone reduces industrial safety risks for these activities. The team considered this as a good practice.

The plant process for the identification of structures, systems and components (SSCs) to be included in the scope of ageing management (AM) and long-term operation (LTO) is performed in four stages, where the first three stages are done at corporate level, and stage four is at the plant and Unit level. In some cases the process lacks detailed guidance and selection criteria. The plant has yet to complete the scheduling and implementation of dedicated AM walkdowns and to document the results. The information and data on best international practices and IAEA approaches in LTO are not always utilized by plant personnel. The team made a suggestion for the plant to consider enhancing its process and provisions to identify the SSC scope and ensure timely verification in preparation for LTO.

12.6. TIME LIMITED AGEING ANALYSES (TLAAs)

The plant is completing the work for the identification of structures, systems and components (SSCs), the life of which is to be extended based on time limited analyses (TLAAs) and on the revalidation of analyses for the planned period of LTO. A comprehensive list of TLAAs is yet to be developed and all necessary condition assessments are yet to be finalised. Also, there is a need to improve record keeping regarding to the decisions taken when selecting samples of equipment and representativity of the results for the specific plant. The team made a suggestion for the plant to consider enhancing its efforts towards identifying SSCs, the life of which is to be extended based on time limited ageing analyses and the revalidation of the analyses, to ensure equipment readiness for safe long-term operation.

12.9. TECHNOLOGICAL OBSOLESCENCE MANAGEMENT

The plant implemented a technological obsolescence management programme using specific software. The programme is aimed at proactive identification, recording, prioritisation, decision making and timely resolution of obsolescence related issues, and it is used throughout the fleet. The system is accessible to all stakeholders and consists of steps enabling monitoring, processing obsolescence alerts and using operating experience feedback from the 'Cameleon' database. The team considered this as a good practice.

DETAILED LONG TERM OPERATION FINDINGS

12. LONG TERM OPERATION

12.1(a) Good practice: Use of drones to identify, record and monitor the status of inaccessible areas of civil structures to timely identify and address degradation of their surface.

The joint modification department at Paluel (civil engineering and modifications) has started the use of drones to carry out expert assessments of material conditions in various areas such as civil engineering structures.

The NPP uses drones for expert appraisals in various environments such as confined areas, investigations of civil engineering structures and marine and underwater environments. Drones can be used both indoors and outdoors and provide accurate readings on cracks and civil engineering flaws. Taking infrared readings is also possible, as well as inspections or readings of probes or any other type of equipment.

As part of this innovation, the drone reduces industrial safety risks for activities and substitutes for scaffold erection or the use of rope climbers. In addition to this, the process improves timely responsiveness at a lower price.

Operating drones is a new skill which is now fully part of the qualification process of the relevant staff members.

Acceptance of works on concrete cladding, at a 60m height:

No need to use rope climbers. Acceptance was completed within 30 minutes for one unit (versus two days with rope climbers). This is currently being carried out on the other 3 Units.

Monitoring of the dike

In the past, it was difficult to monitor the state of the sea-side of the dike, because of tidal movements and waves. Currently, a drone monitors the area every five years. The assessment was completed within 30 minutes.

Planned expansion of the technology:

The plant uses drones outdoors, for cliff appraisal and for checking the cladding of the pump house and other building, as well as corroded cage ladders.

When a new drone is purchased, including dedicated qualification of a staff member in the modification department, the opportunities will be extended to roofs of the nuclear auxiliary and fuel buildings and internal stack inspections in the ventilation systems. Industrial safety also significantly improves, as performance of these activities in the traditional way requires the installation of access equipment or the use of rope climbers.

12.1(1) Issue: The plant process and provisions for the identification of structures, systems and components (SSCs) to be included in the scope of ageing management (AM) and long-term operation (LTO) are not comprehensive enough and the results of work done are not always appropriately documented.

The team noted the following:

- The corporate expectations are that all safety related SSCs have to be included in the AM scope. However, the review showed that post-Fukushima equipment had not yet been included in the scope.
- The AM organisation going through a period of change. The SSC scope for AM is getting wider. For the fourth ten-year outage (VD 4), the plant involvement at local level is increasing, especially for SSCs related to asset protection and for conventional risks. The plant intends to create ageing analysis sheets (AASs) for this additional equipment, but these are not finalised yet.
- The plant is preparing a Unit Ageing Analysis Report (UAAR) based on SSC scope predefined at corporate level. This report should include results of dedicated walkdowns to identify non-safety related SSCs, to be included in the AM scope because of spatial interactions, but these are not implemented yet.
- Corporate level document dated 7 July 2020, defines in a very general way the need to select non-safety related SSCs the failure of which may prevent SSCs important to safety from performing their intended functions. Detailed guidance on how to select relevant SSCs based on walkdowns at plant or corporate level has not yet been developed.
- The plant has not yet developed detailed plans and schedules for dedicated walkdowns to identify non-safety related SSCs the failure of which may prevent SSCs important to safety from performing their intended functions.
- Scoping is done according to corporate standards, based on several separate lists of equipment. There is no single database, nor comprehensive master list.
- The plant does not have a complete list of in-scope and out of scope SSCs, including scoping criteria.
- The International Generic Ageing Lessons Learned Programme (IGALL) is used as reference for benchmarking at corporate level only. All ageing effects/degradation mechanisms (AE/DM) have been properly reviewed against the IGALL ageing management review (AMR) table, but review results are not documented for the 1300 MWt series.
- Lessons learned from previous IAEA reviews of AM and LTO areas in French NPPs have not been analysed and taken into account by the plant. OSART mission reports are available in the corporate intranet, but very few people at the plant know where they are and actually use them.

