NSNI/OSART/206F/2021
ORIGINAL: English

IAEA | Operational Safety Review Team OSART

# REPORT
**of the**

# PRE-OPERATIONAL SAFETY REVIEW TEAM (PRE-OSART)

# MISSION

**TO THE**

# FLAMANVILLE UNIT 3 NUCLEAR POWER PLANT

# FRANCE
# 17 JUNE TO 4 JULY 2019

**AND**

# FOLLOW UP MISSION

# 6 TO 10 DECEMBER 2021

**DIVISION OF NUCLEAR INSTALLATION SAFETY**
**OPERATIONAL SAFETY REVIEW MISSION**
**NSNI/OSART/206F/2021**

## PREAMBLE

This report presents the results of the IAEA Pre-operational Safety Review Team (Pre-OSART) review of Flamanville Unit 3 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.

This report also includes the results of the IAEA's Pre-OSART follow-up mission which took place 29 months later. The inputs resulting from the follow-up mission can be found in the following chapters: last paragraph in the Executive Summary, Self-assessment of the follow-up mission by the host organization and Follow-up Conclusions by the IAEA follow-up team in the Introduction and Main Conclusions sections. In addition, the Plant Response/Action and IAEA Comments and Conclusion are under each Recommendation and Suggestion. The status of each issue is in the Summary of Status of Recommendations and Suggestions and the Follow-up team composition can be found at the end of the report.

The purpose of the follow-up mission was to determine the status of all proposals for improvement, to comment on the appropriateness of the actions taken and to make judgements on the degree of progress achieved.
Any use of or reference to this report that may be made by the competent French organizations is solely their responsibility.

# FOREWORD

## 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 ten 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 Pre-OSART mission conducted at Flamanville Unit 3 Nuclear Power Plant in France from 17 June to 4 July 2019.

The purpose of a Pre-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 Pre-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; Human, Technology and Organization Interactions and Commissioning.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader and the team was composed of experts from Canada, Finland, Germany, Russia, Spain, Sweden, The United States of America, and the IAEA staff members and observers from Russian Federation and Republic of Korea. The collective nuclear power experience of the team was 350 years.

The team identified 21 issues, resulting in Six recommendations, and 15 suggestions. Eight good practices were also identified.

Several areas of good performance were noted:

- Liaison officer dedicated to Operating experience in sister plant Taishan for in-depth Operating experience sharing;
- Use of ‘post-Fukushima Boxes’ for fuel handling in adverse conditions;
- Effective implementation of a holistic Human Factors approach throughout the life cycle of the plant.

The most significant issues identified were:

- The plant should fully implement its Foreign Material Exclusion programme throughout all departments and areas to attain a high standard of implementation;
- The plant should consider implementing procedures and practices to ensure that the potential impact of unsecured items on safety related equipment in seismically qualified areas is minimized;
- The plant should improve the arrangements and practices targeting the integrity of fire barriers and prompt fire suppression to ensure that fire risk is always minimized.

Flamanville 3 NPP management expressed their commitment to address the issues identified and invited a follow up visit in about eighteen months to review the progress.

At the time of the follow-up mission in December 2021, 29 months after the Pre-OSART mission, 67% of issues had been resolved, 33% had made satisfactory progress. No issue was assessed as having made insufficient progress to date.

## CONTENT

# INTRODUCTION AND MAIN CONCLUSIONS

## INTRODUCTION

At the request of the government of France, an IAEA Pre-operational Safety Review Team (Pre-OSART) of international experts visited Flamanville Unit 3 Nuclear Power Plant from 17 June to 4 July 2019. 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; Human, technology and organization interactions and Commissioning. 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 Flamanville 3 NPP OSART mission was the 206th in the programme, which began in 1982. The team was composed of experts from Canada; Finland; Germany; Russia; Spain; Sweden; United States of America; the IAEA staff members and observers from Russian Federation and Republic of Korea. The collective nuclear power experience of the team was 350 years.

Before visiting the plant, the team studied information provided by the IAEA and Flamanville Unit 3 NPP to familiarize themselves with the plant's main features and current 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 Pre-OSART team concluded that the managers of Flamanville Unit 3 NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

- Liaison officer dedicated to Operating experience in sister plant Taishan (China) for in-depth Operating experience sharing;
- Use of ‘post-Fukushima Box’ for fuel handling in adverse conditions;
- Effective implementation of a holistic Human Factors approach throughout the life cycle of the plant.

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

– The plant should fully implement its Foreign Material Exclusion programme throughout all departments and areas to attain a high standard level of implementation.

– The plant should consider implementing procedures and practices to ensure that the potential impact of unsecured items on safety related equipment in seismically qualified areas is minimized.

– The plant should improve the arrangements and practices targeting the integrity of fire barriers and prompt fire suppression to ensure that fire risk is always minimized.

Flamanville Unit 3 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.

**FLAMANVILLE 3 SELF ASSESSMENT FOR THE FOLLOW-UP MISSION**

The Flamanville 3 leadership team and plant personnel appreciated the high-quality feedback provided by the Pre-Operational Safety Review Team (Pre-OSART) during the Pre-OSART mission to Unit 3 of the Flamanville NPP from 17 June to 4 July 2019. The 6 recommendations and 15 suggestions identified were very helpful for the plant to improve plant safety and to prepare Unit 3 for safe and successful commissioning. The plant was thankful for the good practices identified and they welcomed the opportunity to continuously improve the performance of the plant in all functional areas.

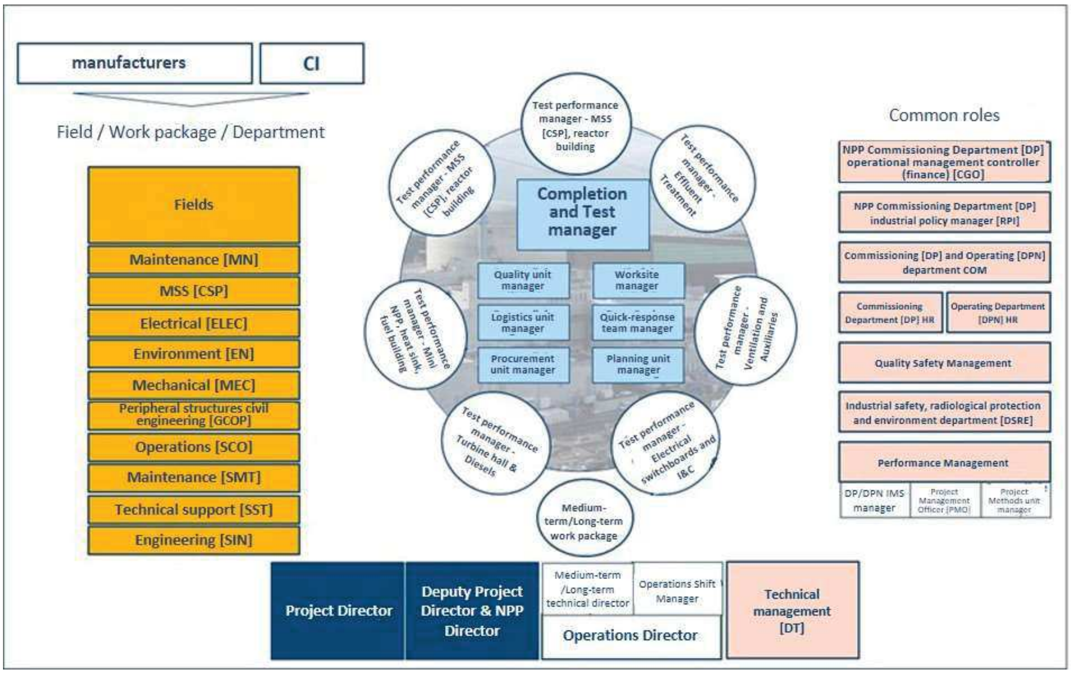
At the beginning of 2020, following the Pre-OSART mission and the hot functional tests, the site carried out a redesign of its overall organization to create a unified "OneFla3 organization" bringing together the EDF entities in charge of construction and tests with those in charge of operations.

This was set up to finalize the Flamanville 3 facilities, as quickly as possible while maintaining high safety standards, by allowing:

– Pooling of skills between the entities in charge of construction, tests and operations;
– Creation of synergies to take account and deal with actions "to be completed" and improve coordination as suggested by the IAEA;
– Simplification of interfaces.

New organizational methods within the project/work packages have led to an increased efficiency in several areas: completion of the fixed schedule for tests carried out after the hot tests, major stages in modifications such as the update of I&C systems and reception of the fuel assemblies, despite the disruption caused by the Covid-19 health crisis.

The organization chart shows the new organization in "work packages":




OneFla3 has brought together many key areas such as nuclear safety, industrial safety, fire protection and quality control:

- With regard to safety, the creation of the industrial safety, radiological protection and environment department (DSRE) has made it possible to optimize safety management on site and the plant are now seeing the benefits with better coordination in the field and sharing of practices.
- With regard to fire prevention and protection, a comprehensive site-wide action plan under the OneFLA3 umbrella allowed the "control of fire risk" milestone to be reached in 2020.
- OneFLA3 has also allowed a quality unit to be set up, which puts quality back at the heart of our activities, essential for fulfilling our commitments and obtaining the authorization to load the reactor.

Other improvements have been put in place, such as the medium-term/long-term project work package, which has made significant progress in the implementation of pre-operation activities. For example, preservation of equipment, taking ageing effects into account following the prolongation of site work, maintenance of equipment in operation and initiation of the periodic test programme as well as preparation for our future operations activities (1$^{st}$ cycle and 1$^{st}$ outage).

These organizational changes help meet the site's objectives through a common OneFLA3 Annual Performance Contract (CAP). Initiated in 2020 and renewed in 2021, this CAP outlines the major actions to be carried out throughout the year in order to allow loading of the EPR with fuel at the end of 2022 and to be ready for operation. In 2020, 85% of the CAP 2020 milestones were reached.

In 2021, the CAP has eight objectives that should allow completion of the facility by dealing with the actions "to be completed" at a pace that guarantees completion of the facilities and preparation for operation, within the deadlines that were set:

- Stopping drift on safety and environmental protection
- Doing it “right first time”, to reduce the rework rate
- Maintaining the critical path schedule for the Main Secondary System (MSS [CSP])
- Securing the essentials for starting operations and reducing the work volume by 20%
- Strengthening the requirements for coordination of FLA3
- Ensuring the proper storage and maintenance of equipment
- Preparing the overall re-qualification and loading-coupling phases
- Ensuring nuclear operator fundamentals are embedded throughout the organization

**Completed milestones**

Since the Pre-OSART carried out in June 2019, activity on the site has been intense, with major milestones passed as well as a number of sizeable operations:

a) Hot functional tests

Initiated in the last quarter of 2019, the hot functional tests of the EPR were a major step towards start-up. Working 24/7, the teams completed this phase successfully in February 2020.

The hot tests included more than 1000 tests carried out, 10,000 design criteria tested and resulted in a compliance rate of more than 95%. Some examples of these tests include:

- Reaching normal hot shutdown conditions (with 303°C and 154 bar in the main primary system).
- Primary side cooling using the secondary circuit and first commissioning of the steam generators.
- Conducting tests on loss of the electrical power supply.
- The running of the turbine at 1500 rpm.

As a result of the hot tests, the operation of the nuclear steam supply system has been tested, including in many incident and/or accident situations, to check the correct operation of the facilities in the most demanding configurations possible. This sequence also verified the ability of the teams to operate the reactor safely.

In addition, in June 2020, the site took an important step with the delivery to the French Nuclear Safety Authority (ASN) of a report on all the commissioning tests carried out on the facility from vessel flushing operations through to hot tests.

This regulatory document will assist in obtaining authorization for commissioning of the facility. This report, of more than 1200 pages, meets an ASN specification. It is based on more than 2500 test performance reports and summarises all tests that are important for the protection of interests (AIP tests). It also indicates, for each test, the results obtained and justification for the acceptability of these results.

The report also specifies the commissioning tests still to be carried out and a list of the tests already carried out but with results that would not, at this stage, allow commissioning of the facility (test reservations currently being processed). The overall re-qualification phase, which will be carried out to re-qualify containment penetration welds currently under repair, will allow the programme to be closed.

b) Receipt of fuel

The site has made good progress in meeting this important milestone in the start-up of the EPR, with the application of a nuclear safety procedure to part of the facility and our nuclear operator fundamentals.

Prior to the arrival of the fuel, reviews were conducted to prepare for and comply with this new procedure and resulted in authorization from our Safety Authority to put partial General Operating Guidelines in place. Through this authorization, the site has shown that it knows how to organize itself to reach the key milestones that will lead to start-up. Everything that has been put in place during this phase, mirrors but on a different scale, what needs to be achieved for the fuel loading milestone. Resolution of the remaining activities for fuel loading will need to be carried out at a pace that is commensurate with the fuel loading target date.

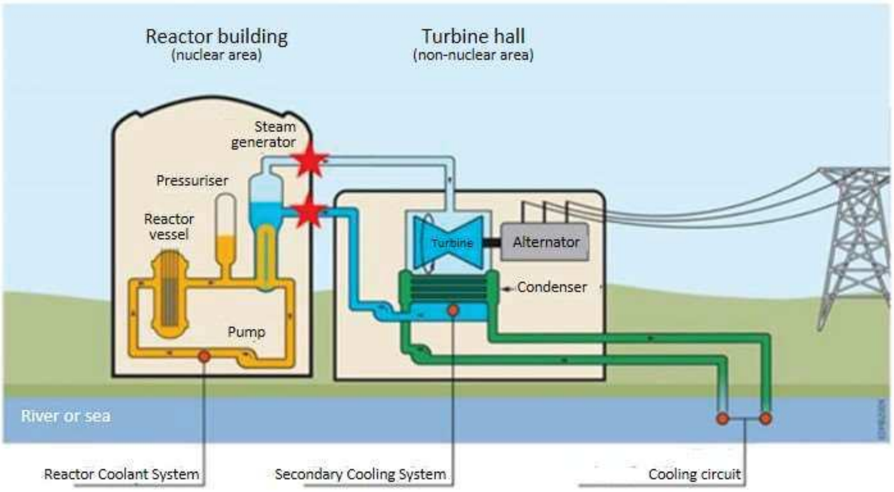
To this end, on Monday 26 October 2020, the first fuel assemblies arrived at the Flamanville 3 site. Since then, a great deal of work has been undertaken by the fuel division teams, unloading the packages and storing them in the fuel building pool. On 24 June 2021, one week ahead of schedule, the 245th and final fuel assembly was received. This is a major milestone for the Flamanville EPR.

The major steps that led to this historic milestone for FLA3:

- on 15/07/20: Meeting of the deviation characterisation committee, to guarantee that there are no deviations which are incompatible with the reception and storage of the fuel
- from 10/08/20: Dry run application of the General Operating Guidelines [RGE] to train our teams in this new procedure
- on 11/08/20: Dry run of the start-up safety committee to identify, in advance, the final blocking points and organizational issues to be resolved
- 18 and 19/08/20: Inspection by the French Nuclear Safety Authority (ASN)
- on 01/10/20: Switch to the common FLA123 internal emergency plan, the reception of fuel by FLA3 requiring the application of such a plan
- on 08/10/20: ASN fuel receipt authorisation

c) Welding operations on the Main Secondary System (MSS) penetrations

At Flamanville 3, the steam part of the main secondary system was designed according to the “break preclusion” procedure. This procedure incorporates high quality of design, manufacturing and operational follow-up and thus excludes the assumption of a line break in the safety studies. At the time the penetration welds were carried out, not all requirements of this procedure had been defined, which led the French regulator (ASN) to request that they be brought up to standard, on 19 June 2019. EDF has decided to extend the repairs to other welds located on the main secondary system (in blue on the diagram overleaf). This circuit consists of a main steam supply system (MSSS [VVP] – in light blue) and a water section (MFWS [ARE] – in a darker blue). The penetration welds are located where the main secondary system penetrates the concrete containment of the reactor building (red stars on the diagram).




After obtaining the green light from the ASN in early 2021, the first penetration weld was completed to the expected quality level in June 2021. Since then, activities have continued on all four trains.

d) Major activities such as the electrical power supply and instrumentation and control

The implementation of modifications prior to loading, in particular to the electrical switchboards and the instrumentation and control systems, constituted important phases carried out after the hot functional tests during the first six months of 2020. To date, work and modifications are ongoing to complete this work.

e) Next milestones

Several sequences of activities are still needed before loading the fuel:

- Completing the upgrades to the MSS [VVP] welds: completion of work in Q2 2022.
- Overall re-qualification in Q2 2022: Overall sequence of tests in hot shutdown conditions to re-qualify equipment that was disassembled during the MSS [CSP] weld repairs. This phase will also allow the remaining test procedures that were unsatisfactory during the Hot Tests to be resolved, and re-qualification of modifications that require hot shutdown conditions.
- Preparation for loading in Q3 2022: final phases of tests and cleaning prior to loading of the fuel in the reactor vessel and regulatory inspection by the Nuclear Safety Authority to authorise loading.
- Start of loading in Q4 2022

**FOLLOW-UP MAIN CONCLUSIONS**

An IAEA Pre-OSART Safety Review Follow-up Team visited Flamanville 3 NPP from 6 to 10 December 2021. There was clear evidence that NPP management had gained benefit from the Pre-OSART process. The plant had analyzed in a systematic way the Pre-OSART recommendations and suggestions and developed a corrective action plan to address all of them.

The plant resolved issues regarding: management expectations to ensure staff members consistently adhere to established standards; application of Systematic Approach to Training and quality of the training programmes; material condition and protection of safety related equipment to ensure equipment availability; implementation of Foreign Material Exclusion (FME) programme; minimizing potential risk from the impact of unsecured items on safety related equipment in seismically qualified areas; development and approval of surveillance procedures; dose constraints to ensure optimization of protection and safety for activities that generate occupational and public radiation exposure; labelling hazardous chemical substances and systems; capability to take post-accident gaseous and liquid sampling; arrangements and means for assembly and evacuation of on-site personnel; the emergency preparedness training, drill and exercise programme; administrative checks for documentation traceability and the emergency response organization on call arrangements; and the interface between Operations and Commissioning organizations.

The following provides an overview of the issues which have demonstrated satisfactory progress towards resolution but where some degree of further work is necessary.

- It is recognized that the Integrated Management System, oversight and monitoring, continuous improvement methods such as annual self-assessment, and management engagement have been improved since the Pre-OSART mission. However, while progress has been made, some key actions need to be completed to fully address causal factors and ensure effectiveness and long-term sustainability of the plant Corrective Action Programme.
- The plant action plan consists of continuing the implementation of the compliance activities related to new regulatory requirements for liquid effluents and gaseous effluents. The plant, with the support from the corporate organization, will complete the analyses and commissioning activities for the gaseous effluent monitoring plant before fuel loading that was planned in Q4 2022.
- The resolution of the provision of further guidance on the interaction criteria with unaffected units and prioritization of resources in the case of a multi-unit event. The use of PSA level 2 for assessing external hazards to challenge multiple units simultaneously depends on the resolution of issues related to accident management (AM10.5(1)) that are foreseen to take place during 2022. The plant and corporate organization have stated their intention to investigate further organizational and operational improvements that would enhance the Severe Accident Management (SAM) programme and consider multiple units facing progress towards core melt conditions simultaneously.
- The 2020 and 2021 annual review of the fire risk process identified the fire load KPI indicator as being red for both years. The plant had completed the analysis of the permissible combustible storage limits for each building and was preparing the documentation to reduce the fire loads to within these limits. It was expected that the new building fire load arrangements would be in place by first quarter in 2022.
- The plant had not completed an analysis to determine which of the pending 37,000 activities (modifications, deviations, reservations, and work order requests) had the potential to impact fuel loading and therefore had to be resolved before fuel loading could commence. Furthermore, there was no integrated resource loaded schedule showing when and how the analysis was expected to be completed.

- While progress has been made in the area of plant Knowledge Management practices the plant needed to complete some activities to fully address causal factors and ensure effectiveness and sustainability.

In 2019, the original Pre-OSART team developed six recommendations and 15 suggestions to further improve operational safety of the plant. At the time of the follow-up mission, some 29 months after the OSART mission, 67% of issues had been resolved, and 33% had made satisfactory progress. No issue was assessed as having made insufficient progress to date.

The team received full cooperation from the Flamanville NPP management and staff and was impressed with the actions taken to analyse and resolve the findings of the original mission. The willingness and motivation of plant management to use benchmarking with other nuclear power plants, consider new ideas and look for improvement was evident and was a clear indicator of the plant's strong safety commitment. The team was able to verify all information considered relevant to its review. In addition, the plant staff demonstrated openness and transparency during discussions and sustainable positive results were obtained in many areas. This open discussion made a significant contribution to the success of the review and the quality of the report.

# 1. LEADERSHIP AND MANAGEMENT FOR SAFETY

## 1.1. LEADERSHIP FOR SAFETY

The plant management team has strong alignment and works together effectively. Initiatives were undertaken to increase management coaching skills and competencies for performing effective field observations. These efforts were recognized as an area of good performance.

The DPN (Operating Organization) has created a project for Safety Leadership that is designed to gradually increase the responsibility of the operating organization during the commissioning process. The team noted that in areas that have been handed over to DPN, standards and material condition is improved. The team encouraged DPN to consider how they can extend this effort to other areas under construction.

A review of events, near-misses, and field observations of workplace conditions identified that standards are not consistently met in some areas that could affect plant and personnel safety. These include industrial safety; fire protection; Exclusion of Foreign Material; and scaffolding. Additional effort is required to establish accountability and commitment by the workforce to meet established standards. The team made a recommendation in this area.

Nuclear safety is reinforced by senior management through multiple communication methods such as the daily operational focus meeting; weekly safety messages; monthly safety reports; a set of safety questions provided to all workers each month which is used for self-reflection; and an annual safety day for which no work is planned, and activities are conducted which focus the plant staff on safety. The team recognized this as a good performance.

## 1.4. DOCUMENT AND RECORDS MANAGEMENT

A comprehensive document management system called 'DOCUMENTUM' is used at the plant. While provisions for the periodic review of procedures maintained in the system is established, detailed guidance on how to conduct periodic reviews has not been created to ensure that the reviews are comprehensive. The team encouraged the plant to consider developing criteria that would be used for those procedures which require periodic review to ensure the technical accuracy and usability of the procedure; that writing standards are met, and that internal and external operating experience is reflected in the procedure.

## DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY FINDINGS

### 1.1 LEADERSHIP FOR SAFETY

**1.1(1) Issue:** Management expectations have not been effectively reinforced to ensure staff members consistently adhere to established standards in some areas important to plant and personnel safety.

The team noted the following:

Industrial Safety

- Performance during the construction phase has been cyclic. The Industrial Safety Accident Rate (ISAR) indicator for the plant did not meet the targets for 2018. The 2018 Industrial Safety Accident Rate (ISAR) target for DPN (Operating Organization) was 1.6, the actual was 5.7. The 2018 ISAR target for the entire plant (operating plus construction organizations) was 3.0, the actual was 6.4.
- Shortcomings in safety have contributed to several Events and Near Misses over the last two years:
  - Exposure and ingestion of oil;
  - Sealing of cable penetrations for incoming feeders of batteries on 3LAV and 3LAB switchboards performed in energized conditions;
  - Installation of scaffolding in 3SEF3250DG with trash rake energized in AUTO ready to start;
  - Energization of a non-transferred electrical penetration in the containment leak off monitoring system (3EPP-6149TWO);
  - Energization of a motor in the chilled water system (DER) during an insulation measurement.
- Two fatalities occurred during construction in 2011 and improvements in safety were realized over the following 4 years. However, it was noted that the accident rate in the AFA (Construction) Organization has trended up over the last three years. An initiative has been undertaken to align the DPN and AFA organizations on common approaches to industrial safety which are beneficial. However, challenges remain with effective coaching and oversight of contractor work in the field.
- Observations during the OSART identified several examples of workers not complying with established standards and expectations for industrial safety including inadequate safety precautions in the field and workers not correcting workplace hazards until identified by management.
- In 2018, DPN experienced 17 near-miss events with a goal of 12.

Foreign Material Exclusion

- FME standards at the plant are not consistently met. Observations during the OSART identified several examples of non-adherence to FME requirements:

  - Non-compliant plastic cable ties were used on cables around and above the spent fuel pool FME risk area and used on fuel handling bridge crane.
  - Access to the polar crane (which can travel above the reactor pool) is not secured and not posted as an FME Controlled area.
  - Scaffolding installed above FME controlled areas was not identified as an FME area even though items could fall from the elevated scaffold area into the FME controlled area.
  - Piping staged for installation in the plant did not consistently have FME covers installed. For example, 50 small bore pipes and tubes stored in the turbine operating floor storage area - FME covers are installed on some but not others.
  - Contrary to plant requirements, barriers for FME controlled areas are sometimes installed using general work area chains (red and white) or hazard chains ((black and yellow) rather than the required FME area chains (pink).

Fire Protection Programme

- Compliance with Fire Protection Programme requirements are not consistently met. During field observations the following examples were noted:
  - A fire door accessing the turbine building was blocked open, two fire doors in the staircase to the turbine operating floor were found left open.
  - A fire door next to Unit 3 I&C maintenance room was wedged open with a ventilation duct with no sign that the opening had been reviewed and approved. The plant expectation is to have an approval notice posted when fire doors have to be left open.
  - Some staff traveling through fire doors do not routinely verify that the door is firmly closed after passing through it.
  - Combustible loads were found stored in several areas without available fire protection (extinguishers, sprinklers, etc.).

Scaffolding

- Standards for the installation and use of scaffolding are not being consistently met, for example:
  - An operator was observed climbing scaffolding marked as not ready for use while hanging tags to support scheduled work activities.
  - In several cases, temporary scaffolds are in direct contact with plant equipment including safety related equipment.
  - Portable scaffolding was stored next to a SEC pipe (a safety related system) with its wheels unlocked.

Contributing to the challenges in compliance with standards and expectations are the large number of contractor workers (3000-4000 at different phases) with varying degrees of experience; differences in culture between AFA and DPN organizations; differences in how standards were implemented between DPN and AFA organizations; the large number of EDF employees that are new to nuclear (36%); shortcomings in effective oversight of workers by team leaders and supervisors; and limited peer-to-peer enforcement of standards by workers in the field.

If the plant staff does not strictly adhere to standards and expectations for key programmes such as industrial safety, FME control, Fire Protection, and scaffold control there is an increased risk to both plant and personnel safety.

**Recommendation:** The plant should reinforce management expectations and implement actions to ensure adherence to standards in those areas important to plant and personnel safety.

**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 license 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.

NS-G-2.4

3.6. The operating organization should establish high performance standards for all activities relating to safe operation of a plant and should effectively communicate these standards throughout the organization. All levels of management should promote and require consistent adherence to these high standards. Management of the operating organization should foster a working environment that encourages the achievement of high standards in safe operation of the plant.

6.61. 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. Human factors which influence the working environment and the effectiveness and fitness of personnel for duty should be identified and addressed. The operating organization should establish an appropriate programme for these purposes. Examples of areas or activities to be reflected in this programme should include, but are not limited to, the following:

- adequacy of the resources, support and supervision provided to manage and perform the work;
- adequacy of lighting, access and operator aids;
- adequacy of alarms, considering factors such as their number, position, grouping, colour coding and prioritizing for audibility;
- frequency and clarity of communications;
- availability of suitable tools and equipment;
- duration of work time for personnel;
- 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; and
- 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.

**Plant Response/Action:**

In late 2019 and early 2020, the site first identified its major weaknesses (causes) that had led to this IAEA recommendation:

**Causes:**

- Two separate entities DPN and Commissioning Department (DP): DPN and DP entities were overseen independently and sometimes in opposition (standards and expectations, reference systems, support and control methods, IT tools for scheduling and managing activities).
- Staff awareness of standards and expectations: depending on their position in the organization, staff were not sufficiently aware of standards.
- Management alignment: management was not sufficiently aligned and involved in the field to support and control actual compliance with standards and expectations in the field.
- Efficient supervision and oversight: managers did not all have full control of standards and expectations to be applied and were not all comfortable as to how to behave in the field (how to detect, behave and feedback to workers). Presence in the field was insufficiently focused on standards and expectations, and consequently were not consistently reviewed.
- Contractor involvement: contractors were not fully involved in improvement initiatives and deployment of standards and expectations.

- Coaching newcomers: personnel new to the nuclear field represented a significant proportion of the workforce and were not sufficiently coached to rapidly acquire knowledge, safety culture and behavioural standards expected in the nuclear sector.

**Actions taken:**

Cause #1: Two separate entities (DPN and DP):

- Merger of both entities DP (operating) and DPN (construction) into one in early 2020: This resulted in the OneFLA3 organization where resources were polled and a common functional organization established.
- Establishment of a common strategic management system with shared priorities in all areas (Quality-Nuclear, Industrial, Radiological and, Fire Safety, FME, Waste, Logistics, Technical. The main focus of this system was the preservation of equipment, commissioning of ESP systems and environment protection). Example: One single yearly safety/environmental programme (OneFla3 Safety and Environmental Management Plan).
- The site is drawing up a single business plan for 2021, OneFLA3, which applies across the site and incorporates operational challenges.
- Common steering and oversight entities.
- Improved coordination of the OneFLA3 project and control of what remains to be done before start-up which aims to improve the quality of activities and the control of safety issues.

Cause #2: Staff awareness of standards and expectations:

- Implementation of operations standards and reference basis (cross-functional fundamentals) according to transfer progress of systems and facilities. For this purpose, the plant was divided into "bubbles" and for each bubble, the applicable reference standards were defined.
- Within the "transferred plant" bubbles with equipment required as part of partial Technical Specifications (due to the presence of fuel on site), the number of applicable reference documents is the highest.
- Every weekend, a "cross-functional fundamental" (Safety, Quality, Industrial Safety, Environment) is communicated to all personnel (EDF and contractors) via the "All together for FLA3" initiative.
- A safety culture survey is sent to all employees every month and the INSO Weekly Safety Report promotes application of safety standards
- More specifically, a joint Safety and Environmental Management Plan between DP and DPN provides for gradual transition to operations standards.
- Self-assessment of life-saving risks: each life-saving risk (work at height, electrical, lifting, asphyxiation, X-ray surveys) is specifically reviewed, with self-assessment and definition of follow-up actions.
- Reinforced monitoring of fire zoning arrangements (monitored by operations) and fire detection (communicated daily by the shift manager during operational focus meeting)
- A communication plan has been developed to deploy all reference standards and a quality assurance team has been set up on site to support these changes.

Cause #3: Management Alignment:

- Management Team Meetings and all oversight entities bring together DP and DPN: results are shared and messages are now consistent and consistently communicated across the site.
- Every Wednesday, the Dedicated Field Team (EDT) evaluates compliance with a cross-functional fundamental (+ housekeeping + industrial safety). The EDT is made up of at least all 3 management levels, plus an expert of the observed fundamental and housekeeping champion.
- Every Monday morning (conference call), the "fundamental" of the week is commented on to the entire site during the "¼ hour OneFLA3" including observations made by EDT
- Every Monday afternoon, a summary report of the previous week's EDT observations is discussed at the OneFLA3 management meeting (Senior Management and Line Managers).
- Daily "Operational Focus" meeting strengthened as part of joint oversight by both DPN and DP, with enhanced leadership by shift manager.

Cause #4: Effective supervision and oversight:

- Field presence was reinforced in 2021 (EDT, management in the field programme within each craft department, OneFLA3 field presence, field presence for transferred plant, walk-down between the FLA3 Project Director and contracting firms with poor industrial safety records)
- At the end of November 2021, the number of captured/documented field walk-downs was over 1700.
- Site management was provided with specific coaching by WANO in 2021 on management behaviour in the field (70 individuals coached).
- The site also implemented another coaching session for managers in order to enhance their industrial safety awareness. The manufacturer/operator management line was invited to this coaching, which was carried out by an external preventionist, with a pair of managers.
- Implementation of Behaviour for industrial safety/environment walkdowns: tours carried out in pairs, EDF jointly with contractors, focused on shared vigilance and coach-the-coach. As part of this initiative, all levels of EDF or contracting firms participate, manager, front-line supervisor and senior foreman, worker level. This is an active network, with about 400 walkdowns per year by managers and engineers.
- Implementation of common tools for reporting hazardous situations (Cameleon database), and enhanced processing of condition reports.
- Industrial safety sensor: Implementation of methods to measure compliance rate: quarterly measurement by Neodyme based on a list of observables specified by EDF, with results for each project bubble.
- Safety culture audit: Neodyme evaluated robustness of safety culture on site (one-shot action).

Cause #5: Provider involvement:

- Senior management carries out more than 30 joint field walkdowns per year with the management of major contracting firms.
- Contractor Oversight Supervisors are provided with specific initial training (corporately driven) and periodic refresher training.
- The process for Contractor Oversight and Supervision is reviewed monthly in each relevant craft department (exchange of best practices, challenges as to behaviours to adopt, etc.)
- Specific industrial safety talks are organized with contracting firms on topics relevant to them: for example, "scaffolders' safety talk", to deal with falling objects and handling of scaffolding tools, a charter has been drawn up with the site's scaffolding contract firms to improve practices. Another example, with scaffolders again, an audit was launched in 2020 on regulatory compliance of scaffolding. The results were then shared in a dedicated meeting with each scaffolding contract firm in order to share information on standards and deviations detected.
- Industrial Safety Club: bi-monthly meeting, led by EDF, with all front-line supervisors in EDF contracting firms. This club enables the plant to jointly develop on proposals for changes in the areas of safety and the environment.

Cause #6 – Coaching of newcomers:

- Each newcomer attends the AK training course (Craft Academy Training for Nuclear Common Knowledge: 3 months), then continues his or her training in a "job-specific academy course".
- For each newcomer, a mentor is appointed and assigned (and receives an incentive for this duty).
- Training plans include immersions in existing plants on the fleet.
- Newcomers are trained on mock-ups (I&C stations, mock-up facilities on the new site training campus, etc.)
- Induction training is mandatory for new contractors (PP58).
- Specific EPR awareness training is provided to all new contractors. The certificate for this training is checked during the "Hold-point removal meeting" before being allowed to work on site for the first time.
- Each newcomer has to take an FME knowledge quiz (certificate visible with a magenta sticker on the badge - test valid for 3 years).

Results obtained:

Industrial Safety Results:

- Decrease in the number of work-related accidents: LTAs for 2019 = 6.6, LTAs 2020 = 5.5, LTAs 2021 = 4.2
- Increased capturing of low-level events (hazardous situations): 2019 = 175, 2021 = 526

FME Results:

- Increased capturing of low-level events (FME): 2019 = 20; 2020 = 36; Nov 2021 = 35
- No safety significant reportable event due to FME in 2021

Fire Safety Results:

- Number of fire outbreaks in 2019 =1; 2020 = 0; 2021 = 0 (0 minor, major or notable fires)

Scaffolding Results:

- A scaffolding audit was conducted in 2020, showing a high number of deviations (minor and a few major deviations). As a result, site management met with each scaffolding firms. Effectiveness review was performed in September 2021, with Marc SA, Nuvia, Orano DS, and KW (documented in Cameleon action A0000175267), in 2021, no deviations were detected on scaffolds.

Results of external safety audits:

- There has been a visible improvement in the safety clock over time (increasing number of crafts are moving from satisfactory to excellent). Safety culture level considered as good, with improved shared vigilance (coach the coach).

Response time for hazardous situations:

- Currently 94% are responded to in less than 48 hours, while in 2019 the average response time was 17 days.

Partial plant commissioning, under the responsibility of operations:

- Successful management of fuel delivery with a proactive process for dealing with hold points (COMSAD process, similar to what would be done during an outage once the unit has been commissioned)
- Application of partial technical specifications on the scope related to fuel after a preliminary rehearsal.

Successful completion of main steam valve welds to a high-quality level (critical path for the site).

Approach to sustainable results:

Sustainability of actions and results is now controlled by the IMS (Integrated Management System).

Each process is managed at site level (DP and DPN) and reviewed every year. Improvement actions are included in the Annual business plan for the following year.

Discussions and actions undertaken in response to the IAEA's recommendations have also led the site to apply this approach to all key areas with operator responsibility (not just for FME, Fire and Industrial Safety areas). The targets to be achieved by the '*Future Responsible Operator'* process are clearly visible and the trajectories towards these targets are controlled in a tighter and more visible way:

Work on preparation for operation during refueling-and-connection-to-the-grid phase and sustainable operations:

- Description of reference status to be achieved at the time of fuel loading (formalized in common decision DC401) and multi-year vision (schedule of activities for first operating cycle and the first outage, industrial policy, etc.)
- Work on site organization after refueling (examples: support services, Fix-it-Now team, tagout activities).

Revived and enhanced FLA3 process for connection to the rest of the fleet:

- Committee including all corporate entities, site, chaired by the Corporate Operations Director for the EDF nuclear fleet
- Enhanced support to Flamanville 3 provided by EDF corporate engineering centers.

**IAEA comments:**

At the time of the initial Pre-OSART mission the DPN (Operating organization) and DP-FLA3 (Construction Organization) were operating as two separate entities governed by different processes, standards, and expectations. This contributed to a work environment in which the two organizations were not aligned and did not have a shared vision for reaching the desired end-state. The main gaps identified as examples in the issue have been resolved. In addition, the plant analyzed the organizational weaknesses that were drivers for the examples and ensured that they were addressed in the action plan.

The Pre-OSART Follow-up Team determined that the causes have been clearly identified by the plant and that the associated action plan fully addresses the necessary actions to address the causes of the issue and ensure long-term sustainability. Among the key actions were:

- The DP (Construction) and DPN (Operating Organization) were merged into one organization in 2020 which led to the establishment of a common integrated management system. This facilitated a common set of standards for how work would be performed, allowed the sharing of resources, led to a common business plan, and the establishment of common oversight and monitoring functions. The outcome was improved coordination of the FLA3 project, consistency in how work would be performed, and alignment on actions that are needed to support plant commissioning and startup.

- Development of a common set of functional area standards and reference basis (cross-functional fundamentals). These standards identified the essential behaviours and work practices necessary to effectively transfer from construction to commissioning and operation phases.

- Alignment of the Management Team to ensure vertical alignment of the organization. Senior leaders developed a comprehensive communication strategy to share results and progress made with the plant staff. To ensure alignment on priorities, a daily Operational Focus Meeting is conducted. To ensure that the desired results are being obtained, a Dedicated Field Team (EDT) comprised of managers from multiple layers of the organization perform weekly field observations to assess compliance with established standards and expectations. Insights from these management activities are shared with the organization to ensure that there is a common understanding of priorities, performance, and a common vision for the future.

– Strengthening leadership engagement, coaching effectiveness, and reinforcement of standards. This was accomplished by strengthening coaching skills, increasing field presence, expanding contractor oversight, and effective use of training to improve performance.

As a result of the actions taken, the plant has achieved noteworthy improvement in the areas of industrial safety, FME control, scaffold control, fire protection, and plant housekeeping. In addition, the plant has established effective continuous improvement programmes such as management observation, self-assessment and audits, and operating experience. Collectively these are working to identify and correct low level issues and prevent significant events.

**Conclusion:** Issue resolved

# 2. TRAINING AND QUALIFICATION

## 2.2. QUALIFICATION AND TRAINING OF PERSONNEL

Some elements of the Systematic Approach to Training (SAT) are not sufficiently implemented to ensure that all safety-related aspects are considered in training. SAT implementation was not yet complete; some important procedures for managing SAT phases were not in place. There were cases of improper identification of training needs; for example, no training on temporary modifications was provided. For many job positions, changes in competences were not tracked to ensure that no safety-related knowledge, skills and attitudes were missed. The team made a suggestion in this area.

Several aspects of the plant training process are not sufficiently robust to ensure the quality of the training programme. Across all key performance indicators (KPIs), there was no effectiveness indicator on how training affects plant performance, such as the number of events due a lack of training. Some of the key performance indicators do not provide motivation to improve the effectiveness of training. In many cases, there were no analyses made on overdue or missed attendance targets. The plant self-assessment in training did not include corrective actions as well as target dates to perform those actions. The team made a suggestion in this area.

The plant has implemented a control system mock-up simulator facility replicating the standard I&C, turbine and generator control systems for training purposes. This facility is used for training of I&C and electrical maintenance staff. In addition, the facility enabled development and testing of control system changes before implementing those changes on the plant. The use of the facility has increased the quality of maintenance of equipment at the commissioning stage. The team recognized this as a good performance.

FLA3 operators have developed a 'Post Fukushima box' filled with tools enabling them to place a fuel element in a safe position in case of plant blackout in the fuel building. They include portable lights with batteries charged, phone, portable tools, breathing air sets with air bottles filled. The use of these tools in adverse conditions is described in a procedure provided in the box. The box will be located nearby the pool, close to the spent fuel machine. All necessary equipment to operate fuel during blackout is maintained in good operational condition available and ready for use and monitored under the surveillance programme. The team recognized this as a good practice.

## DETAILED TRAINING AND QUALIFICATION FINDINGS

### 2.2. QUALIFICATION AND TRAINING OF PERSONNEL

**2.2(a) Good practice**: Use of post-Fukushima Box for fuel handling in adverse conditions

FLA3 operators have developed a ‘Post Fukushima box’ (fig.1) filled with tools enabling them to place a fuel element in a safe position in case of plant blackout in the fuel building.

They include portable lights with batteries charged, phone, portable tools, breathing air sets with air bottles filled. The use of these tools in adverse conditions is described in a procedure provided in the box with the main steps:

- Deploy equipment of the ‘post Fukushima box’ in the dark;
- Use the spent fuel machine manually with specific marks (X, Y et Z) around the pools or cavities;
- Secure the fuel in safe position manually.

The box will be located nearby the pool, close to the spent fuel machine. All necessary equipment to operate fuel during blackout is maintained in good operational condition available and ready for use and monitored under the surveillance programme. A comprehensive approach has been developed to use the box and relevant training has been given to the relevant staff.

Benefits:

Enhanced readiness of teams in charge of fuel operations to deal with adverse situations.

Results:

The box enables staff to find and use easily all equipment needed to place fuel in a safe position in case of a blackout.

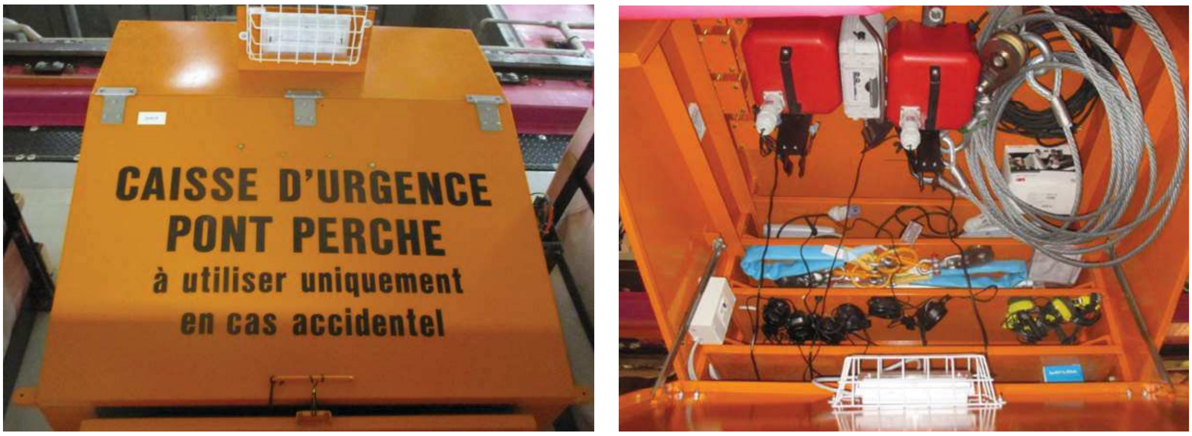



Fig.1 Post-Fukushima blackout box

**2.2(1) Issue:** Some elements of the plant's Systematic Approach to Training (SAT) are not sufficiently implemented to ensure that all safety-related aspects are considered in training.

The team noted the following:

In terms of SAT methodology:

- The plant follows Corporate procedures on SAT, however, those procedures were not sufficiently detailed at the plant level to define staff responsibilities.
- The plant procedure did not require the plant departments' agreement on the safety-related technical content of training materials.

In terms of needs and job analysis:

- Some important procedures for managing SAT phases, such as changing the relevant safety-related training objectives when a relevant job was changed, were not in place.
- The plant has only analyzed 35 out of 79 job positions according to the SAT methodology. In 2019, 10 more job positions are expected to be analyzed, and the other 34 job positions will be analyzed after 2019. Non-SAT-based training programmes were still being used for training.
- The Steam Generator Tube Rupture (SGTR) simulator exercise guide (pedagogical dossier) for MCR staff initial training did not include references to the competences to be taught during the session to ensure that all safety-related knowledge and skills were addressed.
- 'Managing different types of plant waste' classroom training (ref. UFPI/OP2/ERQ/15-00457 and UFPI/OP3/ERQ/15-00458) included specific knowledge to be taught. However, there were no links to the job competences and there was no evidence that all safety-related knowledge and skills belonging to the job position were in line with SAT analysis results.
- Not all permanent safety-related modifications were the subject of training. Approximately 6,000 modifications have been implemented since 2019, including some on safety system equipment. However, the plant believed that 95% of those did not require changes to training materials, since the training objectives were at a generic level. Therefore, for most of modifications training was not developed. In addition, there was no procedure on how to integrate, develop and conduct training on modifications.

In terms of design and development of training programmes:

- There were no plant expectations on how to develop and conduct focused and just-in-time (JIT) training for safety-related tasks.
- The plant develops JIT training sessions in response to department manager requests. To meet needs, the plant has adapted the available programmes for job positions. However, when the training programmes were adapted, a portion of the training was developed on the basis of developer judgement, and SAT was not used in terms of the competences needed for the job. No procedure was available regarding the criteria for waiving portions of the safety-related training.
- The JIT training guide for safety engineers was developed by the department staff. The purpose of this training guide was to refresh the knowledge and skills of safety engineers

on the Full-Scope Simulator to control the plant status. Training personnel did not participate to provide overall ownership of these training materials. This guide was not included in the database as an official training guide.

- There was no procedure on how to incorporate document changes and plant modifications on systems important to safety into training.
- Records were not in place for examination test development for Reactor Operator and Unit Shift Supervisor, confirming that test items were linked to required competences.
- The VISION software to support SAT-compliant development of the training did not track changes needed in training materials in the event of new or revised safety-related knowledge or skills.
- JIT training on how to operate low voltage and high voltage equipment was not developed according to the SAT. It included PowerPoint slides only, with no lesson plan. Most of the training objectives defined for the classroom session were skills based and could not be achieved in the classroom. The content of the classroom session had 136 slides with only one training objective. No summary was provided to emphasize safety aspects of the work.

Without comprehensive implementation of the Systematic Approach to Training, there is a risk that not all safety-related aspects will be properly considered in training.

**Suggestion:** The plant should consider improving the implementation of the Systematic Approach to Training to ensure that all safety-related aspects are considered in training.

**IAEA Bases:**

SSR-2/2 (Rev.1)

4.16. The operating organization shall clearly define the requirements for qualification and competence to ensure that personnel performing safety related functions are capable of safely performing their duties.

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.

NS-G-2.8

4.13 A systematic approach to training should be used for the training of plant personnel. The systematic approach provides a logical progression, from identification of the competences required for performing a job, to the development and implementation of training towards achieving these competences, and to the subsequent evaluation of this training. The use of a systematic approach to training offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control, leading to greater reliability of training results and enhanced safety and efficiency of the plant.