Without a complete scope of SSCs for LTO assessment, the operating organization cannot demonstrate that all ageing effects of SSCs important to safety are properly managed for LTO.

Suggestion: The plant should consider ensuring that all relevant structures, systems and components (SSCs) are included in the scope of ageing management (AM) and long-term operation (LTO) and the results of work done are adequately documented.

IAEA Bases:

SSR-2/2 (Rev. 1)

Requirement 14: Ageing management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

4.51. Long term effects arising from operational and environmental conditions (i.e. temperature conditions, radiation conditions, corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) shall be evaluated and assessed as part of the ageing management programme. Account shall be taken in the programme of the safety relevance of structures, systems and components.

Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

4.54. The comprehensive programme for long term operation shall address:

(b) Setting the scope for all structures, systems and components important to safety;

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5.14. A systematic scope setting (also called ‘scoping’) process to identify SSCs subject to ageing management should be developed and implemented.

5.15. A list or database of all SSCs at the nuclear power plant (such as a master list of SSCs) should be made available before the scope setting process is commenced.

5.19. In addition to the analysis of plant documentation, dedicated plant walkdowns should be used to check the completeness of the list of SSCs whose failure may prevent SSCs important to safety from performing their intended functions.

5.21. After the scope setting process, a clear distinction between SSCs within the scope and those out of the scope should be evident.

5.25. A process to identify relevant ageing effects and degradation mechanisms for each structure or component should be established, and the programmes to manage the identified ageing effects and degradation mechanisms should be in place (see Fig. 4). This process should cover the following steps:

(3) If the ageing of structures or components is managed by existing ageing management programmes, it should be verified that the ageing management programmes are consistent with the nine attributes shown in Table 2.

(4) If the ageing of structures or components is managed by other plant programmes, such as maintenance, it should be verified that these programmes are consistent with the nine attributes shown in Table 2.

12.6 (1) Issue: The identification of structures, systems and components (SSCs), the life of which is to be extended based on ageing limited analyses (TLAAs) and the revalidation of analyses for the planned period of LTO are not sufficient to demonstrate the readiness of the SSCs for safe long-term operation.

The team noted the following:

- There is a corporate document which defines how to assess the lifetime of equipment when ageing effects (AE) cannot be measured. This document establishes rules for the collection of cycle records since the start of operation as the basis for TLAA. However, this is done only for primary and secondary circuits, containment and some crane structures.
- The plant does not have a list of equipment, the life of which is to be extended based on ageing limited analyses.
- TLAAs have only been identified for the 900 MWt series and not yet for the 1300MWt series.
- The corporate tested cables from various plants as part of project 'Extension of lifetime to 60 years'. The results are summarized in report, dated 15 December 2020. One sample of cable was taken from Paluel NPP and another one from Nogent NPP, however:
  - the test was limited to physical/chemical properties, electrical properties were to be tested later.
  - the report does not include information as to whether or not the samples were selected on a conservative basis – from 'hot spots.
  - the report states that the cables are in good conditions but does not specify the expected lifetime.
- In 2014 the plant recorded its highest temperatures in rooms where cables were present. These records were used as the basis for assessing the lifetime and qualification of the cables. However, the records have not been updated since and include only average room temperatures and no information about 'hot spots' affecting SSCs to be qualified.
- There are no records about the decision-making process regarding the selection of sampling points and representativity of the results for the specific plant.
- For representative samples of SSCs (e.g. temperature sensors, connectors) selection criteria were not conservative as they did not mention the influence of ageing factors, only the operational time.

Without a complete identification of SSCs, the life of which is to be extended based on time limited ageing analyses and the revalidation of the analyses for the planned period of LTO, the operating organization cannot demonstrate readiness of the SSCs for safe long-term operation.

Suggestion: The plant should consider ensuring that the identification of SSCs, the life of which is to be extended based on time limited ageing analyses is completed and the revalidation of the analyses, to ensure equipment readiness for safe long-term operation is finalized.