**Plant Response/Action:**

The deployment of SAT on site continues following the Pre-OSART, in accordance with the national framework and incorporating the IAEA suggestion.

SAT analysis:

As of 31/05/2021, the plant analyzed 52 job positions out of a total of 57. The site aims to deploy the remaining 5 job positions by the end of 2021, including those seen as optional.

These job positions are divided into 3 priorities:

- Priority 1 job positions: there are 20 of them and they are a must. They have a direct link with the control of Quality Maintenance in Operations. They have been fully deployed.
- Priority 2 job positions: There are 30 of them and they cover various themes. There are still 3 to be deployed: valve engineer, lifting advisor, and zone manager.
- Priority 3 job positions: There are 7 of them. There are still 2 to be deployed: documentation technician and documentation coordinator.

For the local part, the layout of the training manuals takes SAT into account in the definition of needs, which allows alignment of local training to the job positions.

In addition to this deployment, the following improvements have been made:

Organization of modifications:

Each modification is subject to an accurate analysis of its impact on operating and maintenance practices that would require training. This analysis is shared periodically (every 3 months) between the Local Modification Engineer and the Operational Skills Leader.

This sharing leads to identification of whether there is a need for training development associated with the modification. Needs for changes to the simulator are also identified and taken into account in changes of simulator version.

Just in Time:

All training must follow the SAT process, with the support of the method support function [APM] and is subject to simplified training specifications (CCF). The CCF take SAT synchronization into account in these training courses in connection with the knowledge and expertise associated with the duly defined managerial job positions. Synchronization takes place for training courses that are required to be completed at least twice.

**IAEA comments:**

The plant analyzed the problematic area related to the application of Systematic Approach to Training (SAT) identified during the Pre-OSART mission and developed an action plan considering the national framework and issues specified by the OSART team.

The action plan involved the modification of the training packages for specific job positions to identify those activities which should be analyzed using the SAT process. The job training packages were analyzed in a priority order and all the highest priority analyses had been completed. The remaining 5 job positions were expected to be completed by the end of 2021. As a result, the training packages were more effective as they more clearly identified the technical knowledge and skills required to carry out activities which could have an impact on the safety of the plant.

Accordingly, the plant had modified the process associated with personnel training and procedures to ensure sustainability of the training practices and to ensure that personnel were trained and capable of safely performing their duties.

As a result, the plant had completed all of the work on the training packages for all the 57 job positions using SAT approach and was using the modified documents during the training process. There was high confidence that the remaining work would be finished before the end of 2021.

All the plant modifications requiring additional training in operating and maintenance practices were regularly evaluated by the training department and just in time training provided following the SAT process. Regular meetings took place between the Local Modification Engineer and the Operational Skills Leaders to share the findings from the training evaluations arising from plant modifications.

**Conclusion:** Issue resolved

**2.2(2) Issue:** Several aspects of the plant training process are not sufficiently robust to ensure the quality of the training programme.

The team noted the following:

In terms of training performance evaluation:

- The KPIs and trends used for evaluating Training Centre (TC) performance focus on numbers, rather than training effectiveness. The plant followed General Safety Policy (memo D4008/10.11.18/05.21, Period 2020-2022). Annually the plant receives the corporate target in training man-hours to be performed. The target for 2018 was about 56,000 man-hours; the target for 2019 is about 54,000 man-hours. According to plant indicator SP7.1-05, the target for a given year cannot be changed by more than 2% from the target for the previous year. This does not provide motivation to improve the effectiveness of training, which could result in a large change in the target.
- There were 21 KPIs assigned to the TC by plant management, 17 KPIs assigned to the TC by Corporate, and 4 KPIs arising from the Integrated Management System. No integrated impact evaluation report was done. There was no training effectiveness performance indicator across all 42 KPIs, such as a number of events due a lack of training. Even though the plant is not yet in power operation there were numerous events related to human factors; however, since these events are not tracked by the TC, training effectiveness could not be evaluated.
- The plant conducted a self-assessment (SA) in training. However, no corrective actions were developed in the 2018 SA report, and no target dates to perform corrective actions were put in place. In addition, it was not clear how the SA results and the TC plans avoided contradiction with the actions of other departments, and what were the provisions to support a corrective plan in terms of resources.

In terms of training tools:

- Procedures for configuration control of training tools (such as the Full-Scope Simulators FLA-A, FLA-B, FLA-C) to control and validate that all elements of the training setting met the training requirements were not in place. This included, in particular, the Full Scope Simulator, corresponding training materials, instructor readiness, and plant procedures for MCR crew training, as well as the mock-up facility for maintenance training) No reports were prepared on validation of training tools, and whether they were approved for training.
- Each of the three FSS did not include 20 systems that will be operated from the MCR.
- The plant planned to use the Local Control Center (LCC) for local operation of support systems by field operators. However, the LCC is not commissioned yet and at the time of the OSART mission the LCC simulator had not been commissioned for training purposes. A significant number of those systems, such as DWN (Nuclear Auxiliary Building Ventilation System), TEG (Gaseous Waste Processing System), TEP (Coolant Storage and Treatment System) and others, were required to be operable from the LCC before fuel loading.
- The maintenance workshop, located in building HB0, was used for maintenance training. It included mock-ups of plant mechanical and electrical equipment. However, this temporarily located facility had deviations in the training setting:

  - 3 mechanical mock-ups did not have FME caps;
  - no training materials were used during the training session, only plant procedures;
  - a metal ladder was installed 20 cm from an electrical cabinet, with the risk of it falling on the cabinet;
  - housekeeping issues posed risks of injury to trainees.

In terms of conduct of training:

- The training videos on industrial safety for FLA3 observed by the team contained numerous deviations from the FLA3 plant expectations, such as:
  - not using helmet chin straps;
  - persons in work areas without helmets;
  - persons standing under a heavy load during lifting;
  - graffiti on equipment was not removed;
  - when called on the telephone, the person did not write down the information received;
  - in many cases, work overalls were damaged or not buttoned;
  - in many cases, transportation zones were not established;
  - staff did not use pedestrian crossings;
  - some scaffolding did not have flanges;
  - lifting in the fire risk zone;
  - in some cases, work areas did not have barriers.

The Training Centre did not review the training content before using it in training for plant personnel.

- During the observation of classroom training on Liquid Waste Treatment, the instructor did not conclude the lesson by emphasizing safety-related issues. Training materials, namely the specification and training file (dossier pedagogue) were not followed.

Without a robust training process, quality of the training programme could be compromised.

**Suggestion:** The plant should consider improving the training process to ensure the quality of the training programme.

**IAEA Bases:**

NS-G-2.8

4.1. The operating organization is responsible for training its own staff and ensuring that contractors’ staff are suitably trained and experienced so that all work is carried out safely.

4.5. The training needs for duties important to safety should be considered a priority, and relevant plant procedures, references, resources, tools, equipment and standards should be used in the training process to ensure, as far as practicable, that errors, omissions and poor practices are not accepted. For these critical duties, the training environment should be as realistic as possible, to promote positive carry-over from the training environment to the actual job environment.

4.8. It should be the responsibility of the plant manager, with reference to each position important to safety, to ensure that:

- training needs are continuously analyzed and an overall training programme is developed;
- the training unit is provided with all necessary resources and facilities;
- the performance of all trainees is assessed at various stages of the training;
- the effectiveness of the training is evaluated;

4.15. The following training settings and methods, which are widely used and have proved to be effective in attaining the training objectives when appropriately chosen, should be considered:

(a) The classroom is the most frequently adopted training setting. Classroom training time should be carefully controlled and structured to achieve the training objectives in a timely and efficient manner. Its effectiveness should be enhanced by the use of appropriate training methods such as lectures, discussions, role playing, critiquing and briefing. Training aids and materials such as written materials, transparencies, audio and video-based materials, computer-based systems, plant scale models and part-task simulators should be used to support classroom instruction where necessary.

(b) On the job training should be conducted in accordance with prescribed guidelines provided by incumbent staff who have been trained to deliver this form of training. Progress should be monitored, and assessments should be carried out by an independent assessor.

(c) Initial and continuing simulator-based training for the control room shift team should be conducted on a simulator that represents the control room. The simulator should be equipped with software of sufficient scope to cover normal operation, anticipated operational occurrences and a range of accident conditions. Other personnel may also benefit from simulator-based training.

(d) Training mock-ups and models should be provided for activities that have to be carried out quickly and skillfully and which cannot be practiced with actual equipment. Training mock-ups should be full scale if practicable. Laboratory and workshop training should be provided to ensure safe working practices in those environments.

4.20. The importance of training by means of simulators and computers should be emphasized in order to develop human–machine interface skills.

4.24. In initial and continuing training, trainees should be evaluated by means of written, oral and practical examinations or by discussions of the key knowledge, skills and tasks required for performing their jobs.

4.25. An initial training programme should be established for all plant personnel to achieve the necessary competence to carry out their jobs. Initial training should help personnel to achieve a high level of performance in terms of safety and professionalism, in order to meet the operational standards required to ensure safe operation of the plant.

5.31. Training instructors, on and off the site, should have the appropriate knowledge, skills and attitudes in their assigned areas of responsibility. They should thoroughly understand all aspects of the contents of the training programmes and the relationship between these contents and overall plant operation. This means that they should be technically competent and show credibility with the trainees and other plant personnel. In addition, the instructors should be familiar with the basics of adult learning and a systematic approach to training and should have adequate instructional and assessment skills.

**Plant Response/Action:**

Following the Pre-OSART suggestion, several actions have been carried out:

Self-assessment:

Self-assessment of the skills programme was the subject of an action plan in November 2019 which was completed at the end of 2020. It was on this occasion that the plant decided to use the Caméléon tool to track deviations in the performance of training (absence of an instructor, non-compliance with training specifications, educational objectives not achieved, etc.). In 2021, the plant also re-launched the use of part-time instructors and introduced the sharing of the capacity maintenance performance report with the operations department.

Video training:

The training videos on industrial safety for Flamanville 3 have been replaced by the “PP58” training course. The latter is managed entirely by EDF’s centralized units, which provide e-learning to carry out the training.

Monitoring of training indicators:

With regard to indicators, Training Committee 3 (CF3) is currently the body that monitors the production and performance indicators of the training process. The indicators reported are as follows:

- Rate of Site-Wide Training Committee meetings (CF3): 2019-100%; 2020- 100%; 2021(as of 1st October) - 100%
- Number of hours of just-in-time training: 2019- 2.088 hrs; 2020- 1.946 hrs (Covid effect); 2021(as of 1st October) - 2.074 hrs
- Completion rate of site training plan: 2019- 77%; 2020- 68% (Covid effect); 2021(as of 1st October) - 75%
- Absenteeism and no-show rate: 2019- 3.06%; 2020- 4.1% (Covid effect); 2021(as of 1st October) - 3.5%
- Tracking of qualifications over a 12-month rolling basis, from April to April: 2019 – KPI not tracked in 2019; 2020- 98%; 2021-100%
- Number of overdue training-related improvement actions: 2019;- 15; 2020-13; 2021-3

Progress with the training building:

The campus training building project currently under way on site will allow the site to monitor the use and compliance of our campus teaching tools. In practical terms, this is reflected in the construction of a worksite school incorporating the significant risks encountered on the facility:

FME, chemical risk, asphyxiation risk, risk of falling from height, electrical risk, contamination risk, internal contamination risk, etc.

Authorization of training instructors:

Instructors follow a teacher training programme and are authorized to train and assess after line management has sat in on their training sessions. A certificate of authorization was issued, and each instructor was assessed through line management sitting in on sessions once every two years.
All these actions have been put in place to improve the training process to ensure the quality of the training programme.

**IAEA comments:**

In response to the suggestion made by the Pre-OSART team, the plant developed and implemented an action plan to address deviations and enhance the training process. A self-assessment of the skill programme resulted in a decision to use the 'Camelion' tool to track and trend deviations and deficiencies in the training process and act upon them promptly. As a result, the number of overdue training related improvement actions were reduced from 15 in 2019 to 3 in 2021. In addition, the plant set new actions to address the deficiencies identified such as the use of part-time instructors to reduce the number of training events cancelled due to lack of instructors. During the first 10 months of 2021 the completion rate for the site training plan was almost at the same level as in 2019 and was expected to exceed the 2019 level by the end of the year. (The equivalent 2020 figure was impacted by the Covid pandemic and therefore is not a representative comparison.) In combination with several performance indicators that are under Training Committee 3 scrutiny, the plant showed significant improvement in the training process. For example, the number of hours of just in time training for the first 10 months of 2021 was almost at the same level as in 2019 and was expected to exceed the 2019 value by the end of 2021.

The plant corrected several deficiencies identified by the Pre-OSART team such as:

- the plant Industrial Safety training video, which contained numerous deviations from the plant expectations, was replaced by the corporate e-learning industrial safety training course which provided clearer guidance on the industrial safety expectations at the site.
- the plant training instructors get their adult training in a specialized EDF institution and were required to have regular refresher training.

**Conclusion:** Issue resolved

# 3. OPERATIONS

## 3.1. ORGANIZATION AND FUNCTIONS

The plant has developed and made a simulator available at the staffs' disposal, conveniently located close to the Main Control Room (MCR). As the simulator is on the same level as the MCR, in the administrative part of the building, the operators only have to walk a short distance for access. During periods of steady operation, when the full staff complement is not required in the MCR, some of the operators can take the opportunity to practice in this simulator. The simulator replicates the human-machine interface of the real control room, and the software is a copy of that installed on the full scope simulator. The team recognized this as a good performance.

## 3.4. CONDUCT OF OPERATIONS

The plant has defined clear responsibilities for the operations and commissioning teams to control the status of equipment and areas which are at different levels of readiness for operations. However, the team observed that in some areas, conditions do not fully guarantee that safety of equipment in testing or operation is not placed at risk. Some deviations in material condition or prevention of unauthorized access to a safety related equipment rooms were not identified or reported during field operator's rounds. Some arrangements for clear identification and protection of safety related equipment have not been developed and implemented. The team made a suggestion in this area.

The plant has implemented a project to improve tagging and line-up using mobile devices. The mobility part involves giving all field operators and tagging officers' mobile phones with dedicated applications in order to improve the efficiency of field activities. These applications include Easy Work Request, a tool that can be used to search, create and monitor work requests very easily in real time while in the field. The interface is designed to be simple and intuitive. The user can add images, videos or sound recordings to support the work request. The application reinforces the ownership of work requests by field operators. The team identified this as a good performance.

## DETAILED OPERATIONS FINDINGS

### 3.4. CONDUCT OF OPERATIONS

**3.4(1) Issue:** The plant has not taken necessary actions to maintain the material condition and protection of safety related equipment to ensure equipment availability.

The team noted the following:

- The plant does not have requirements for the clear identification of the status of components in the field on whether they are in construction, commissioning or operation mode.
- The plant has not yet implemented the procedure for identification and physical protection of redundant safety trains unaffected by maintenance or testing.
- The plant has no requirement to keep rooms housing 0.4 kV and 10 kV switchboards for equipment important to safety locked if there are no accessible parts that are energized.

In construction and commissioning teams' responsibility areas:

- There is no requirement to have defect tags in place for the equipment which is in the commissioning phase.
- Safety injection pump 3RIS4420PO (which is in the testing phase) was not labelled. Related equipment for the pump was labelled with temporary handwritten labels.
- A cable was laying on the safety injection pump 3RIS4420PO shaft.
- Cables in reactor building room HK1088 were compressed by erected scaffolding which could cause damage.
- Cables were laying across the rails for the fuel machine in the spent fuel pool room in the reactor building.

In operations department's responsibility areas:

- The plant has not implemented a procedure for managing operator aids.
- Two pumps inside the pumping station were found with oil seeping from the bearings. There were no defect tags in place in either case.
- A small oil leak from the supporting auxiliary feed water pump 3ASG7210POM bearing (safety-related, in commissioning) and minor deviations such as untied cables, open fire door, fire damper cover laid on the cable tray, were not identified by the operator during the plant tour in the pumping station.
- Some breakers of the switchboard transferred to operations were not properly secured with padlocks and padlocks controlled by the commissioning team.
- There was a water puddle about 5cm by 5cm under the Plant Blackout Diesel Generator 3LJP (not identified by a work request).

Without full implementation of necessary actions to maintain the material condition and protection of safety related equipment its availability cannot be ensured.

**Suggestion:** The plant should consider full implementation of necessary actions to maintain the material condition and protection of safety related equipment to ensure equipment availability.

**IAEA Bases:**

SSR-2/2 (Rev.1)

Requirement 23: Non-radiation-related safety

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.

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.

7.6. A clear operating policy shall be maintained to minimize the use of, and reliance on, temporary operator aids. Where appropriate, temporary operator aids shall be made into permanent plant features or shall be incorporated into plant procedures.

Requirement 28: Material conditions and housekeeping

The operating organization shall develop and implement programmes to maintain a high standard of material conditions, housekeeping and cleanliness in all working areas.

7.10. Administrative controls shall be established to ensure that operational premises and equipment are maintained, well-lit and accessible, and that temporary storage is controlled and limited. Equipment that is degraded (owing to leaks, corrosion spots, loose parts or damaged thermal insulation, for example) shall be identified and reported and deficiencies shall be corrected in a timely manner.

7.12. The operating organization shall be responsible for ensuring that the identification and labelling of safety equipment and safety related equipment, rooms, piping and instruments are accurate, legible and well maintained, and that they do not introduce any degradation.

NS-G-2.14

4.35. Personnel assigned the task of carrying out rounds should be made responsible for verifying that operating equipment and standby equipment operate within normal parameters. They should take note of equipment that is deteriorating and of factors affecting environmental conditions, such as water and oil leaks, burned out light bulbs and changes in building temperature or the cleanness of the air. Any problems noted with equipment should be promptly communicated to the control room personnel and corrective action should be initiated.

5.1. A consistent labelling system for the plant should be established, implemented and continuously maintained throughout the lifetime of the plant. It should be ensured that the system is well known by the staff. The system should permit the unambiguous identification of every individual component in the plant.

5.6. Specific measures should be developed and maintained to prevent unauthorized access to systems and equipment important to safety. These measures should include controlled access to certain rooms or compartments and an effective key control system or other measures to prevent an unauthorized change in the position of, or an unauthorized intervention affecting, certain important safety valves, transmitters, breakers or other specified equipment.

6.23. All plant equipment should be made easily accessible to field operators.

6.24. Areas in the plant and systems and their associated components should be clearly and accurately marked, allowing the operator to identify easily the equipment and its status. Examples of such systems are isolations, positions of motor operated and manually operated valves, trains of protection systems and the electrical supply to different systems.

SSG-28

3.44. The following interfaces between commissioning activities and operating activities in particular should be considered:

– Provisions in the specification of the role, functions and delineation of responsibilities of the operating group and the commissioning group before the transfer of structures, systems and components for operation;
– Changes in responsibility for safety, depending on the milestones in commissioning that are considered and the transfers to operation that are performed, including the nomination of responsible persons;
– Conditions for access of personnel, with account taken of the delineation between systems already in operation and systems being tested;
– Control of temporary procedures and equipment that are available during commissioning but not appropriate to normal operation, for example, special start-up instrumentation or duplicate safety keys and authorization for the use of jump and lifted leads;
– The implementation of operating requirements and maintenance requirements for structures, systems and components as each system is transferred to the operating group;

3.46. Procedures for operating and periodic testing should be used in the commissioning stage as far as the conditions at the plant will allow, so as eventually to validate the procedures with success criteria more numerous or more challenging than those to be used during operation. Interorganizational arrangements should be made to schedule this activity so as to ensure that procedures, including operating, maintenance and surveillance procedures, are adequately validated.

3.47. Personnel should adhere to normal operating rules such as those relating to access to the control room, access to control cabinets and switchboards, control of information, communication with the control room about abnormalities and changes to plant configuration.

SSG-38

4.16. The principal activities of the personnel in the construction organization should include the following, as a minimum:

(b) Ensuring that the construction organization and contractors are established on the site in a controlled manner in allocated areas and are provided, where appropriate, with the necessary site services, information and instructions with regard to the applicable nuclear safety and industrial safety requirements;

(d) The preparation of safety related working procedures, including industrial, environmental and safety procedures, for issue to the personnel of the construction organization and contractors, and the verification that the industrial safety arrangements of the construction organization and contractors on the construction site comply with the applicable requirements;

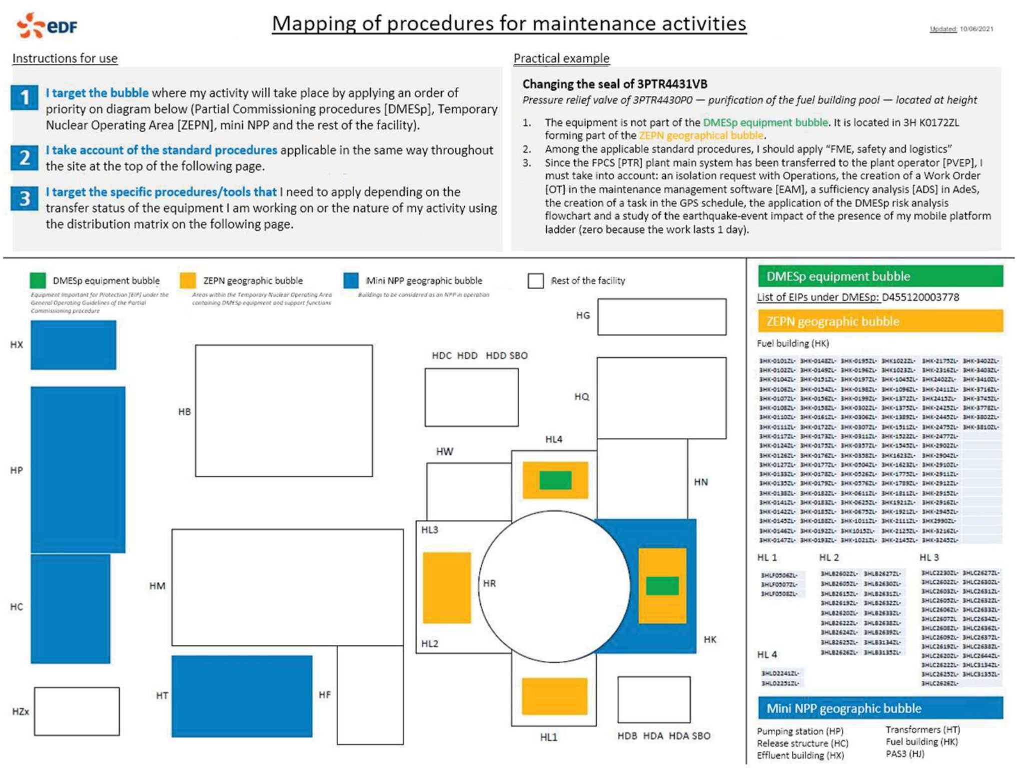
(e) The monitoring of nuclear safety and industrial safety policies and of the activities of all personnel, to ensure compliance with statutory and regulatory requirements with regard to quality and safety;

(h) Ensuring preservation of installed equipment, by carrying out maintenance of the equipment as required, ensuring proper care of equipment that could deteriorate during construction, such as equipment for dehumidification of electrical equipment and preservation of critical surfaces that could rust, and the performance of adequate housekeeping activities to protect open equipment against intrusion of foreign materials and contaminants.

**Plant Response/Action:**

Since the Pre-OSART, the site has been engaged in the establishment of operating procedures, as the transfer of systems and buildings has progressed. For this purpose, the facility has been divided into “bubbles”, the applicable procedures for each bubble have been defined.

Within the “Mini NPP” bubbles and where equipment required by the partial General Operating Guidelines (RGEp - DMESp) is present (link with the presence of fuel on site), the number of applicable procedures is the highest.



For example, in mini NPP bubbles, and where equipment is required by RGEp, the "Sectorization" of fire hazard risk procedure is fully applicable as in operation.

The different operating procedures will therefore be applied progressively on the facility and will be fully deployed at fuel loading.

A communication plan has been drawn up and a quality unit set up on site to support this development.

The operations department is in charge of the monitoring and operation of the systems only after their transfer to the plant operator [PVEP]. Before this transfer, these activities are carried out by the testers. However, specific monitoring may be requested from the operations department by the testers via a temporary operating instruction (CTE).
This transfer to PVEP attests to the system's capacity to function normally and also allows the plant operator to finalize the update of its documentation (design stability). It is at this time that all the local monitoring activities and the monitoring actions from the control room (block rounds and alarm management) are put in place for the equipment concerned.
It is also from PVEP that the management of malfunctions develops each finding or anomaly that gives rise to the generation of a Work Request (DT) for processing, as in operation, for the different site specialists (operator's maintenance teams, assembly and test contractors, civil engineering, etc.).

The setting up of the operational focus every morning also allows the operations shift manager to highlight the priorities for operations and thus guarantee the availability of safety systems (e.g. request for reactive handling of an alarm flickering in the main control room). These priorities also include those on non-transferred systems (joint meeting with all site specialties following the establishment of the OneFLA3 organization). So that an integrated vision of the facility was established. This is a notable development compared with the situation assessed during the Pre-OSART.

These provisions, tested since the completion of the Hot Functional Tests, remain applicable to date with a better level of control of the facility.

To guarantee the effectiveness of the arrangements for monitoring locally and in the control room, the operations department carries out 2 annual in-department reviews and one with site management. These reviews allow for analysis of the correct implementation of our operating fundamentals, including the two basic processes of control room and field monitoring:

The basic process (PE) of monitoring in the control room. This included setting up audible warnings on control room alarms and controlling and limiting the number of temporary operating instructions (CTEs) that were remarked on during the Pre-OSART. The operation of the basic process has improved the quality of the block rounds. Several actions have been taken such as the awareness of the operators regarding the requirement for block rounds, putting a timer (2h) in place, and also defining and setting up a specific block round adapted to the site phase.
The current action plan identifies actions that are still to be deployed and that depend on the progress with transfers and activities on the work site: finalization of validation of alarms in the instrumentation and control (in connection with the activities remaining to be completed

on the site as modifications) or finalization of transfers for temporary operation, such as making the fire supervisor available. These actions will allow the plant to further improve the effectiveness and quality of our monitoring from the control room.

The basic process (PE) of local monitoring. Several improvements have been made since the Pre-OSART. In 2020 and 2021, a field operator was seconded during the day to work specifically on optimizing field inspections and collecting OPEX from shift personnel. This work allowed field inspections to be optimized, both on the route taken and on the required actions and observations (creation of new generic actions, updating of the inspection log to incorporate OPEX). A new version of the field inspection application has also been introduced, moving from paper to smartphone. One area requiring further work is a better link with the engineering department, specifying the requirements to be incorporated into the field inspection. The observational skills of staff members are ensured through the presence of team management in the field, and to date do not show signs of drift. Since the Pre-OSART, the dynamics around the field inspection have been positive due to the state of the facility, which is improving day by day, and the rate of equipment or parts of the facility being transferred to the plant operator, and also through the incorporation of OPEX.

An internal control plan within the operations department confirms the good progress made with these actions and makes it possible to secure the deployment of all our fundamentals on the facility from now until the time of loading and beyond.

**IAEA comments:**

In order to improve the material condition and protection of safety related equipment, the plant analyzed the issue and identified that improvements were needed to the quality of field operator rounds and to the controls on equipment handed over to operations. In order to improve the control on equipment handed over to operations the plant was divided into sectors and in sectors where the plant had been handed over to operations, the operational procedures were applied. At the time of the Pre-OSART Follow-up mission: Pump House (HP), effluent building (HX), transformers (HT) and fuel building (HK) and their associated equipment, were under operations control. Within these sectors, the equipment which was under operations control was also clearly identified.

Field operator rounds were enhanced to ensure that equipment condition, for equipment under operations control, was maintained and the arrangements for the identification and recording of equipment defects improved. For field operator rounds the procedure was revised to clarify what field operators should look for during field rounds and the field operator round routes optimized. A new smartphone device was introduced to allow operators to record defects, and these are then categorized at the work request meeting. In 2021, field operators reported 200% (357 total for 2021) more equipment related work requests than in 2020. However, during a walkdown of the Pump House some minor housekeeping issues were identified and on the fuel pool cooling and purification system pump (3PTR1130PO) there were small deposits of excessive grease drips underneath the pump casing which had not been identified during the recent field operator round. The access arrangements for entering rooms containing equipment important to safety had been enhanced and when entering the room containing the fuel pool cooling and purification system pump (3PTR1130PO), the escort had to obtain the appropriate key and badge-in before access was granted.

The operations department has also set up an internal controls programme (PCI) where themed reviews of specific topics take place six times per year. In 2020 the target number of reviews were carried out and for the first six months of 2021, 100% of the reviews had been completed. Typical themes were main control room monitoring, tagging, housekeeping, and field observations. The findings from the March and September 2021 internal controls review on tagging identified that workers were aware of the important risks related to tagging and the November review reported that workers had a good control of the industrial safety aspects associated with tagging. Furthermore, both reports identified only minor housekeeping deviations.

In addition, the plant now analyses and codes the causes of operations deviations such as tagging, which are entered into the low-level events database (Cameleon). For example, for the period from January 2021 to November 2021, 98 tagging related low-level deviations were recorded, of which 30% were associated with the accuracy of the tagging documentation, 15% with tagging preparations, and 10% with the establishment of the tagging requirements. Corrective actions were set to address these deviations and there have been no significant events associated with tagging in the past 18 months.

The manager-in-the-field programme (VMT) is also used to ensure equipment condition is maintained.

**Conclusion:** Issue resolved

# 4. MAINTENANCE

## 4.5. CONDUCT OF MAINTENANCE

To perform load tests on monorail crane equipment the installation of test loads equivalent to 1.5 times the safe working load (SWL) of the crane is necessary. This type of activity involves many heavy load handlings in buildings and near to, or above, safety related equipment. The test kit makes it possible to perform these load tests without using a load. The required test force is provided by two hydraulic cylinders. The hydraulic system is pressurized using a hand pump, without electrical or air energy source. This test kit is able to perform all load test for monorails up to 2 tons SWL. However, the same kit is also available for testing up to 15 tons SWL. The team considered this as a good performance.

A portable visual acoustic pressure meter with visual display is used in potentially noisy workspaces to measure the current sound-volume and display it visually as a pictogram. If the measured value exceeds 80 dB, the green illuminated display switches to a yellow display. The team considered this as a good performance.

Tie-off points for attaching a safety harness are permanently installed at all potential crash surfaces and floor openings, to secure a harness or fall arrester. They enable workers to perform their job safely when a risk of fall from height is present. When their yearly check is due, and/or the tie-off point is damaged, it is tagged out using a tagging device. The team considered this as a good practice.

## 4.6. MATERIAL CONDITION

There are notable differences regarding the material condition between buildings, systems and components that have been handed over to the plant organization and buildings, systems and components in commissioning or in the test phase. These differences are reflected particularly in precautions against foreign material exclusion. The plant has focused attention on this topic on the spent fuel pool and the reactor cavity, however, the team observed several cases of inappropriate implementation of the FME policy. The Team made a recommendation in this area.

## DETAILED MAINTENANCE FINDINGS

4.5. CONDUCT OF MAINTENANCE

**4.5(a) Good Practice:** Tie-off points for attaching a safety harness are permanently installed at all potential crash surfaces and floor openings, (see figure 1) to secure a harness or fall arrester. They enable workers to perform their job safely when a risk of fall from a height is present. Their maximum rated load capacity is (10kN). These tie-off points are checked once a year to ensure usability. When their yearly check is due, and/or the tie-off point is damaged, it is tagged out using a tagging device. See Figure 2.


Figure 1: Tie-Off Point

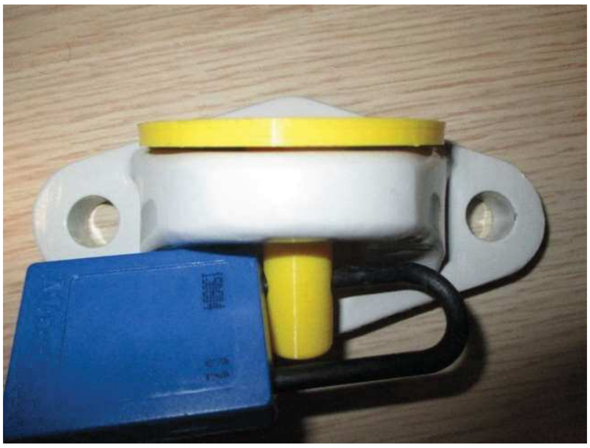


Figure 2: Tagged-out Tie-Off Point

Benefits:

Safe access to locations where there is a risk of fall from a height (floor openings, movable floor gratings, access to cranes and platforms).

Results:

Since the implementation of these tie-off points no event due to fall from a height have been recorded.

## 4.6. MATERIAL CONDITION

**4.6(1) Issue:** The Foreign Material Exclusion (FME) programme is not fully implemented at the plant to ensure that foreign materials are prevented from entering the plant systems and components.

The team noted the following:

- Five breakers for Station Blackout Diesel Generator 3LJP were racked out in two different electrical control rooms. The openings were not covered to protect them from potential foreign material dropping inside.
- Four flexible water hoses, laying on a palette in the nuclear auxiliary building, were observed without FME covers on their ends. Foreign materials could be injected into safety systems.
- Several unused holes were not covered or capped in a reactor building electrical penetration. Foreign materials could migrate inside the penetration and cause electrical damage.
- FME covers in the maintenance workshop were used in different ways. One was used for collecting nuts and bolts, some others for plugging holes.
- FME covers which were not in use were lying around on workbenches and on pallets.
- An FME cover was not properly installed on the top of the concrete mixing equipment in the waste treatment building, because it is not adapted for use on this type of equipment.

Without rigorous implementation of an effective Foreign Material Exclusion programme, when performing activities in the plant, the potential for foreign material intrusion could be significantly increased.

**Recommendation:** The plant should fully implement its FME programme throughout all departments and areas to ensure that foreign materials are prevented from entering the plant 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.

NS-G-2.5

3.9. 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.

3.19. Inspections should neither damage the fuel nor introduce any foreign material into it. Inspectors should identify any foreign material already present in the fuel and should remove it.

4.2. The steps necessary to assemble fresh fuel and to prepare it for use in the reactor should be specified in the procedures, including any arrangements for holding it in intermediate storage. Only approved fuel should be loaded into a reactor core. Checks should be carried out to confirm that the fuel has been assembled correctly. In all procedures for fuel handling and maintenance, it should be ensured as far as possible that no foreign material is introduced into the reactor.

5.19. A policy for the exclusion of foreign materials should be adopted for all storage of irradiated fuel. Procedures should be in place to control the use of certain materials such as transparent sheets, which cannot be seen in water, and loose parts.

6.8. Where appropriate, programmes should be established for the surveillance and maintenance of core components during service. Checks should be made for physical changes such as bowing, swelling, corrosion, wear and creep. These programmes should include examination of components to be returned to the core for further service and examination of discharged components in order to detect significant degradation during service. Maintenance programmes should include procedures to prevent the introduction of foreign materials into the reactor.

**Plant Response/Action:**

Organization:

The implementation of “OneFLA3” since the Pre-OSART has allowed the FME procedure to be fully rolled out and incorporated across the entire site.

In more concrete terms, a Strategic Lead (Director of Operations OneFLA3) has the support of an FME Operational Lead who is in charge of coordinating and managing the FME procedure for the site. The latter leads a network of contacts in each of the project work packages, specialists and departments, to share information on FME. Some examples of the topics covered include:

- Changes in the national EDF procedure and needs expressed by workers
- Sharing good practice observed on the work site, EDF fleet and even internationally
- Taking OPEX into account and adapting it.

This network meets regularly, with four sessions scheduled per year. In addition to these scheduled exchanges, the FME operational lead remains the contact person available at any time to support specialists whenever necessary, which gives rise to numerous daily discussions.

An action plan has been developed and is currently being deployed to move the site towards a high level of FME risk control. This action plan takes up the rules for application of FME and includes in particular the remarks made during the Pre-OSART and various assessments or appraisals, internal to EDF or external such as WANO. It involves all site players, in particular the management, the training department, OPEX management, as well as the various operational departments and service providers.

This action plan is divided into 20 actions, all priority 1, and traced in the Caméléon action monitoring tool. Of these 20 actions, 15 have been deployed and closed. There are still 5 actions to be taken, in particular further contractual integration of the FME risk.

The progress of the action plan is monitored on a monthly basis in the main coordination body (Hebdo-MDL), which brings together the entire management team and the heads of department.

Among the various actions, complementary to the procedures applied in the rest of the fleet, the FLA3 procedure includes the FME risk in electricity. This topic came up during the Pre-OSART. The electrical switchboards equipping our facilities present a risk of introducing foreign bodies. Following an event that took place in September 2019, it was decided take account of electricity in the FME procedure. Protective measures have been specifically developed and a campaign to clean the electrical switchboards has been implemented to certify the absence of any loose parts in the electrical switchboards already installed.


Support for workers:

Several measures were taken following the Pre-OSART to provide support for workers and better take account of the FME risk:

The FME risk has been taken into account by subcontractors' workers. FME risk prevention has been explicitly incorporated into the contractual management of activities. Since 2020, the new operations contracts and project management have included the FME risk and a reminder of the risk is given at "kick-off meetings" between EDF and its' subcontractor. In addition, EDF incorporates the management of FME risk into its monitoring programmes.

FME OPEX has been taken into account during work planning and execution. To facilitate the implementation of FME countermeasures, all FLA3 FME events have been traced in our OPEX tool ('Cameleon Constat'). In addition, the site's FME lead receives OPEX from other plants.

The main workers' OPEX sheets have been extracted and printed as a booklet to facilitate discussions with workers on specific cases. This booklet is given to workers during FME awareness-raising sessions (safety day, FME awareness-raising for specific sites or companies, etc.) and distributed through the FME contacts in the various operations departments and project management.

The availability of FME prevention equipment in the field has been improved. Following the identification that there were insufficient FME resources in the field, it was decided to make them available as close as possible to work sites in the industrial buildings. Thus, twelve FME distribution points have been set up across the site. Where activities require specific resources, the operational lead has a budget for the manufacture of suitable devices (examples of devices made include pool tarpaulins, large-size plugs and equipment-specific resources).

The key to successful FME risk management is impeccable housekeeping of the work site. As a result of various findings, a field service has been put in place under the Housekeeping [MEEI] procedure to make progress in site housekeeping. This service is particularly useful in a building such as the reactor building where a number of finishing activities were under way.

In addition to the compulsory training given to all workers who have to work in an area of FME risk, the site had developed targeted training for different audiences (security, supervisors, management). These training courses were based on concrete cases, practices seen elsewhere and field feedback. The aim of the site was to create an interactive FME module adapted to the requirements of the EPR site for all workers who have to work in an area of FME risk.

A communication plan was developed jointly between the FME lead and the communication department, which helped to increase visibility of FME to everyone on site. Some examples of the actions carried out include:

- Regular publication of information notes [NIS]
- Scheduling of FME topics in the 15-minute safety meeting
- Simulation of FME situations on industrial/nuclear safety days
- Publication of articles in the internal newsletter “All Together for Safety”
- Publication of articles in the “work site life” magazine
- Broadcast of video clips on the screens present in the buildings
- Display of posters in various strategic locations on the site

Finally, a field support team has been set up to assist workers on demand (response to specific situations, sharing good practice, etc.), during inspection of activities identified as being at FME risk or, more generally, during inspections of the facility and detection of at-risk situations.

External assessments:

To measure the effectiveness of the action plan, the site requested internal EDF and external support to give an independent view of the progress made in taking the FME risk into account.

The site was the subject of an internal FME audit carried out by the EDF Nuclear Inspectorate [IN] in September 2020. The inspectors noted the good level of FME control (especially for the fuel building pool), leadership of the network and identification of the TOP 10 activities with a FME risk. Leadership of the network of FME contacts and the communications media were highlighted. The site also took into account the remarks on the identification of the FME risk in daily operational activities. The modification of site organization around a common project, OneFLA3, has made it possible to highlight management of the FME risk and to harmonize practices.

Maintenance and Operations “Non-Qualities” [NQME] peer reviews are assessments carried out by EDF leads on the Maintenance and Operations “Non-Quality” procedure. This review, carried out in June 2021, showed a significant improvement in taking the FME risk into account at FLA3. As a result, FME was deemed to be under control. FME risk control in this review showed progress compared with the previous one, conducted in 2019 and which came after the Pre-OSART.

**The 4 Operations and Maintenance Quality Control [MQME] essentials - No. 3: FME measures**

| Operations and Maintenance Quality Control [MQME] programme key points - PBA | Key observations (Strengths - Areas for improvement) | R3 2019 | R1 2021 |
|---|---|---|---|
| **Essential No. 3**<br><br>**I comply with FME measures**<br><br>**(1/2)**<br> | **Very good organisation around FME risk control with representatives in all departments who champion the topic effectively, and implementation in the field with no deviations noted. The fuel building [HK] is a model of its kind in safety regarding loose parts.**<br>❖ **Maintenance [SMT] workshop:** FME risk properly taken into account (FME covers on all open mechanisms / pipes)<br>❖ The contractor **ORANO** fully understands the FME measures. Tools, FME inventory on entering/leaving FME area. FME tests are performed under EUREKA. Security around the fuel building pool applies FME requirements in the pool area.<br>**Operations:**<br>❖ Field workers are aware of the arrangements for controlling the FME risk on electrical cells: FME protection put in place on unplugged isolation of a cell, protection added if such a cell is detected without protection during the field inspection.<br>❖ **ENDEL:** FME risk management is very well taken into account in the risk assessment and follow-up document (phases at FME risk highlighted in magenta).<br>❖ FME protection in line with expectations during work on the diesel generators. FME area properly marked out. Staff members are aware of the risks and countermeasures.<br>**Fuel department [KLD]:**<br>❖ Very good preparations had been made for the reception of new fuel and the staff are focussed on controlling the very marked FME risk. | Yellow | |

To benefit from an outside perspective, the site requested support from WANO on FME. To this end, WANO seconded 3 experts to visit Flamanville 3 in January 2021 in order to compare Flamanville 3 with international best practice on FME issues. As a result of this support mission, improvements have been proposed to the site and taken into account in our action plan, including:

- Further development of management support for the requirements,
- Extension of the field inspection of the reactor building to include the area at FME risk,
- Eradication of all wooden or transparent materials in the perimeter of the mini NPP,
- Creation of local FME training tailored to the site’s requirements
- Development of an FME poster campaign in the field and in workshops,
- Definition of FME trend indicators and monitoring.

All of these proposals have been incorporated into the site action plan mentioned above.

In addition to this support mission, the site again called on WANO in June 2021 for management training (in the broadest sense: from supervisor to management level) on bringing coaching skills to site inspections. This training took place over a week and allowed 80 managers to be trained in the field in a targeted manner in a number of procedures, and FME in particular.

Field monitoring and effectiveness of the action plan:

Since the deployment of Caméléon in 2019, field inspections and observations have been traced using this tool. Thus, any staff member can trace and bring up any malfunction and attach it to the FME process. The FME process is monitored and referenced using special codes. The FME operational lead ensures analysis and trend tracking.

Since 2019, there has been a positive change in the number of positive findings traced in Caméléon, with a constantly increasing number, from 7 findings/year to more than 20 findings/year in 2021.

On the other hand, despite a substantial increase in the volume of negative findings issued between 2019 and 2020, there has been a decrease in the number of negative findings in 2021, based on the data available mid-year.

These two observations lead the plant to believe that the handling of FME by staff members is showing a positive trend.

In addition, over the period 2019-2021, for all findings issued, there has been an increase in the number of findings leading to corrective actions. This indicates better traceability, but also more rigorous handling of malfunctions.

The FME process is also the subject of field inspections which are documented in Caméléon. A template is made available to all staff in order to assess all points relating to the FME procedure. Since 2021, and as part of OneFLA3, this template has also been rolled out to work package staff, to allow them to carry out FME field inspections. There has been an increase in the number of FME field inspections carried out, from 12 in 2020 to 17 by mid-2021. This indicates an improvement in FME observation, linked to the increase in the number of findings observed (both positive and negative).

The OneFLA3 site keeps a tally of the various FME events that may be brought up through different channels (Caméléon findings, security, workers).

To date, the site has seen 24 FME events in 2021 broken down as follows:

- Electrical FME
- Site cleanliness/contamination
- Historical FME
- Bad FME practice

The number of events may seem high, but it should be read in the context of the number of activities over the period and with a better capacity to detect and analyse the different events. A number of FME events are considered “historic” and foreign bodies from the period prior to the deployment of the FME procedure have been found during the testing of circuits. Specific provisions are considered for these “historic FME” before fuel loading, such as flushing procedures and cleaning of circuits.

Overall FME findings have improved. As an example, on major, long-term activities such as the modification of the CCWS/ESWS [RRI/SEC] heat exchangers, there were no FME events thanks to site preparation, awareness-raising among workers, and regular FME field inspections.

The operational lead updates a monthly performance indicator to report on progress made on control of the FME risk and what is still to be achieved. The performance indicator includes the following information:

- Results in terms of number of FME events,
- Main FME OPEX from the fleet in operation,
- A “Top Flop” to raise awareness about good and bad practices.

The performance indicator is sent to the FME contacts in the departments who redistribute it to their colleagues. The performance indicator is shared through the Operations Committee once every two months, bringing together management representatives from the various OneFLA3 entities.

Below is an example of the FME Weekly bulletin:

**IAEA comments:**

At the time of the initial Pre-OSART mission the Foreign Material Exclusion (FME) Programme was not fully implemented at the plant which contributed to the deficiencies identified by the Pre-OSART team. While individual issues noted in the Pre-OSART FME issue were quickly corrected, the main focus of the plant response was on identifying and correcting the causes for noted weaknesses in FME programme compliance.

The Pre-OSART Follow-up Team determined that the causes have been clearly identified and that the action plan fully addresses these causes. The following key actions have been taken to not only address identified causes but to ensure the long-term sustainability of actions:

- The DPN (Operating Organization) and DP-FLA3 (Construction Organization) groups have aligned on common FME standards which are consistent with EDF corporate guidelines and industry standards.
- The Integrated Management System has been strengthened by enhancing the FME guidelines, increasing the effectiveness of oversight and monitoring of the FME programme, and establishing continuous improvement initiatives including FME field observations, FME self-assessments, and periodic trending and analysis of FME operating experience.
- Worker training and knowledge of FME standards had been improved. Initial FME training was provided to all workers and refresher training was provided every three years. Completion of FME training was required of all workers that have access to FME controlled areas. A certification form or sticker on the worker's badge indicates that the worker had completed FME training and was competent on FME requirements. A communication plan had been established to periodically reinforce FME programme requirements with the plant staff – these included newsletters discussing key aspects of the FME programme, the sharing of FME operating experience, and the posting of signs in work areas to promote understanding of FME requirements.
- Contracts with key vendors now include requirements for the vendors to comply with plant FME requirements and processes. Compliance with these requirements was periodically evaluated, documented on vendor scorecards, and accountability measures established.
- Plant management was actively engaged in monitoring FME programme effectiveness through management review meetings, participation in field observations, and ensuring organizational awareness and readiness for high risk FME work.

It is noteworthy that since the action plan was implemented there have been no safety significant FME issues. In addition, minor FME programme compliance issues have been effectively identified and corrected by the established management oversight and continuous improvement activities.

Since the Pre-OSART mission, two significant projects which were identified as having high FME risk were successfully implemented without any FME issues. This included the receipt, inspection, and transfer of new fuel into the Spent Fuel Pool and the modification of core cooling heat exchangers.