IAEA Bases:

SSR-2/2 (Rev. 1)

Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

4.54. The comprehensive programme for long term operation shall address:

(b) Setting the scope for all structures, systems and components important to safety;

(d) Revalidation of safety analyses made on the basis of time limited assumptions;

(e) Review of ageing management programmes in accordance with national regulations;

(f) The implementation programme for long term operation.

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2.32. If a decision is taken to pursue long term operation, justification of the adequacy of ageing management for the planned period of long term operation should be provided, based on the results of the periodic safety reviews [7] or the results of an adequate evaluation process (that includes scope setting, ageing management review, and revalidation of time limited ageing analyses, as described in this Safety Guide), and this justification should be evaluated for adequacy by the regulatory body.

3.34. For in-scope structures or components, the operating organization should identify all time limited ageing analyses and should demonstrate either that all these analyses will remain valid for the planned period of long term operation, or that the structures or components will be replaced, or that further operation, maintenance or ageing management actions will be implemented.

4.29. The qualification status of equipment should be properly documented and maintained throughout the lifetime of the plant. The documentation relating to equipment qualification, which is typically part of the equipment qualification programme, should include:

(a) A master list of qualified equipment;

(b) Results of temperature monitoring and radiation monitoring in the plant;

(c) The evaluation report for equipment qualification;

(d) Test reports relating to equipment qualification;

(e) Reports of time limited ageing analyses relating to equipment qualification (for the evaluation for long term operation) or reports of another suitable equivalent analysis.

4.36. A list or database should be developed and maintained to document the adequacy of non-destructive examination in detecting, characterizing and trending the degradation of structures or components. The database should provide the technical bases to support the findings and the conclusions necessary to support ageing management decisions.

5.10. The data collection and record keeping system should be established in the early stages of the lifetime of the plant (ideally, data should be collected from the construction stage onwards) in order to provide information for the following activities:

(a) Identification of fabrication, construction and environmental conditions that could adversely affect the ageing of SSCs, including any periods of delayed construction or suspended operation;

(b) Identification of relevant fabrication records, such as heat treatment history and certified reports on material tests;

(c) Identification and evaluation of degradation, failures and malfunctions of components caused by ageing effects;

(d) Decisions on the type and timing of maintenance actions, including calibration, repair, refurbishment and replacement;

(e) Optimization of operating conditions and practices that prevent or minimize ageing effects;

(f) Identification of all ageing effects before they jeopardize plant safety or reduce the service life of SSCs;

(g) Records of configuration and modification management, maintenance, surveillance and in-service inspection results, as well as chemistry control records.

5.11. To facilitate obtaining the necessary quality and quantity of ageing related data from plant operation, maintenance and engineering, representatives of the operations, maintenance and engineering units should be involved in the development and maintenance of the data collection and record keeping system.

12.9(a) Good practice: Technological obsolescence management using specific software programme.

Objectives: Introduce proactive approach to obsolescence management, through timely identification, recording, prioritization, decision making and timely resolution of obsolescence related issues, working throughout all organizational levels.

The system is set up using the SharePoint software and is accessed by personnel of all stakeholders: plant personnel, Engineering Centers, corporate personnel, EDF SA. It consists of three steps: monitoring, processing the alert and using operating experience feedback from the 'Cameleon' database.

The system has several roles: identification and prompt initiation of obsolescence alerts, status monitoring, cross-disciplinary involvement for issue prioritization and issue resolution and consideration of operating experience feedback.

Home page

An alert can be raised by any staff member from any workplace. The software allows items to be grouped using a drop-down menu and the alert record form to be completed using the following criteria:

- Equipment items concerned, plant series, source, date discovered, originator's name;
- Technical and logistical data;
- Impact on nuclear safety / event, safety classification, AP913, maintenance required, assessment of issues, prioritization;
- Potential mitigating measures, if identified (recovery, life-time stock, repair, procurement contract, etc);
- Status of the request (awaiting action, being analysed, etc);
- Summary records of the formal discussions in technical committees;
- Associated documentation with a link to the EDF documentation database;

– Reflex action sheets: obsolescence report, initial characterization, monthly alert review briefing.

This tool acts as a corporate obsolescence register. It can track actions related to operational divisions (person responsible, deadline, deliverables) and makes best use of the method (reflex-action) sheets.

The software contains information about the document management (process memo, deliverables, reports, etc.) via interfaces with the ECM (the IT system that manages documentation).

The plant has carried out benchmarking with the Arianespace and EuroCopter companies, who decided to copy the system.

Each year, the sites report 120 obsolescence alerts, resulting in 35-40 case files for managing obsolescence.