The Pre-OSART team conducted interviews with plant and contractor workers and performed field observations to further validate action effectiveness. The following insights were obtained during these activities:

- Plant and contract workers were familiar with FME training and requirements. Workers were able to describe how qualifications are obtained and noted that training was helpful.
- FME controls were checked in the Mechanical Maintenance Shop and found to be consistent with plant requirements. FME protection was correctly applied to equipment being worked on in the shop, FME lockers were provided in the shop and contained abundant FME control materials. FME signs were posted in the maintenance shop which reinforced plant requirements.
- An inspection of the Spent Fuel Pool was performed and no FME issues were identified. Robust FME barriers were placed around the Spent Fuel Pool, FME control zone signs were placed around the pool, and housekeeping in the area was exceptional.
- Three FME control points were checked and, in each case, the assigned FME monitor was able to describe the purpose of FME controls and demonstrate an understanding of FME requirements. The FME material accountability logs were reviewed, and no discrepancies were noted.
- FME lockers were provided near FME control areas in the plant which contained abundant FME control materials and were readily available to workers. FME signs were posted in the plant and reinforced FME requirements.

**Conclusion:** Issue resolved

# 5. TECHNICAL SUPPORT

## 5.1. ORGANIZATION AND FUNCTIONS

The plant has no specific guidelines or rules for the storage of materials in seismically qualified areas in the commissioning phase. The plant does not assess risk for potential seismic interaction between stored items and safety related equipment. The team noted that the plant does not provide observations regarding seismic risk in the areas that have not been handed over. The team also noted seismic issues at several locations in these areas and also in buildings that have been handed over to the plant, where the plant has clear expectations. The team made a suggestion in this area.

## 5.4. AGEING MANAGEMENT

The plant has developed an extensive programme to monitor equipment reliability and to monitor the environmental conditions of all relevant components and locations. The plant has developed a surveillance programme for the reactor pressure vessel. Several databases have been developed to record different Ageing Management Programme (AMP) data, however there is no overall programme which integrates all relevant ageing data in a systematic way. The team encouraged the plant to develop the overall AMP.

## 5.6. SURVEILLANCE PROGRAMME

The team observed that changes to the plant’s surveillance programme are still under consideration and 404 out of 783 surveillance procedures have not been updated. The team noted that the process of updating surveillance procedures does not always ensure the correctness of procedures. The team made a suggestion in this area.

## 5.7 PLANT MODIFICATION SYSTEM

The plant has made efforts to minimize unauthorized access to, or interference with, I&C items important to safety, including computer hardware and software. The plant introduced effective methods based on appropriate combinations of administrative measures and physical access control (such as locked enclosures, locked rooms and alarms on enclosure doors) to prevent unauthorized access and to reduce the possibility of error. The team recognized this as a good performance.

## 5.8. REACTOR CORE MANAGEMENT (REACTOR ENGINEERING)

The reactivity management programme is not yet fully implemented in the plant. The plant is in the phase of validating and verifying the plant-specific reactivity management requirements in the field. Due to the extensive use of an offsite control system test platform for design and commissioning needs, some surveillance test and maintenance procedures related to I&C parameter modification could not be performed as planned. Commissioning staff are not fully aware of the importance of the reactivity management programme. The team encouraged the plant to finalize the implementation of all activities associated with reactivity management.

## DETAILED TECHNICAL SUPPORT FINDINGS

### 5.1. ORGANIZATION AND FUNCTIONS

**5.1(1) Issue**: The plant procedures and practices do not always ensure that the potential risk from the impact of unsecured items on safety related equipment in seismically qualified areas is minimized.

During the review of the areas with construction and commissioning activities the team noted:

- The plant has no specific procedures and guides for storage of equipment in seismically qualified areas in the commissioning phase. The plant practice is to place a white chain fence around equipment. There is an instruction that trollies, scaffolds, and heavy equipment should have their brakes locked, this instruction also applies to commissioning.
- In the fuel pool area, multiple cases of heavy objects such as a trolley with tools; a trolley with protective tiles and a trolley that supports equipment were observed and found unsecured at locations that have not been designated as storage areas.
- In the auxiliary safety system building, a trolley was found near the safety related equipment not secured from inadvertently moving.
- In the auxiliary safety system building temporary storage with trolleys and ladders was found without appropriate signs.

The plant has expectations for the storage of equipment in buildings that have been handed over to operations. However, during the review the team noted:

- In the train 3 pumping station, temporary scaffolds (about 1m x 2m x 3m in size and with their four wheels unlocked) were in contact with an essential service water pipe, which is safety related system.
- An approximately 2m x 2m x 4m scaffold was in contact with a non-return valve of the fire protection duct in the train 3 pumping station containing essential service water components.
- In the train 1 pumping station, an open hatch had unsecured materials stored next to the opening.
- In the train 1 pumping station, a trolley with its four wheels unlocked was stored unsecured next to the electrical panels in the switchgear room.
- In the train 1 pumping station, a heavy key storage rack was found next to the electrical panels in the switchgear room and was not fixed.

Without proper procedures and practices in controlling of additional items in seismically qualified areas, the operability and reliability of structures, systems and components could be jeopardized.

**Suggestion:** The plant should consider implementing procedures and practices to ensure that the potential impact of unsecured items on safety related equipment in seismically qualified areas is minimized.

**IAEA Bases:**

GSR Part 2

4.32. Each process or activity that could have implications for safety shall be carried out under controlled conditions, by means of following readily understood, approved and current procedures, instructions and drawings.

SSR-2/2 (Rev.1)

Requirement 13. The operating organization shall ensure that a systematic assessment is carried out to provide reliable confirmation that safety related items are capable of the required performance for all operational states and for accident conditions.

NS-G-2.13

5.33. Plant walk-downs are one of the most significant components of the seismic safety evaluation of existing installations, for both the SMA and the SPSA methodologies. Plant walk-downs should be performed within the scope of the seismic safety evaluation programme. The term ‘plant walk-down’ is used here to denote the ‘seismic capability walk-down’ for the SMA approach and the ‘fragility walk-down’ for the SPSA approach. These walk-downs may serve many purposes, such as: gathering and verifying as-is data; verifying the screening-out of SSCs due to high capacities on the basis of engineering judgement; verifying the selection of safe shutdown paths for the SMA; evaluating in-plant vulnerabilities of SSCs, specifically issues of seismic system interaction (impact, falling, spray, flooding); identifying other in-plant hazards, such as those related to temporary equipment (scaffolding, ladders, equipment carts, etc.); and identifying the ‘easy fixes’ that are necessary to reduce some obvious vulnerabilities, including interaction effects. Walk-downs should also be used to consider outage configurations that are associated with shutdown modes. Detailed guidance on how to organize, conduct and document walk-downs should be developed or adapted from existing walk-down procedures.

**Plant Response/Action:**

The site took this suggestion into account in a broader way through the implementation of an "earthquake event" approach, so that an item of equipment important for safety is not the target of another item of equipment, fixed or mobile, in the event of an earthquake hazard.

A road map with 5 milestones is intended to be gradually deployed across the entire site:
- 1st Milestone, October 2020 (Fuel delivery): implementation of scaffolding rules within the HK perimeter and handling rules
- 2nd milestone, March 2021: implementation of scaffolding rules within the "mini NPP" perimeter and handling rules
- 3rd milestone, 30 September 2021: earthquake-event rules for EDF plants in operation partially applied to mini NPP (risk assessment on the fuel building [HK] –except set down area / service water pump building [HP] / release structure [HC]).
- 4th milestone, General Operating Guidelines dry run (1st half 2022): earthquake-event rules for EDF plants partially applied throughout the facility (risk assessment)
- 5th milestone, loading (2nd half 2022): earthquake-event rules for EDF plants applied in full throughout the facility.

Situation to date:
- The 1st milestone is completed.
- The 2nd milestone was reached after providing support to scaffolding service providers along with an Information Note specifying the jacking requirement associated with the earthquake risk. Crossing this milestone has led to significant progress, the rules are now known to the scaffolding companies and implemented in particular in the "mini NPP" perimeter (fuel building [HK] / service water pump building [HP] / release structure [HC]).
- Progress has also been made in compliance with the earthquake event rules for handling equipment (compliance with handling chains and parking positions).
- The 3rd milestone was reached at the end of September 2021, and it will allow for the implementation of risk assessment by all contractors working on the "mini NPP". The aim is to identify the earthquake-event risk caused by an activity and put appropriate countermeasures in place. Among the risks to be taken into account, the main one is storage of equipment, with the countermeasures being: keeping targets at distance, tying down the equipment; and the absence of stacking.

Completion of these milestone was supported by the following communication plan:
- Presentation in the weekly second line management [MDL] meeting (done)
- Information Note with typical risk assessment (done)
- Site newspaper (done)
- Meetings with the various contractors (done)

Since September 2021, monthly field inspections are undertaken to assess the level of implementation of the requirements specified for the "mini NPP".

**IAEA comments:**

EDF has existing guidance for minimizing the potential impact of unsecured items on safety related equipment in seismically qualified areas. This guidance covers carts, lifting equipment, and scaffoldings in seismically qualified areas. This guidance was not applied at Flamanville 3 site at the time of the Pre-OSART mission.

The plant analysis of the suggestion by the Pre-OSART team identified the root cause as a lack of awareness of the nuclear safety risks generated by seismic events amongst EDF operations, maintenance and engineering personnel, and contractors. There was also a lack of awareness of the corporate guidance for seismically qualified areas. There was a lack of awareness of the risk assessment process to identify the seismic risks in safety related areas. Finally, there were no clear requirements to apply the corporate guidance in designated buildings.

As a result, the plant initiated an awareness campaign with the site personnel. They also required the plant personnel to implement the requirements in a progressive manner, starting in seismically qualified buildings where the fuel is currently stored (HK), and adding more buildings as time went on.

The effectiveness of the corrective actions was measured during walkdowns carried out by the plant management. Deviations from the requirements were recorded and trended. The trend shows a clear improvement for the compliance with the seismic requirements. The plant was committed to continue with ensuring compliance with seismic requirements and to track its progress.

**Conclusion**: Issue resolved.

## 5.6. SURVEILLANCE PROGRAMME

**5.6(1) Issue:** The process for the development and approval of surveillance procedures is not sufficiently rigorous to support safe plant operation.

The team observed the following:

- Surveillance test procedures are written and verified by the operations department or by a contractor and approved by the operations department. Safety engineers and system engineers are not involved in the verification of procedures.
- The independent evaluation of the surveillance process made in year 2016-2017 provided the suggestion to improve the process for updating procedures (the engineering department recognized that the process could be improved, while operations thought the process did not need to be improved to avoid mistakes). In 2018, the operations department introduced some changes in the guideline for updating surveillance procedures; however, the errors appeared again.
- Independent evaluation identified that two lines of defense applicable during the writing and approval of surveillance procedures failed (use of the wrong reference documents, improper understanding of acceptance criteria, non-rigorous independent verification and approval process).
- Errors were identified in procedures related to electrical containment penetrations and sensor codes. The operations department additionally reviewed surveillance procedures for the containment penetration and did not extend the analysis of the cause of these events to identify whether the same problem had occurred in other surveillance test procedures.
- Surveillance test procedures for systems related to reactor control are still under development, and only 3 procedures of the planned 120 documents have been written and approved.
- The plant identified that 149 procedures out of 783 surveillance test procedures are sensitive and complex. Forty-eight are required to be available for the phase 2 hot functional test milestone. However, not all of these are yet updated.

Without a rigorous process for the timely development and approval of surveillance procedures safe plant operation might be affected.

**Suggestion**: The plant should consider improvements to the rigor of the process for timely development and approval of surveillance procedures to ensure support for safe plant operation.

**IAEA Bases:**

SSR-2/2 (Rev.1)

8.2. The operating organization shall establish surveillance programmes for ensuring compliance with established operational limits and conditions and for detecting and correcting any abnormal condition before it can give rise to significant consequences for safety.

NS-G-2.6

2.12. The operating organization should establish a surveillance programme to verify that the SSCs important to safety are ready to operate at all times and are able to perform their safety functions as intended in the design. Such a surveillance programme will also help to detect trends in ageing so that a plan for mitigating the effects of ageing can be prepared and implemented.

9.1. A surveillance programme should be established by the operating organization to verify that provisions for safe operation that were made in the design and checked during construction and commissioning continue in effect during the operating lifetime of the plant and continue to supply data to be used for assessing the residual service life of SSCs. At the same time, the programme should verify that the safety margins are adequate and provide a high tolerance for anticipated operational occurrences, errors and malfunctions.

9.7. The surveillance programme should be developed by the operating organization sufficiently early to permit it to be properly implemented as and when plant items become operational in the commissioning phase or, where appropriate, upon installation. Implementation should be scheduled such that the safety of the plant does not depend on untested or unmonitored SSCs.

**Plant Response/Action:**

The technical check [CT] implemented by the plant operator in advance of the Pre-OSART did not detect deviations from some of these periodic test worksheets, as shown by an audit conducted by the Independent Safety Team [FIS].

A specific action plan was implemented by the plant operator in response to this finding, taking up the IAEA suggestion:
- Comprehensive checks of all periodic test worksheets
- Internal checks within the department in charge of periodic tests
- Drafting of the periodic test worksheets brought back in house, after previously being carried out by a subcontractor
- Checks done by the Independent Safety Team [FIS]

This action plan has been productive and has improved technical checks on periodic tests.

In terms of effectiveness, the periodic test worksheets required for fuel delivery and applicable to date are satisfactory and field validation of these worksheets has not detected any deviation.

Following the Pre-OSART, a new check on periodic tests by the Independent Safety Team [FIS] revealed no malfunction in the checking and drafting of these periodic test worksheets.

In addition, all periodic test worksheets will be available for loading and the vast majority will be tested before loading, which will allow for a final check on the quality of the worksheets drafted. Specific provisions are identified for those that would not be tested before fuel loaded.

**IAEA comments:**

The plant conducted a root cause analysis of the gap identified by the Pre-OSART mission related to the process of preparing and verifying procedures for periodic tests. It concluded that the current process for the preparation of the periodic test procedures was not effective because the test rules for equipment were not clearly understood, the contractors and plant reviewers assigned to the drafting and review of the procedures had limited experience, there were constant updates to the operating limits and conditions, and the review process was not sufficiently thorough.

The action plan elaborated and implemented by the plant included:

- The operation staff who were tasked with drafting the procedures had to first review the test rules and provide feedback to Independent Safety Oversight, who were acting as interface with the engineering centre.
- At the time of the Pre-OSART mission, a contractor was used to write and verify the surveillance procedures and the verification process did not always identify errors in the documentation. Since the Pre-OSART mission, the operations department had taken over full control for the production, verification, and approval of the surveillance procedures. Since this change was introduced, no deviations were detected in the surveillance test documentation required for fuel delivery.
- The review process had been formalized and the personnel assigned to it had to be qualified for this task. The review process now included a desktop review of all the steps in the procedure.
- The procedures were executed for the first time in the Main Control Room, and when relevant with field operators.
- An internal review of four periodic testing procedures in 2021 did not detect any deviations.

The effectiveness of these changes was assessed by trending the number of procedures that had completed this process. The trend at Q4 of 2021 showed that 5310 of 6300 procedures had been drafted and complied with plant expectations. The plant planned to complete all the steps for the remaining periodic test procedures before fuel loading.

**Conclusion**: Issue resolved.

# 6. OPERATING EXPERIENCE FEEDBACK

## 6.7. UTILIZATION AND DISSEMINATION OF OPERATING EXPERIENCE

The plant's Corrective Action Programme (CAP) has not been effective in addressing performance deficiencies and adverse trends in a timely manner. The team observed deficiencies that have not been reported; performance targets that had consistently not been achieved; corrective actions that have not resulted in any visible improvement; self-assessments that have not been utilized to determine the effectiveness of programmes; and a lack of action plans to address a variety of performance deficiencies. The team made a recommendation in this area.

## 6.8. TRENDING AND REVIEW OF OPERATING EXPERIENCE

The plant has established an agreement with its sister plant Taishan to receive in-depth knowledge of Operating Experience (OE). One of the key elements in this agreement consists of a liaison engineer seconded to Taishan who communicates OE to both plants. The second key element is that Flamanville 3 take part in Taishan's operational activities and evolutions which provided them with valuable first-hand experience and knowledge. Conversely 16 employees from Taishan are taking part in FLA3's commissioning activities to share their technical expertise and mentor staff. The team considered this as a good practice.

The plant demonstrated well established processes and review meetings to ensure that external and internal OPEX is reviewed and analyzed for use by Flamanville 3 staff and that internal OPEX is communicated to the rest of industry. These processes were well understood by all staff interviewed and the participants in the review meetings demonstrated compliance with the established processes. The team considered this as good performance.

## DETAILED OPERATING EXPERIENCE FEEDBACK FINDINGS

### 6.7. UTILIZATION AND DISSEMINATION OF OPERATING EXPERIENCE

**6.7(1) Issue:** The plant Corrective Action Programme (CAP) is not effective in addressing performance deficiencies and adverse trends in a timely manner.

The team observed the following:

- Many different types of deficiencies and adverse performance trends were not reported in the plant's CAP.
- The plant's Department Trend Reports for the 1st Quarter of 2019 each identified adverse trends, however 5 of 6 of the trend reports did not identify any actions to fix the adverse trends.
- The plant has not utilized self-assessments to determine the effectiveness or implementation of the Operating Experience (OE) Programme.
  - No Plant wide self-assessment plan for OE or the CAP;
  - 75% of Managers interviewed indicated they had not done a self-assessment on the implementation of the OE programme within their departments.
- The plant's actions (recorded in minutes of meetings) have not been effective in improving the percentage of overdue actions, which has not met target in over 6 months.
- The plant has not established a corrective action plan for the WANO SOER on Risk Management that was graded unsatisfactory in April 2018. A corporate team has been established to develop plan and meets monthly, however there is still no action plan 14 months later.
- The plant has not conducted trend analysis of housekeeping deficiencies to establish corrective actions to prevent re-occurrence.
- Plant Managers and staff interviewed did not have a good awareness of what the plant OE performance indicators are in order to help the plant improve performance.
  - 47% Awareness of Participation Rate Indicator;
  - 47% Awareness of Participation Rate Target;
  - 18% Awareness of Escalation of Priority to address Participation Rate Indicator;
  - 65% Awareness of % of Overdue Actions Indicator;
  - 41% Awareness of % of Overdue Actions Target;
  - 47% Awareness of 10 OPEX Provided to Industry Indicator;
  - 29% Awareness of 100% of Previous Years Industry OPEX Analyzed;
  - 27% Awareness of sister plant Taishan Agreement Performance Indicator;

Without an effective Corrective Action Programme, performance deficiencies and adverse trends will not be addressed in a timely manner to prevent re-occurrence.

**Recommendation:** The plant should enhance its Corrective Action Programme to ensure performance deficiencies and adverse trends are addressed in a timely manner.

**IAEA Bases:**

SSR-2/2 (Rev. 1)

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.

SSG-50

2.56. The types of trends (including trends in low level events and near misses) that should be identified and reviewed include the following:

(a) Recurring issues occurring in several relevant reported events;

(b) Events or issues arising particularly in certain operating modes or during certain activities;

(c) Recurring failures or degraded performance of particular systems or components;

(d) Trends in causes of identified events or issues;

(e) Adverse trends in human and organizational performance;

(f) Trends involving small incremental changes over a long period of time;

(g) Trends identified by comparing current performance to a previous similar operating condition (e.g. comparing two outages);

(h) Positive trends.

2.57 An appropriate review should be conducted in response to identified adverse trends.

2.76 The effectiveness of the operating experience programme should be assessed using methods such as self-assessment, benchmarking and independent peer reviews. Such assessment should be carried out on a regular basis by teams of experienced personnel who are familiar with the operating experience programme.

**Plant Response/Action:**

Analysis of the issues identified during the IAEA Pre-OSART mission identified the following causes:

- CAP and OE expectations were neither clear nor known
- Multiple data bases resulting in confusion for staff
- OE not considered as essential by staff and senior management
- Not enough CAP indicators for effective CAP management
- This results in a lack of consideration and motivation towards participating in CAP at Flamanville 3.

To address the noted cause the plant launched the following key actions:

- Clarify our standards and expectations
- Review of our objectives and indicators
- Improved processes with the switch to the OneFLA3 organization
- Updating of document management procedures
- Staff training to place the focus on OE being essential

– Communication and reinforcement of standards and expectations
– Oversight and monitoring with KPIs and dashboard

The results of these actions are in line with our expectations, and the plant are now measuring their effectiveness.

To ensure proper management of SOERs at Flamanville 3 (in line with existing memo in sub-process *[PIL STR Develop strategy and oversight; reference No. D455115002934; Dated 14/08/2015])*, each SOER now has a sponsor as well as a strategic owner at the senior management level. Action plans are defined for each SOER, with actions documented in the action tracking module of the Cameleon database (conditions reports). The plant had updated the document management procedure to reflect these new requirements *[Memo on analysis of SOERs for start-up assessments of Flamanville 3; reference No. D455115000117; latest revision on 19/06/2020].* The role of the sponsor is to document and ensure proper implementation of actions in response to SOER recommendations. He/she is an engineer or department head, depending on the SOER. The strategic owner sets the scope and has a support role. He/she is a department head or member of senior management. In addition, each SOER is subject to a yearly situational test with a blank evaluation in the presence of the Station Director and the Technical Director. This effective method has reaped benefits since actions are now managed with some having already been completed, thus enabling the plant to respond to expectations in a satisfactory manner.

When trend analyses are carried out by the departments and by each of the macro-processes, it may be decided to take one or more actions to correct and/or analyze low-level events. These actions are entered into the Chameleon Action Tracking tool to ensure follow-up and monitoring, and action numbers are included in the trend analysis document. *[PIL REX Carry out trend analyses; reference No. D455114000583*; *latest revision on 25/04/2019].* The plant has been able to measure effectiveness of monitoring as the previously identified low level events have not reappeared. Trends are measured every 6 months, and if an adverse trend is observed, periodicity would increase to once per quarter.

Since January 2019, a new single condition report data base called Cameleon has replaced the numerous previous OE and CAP data bases (Field presence, eBrid, action tracking tool), a confusing element to staff to have different typologies of discrepancies followed in different instances. The expected end result is for senior management and the whole site to have a complete overview of this matter.

As to maintaining good housekeeping conditions, the relevant data base is called EXOCET and has been in place since June 2019. With both tools, no information is lost because if a report is issued by mistake in Cameleon instead of EXOCET, it is switched with a reference number for follow-up.

To have broader trend analyses, the analyses were extended to the EXOCET tool. These analyses show a positive trend on the EXOCET side, with no low-level occurrences detected since its implementation. Efficiency is measured by avoided repeat events.

The plant has done a lot of communication with our staff to make them aware of and adhere to these tools, and the plant have also updated related document management procedures. The plant is satisfied with current results with continuous improvement:

| | |
|---|---|
| Number of CRs for year 2019 | 2877 |
| Number of CRs for year 2020 | 2753 (COVID health context) |
| Number of observations for year 2021 (01/01 to 06/12) | 3459 |

To standardize OE processes, the plant has grouped together the DPN and the DP OE into OneFLA3 single process. Thus, efficiency has improved and resulted in more fluid information exchanges. To further improve, a yearly effectiveness review of CAP and OE is carried out using the evaluation form provided by the plant IMS, with a look back on the year's successes, challenges, and plan for future improvements.

The plant carried out an assessment for the OneFLA3 annual review in November 2020 and again in September 2021, in accordance with what is included in a new procedure [memo on the organization of OE at the Flamanville 3 nuclear power plant; reference No. D455121002771; developed on 25/02/2021]. These assessments of CAP and OE have enabled the plant to achieve satisfactory running of the processes, and they will be renewed on a yearly basis.

To overcome the lack of awareness of CAP indicators among the staff, the plant has simplified the process with only the OE OneFLA3 dashboard. Indeed, it was noticed that the presentation of multiple data and graphs was not the best way to remember expected targets and objectives for the year. In addition, in the dedicated forums, data are monitored and followed up with graphs and more specific indicators have been kept (e.g., on effectiveness review).

To improve the indicator for actions overdue by more than 6 months at the time of the IAEA review in 2019, the following actions have been undertaken:

- Prioritize actions with the right focus:
  - priority 1: corporate and regulatory requirements, event root-cause analysis
  - priority 2: suggestions raised by INSO
  - priority 3: simple actions
- Improve the management of overdue actions, with the objective of keeping the site indicator.
- Culture change among staff members to close-out actions.
- Monthly excerpt of overdue actions by CAPCO, with communication thereof to senior management and department heads
- Weekly management reinforcement during team meetings, with presentation of justification of overdue processing by action owner

For this purpose, the plant has strengthened its management: less than 15% of actions are overdue, and follow-up of priority actions that can impact the plant: less than 5% of P1 actions are overdue. The objective is not only to control the volume of actions, but also to secure the actions classified as priorities by not putting all actions at the same level.

The results for year 2021 show a good trend in the indicators with a gradual downward trend in the number of overdue actions since August 2021 such that at the time of the Follow up mission the total number of overdue actions was below the 15% target level. For P1 overdue actions, for 2021, while there was an overall reducing trend, it was still above the 5% target and at the time of the Follow up mission it was 5.2%. In addition, staff must be coached into completing actions within the allotted timeline and to not have any overdue actions. The expectation is to bring the rate of overdue P1 actions to 0% in the long term, as follows:

- Broader dissemination of our indicator on the number of tracked postponements, with a quantified target
- Continuous tracking of overdue actions depending on priorities (Overall Priority and P1)
- Definition of short and long-term actions in the Cameleon data base
- Implementation of indicator on average opening time for actions, according to actions being short or long term.
- Identification of the average number of overdue days for action completion
- Definition of criteria possibly leading to action postponement (with what justification and related risk assessment)
- Coach plant staff into raising SMART actions
- Define a criterion for monitoring and quality of event analysis
- Investigate an accountability method to ensure that staff members close out their actions within the due dates

Priorities are graded when creating the actions: priorities 1 to 3, as indicated in our memo *[Rules for creating and managing actions at the Flamanville 3 Nuclear Power Plant; reference No. D455119006365; latest revision on 29/02/2020].*

Every month, the CAPCO communicates on overdue actions by Macro Process (MP) and by department. And each MP owner manages relevant overdue actions in a bi-monthly committee, and each department does the same during weekly team meetings.

All plant staff have access to the dashboard on management of actions located in the KIBANA tool connected to the Cameleon Action Tracking module.

The quality of the action close-out methods is verified in the Friday morning CAP meeting (RMPAC CAP Management Meeting) in accordance with our procedure [*PIL REX Process Memo for the Process of CAP condition reports; reference No.* D455114000351; *Latest revision on 05/08/2021].*

Actions are completed based on due dates indicated below and for which targets must be set due to diverse origin of actions into the various priority batches:

Rolling one-year average from inception to close-out date:

- P1: 79 days

- P2: 92 days
- P3: 105 days

To evaluate effectiveness of actions implemented, the owner is asked to:

- Check that the action to be measured is processed in accordance with the request: comply with processing time and ensure satisfactory method of providing evidence in line with request.
- Define a "success criterion" to be reached to judge action effectiveness and ensure that the event and/or deviation does not recur (adequate and known organization, effectiveness of countermeasures in place).
- Analyze actions effectiveness based on facts (interview with relevant personnel, field presence).
- Evaluate the result following his analysis and judge effectiveness level of the action.

The Quality Department checks achievement of the expected result for action. This organization has been described in a memo [Memo on effectiveness measures of actions; reference No. D455121005337; Latest revision on 19/11/2021]

Sustainability:

The plant is confident that the process will be sustainable because the tools used are mature and proven. The actions taken have been effective by having deviations handled and trends identified in a timely manner. The plant integrated management system (IMS) has been updated and the defined requirements have been met.

The culture of change is still underway with our staff to complete actions within the allotted timeline, the trend and momentum given to move towards 0% for overdue actions and completion of actions within the allotted time make the plant confident that the target will be met.

**IAEA comments:**

The Pre-OSART Follow-up Team determined that the causes have been clearly identified and that the action plan, when completed, will provide the needed improvements to address the recommendation.

It is recognized that the Integrated Management System, oversight and monitoring, continuous improvement methods such as annual self-assessment, and management engagement have been improved since the Pre-OSART mission. However, while progress had been made, the following key actions need to be completed to fully address causal factors and ensure effectiveness and long-term sustainability of the plant Corrective Action Programme:

- Strengthen the control to prevent overdue actions from occurring and to ensure that actions are completed in a timely manner.

- The process for due date extensions should be enhanced to ensure that justification is provided and the risk to the plant/organization is assessed. The management team should review the justification and risk assessment prior to approving due date changes for Priority 1 (most significant) activities which represent higher vulnerability.

- Metrics should not only include the number of overdue items and due date extensions, but also track the average age to complete actions (timeliness) and include targets for timeliness of action close-out.

- The plant did not have a way to exclude long-term corrective actions from performance indicators related to timeliness so that long-term corrective actions should be tracked separately. The plant current average times to correct deficiencies were artificially high due to the inclusion of long-term corrective actions such as activities that cannot be completed until startup or delayed due to material availability.

- Further work is required to develop further a simple “Picture of Excellence” for CAP/OE that describes the general behaviors, individual responsibilities, management responsibilities, and screening team activities that are essential to achieving excellence. So that, the CAP/OE programme is seem as being “value based” rather than “compliance based”.

**Conclusion:** Satisfactory progress to date

## 6.8. TRENDING AND REVIEW OF OPERATING EXPERIENCE

**6.8(a) Good Practice –** Liaison officer dedicated to Operating Experience in sister plant Taishan for in-depth sharing of OE

To ensure that Flamanville 3 has in-depth knowledge of the Operating Experience from its sister plant Taishan, a special agreement between the two plants has been established. There are 2 key elements of this agreement that enables staff to be immersed in and aware of important OPEX from Taishan.

The first key element is the presence of a liaison engineer seconded to Taishan. This liaison officer (seconded since 2016) who is paid for by EDF and FLA3, is dedicated to communicating OPEX both ways.

The liaison officer is responsible for drafting a weekly report of activities performed in Taishan and highlighting potential points of interest for FLA3. This report is analysed in-depth during a weekly conference call between the liaison engineer and the FLA3 Technical Director, OPEX Single Point of Contact and various department members. This conference call is an open discussion, which allows participants to flag and initiate OPEX actions or potentially request additional information from Taishan to FLA 3 and vice-versa.

Another element of the liaison officer role is to identify opportunities to participate and learn for first time evolutions. FLA3 staff (from technicians to engineers, as well as top management) take part in Taishan's key activities and evolutions. For instance, between January and May 2019, 16 staff members took part in operational activities in China during the start-up of Taishan 2, and the first outage of Taishan 1. These opportunities provide invaluable first-hand experience that is brought back, shared and applied when similar activities are carried out at FLA3.

Conversely 16 employees from Taishan are taking part in FLA3's commissioning activities to share their technical expertise and mentor staff.

FLA 3 has benefited from this agreement by:

- Ability to use OE from Taishan 1 & 2 hot functional tests to prepare and complete FLA3's own phase 1 hot functional tests (integrating OPEX into operations procedures and training programme).
- FLA3 Fuelling Managers attended Taishan 1 fuel load operations (opportunity to train on the EPR fuel handling machine and to identify improvements for FLA3).
- FLA3 staff have taken part in Taishan's key start-up tests.
- FLA3 staff have taken part in Taishan's first outage (set up of the core instrumentation: opportunity to improve work procedures, training needs and procurement of tools)

# 7. RADIATION PROTECTION

## 7.2. RADIATION PROTECTION POLICY

The plant has put in place several dose optimization measures and has a well-documented ALARA programme. The team noted, however, that the plant has not yet implemented dose constraints. The team made a suggestion in this area.

## 7.3. RADIATION WORK CONTROL

The Radiation Protection (RP) group has requested several design changes to optimize radiation exposure during operation and outages. The team recognized this as a good practice.

## 7.5. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING AND FACILITIES

Before reaching the Radiation Controlled Area (RCA), there are several change rooms that allow workers to remove their clothes and put on protective coveralls. Access to the RCA is through a single entrance that requires workers to scan their badges. The plant has installed computerized stations near the change rooms that allow the workers to check that they meet all the administrative and regulatory requirements to enter the RCA. The team identified this as a good performance.

The hot workshop is shared between Flamanville units 1, 2 and 3. It includes storage areas for contaminated items, decontamination vessels, underground storage tanks for liquid effluents, and a laundry facility. The facility is well maintained, but the decontamination area is cluttered with obsolete or decommissioned equipment that has not been removed. The team encouraged the plant to dispose of unneeded equipment.

## 7.6. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The plant has implemented a bar-code system that tracks radioactive waste from the point of generation to the eventual disposal site. The system allows real-time tracking of inventories, location and detailed information regarding the content of waste packages. The team recognized this as a good practice.

The plant has implemented a comprehensive programme to monitor radioactive and conventional discharges to the environment. The gaseous radioactive effluent monitoring system includes two duplicate chains of instrumentation which comprise:

- molecular sieves for carbon-14 in the chemical form of carbon dioxide, with an oven to oxidize methane;
- a tritium sampler with two bubblers in series;
- filters and charcoal cartridges for particulates and iodine;
- a beta proportional chamber for noble gases;
- a gamma spectroscopy system.

Radioactive liquid effluents are to be sampled from the liquid effluent tanks and analysed in a laboratory. The releases will be reported monthly and annually to the regulator and the public.

During the commissioning of the stack monitoring system, the plant is not planning to carry out tests to measure the sampling efficiency. The sampling efficiency of a stack monitoring system is determined by measuring the recoveries of various test reagents injected into the stack. The sampling efficiency is one of the largest contributors to measurement biases in the stack monitoring system. The plant reports effluent releases to the environment without uncertainties, while environmental concentrations in air and water are reported with uncertainty. The team made a suggestion regarding the assessment and reporting of uncertainties.

## DETAILED RADIATION PROTECTION FINDINGS

### 7.2. RADIATION PROTECTION POLICY

**7.2(1) Issue:** The plant has not implemented dose constraints to ensure optimization of protection and safety for activities that generate occupational and public radiation exposure.

The team noted the following:

- The plant has not implemented dose constraints for occupational exposure. The EDF Corporate organization will issue a policy on dose constraints in 2020. The plant will implement this policy later.
- The plant has not proposed public dose constraints to the regulator or implemented dose constraints set by the regulator.
- The implementation of ALARA at the plant does not include dose constraints.

Without implementing the dose constraints in the plant, the protection and safety for activities that generate occupational and public radiation exposure may not optimized.

**Suggestion:** The plant should consider implementing dose constraints in compliance with standards requirements.

**IAEA Bases:**

GSR Part 3

1.22. Dose constraints and reference levels are used for optimization of protection and safety, the intended outcome of which is that all exposures are controlled to levels that are as low as reasonably achievable, economic, societal and environmental factors being taken into account. Dose constraints are applied to occupational exposure and to public exposure in planned exposure situations. Dose constraints are set separately for each source under control, and they serve as boundary conditions in defining the range of options for the purposes of optimization of protection and safety. Dose constraints are not dose limits: exceeding a dose constraint does not represent non-compliance with regulatory requirements, but it could result in follow-up actions.

1.23. While the objectives of the use of dose constraints for controlling occupational exposure and public exposure are similar, the dose constraints are applied in different ways. For occupational exposure, the dose constraint is a tool to be established and used in the optimization of protection and safety by the person or organization responsible for a facility or an activity. For public exposure in planned exposure situations, the government or the regulatory body ensures the establishment or approval of dose constraints, taking into account the characteristics of the site and of the facility or activity, the scenarios for exposure and the views of interested parties. After exposures have occurred, the dose constraint may be used as a benchmark for assessing the suitability of the optimized strategy for protection and safety (referred to as the protection strategy) that has been implemented and for making adjustments as necessary. The setting of the dose constraint needs to be considered in conjunction with other health and safety provisions and the technology available.

3.25. For occupational exposure and public exposure, registrants and licensees shall ensure, as appropriate, that relevant constraints are used in the optimization of protection and safety for any particular source within a practice.

For occupational exposure, the relevant dose constraint is on individual doses to workers, established and used by registrants and licensees to set the range of options in optimizing protection and safety for the source. For public exposure, the relevant dose constraint is a source related value established or approved by the government or the regulatory body, with account taken of the doses from planned operations of all sources under control. The dose constraint for each particular source is intended, among other things, to ensure that the sum of doses from planned operations for all sources under control remains within the dose limit.

3.77. Employers, registrants and licensees:

(b) Shall establish and use, as appropriate, constraints as part of optimization of protection and safety.

**Plant Response/Action:**

During the 2019 Pre-OSART, the IAEA noted that the site had not defined a dose constraint for workers in accordance with GSR Part 3.

The concept of dose constraint was transcribed into French law through "Decree No. 2018-437 of 4 June 2018 on the protection of workers against the risks of ionizing radiation", in compliance with the EURATOM Directive 2013/59.

Article R4451-3 of the Labour Code defines the dose constraint as "a restriction defined by the employer prospectively, in terms of individual dose, used to define the options considered for optimizing worker protection".

Under article R4451-3, the employer is required to define individual dose constraints relevant to the optimization of radiation protection in advance and to update them if necessary. The radiation protection advisor assists the employer in defining these constraints.

At the time of the Pre-OSART mission at Flamanville 3, in July 2019, an action plan had not yet been developed. The reason for a lack of action plan to implement dose constraints at the plant was due to a series of delays at the government and the corporate level.

In 2020, the regulatory requirements from 2016 were taken into account by EDF's national engineering unit in the "Radiation protection management and organization, employer obligations" reference document (D455020001658) and the associated guide (D455020003639).

The request from EDF's national engineering department is to integrate the new requirements from the "Management and organization of radiation protection, employer obligations" standard by 1 January 2022 at the latest.

As part of the implementation of the requirement by Flamanville 3, an action plan has been defined, one of which is "Establish an organization for the definition and monitoring of dose constraints". It is tracked via the Cameleon action tracking tool and bears the reference A0000239739.

The creation of the Radiation Protection and Environment Department in 2019 has provided an opportunity to change the way radiation protection is organized at the plant, in order to comply with new regulations. Under the new organization, one of the radiation protection advisors has been assigned the responsibility to help define dose constraints. As a result, an annual dose constraint has already been established for each employee of the plant for the year 2022. Furthermore, this will be an on-going activity that will be carried out annually.

Currently, plant workers at Flamanville 3 receive very little exposure due to the absence of radiological risk at the facility. It has therefore been decided that EDF workers at Flamanville 3 should not exceed an integrated dose of 1 mSv in the context of activities they may carry out on secondment to other nuclear installations. In the event that a worker approaches this value, steps are taken to ensure that the dose does not exceed 1 mSv/year. In the event that this constraint cannot be met, a member of the site management will be asked to validate the situation.

Regarding the dose constraints for the public, the plant has identified the following facts:

- French regulations (Public Health Code) set an effective dose limit of 1 mSv/year for the exposure of the population to ionizing radiation resulting from all nuclear activities.
- In addition, the regulator has specified optimized radioactive release levels for normal operation. These “authorized release limits” are specific to each facility and correspond to a dose of 8E-4 mSv/y, a value between the annual limit for the public and the actual releases during normal operation. EDF proposes that these “authorized release limits” are an enforcement requirement for dose constraints for the public.

In practice, the plant easily complies with the “authorized release limit”, since in 2020, the limiting dose to a member of the public was 1E-4 mSv/year in 2020.

**IAEA comments:**

The plant reviewed the suggestion and attributed the gap to a lag between the publication of the International Commission on Radiation Protection ICRP 103 in 2007 and GSR Part 3 in 2014, and the implementation of the new requirements, in the national regulations, in June 2018. Within the corporate organization, the target for implementation was set for January 2022. At the time of the Pre-OSART, in July 2019, the plant was aware of the upcoming requirements and intended to create dose constraints for occupational exposure, although it had not yet formulated an action plan.

Once corporate requirements were specified in 2020, the plant implemented an action plan to create occupational dose constraints. A radiation protection advisor had been given the responsibility to create dose constraints for the employees.

The effectiveness of the action plan will be verified at a later stage as there are currently no radiological risks on site. However, in 2021 the plant put into place dose constraints for plant workers who are seconded to other nuclear installations. Only one employee exceeded the dose constraints in 2021 and this led to a reassessment of his assignments. This verified that the programme has been implemented successfully. In 2021, an update to the annual dose constraint was established for each employee of the plant for 2022.

Regarding the dose constraints for public exposure due to radiological releases, the plant had proposed that the optimized ‘authorized release limits’ issued by the regulator are an enforcement requirement for dose constraints. In 2020, the actual releases from the plant have met the ‘authorized release limits.’

**Conclusion**: Issue resolved.

## 7.3. RADIATION WORK CONTROL

**7.3(a) Good Practice:** Optimization of the design to improve occupational exposure and the effectiveness of RP facilities.

Since the beginning of construction of FLA3, the radiation protection group has analysed the way work will be carried out in the RCA and has requested several design changes to optimize radiation exposure during operation and outages. Some of the examples include:

- Installation of five portal monitors C2 and three small object monitors CPO at the exit of the RCA instead of six portal monitors C2 and two small object monitors. This modification improves the flows at the exit of the RCA and reduces the background of interference of portal monitors.
- The installation of a container full of RP equipment in the extension of the fuel building. The equipment is used to check the fresh fuel upon arrival.
- The C1-RB portal monitors were relocated at the exit of the airlock at 19.5m to maintain good contamination control.
- A room was repurposed for decontamination at the exit of the RCA.
- The water filter transfer machine adapted from Konvoy initially lacked a system to ensure negative pressure during transfers. The plant requested a system modification to deal with this inadequacy.

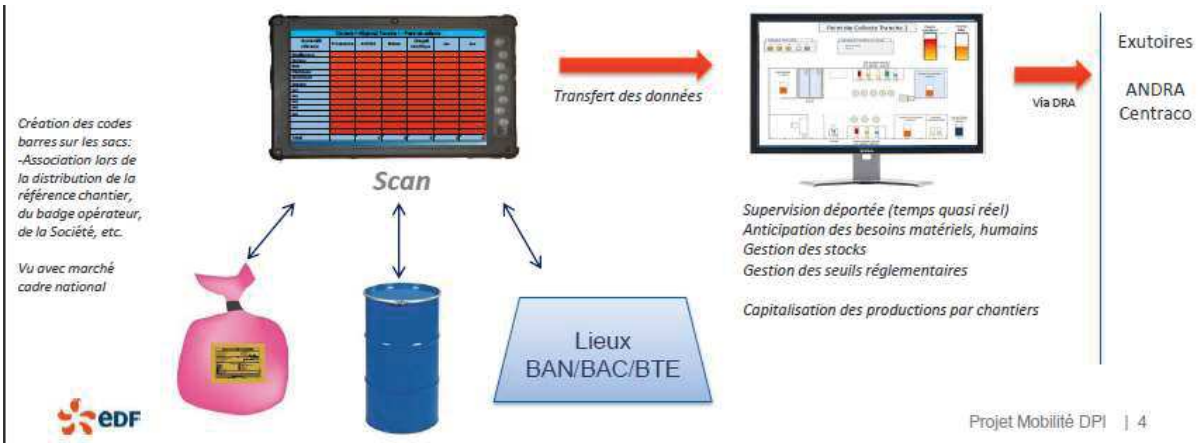
Benefits:

The design changes allow better workflow, shorter intervention times, improved radiological conditions, better contamination control and more efficient entry and exit from the RCA.

As a result of the design changes, the modified equipment, facilities, and layouts provide noticeable improvement in the usability of the installations. This will lead to shorter stay time in high radiation areas, better shielding, and more efficient workflow resulting in reduced occupational exposure.

7.6. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

**7.6(a) Good Practice:** The plant has implemented a bar-code system that tracks radioactive waste from the point of generation to the eventual disposal site. The system is called WasteApp.




At each work site, the person in charge sorts and puts the radioactive waste in bags labelled with a bar code. A tablet allows this person to scan the bag and enter information regarding the person who bagged the waste, the location of the work site, the number of the work permit, the type of waste in the bag, the dose rate on contact with the bag.

Bagged waste is then compacted into drums. Each drum is identified with a bar code. The operator uses a tablet to scan the drum and scan each bag put into the drum. Ultimately, each shipment to the ANDRA disposal site can be tracked by bar code and the full history of the waste stored at the site can be retrieved.

All of the Intermediate-Level Waste, Low-Level Waste and Very-Low-Level Waste packages (including waste bags and other types) are tracked by the application. The system provides information on where they were produced, processed, and stored (such as Nuclear Auxiliary Building, Auxiliary Waste Conditioning Building, Waste Treatment Building, Very-Low-Level Waste storage area, ANDRA).

This system allows the plant to comply with the administrative and regulatory requirements related to tracking the content of radioactive waste in an effective and efficient manner. It reduces the administrative burden associated with these tasks.

**Benefits:**

The system provides real-time information on the quantity of waste produced, where it is currently stored, and what it contains.

The plant can gather OPEX on the quantity of waste generated by each type of intervention on the plant's systems.

It is also possible to track the inventory of bags, containers, drums and order more when the inventory falls below a threshold.

**7.6 (1) Issue**: The plant's process for reporting effluent releases does not include the assessment and reporting of uncertainties to convey the quality of the results and significance of the releases.

The team noted the following:

- The plant plans to report effluent releases (activity released per month or year) without uncertainties but environmental media results (activity in air per cubic meter, activity in water per litre) will be reported with uncertainty.
- During the commissioning of the stack monitoring system, the plant is not planning to carry out tests to measure the line losses and other key parameters that define the overall uncertainty of the system. The sampling efficiency of a stack monitoring system is determined by measuring the recoveries of various test reagents injected into the stack.

Without assessing and reporting the uncertainty associated with effluent releases, the interpretation of monitoring results and dose assessment procedures may not accurately capture the quality of the results and significance of the releases.

**Suggestion:** The plant should consider assessing all sources of uncertainties associated with the effluent releases, and report the uncertainty associated with effluent releases.

**IAEA Bases:**

GSR Part 3 Requirement 14

Registrants and licensees and employers shall conduct monitoring to verify compliance with the requirements for protection and safety.

RS-G-1.8, Table 6

MONITORING QUANTITIES AND MEASUREMENT GUIDANCE include

- Gamma dose rate at the source;
- Gases in released air;
- Aerosols in released air;
- Activity in released water;

RS-G-1.8

6.35. The uncertainties in monitoring results should be determined with account taken of uncertainties in sampling and measurement procedures, including the uncertainties in sample processing parameters and equipment calibration, and they should be reported together with the monitoring results. The uncertainties in monitoring results should be taken into account in dose assessment procedures and in the interpretation of monitoring data.

**Plant Response/Action:**

During the Pre-OSART carried out in 2019 at the Flamanville 3 site, the process of determining uncertainties had not started. The cause of the deviation corresponds to a postponement of the deadline for the studies and activities planned for the commissioning of the gaseous effluent monitoring system.

As of December 2021, the regulatory monthly register sent to ASN does not include the uncertainties associated with the values of liquid and gaseous discharges.

Regarding liquid discharges, article 3.2.6 II of "Decision No. 2017-DC-0588 of the Nuclear Safety Authority of 6 April 2017 relating to the methods of water withdrawal and consumption, of discharge of effluents and environmental monitoring of pressurized water nuclear power reactors" requires the inclusion in the effluent register of total uncertainties associated with the emission values of liquid discharges T, S and EX.