Benefits:

This tool acts as a single and national obsolescence register. It can track actions related to operational divisions (person responsible, deadline, deliverable) and makes best use of the method (reflex-action) sheets. Thanks to easy access and user friendliness of the tool, the number of obsolescence alerts issued annually by the plants has increased from 22 in 2018 to 120 to date.

In addition, the tool enables more frequent and more efficient review of new obsolescence issues and follow-up of related actions. The processing time is shortened to about one month to address a new issue, instead of three to six months before the implementation of the tool.

The intranet based system documents the papers (process memo, deliverables, reports, etc.) via interfaces with the ECM (the IT system that manages documentation).

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

A recommendation is advice on what improvements in operational safety should be made in the activity or programme that has been evaluated. It is based on inadequate conformance with the IAEA Safety Requirements and addresses the general concern rather than the symptoms of the identified concern. Recommendations are specific, realistic and designed to result in tangible improvements.

Suggestion

A suggestion is advice on an opportunity for safety improvement not directly related to inadequate conformance with the IAEA Safety Requirements. It is primarily intended to make performance more effective, to indicate useful expansions to existing programmes and to point out possible superior alternatives to ongoing work.

Good Practice

A good practice is an outstanding and proven programme, activity or equipment in use that contributes directly or indirectly to operational safety and sustained good performance. A good practice is markedly superior to that observed elsewhere, not just the fulfilment of current requirements or expectations. It should be superior enough and have broad enough application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence. A good practice:

- is novel;
- has a proven benefit;
- is replicable (it can be used at other plants); and
- does not contradict an issue.

Normally, good practices are brought to the attention of the team on the initiative of the plant.

REFERENCES

Safety Fundamentals (SF)

SF-1 Fundamental Safety Principles (Safety Fundamentals)

General Safety Requirements (GSR)

GSR Part 1 Governmental, Legal and Regulatory Framework for Safety

GSR Part 2 Leadership and Management for Safety

GSR Part 3 Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

GSR Part 4 Rev.1 Safety Assessment for Facilities and Activities

GSR Part 5 Predisposal Management of Radioactive Waste

GSR Part 6 Decommissioning of Facilities

GSR Part 7 Preparedness and Response for a Nuclear or Radiological Emergency

Specific Safety Requirements (SSR)

SSR-2/1 Rev.1 Safety of Nuclear Power Plants: Design

SSR-2/2 Rev.1 Safety of Nuclear Power Plants: Commissioning and Operation

General Safety Guides (GSG)

GSG-2 Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency

GSG-7 Occupational Radiation Protection

GSG-11 Arrangements for the Termination of a Nuclear Radiological Emergency

Safety Guides (SG)

NS-G-2.1 Fire Safety in the Operation of Nuclear Power Plans

NS-G-2.13 Evaluation of Seismic Safety for Existing Nuclear Installations

GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities

GS-G-2.1 Arrangement for Preparedness for a Nuclear or Radiological Emergency

GS-G-3.1; Application of the Management System for Facilities and

	Activities
GS-G-3.5	The Management System for Nuclear Installations
GS-G-4.1	Format and Content of the Safety Analysis report for Nuclear Power Plants
RS-G-1.8	Environmental and Source Monitoring for Purposes of Radiation Protection

Specific Safety Guides (SSG)

SSG-2 Rev.1	Deterministic Safety Analysis for Nuclear Power Plants
SSG-3	Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants
SSG-4	Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants
SSG-13	Chemistry Programme for Water Cooled Nuclear Power Plants
SSG-25	Periodic Safety Review for Nuclear Power Plants
SSG-28	Commissioning for Nuclear Power Plants
SSG-38	Construction for Nuclear Installations
SSG-39	Design of Instrumentation and Control Systems for Nuclear Power Plants
SSG-40	Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors
SSG-47	Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities
SSG-48	Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants
SSG-50	Operating Experience Feedback for Nuclear Installations
SSG-54	Accident Management Programmes for Nuclear Power Plants
SSG-70	Operational Limits and Conditions and Operating Procedures for Nuclear Plants
SSG-71	Modifications to Nuclear Power Plants
SSG-72	The Operating Organization for Nuclear Power Plants
SSG-73	Core Management and Fuel Handling for Nuclear Power Plants
SSG-74	Maintenance, Testing, Surveillance and Inspection in Nuclear Power Plants
SSG-75	Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

SSG-76 Conduct of Operations at Nuclear Power Plants

International Labour Office publications on industrial safety

Guidelines on occupational safety and health management systems, International Labour office (ILO), Geneva, ILO-OSH 2001

Safety and health in construction, International Labour office (ILO), Geneva, ISBN 92-2-107104-9

Safety in the use of chemicals at work, International Labour office (ILO), Geneva, ISBN 92-2-108006-4

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Review Area: Long Term Operation