The global action plan to respond to article 3.2.6 of ASN decision No. 2017-DC-0588 is managed by Corporate. Currently, the Flamanville site (like the entire fleet) is preparing an action plan for compliance with the two paragraphs of article 3.2.6 of ASN decision n ° 2017-DC-0588. This action plan is carried out by Action Cameleon A0000222929 for the Flamanville site which is entitled "Take into account article 3.2.6 DMOP in the 'SIRENe' application: Measurement of KER, TER and SEK discharge rates with uncertainty less than 10%" (due on 31-Dec-2021), and by the deployment of version 1.3 of the 'SIRENe' application (no due date to date).

Regarding gaseous emissions, measurement and sampling uncertainties are currently evaluated in the 'SIRENe' application and made available to ASN.

As part of the commissioning of the Flamanville 3 EPR reactor, the following activities will be completed before fuel loading (Q4 2022):

- An assessment of the measurement and sampling uncertainties for gaseous discharges, in accordance with article [EDF-FLA-200] of ASN decision No. 2018-DC-0640:
  - Measurement uncertainties are carried by procedures drawn up by Corporate EDF entities.
  - Sampling uncertainties are carried by procedures drawn up by Corporate EDF entities. The sampling uncertainty values for FLA3 are currently being determined.
- Demonstration of the representativeness of the sampling points in the gaseous effluents, in accordance with Article 5 of "ASN Decision No. 2018-DC-0640 of 19 July 2018 - setting the requirements relating to the methods of sampling and consumption of water, effluent discharge and environmental monitoring of basic nuclear installations n ° 108, n ° 109 and n ° 167 operated by Électricité de France (EDF) in the municipality of Flamanville".

**IAEA comments:**

As of Q4 2021, the plant did not report the uncertainty associated with the liquid and gaseous effluents.

The plant identified that the root cause for the gap identified by the Pre-OSART mission was related to delays in compliance with new regulatory requirements for liquid effluents, and delays in the supporting analyses and activities related to the commissioning of the gaseous effluent monitoring system.

Regarding the liquid discharges, the plant received a regulatory order in 2017, requesting that the plant reports the uncertainty, along with the value of the liquid effluents.

Regarding the gaseous effluents, the measurement and sampling uncertainties for operating plants are currently evaluated in the 'SIRENe' application and made available to the regulatory authorities. The parameters for Flamanville 3 had not been entered in the 'SIRENe' application. In addition, corporate received a regulatory order in 2018, requesting an analysis demonstrating that the gaseous sampling system was representative.

The action plan consists of continuing the implementation of the compliance activities related to new regulatory requirements for liquid effluents and gaseous effluents. The plant, with the support from corporate organization will complete the analyses and commissioning activities for the gaseous effluent monitoring plant before fuel loading planned in Q4 2022.

The progress to date includes the following activities:

- An activity related to the uncertainty for the discharge rate of the liquid effluent is on-going and had to be completed by 31-Dec-2021.
- An update to the 'SIRENe' application by the corporate organization will be required to report the value and the associated uncertainty for the liquid effluents. There was no due date for this update.
- The analysis demonstrating the representativeness of the gaseous sampling system was ongoing and will be completed before fuel loading.
- The analyses and commissioning activities for the Flamanville 3 gaseous sampling system were ongoing and will yield parameters for the 'SIRENe' application before fuel loading.

**Conclusion**: Satisfactory progress to date

# 8. CHEMISTRY

## 8.2. CHEMISTRY PROGRAMME

A chemistry manual is available at the plant as the basis for all the plant-specific chemistry parameters. To reduce dose from colbalt-60 on component surfaces during operation, zinc-injection is performed. This covers surfaces with a special stable oxide layer (spinel) which will prevent cobalt build-up at the surface of the components during normal operation, and thereby minimizes the dose. The team recognized this as a good performance.

The team noted that the plant policy for labelling hazardous chemical substances and systems is not always consistently applied to prevent adverse effects on industrial safety or the condition of equipment. For example, some bottles, containers containing fluids and pipes were not labelled correctly. The team made a suggestion in this area

## 8.3. MANAGEMENT OF CHEMISTRY DATA

The team noted the plant practice to manage chemistry related records does not always ensure their integrity. For example, during commissioning, analysis results were not documented in the plant chemistry electronic documentation system but in handwritten notes. Several records have been partly over-written or corrected with eraser. The team encouraged the plant to improve in this area.

## 8.4. CHEMISTRY SURVEILLANCE AND CONTROL PROGRAMME

Management of the chemistry surveillance and control programme is also facilitated by the database in which the specifications from the chemistry handbook are stored.

In chemistry, all the necessary analysis equipment is available as well as all the necessary regulations and instructions. The plant introduced an additional monitoring programme during the start-up phase. The team recognized this as a good performance.

## 8.5. LABORATORIES AND MEASUREMENTS

The team noted the plant capability to take post-accident gaseous and liquid sampling is not fully established to support assessment of plant conditions in case of emergency situations. For example, the procedure for taking samples during a severe accident does not provide clear instructions. There is no shielding or glove box installed for protecting the chemistry personnel while they take samples in potentially high dose rate situations. There is no facility to dilute the sample to reduce the dose rate. No training for post-accident sampling has been performed. The team made a recommendation in this area.

## DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY PROGRAMME

**8.2(1) Issue:** The plant policy for labelling hazardous chemical substances and systems is not always consistently applied to prevent adverse effects on industrial safety or the condition of equipment.

The team noted the following:

- The pipes are marked differently in the chemical injection room: the pipes are labelled 'peroxide' and the corresponding fittings are labelled 'hydrazine'. Hydrazine is transported in the pipes. The system has not yet been transferred to the plant.
- a bottle containing a diluting solution was not labelled with the date of preparation;
- a bottle containing sulphuric acid was not labelled correctly;
- a bottle containing solution prepared for analyses was not labelled correctly;
- a bottle containing hydrochloric acid was not labelled with the date it was opened;
- Some bottles used to prepare a preliminary test and stored in a small box had partially completed labels;
- Between the diesel generator building and the fuel building (opposite the entrance to the diesel building) some containers with diesel fuel waste were stored. The containers did not have the correct hazard labelling in accordance with plant rules;
- A tank intended for ethanolamine was labelled with morpholine and ethanolamine. The system had not yet been handed over;
- Hydrazine is stored in a chemical storage cabinet, but the cabinet is not connected to the ventilation system or to an active carbon filter system.

Without strict application of the policy for labelling hazardous chemical substances and systems, adverse effects on the safety of personnel and equipment may occur.

**Suggestion:** The plant should consider reinforcing the application of the policy for labelling hazardous chemical substances and systems to ensure the safety of personnel and plant equipment.

**IAEA Bases:**

SSG-13

2.9. Management of the operating organization should periodically evaluate the activities of the chemistry programme by carrying out walkdowns of chemistry facilities and checking plant chemistry equipment. Managers responsible for chemistry programme activities should monitor those indicators of staff behaviour and attitudes that show the development of a strong safety culture (e.g. proper attention to alarms, timely reporting of malfunctions, minimization of backlog of overdue maintenance, adequate labelling, accurate recording of data).

9.12. Staff involved in receiving, storing, transporting and using chemical substances should be trained to understand storage compatibility, labelling requirements, handling, safety and impacts on structures, systems and components at the plant (see Section 8).

9.13. Management should periodically carry out walkdowns of the plant to evaluate the effectiveness of the chemistry programme and to check for uncontrolled storage of chemicals.

9.15. Chemicals should only be stored in an appropriate store that is fire protected and captures spillages and which is equipped with a safety shower, as required. Oxidizing and reducing chemicals, flammable solvents and concentrated acid and alkali solutions should be stored separately. Tanks containing chemicals should be appropriately labelled. Reasonably small amounts of chemicals can be stored in other controlled environments in the workshops or operational department.

**Plant Response/Action:**

During the mid-2019 assessment, several findings highlighted that the provisions implemented by the site were not sufficient to guarantee the proper and systematic application of the policy of labelling hazardous chemicals and identification systems, to ensure the safety of staff and equipment.
The issue has been analyzed and came up with the following underlying cause: policy implementation was not consistently applied.

To remove this cause, the site has implemented the following actions:

For chemicals stored in the laboratory:

- Since 2020, improvement and implementation of the labelling system of prepared solutions to facilitate quality assurance (calibration solutions, reagents, effluents and effluent from laboratory equipment): generic labels are pre-populated with the names of the reagents, concentrations and associated risks for each solution, with the operator adding the date of preparation and validity of the solution.
- Internal controls and periodic field inspections on the compliance of labelling products in the laboratory.
- Awareness actions by the Chemistry team, whenever necessary, according to feedback from internal controls and field inspections.
- The common laboratory recently commissioned for all three units aims to ensure that chemistry practices are consistent.

For chemicals stored on-site, outside of the laboratory:

- Since the beginning of 2020, monthly field inspections by the risk prevention group to monitor the cabinets of chemicals used by the operator’s departments (maintenance, operations, warehouse, chemistry) for periodic checks and support for their proper implementation,
- Since 2020, chemical risk has been incorporated into the regular field inspections on the worksite, including storage areas of contractors, carried out by the plant environmental team. Labelling of stored chemicals is checked during these inspections.

For equipment carrying chemicals (pipes and tanks):

– Since June 2020, review of the compliance of equipment labelling (pipes and tanks) in all industrial buildings under the CLP (hazardous products management) regulations and implementation of a plan to correct non-compliant labelling, according to the following schedule:

  - 1st perimeter: compliance of labels in the fuel building [HK] (labels at "eye level", that is, visible without any scaffolding);
  - 2nd perimeter (priority): compliance of pipes carrying dangerous substances (hydrogen, oxygen, concentrated chemicals, oils and dangerous hydrocarbons) in all other industrial buildings (HN, HM, HL, HQ, HR, etc.). These first 2 perimeters are in the process of being completed with a completion rate of 70%.
  - 3rd perimeter: bringing labels into compliance (at "eye level") on other systems where the risk has been overstated, with a target for completion by the end of 2022.
  - 4th perimeter: bringing "non-eye level" labels into compliance, carried out when relevant during maintenance activities.

To measure the effectiveness of this action plan, the plant has established and monitored an indicator since 2020, with the following results: in a 2-year period, the number of deviations on chemicals labelling has decreased by 40% from 68 to 46.

**IAEA comments:**

The plant developed and implemented a policy and a process for handling of chemicals, however the application of the policy and use of the process, specifically labelling of hazardous chemicals and identification chemistry systems, was not consistently applied by the plant personnel and contractors at the time of the Pre-OSART mission. This was identified by the plant as an underlying cause that led to the suggestion made by the Pre-OSART team. The plant management reinforced its expectations for the handling of chemicals by communicating them to the plant staff and contractors and making efforts to ensure that these expectations were well understood.

To support this undertaking the plant developed a procedure for labelling chemicals in laboratories and consistently, via weekly meetings, made the relevant personnel aware of a change and provided coaching in the use of the new practice. The plant introduced a practice of periodical field inspections on the use of chemicals in the laboratories within the process on 'Technical checks'.

Additionally, the plant introduced regular inspections by the risk prevention group focused on monitoring of industrial and storage areas, specifically, on the labelling of stored chemicals and cabinets of chemicals used by departments (maintenance, operations, warehouse, and chemistry) and contractors.

To ensure that chemistry equipment and systems (pipes and tanks) were identified according to the plant expectations, the plant implemented an action plan to correct non-compliant labelling, using a priority based on potential safety implications.

The plant indicators demonstrate significant decrease in number of deficiencies related to handling of chemicals. During the plant tour the team observed the plant practices for handling hazardous chemicals and did not find deviations from the plant standards.

**Conclusion:** Issue resolved

## 8.5. LABORATORIES AND MEASUREMENTS

**8.5(1) Issue:** The plant capability to take post-accident gaseous and liquid sampling is not fully established to support assessment of plant conditions in case of emergency situations.

The team noted the following:

- The plant has a system for taking gaseous samples after an accident, however the equipment for taking samples is not available in Flamanville 3 but stored on NPP Chinon site, which is about 400km away.
- The procedure for taking liquid samples during a severe accident does not provide clear instructions on taking samples:
  - Instructions how to transport sampling equipment to the sampling point for liquid samples two floors below the ground.
  - There is no shielding or glove box installed for protecting the chemistry personnel while they take samples.
  - There is no facility to dilute the sample to reduce the dose rate.
  - A brochure with the functions of the sampling system after accidents is available, but detailed plans have not been prepared for the sampling chemistry personnel.
- No training for post-accident sampling has been conducted.

Without a fully established post-accident gaseous and liquid sampling capability, the assessment of plant conditions in case of emergency could be challenged.

**Recommendation:** The plant should establish the capability of post-accident gaseous and liquid sampling to support assessment of plant conditions in case of emergency situations.

**IAEA Bases:**

GSR Part 7

6.28. The operating organization and response organizations shall identify the knowledge, skills and abilities necessary to perform the functions specified in Section 5. The operating organization and response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel selected have the requisite knowledge, skills and abilities to perform their assigned response functions. The arrangements shall include arrangements for continuing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities in an emergency response undergo the specified training

5.32. The operating organization of a facility in category I, II or III shall make arrangements to promptly assess and anticipate:

(a) Abnormal conditions at the facility;

(c) Radiological conditions on the site and, as appropriate, off the site;

SSR-2/1 (Rev.1)

Process sampling systems and post-accident sampling systems

Process sampling systems and post-accident sampling systems shall be provided for determining, in a timely manner, the concentration of specified radionuclides in fluid process systems, and in gas and liquid samples taken from systems or from the environment, in all operational states and in accident conditions at the nuclear power plant.

6.31. Instrumentation and recording equipment shall be provided to ensure that essential information is available for monitoring the status of essential equipment and the course of accidents, for predicting the locations of releases and the amounts of radioactive material that could be released from the locations that are so intended in the design, and for post-accident analysis.

SSR-2/2 (Rev.1)

5.5. A training programme for emergencies shall be established and implemented to ensure that plant staff and, as required, staff from other participating organizations possess the essential knowledge, skills and attitudes required for the accomplishment of non-routine tasks under stressful emergency conditions.

5.7. Facilities, instruments, tools, equipment, documentation and communication systems to be used in an emergency, including those needed for off-site communication and for the accident management programme, shall be kept available. They shall be maintained in good operational condition in such a manner that they are unlikely to be affected by, or made unavailable by, accidents. The operating organization shall ensure that relevant information on safety parameters is available in the emergency response facilities and locations, as appropriate, and that communication between the control rooms and these facilities and locations is effective in the event of an accident [2]. These capabilities shall be tested periodically.

SSG-13

6.33. Industrial safety (provision of fume hoods for ventilation, appropriate storage of flammable solvents and hazardous materials, and flammable and other gases, and provision of safety showers for personnel, as well as personal protective equipment and first aid kits) and radiological safety (proper radiation shielding and contamination control facilities) should be ensured. All laboratory and work practices should be carried out in accordance with industrial safety standards and the principle of optimization of protection (and safety) [3, 14].

6.43. A post-accident sampling system or other adequate sampling facility should be ready to operate when required by emergency procedures and should also be considered for use in taking regular samples from plant systems. If a post-accident sampling system does not exist, other approaches should be adopted for core damage evaluation and for estimation of the inventory of fission products released into the containment.

SSG-25

5.124. The review should examine the following types of procedures:

- Operating procedures for normal and abnormal conditions (including anticipated operational occurrences, design basis accident conditions and post-accident conditions);

6.44. For proper operation of a post-accident sampling system, the following should be provided:

(a) Operating procedures for the post-accident sampling system.

(b) Radiation protection measures for personnel who carry out sampling and analysis; such measures should be evaluated in advance and applied when the post-accident sampling system is used.

(c) A programme for preventive maintenance;

(d) Regular checks of the operability of the post-accident sampling system;

(e) Regular training of personnel designated for operation of the post-accident sampling system (i.e. personnel taking grab samples and performing subsequent activities);

(f) Specification of the chemistry parameters to be monitored (e.g. conductivity in the reactor water clean-up system and gaseous fission products in the main steam system);

(g) Procedures for optimizing occupational radiation exposure.

8.8. Consideration should be given to training facilities and methods that are widely used and which have been proven to be effective in attaining the training objectives when appropriately chosen. Such proven facilities and methods include the following:

(b) On the job training should be conducted in accordance with written operating procedures for activities such as taking samples, controlling of water treatment technologies, using an on-line chemistry station, fixing deficiencies in on-line and off-line equipment, performing regular minor maintenance on on-line equipment and laboratory instruments, and using the post-accident sampling system.

SSG-28

A.2. The following activities and checks should be considered for completion before fuel loading:

- Availability of a post-accident sampling system;
- Availability of a post-accident radiation monitoring system;

SSG-39

8.19. “Instrumentation and recording equipment shall be provided to ensure that essential information is available for monitoring the status of essential equipment and the course of accidents, for predicting the locations of releases and the amounts of radioactive material that could be released from the locations that are so intended in the design, and for post-accident analysis.”

8.21. The set of displays for monitoring accident conditions is usually called an ‘accident monitoring system’ or a ‘post-accident monitoring system’. Such displays may be provided as part of another system or may be a collection of individual instrument channels.

**Plant Response/Action:**

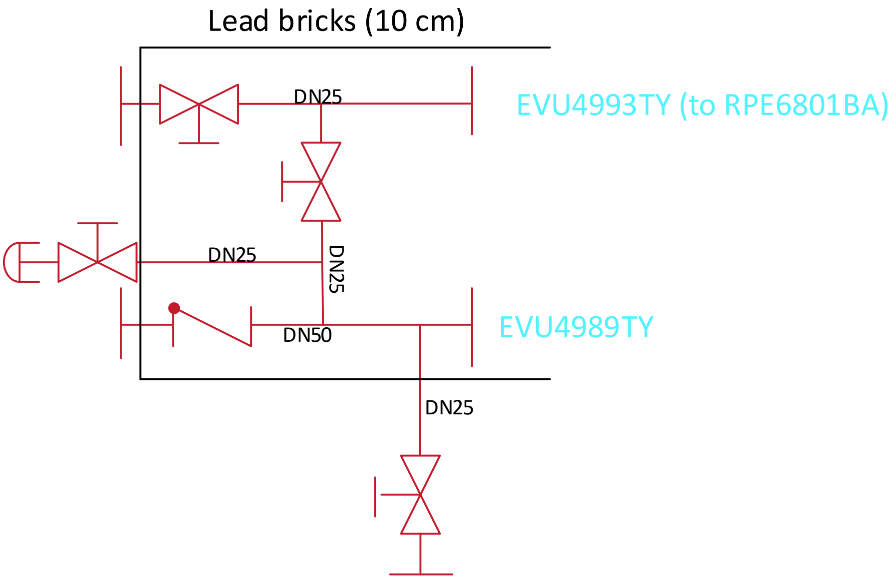
In order to take gas samples in post-accident situations, EDF’s organization on the management of post-accident sampling prescribes the availability of pooled equipment for gas sampling, given the time frames allowed in such situations (intervention 30 days after an accident).

Therefore, for taking liquid samples in post-accident situations, to make it fully compatible with the procedures in use (dosimetry, staff safety and representativeness of the sample), a modification to the facility was adopted and validated following the Pre-OSART. This responds to the recommendation in two stages, for reasons of compatibility with the unit configuration: provisional measures for the start-up of the facility will be in place before the fuel loading and a permanent modification will be carried out during the first outage.

Provisional modification to the facility:

Interim start-up provisions are being considered as part of a modification to the facility. Incorporation of the modification on site has been approved and is planned for August 2022, so it will be available for loading.

This interim modification consists in upgrading a line on the CHRS [EVU] ultimate heat removal system, used for re-injection of CHRS effluent in the event of an accident. As part of this modification, new lines with valves, quick couplings and biological shield devices will be added to the facility:




Basic flow diagram of the provisional modification

These provisions meet the following requirements:

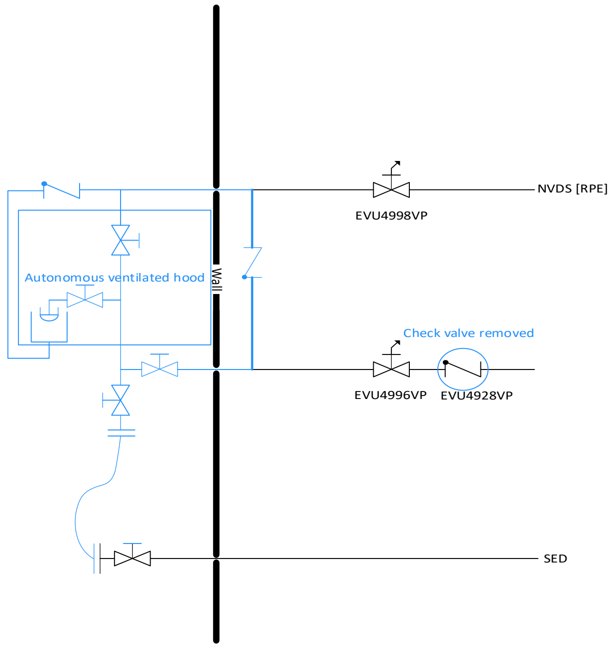
– Representativeness of primary effluent sampling in all post-accident situations for design basis accidents and severe accidents, by the installation of a line for recirculation of CHRS effluent to the NVDS [RPE] (effluent collection system),
– Guaranteed accessibility of the facilities via access only to room no. HLF1101ZL in the radiologically controlled area with the permanent sampling facilities,
– Limiting dose uptake by workers to acceptable values by installing lead brick biological shields just above the lines added and by connection to the demineralised water makeup system SED to allow dilution of the sample and rinsing of the lines after intervention.

The operational worksheet with a detailed diagram of this facility will be described by the end of 2021 in the procedure for the plant operator's chemists.

The ability to take samples under these new provisions will be tested by October 2022 to confirm the performance of the system as well as to train the chemistry staff in taking these samples. Following that, tests with the unit in power operation will periodically check the functionality of the system.

Permanent modification to the facility:

A permanent design provisions to further optimize radiation protection and safety during sampling has been identified and approved by the FLA3 project management decision-making committees. The modification has been described in principle (note FA3-DITSCV-2021-FR-0123), pending formalization in the modification process after start-up. Detailed studies are being carried for incorporation of the modification during the first outage (VC1).




Basic flow diagram of the modification

With the temporary modification that will be in place for the fuel loading and a permanent modification expected during the 1st outage, the plant considers the issue as resolved.

**IAEA comments:**

In response to the issue the plant has performed an analysis supported by the EDF corporate engineering organization and came up with a solution to modify the system for taking samples in post-accident situations considering dosimetry, staff safety, and representativeness of the samples. The design of the modification was complete and approved and the plant had implemented most of the modification.

The modification involves two stages of implementation: first prior to the first fuel loading and the second during the first outage. The plant performed all the necessary analyses on the dose rates and potential dose for the personnel involved during design basis accidents and severe accidents. The results demonstrate compliance with the permissible values associated with these conditions.

The first stage modification to make the system for sampling operable was being implemented and involved personnel training and validation of the testing procedures. As of February 2022, the plant will be able to take samples and make the necessary analysis. The impact of the Covid pandemic had delayed the implementation but evidence was provided to conclude that all the necessary implementation measures were in place.

The second stage of modification of the sampling system aimed at optimising the radiation protection and safety during the sampling process will be finalized during the first outage. The plant first fuel loading date for the reactor had been changed from late 2022 to second quarter 2023.

**Conclusion:** Issue resolved

# 9. EMERGENCY PREPAREDNESS AND RESPONSE

## 9.2. EMERGENCY RESPONSE

The team observed that arrangements for assembly and evacuation of on-site personnel during the emergency are not comprehensive to ensure effectiveness under all postulated situations. For instance, the team found that routes to assembly points are not signaled, these points are located in storage and warehouse areas, where heavy equipment is stored very close by, no key box is available to place the emergency equipment cabinet keys, a minimum number of buses to use during an evacuation is not ensured and there is no time estimate for the arrival of buses and effective completion of the evacuation. The team made a recommendation in this area.

The team observed that the approach to assess the radiological consequences of accidents and adapt the protection strategy is not always consistent with the graded approach defined in IAEA standards. The team found that no criteria based on effective dose are used to define different radiological emergency categories and determine the possibility of terminating the emergency and, therefore, operational intervention limits cannot be adapted, based on prevailing conditions. In addition, guidance to prioritize resources, based on the status of the different units, and guidance to shut down unaffected units, as applicable, are not available. The team made a suggestion in this area.

The team found that a dedicated taskforce is available to provide support to the plant in the event of a severe accident, ensuring the deployment of a minimum capability in terms of means and personnel within 24 hours from the accident. This taskforce is made up of different groups who periodically train on different sites of the fleet and are also integrated in the operating organization. The different groups of this taskforce are periodically trained on different fleet sites, and spend time integrated in the operating organization as well. The team considered as a good performance.

The team found that the authorities have delegated to the plant the responsibility to activate the off-site plan in case of an emergency potentially involving early radiological releases. Thus, the population surrounding the plant is alerted to stay at home and to listen to the news on the media. The team considered this as a good performance.

The team found that there is a maximum activation time of two hours for the emergency response organization at corporate level. The team considered this as a good performance.

## 9.3. EMERGENCY PREPAREDNESS

The team observed that the training, drill and exercise programme does not cover all aspects of activation and coordination of the Emergency Response Organization. For instance, the team found that only one exercise involving the isolation of the plant has been performed, and it lasted only 4 hours; activation tests are always performed during working days from 7pm to 8pm; there is no individual requirement for personnel to participate in mobilization drills; the participation requirements do not distinguish between the “in function” and the “not-in-function” roles and no process is established to provide training when response implementing procedures are revised. The team made a suggestion in this area.

The team observed that administrative checks and arrangements are not always sufficient to ensure that resources, in terms of personnel on call and emergency documentation, remain adequate at all times. For instance, the team found that there is no requirement to warn the

Emergency Director when a person on call is not reached during an activation test; no specific criteria are in place to ensure fitness for specific emergency response duties assigned to personnel; and no procedure is in place to contact relatives and provide them with detailed information on emergency workers' health status. Furthermore, no forms are in place to record the replacement of emergency response implementing procedures and to record the hand-over of the folder containing the procedures that key positions on call must have at all times. The team made a suggestion in this area.

The team found that the site has an emergency response centre that provides protection for emergency responders against a wide spectrum of adverse conditions, including high radiation levels and earthquakes. This centre is intended to store portable equipment used to support the operational response, therefore, minimizing the movement of personnel throughout the site. The team considered this as a good practice.

The team found that badge readers are available in the assembly points to control not only the arrival of personnel to the point but also their departure. This facilitates the traceability of personnel during movements, for instance, for evacuation. The team considered this as a good performance.

The team found that a truck is available on-site for rescue and initial response teams to set a command post in the field and perform firefighting, first aid provision, and other required actions. The team considered this as a good performance.

## DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

### 9.2. EMERGENCY RESPONSE

**9.2(1) Issue:** Arrangements and means for assembly and evacuation of on-site personnel are not comprehensive to ensure effectiveness under all postulated emergency conditions, including during early stages of an emergency.

The team noted the following:

- A survey of 10 people on the subject of emergency alarms yielded the following results:
  - None were able to identify the general site alarm from memory;
  - 4 out of 10 did not realize the information is available on their badges;
  - 6 out of 10 were not able to identify the closest assembly point, although they all know the biggest one, usually utilized in drills.
- Currently, there are no signs in the construction area indicating the way to assembly points.
- The four assembly points on-site for Flamanville 3 are located in either workshop or warehouse areas, storing heavy electrical and mechanical equipment, with low isolation capacity, and without fixed radiation monitors to ensure continuous monitoring at all moments; in 2 of the 4 assembly points, materials were found in front of or by the cabinets with emergency equipment and the badge readers; in 1 of the 4 assembly points, one device to detect contamination was missing.
- Assembly points are equipped with masks to limit (to a certain extent but not completely prevent) the ingestion and inhalation of particles; but no contamination protection clothes, delimiting and signaling tools, nor other means to prevent contamination spreading, nor spare batteries for electrical equipment, are available in the assembly points.
- Cases with cabinet keys are not available in the assembly points to ensure accessibility to emergency means stored in the cabinets.
- The inventory list in the assembly points does not include the water bottles and the toxicity masks. The frequency for checking emergency means in the assembly points is not established, and no official form with a checklist is available.
- The calibration of devices to check radiological conditions stored in the cabinets in assembly points is managed through a system to control the inventory of equipment and materials stored on-site, in accordance with a procedure which includes the requirement to warn the user of the device on-site of the need to return the device for calibration. However, currently, the person assigned in the system as the device user is not the person responsible for the devices (the emergency preparedness specialist).
- The minimum inventory list of medical assistance means was not defined at the time of the mission.
- The required surveillance frequency of emergency protective equipment for emergency responders is only once per year. It was stated that additional checks are to be performed before each exercise, but this instruction in not written in a procedure.

- No procedure exists defining the instructions for personnel to follow once an emergency alert is triggered.
- No expectation exists for personnel to take car keys with them when moving to assembly points following the triggering of the emergency alarm. As a result, if evacuation is warranted, personnel may need to come back for keys or take a bus to be evacuated.
- Personnel responsible for ensuring control and safety in assembly points are not assigned dedicated mobile communication devices (TETRA) to ensure communication in all circumstances.
- The time needed for the buses to arrive on the site in the event of evacuation has not been calculated and there is no specific procedure or agreement to ensure that a minimum number of buses is available to be deployed on-site.
- No evacuation drill involving the whole plant personnel has ever been performed, and partial evacuation drills include only moving personnel to a fallback centre within 7 kilometres from the plant, but not outside of the 10-kilometer planning zone.
- The fallback centre, intended for assembling the personnel evacuated from the site, is not equipped with means to avoid contamination spreading; no dedicated TETRA devices are stored for bus drivers to ensure communication and coordination during the evacuation.
- No specific protective equipment is pre-defined and pre-located for bus drivers to take when approaching the site to collect personnel during evacuation.

Without having comprehensive arrangements for assembly and evacuation of on-site personnel, these actions may not be performed in a prompt and effective way to minimize hazards.

**Recommendation:** The plant should improve the arrangements and means for assembly and evacuation of on-site personnel, to ensure their effectiveness under all postulated emergency conditions, including during early stages of an emergency.

**IAEA Bases:**

GSR Part 7

5.39. Within the emergency planning zones and emergency planning distances, arrangements shall be made for taking appropriate protective actions and other response actions effectively, as necessary, promptly upon the notification of a nuclear or radiological emergency. These arrangements shall include arrangements for:

(a) Prompt exercise of authority and discharge of responsibility for making decisions to initiate protective actions and other response actions upon notification of an emergency (see para. 5.12);

(b) Warning the permanent population, transient population groups and special population groups or those responsible for them and warning special facilities;

(c) Taking urgent protective actions and other response actions such as evacuation, restrictions on the food chain and on water supply, prevention of inadvertent ingestion, restrictions on the consumption of food, milk and drinking water and on the use of commodities, decontamination of evacuees, control of access and traffic restrictions;

(d) Protection of emergency workers and helpers in an emergency.

5.41. The operating organization of a facility in category I, II or III shall make arrangements to ensure protection and safety for all persons on the site in a nuclear or radiological emergency. These shall include arrangements to do the following:

(a) To notify all persons on the site of an emergency on the site;

(b) For all persons on the site to take appropriate actions immediately upon notification of an emergency;

(c) To account for those persons on the site and to locate and recover those persons unaccounted for;

(d) To provide immediate first aid;

(e) To take urgent protective actions.

5.42. Arrangements as stated in para. 5.41 shall also include ensuring the provision, for all persons present in the facility and on the site, of:

(a) Suitable assembly points, provided with continuous radiation monitoring;

(b) A sufficient number of suitable escape routes;

(c) Suitable and reliable alarm systems and other means for warning and instructing all persons present under the full range of emergency conditions.

**Plant Response/Action:**

The triggering of sirens and public address system messages is a priority action and occurs in the case of an emergency plan (PUI) situation that can lead to radiological releases (Radiological Safety PUI (SR PUI) and Climate and Similar Hazards Safety PUI (SACA PUI)). On hearing the sirens, all the staff present on the site go to the PUI assembly points that are spread out over the site. Each PUI assembly point is managed by an on-call staff member. At Flamanville, the on-call staff in charge of the assembly points are the resources command posts (PCM) 5.3 to PCM5.18. They are under the responsibility of PCM5, who is responsible for managing staff assembly on site and is an integral part of the "In Operation" resources command post of the Site Emergency Response Centre (CCL). PCM5 assesses the status of staff assembly by contacting the managers of the PUI assembly points and provides instructions to follow as the situation develops. If the Emergency Response Director decides to evacuate the staff, PCM5 and his deputy (PCM5.2) tell the assembly point managers what action to take.

However, the provisions implemented by the site were found to be not sufficient during the assessment at the end of June 2019 to ensure the protection and evacuation of staff, including in situations involving radiological releases. To reinforce these provisions, the site has taken the following 3 actions:

- Action 1: PUI assembly points brought up to standard in accordance with PUI specifications;
- Action 2: Signs put in place to enable all staff to identify the nearest PUI assembly point;
- Action 3: Update of the emergency response procedure and associated operating documents.

Progress with action 1:

There are 6 PUI assembly points on the Flamanville 3 site. Each area is managed by at least one PUI on-call team. Each area is equipped with the follow resources:

- A system for automatic counting of the assembled staff;
- Two land-line telephones on independent networks, one of which is electrically backed up by the unit's emergency generators;
- The site-wide public address system, which is electrically backed up by emergency generators;
- A megaphone in case of unavailability of the site-wide public address system;
- A radiation meter;
- A contamination meter;
- An active dosimeter;
- A passive dosimeter;
- Iodine tablets;
- FFP3 masks;
- An emergency response folder containing the documents needed by the on-call manager of the assembly point.

These resources allow the on-call PUI assembly point manager to take charge of the assembled staff in any situation. This manager has the procedures specific to each PUI and a direct telephone line to the resources command post (PCM) in charge of staff assembly across the entire site and coordination of the staff evacuation strategy if this is required.

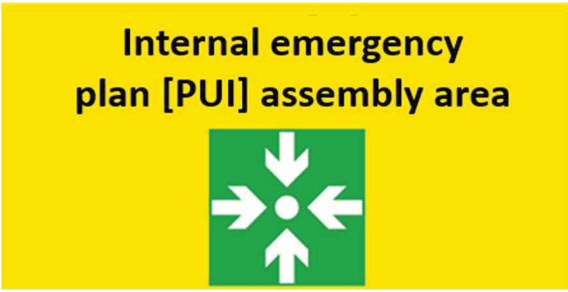
Checks on the equipment available in each PUI assembly point are carried out by the assembly point managers during drills. In the event of malfunction of an item of equipment, a Caméléon report is issued, and a corrective action is created (see example report C0000248082 and the associated action A0000225768). For radiation protection equipment, a monthly check is carried out in addition to the checks during drills and periodic regulatory inspections.

Progress with action 2:

In October 2020, following the implementation of the new FLA123 PUI, the layout of the PUI assembly points changed. Since that date, the site has 6 PUI assembly points. However, the signage was not sufficient to ensure that they could be easily located by someone working on the site. As a result, it was completely renewed.

First, a study was carried out to determine the location of the nearest PUI assembly point for each part of the site. Once this work was carried out, signs indicating the direction to follow to reach the point were installed (see image below).


At the entrance to each PUI assembly point, signs identifying them as such have been put in place (see image below).





Finally, in all site buildings, the safety instructions have been updated to include the location of the nearest PUI assembly point. In accordance with the Labour Code, these safety instructions are available in:

- all areas in which readily explosive, oxidising or flammable substances are handled or stored;
- all rooms that can accommodate more than 5 people;
- all areas or exit routes serving a group of rooms.

All the signs have been produced, received on the site and installed across the entire site.

Progress with action 3:

In addition to the previous two actions, the emergency response procedure and associated operational documents have been updated to incorporate the new staff evacuation strategy in connection with the National Response Plan (PNR) and the authorities' Civil Emergency Plan (PPI). The National Response Plan defines the following 3 specific situations for nuclear installations:

- Situation 1: Installation accident leading to an immediate and short-term release (<6h). There is a proven and almost immediate release of short duration, with moderate consequences likely to have an impact over areas of a few kilometres.
- Situation 2: Installation accident leading to an immediate and long-term release. There is a proven and almost immediate release lasting up to a few days or even a few weeks with potentially severe consequences likely to have an impact over areas that can reach 20 km or even more.
- Situation 3: Installation accident leading to a delayed and long-term release. There is the threat of a release, followed or not by a delayed release lasting up to a few days or

even a few weeks with potentially severe consequences likely to have an impact over areas that can reach 20 km or even more.

Depending on the situation, the site's response for staff protection is adapted to the authorities' response for staff protection.

For an accident falling within situation 1, the site has a delegation of power from the Prefect to require immediate sheltering in place over a predetermined perimeter within a radius of 2 km. The evacuation of site staff will only be initiated following a decision by the authorities and will be organised in consultation with them.

For an accident falling within situations 2 or 3, immediate evacuation must be prepared over a predetermined radius of 5 km around the NPP. This evacuation is ordered by the Prefect after a quick consultation with experts and the site. The conditions for success of this response are based on the following principles:

- The Prefect plans this response in detail in liaison with the municipalities concerned so that evacuation can be carried out as soon as possible (within a few hours).
- The Prefect takes care to define an operational perimeter of 5 km (+/- a few hundred metres) based on the realities on the ground.
- The Prefect, in liaison with the mayors of the municipalities concerned, then identifies the various populations in this perimeter, separating people who will be able to self-evacuate from those who will need evacuation support.
- The Prefect then sizes the support required in terms of both conventional and specific means of evacuation in liaison with the municipalities concerned, the Regional Health Agency (ARS), the Departmental Fire and Rescue Service and EDF.
- Within the defined perimeter, the Prefect lists each of the establishments likely to encounter special difficulties during evacuation (hospitals, retirement homes, etc.) and uninterruptible activities (chemical industry, furnaces, etc.) and for each of them, at the suggestion of the operator concerned, orders the best system to put in action.

The population is then evacuated to various population reception centres that will be chosen in liaison with neighbouring prefectures and the local prefecture, if possible, beyond a radius of 30 km around the NPP in order to alleviate the management of populations around the accident site. The evacuation of site staff will only be initiated following a decision by the authorities and will be organized in consultation with them.

This change in the evacuation strategy led to the withdrawal of the emergency fall back room and changes to the PUI action sheets for several PUI on-call team members, in particular the action sheet for PUI team member PCM5.2, in charge of preparing and coordinating staff movement away from the site and evacuation of the site. This procedure describes the tasks to be carried out to prepare site evacuation according to the 3 situations in the National Response Plan. Evacuation of site staff will only take place after consultation with the authorities and with their agreement.

**IAEA comments**:

In order to resolve the issue, the plant defined and implemented three sets of actions to improve the arrangements and means for assembly and evacuation of on-site personnel. These actions were: to ensure that all assembly points were correctly equipped, to improve the signing of routes to the nearest assembly point and to update the emergency response procedure and associated documents. The plant had also established monthly inventory and function checks on assembly point equipment and any deviations were recorded and actioned through the Caméléon system.

In addition, the site had carried out 21 emergency exercise drills since the Pre-OSART mission and the actions arising from these exercises have been used to further improve the evacuation of on-site personnel, under different postulated emergency conditions, including during early stages of an emergency.

The team noted that these actions were effectively implemented to resolve the issue and to respond to the supporting facts.

**Conclusion:** Issue resolved

**9.2(2) Issue:** The plant practices to assess the radiological conditions is not always comprehensive.

The team noted the following:

- There are two criteria to declare the emergency based on activities from process monitors, but there is no criterion based on radiation levels or total effective dose. In addition, the emergency classification system is not graded based on total effective dose estimates.
- Regarding the criteria to terminate the emergency, a criterion consisting in ensuring the releases are arrested is used, but there is no criterion based on residual dose.
- No written guidance exists on criteria to interact with unaffected units during the emergency.
- There is no written guidance in emergency response implementation procedures to prioritize resources in case of a multi-unit event.
- Regarding the capability to perform dose estimations, tables showing the effective dose due to releases for a wide spectra of accidents are available individually for each unit, but there is no capability on-site to perform an actual estimation based on process monitor readings and environmental surveillance data. This calculation is done at the corporate level, whose personnel are only required to be ready within two hours.
- No evidence of use of Probabilistic Safety Assessment Level 2 in the definition of postulated emergency events was provided.

Without having a comprehensive approach to assess the radiological consequences the prioritization of actions may not be realized in a timely manner.

**Suggestion:** The plant should consider improving the practices for assessment of radiological conditions.

**IAEA Bases:**

GSR Part 7

4.23. In the hazard assessment, facilities and activities, on-site areas, off-site areas and locations shall be identified for which a nuclear or radiological emergency could — with account taken of the uncertainties in and limitations of the information available — warrant any of the following:

(a) Precautionary urgent protective actions to avoid or to minimize severe deterministic effects by keeping doses below levels approaching the generic criteria at which urgent protective actions and other response actions are required to be undertaken under any circumstances, with account taken of Appendix II;

GSR Part 7

4.31. The government shall ensure that the protection strategy is implemented safely and effectively in an emergency response through the implementation of emergency arrangements, including but not limited to:

(f) Assessing the effectiveness of the actions taken and adjusting them as appropriate on the basis of prevailing conditions and available information as well as the reference level expressed in terms of residual dose;

GSR Part 7

5.14. The operating organization of a facility or activity in category I, II, III or IV shall make arrangements for promptly classifying, on the basis of the hazard assessment, a nuclear or radiological emergency warranting protective actions and other response actions to protect workers, emergency workers, members of the public and, as relevant, patients and helpers in an emergency, in accordance with the protection strategy (see Requirement 5). This shall include a system for classifying all types of nuclear or radiological emergency as follows:

(a) General Emergency;

(b) Site Area Emergency;

(c) Facility Emergency;

(d) Alert.

Note: The emergency classes may differ from those specified in (a)–(e) provided that emergencies of all these types are included.

GSR Part 7

5.58. Arrangements shall be made to assess as soon as practicable the individual doses received in a response to a nuclear or radiological emergency by emergency workers and helpers in an emergency and, as appropriate, to restrict further exposures in the response to the emergency (see Appendix I).

GS-G-2.1

4.17. OILs should be developed for radioactive releases and/or direct exposures resulting from emergencies involving facilities in threat categories I, II and III and for radiological emergencies, by using realistic assumptions and including arrangements to revise the OILs as appropriate to take into account the conditions prevailing during the emergency.

GSG-2

5.6. Reference [2], in para. 4.71, states that "arrangements shall be made for promptly assessing the results of environmental monitoring and monitoring for contamination on people in order to decide on or to adapt urgent protective actions to protect workers and the public, including the application of operational intervention levels (OILs) with arrangements to revise the OILs as appropriate to take into account the conditions prevailing during the emergency." In addition, para. 4.89 of Ref. [2] states that default OILs shall be established together with the means to revise the OILs for "environmental measurements (such as dose rates due to deposition and deposition densities) and food concentrations; the means to revise the OILs; timely monitoring...for ground contamination in the field; the sampling and analysis of food and water; and the means to enforce agricultural countermeasures."

5.10. The dosimetric models for developing the OILs should be established during the planning phase. These models should include a full set of parameters important for the purposes of decision making for dose assessment. For internal dose assessment and the development of corresponding OILs, the application of computer codes is necessary.

5.12. These default OILs should be developed on the basis of assumptions regarding the emergency, the affected population and the prevailing conditions; these assumptions, however, may not accurately reflect the emergency in question. Consequently, Ref. [2] requires that means be established to revise the default OILs to take into account prevailing emergency conditions. However, revising the OILs during an emergency may be disruptive, and they should therefore only be revised if the situation is well understood and there are compelling reasons to do so. The public should be informed of the reasons for any change in the OILs applied in an actual emergency.

Table 12. Emergency Classification for Light Water Reactors in Operating, Standby or Hot Shutdown Mode

**Plant Response/Action:**

Following the points identified by the IAEA expert, the site consulted EDF central services concerning our approach to the assessment of radiological consequences in relation to IAEA standards. In its reply by letter, reference D455021005545, EDF central services considers that the approach to the radiological consequences of the Flamanville 1, 2 and 3 emergency response organization is in line with the approach defined by the Standard Reference Document which is consistent with the National Response Plan (PNR). This National Response Plan sets out the responsibilities of plant operators and the authorities in managing a major nuclear accident in France. These documents have been approved by the authorities.

Indeed, the station has defined criteria to initiate the various PUIs. These criteria are generally identified by:

- the actual or potential damage to one or more safety functions which may lead to a degradation of the containment barriers damage and therefore, to radiological releases,
- and/or the proven significant degradation of the first and/or second containment barrier,
- and/or the detection of released radioactive materials exceeding, over a long period, the authorized limits in normal conditions.

The vast majority of the criteria to initiate a PUI are related to the state of the facility and are part of the operators' instructions. Therefore, in most cases, the PUI is initiated prior to any radiological release to the environment.

Additionally, once the PUI is initiated, some emergency response members are tasked with identifying the radiological releases that will take place and the protective actions to implement. In order to do this, they rely on various guidelines based on worst case scenarios with pre-established release calculations. These release calculations help calculate the effective dose and the dose to the thyroid that is likely to occur. They, therefore, allow the taking of the necessary measures to protect the personnel and the population (sheltering, evacuation, taking iodine tablets or wearing respiratory protection) in advance. These release estimates will then be adjusted using measurements in the environment and tools available to EDF's national emergency response organization.

In addition to this letter, the emergency procedure at the Flamanville site has been completely revised following a change in French regulations concerning the management of emergency situations for nuclear installations. During this revision, items were incorporated into the site

PUI to make a link between situations in the National Response Plan, typical accidents and the IAEA event scale. The table below can thus be found in the site PUI.

| **National Response Plan (PNR) situation no.** | **Name of the situation** | **Typical accidents** | **IAEA emergency scale** |
|---|---|---|---|
| 0 | Uncertainty, rumors of an accident, etc. | Accident not yet characterized | **Alert** |
| 1 | Installation accident leading to an <u>immediate and short-term release</u>:<br>From a nuclear installation (BNI), proven and immediate release (less than 1 hour after the start of the incident), with moderate consequences likely to have an impact over areas of a few kilometres (e.g. the civil emergency plan (PPI) area).<br>Possible activation of the PPI | • Steam Generator Tube Rupture (SGTR [RTGV])<br>• SLB + SGTR<br>• CVCS [RCV] tank rupture (liquid phase)<br>• GWPS [TEG] tank rupture<br>• Drop of a fuel assembly in the Reactor Building<br>• Drop of a fuel assembly in the Fuel Building | **On-site emergency situation**<br>(In some cases, general emergency situation) |
| | | • Steam Generator Tube Rupture (2-tube SGTR) [EPR]<br>• NSS [REN] line break [EPR]<br>• CVCS [RCV] line break [EPR]<br>• GWPS [TEG] failure [EPR]<br>• Multiple failure of nuclear auxiliary building [BAN] / effluent treatment building [BTE] / LRMDS [KER] tank / ExLWDS [TER] following an earthquake [EPR] | |

| National Response Plan (PNR) situation no. | Name of the situation | Typical accidents | IAEA emergency scale |
|---|---|---|---|
| 2 | Installation accident leading to an immediate and long-term release:<br>From a nuclear installation (BNI), proven and immediate release (less than 6 hours after the start of the incident), lasting up to a few days or even a few weeks with potentially severe consequences likely to have an impact over areas that may exceed that of a PPI.<br>Activation of the PPI | • Primary circuit break – 100% clad failure<br>• Primary circuit break – 100% core meltdown<br>• S3 – U5 release by the sand filter | **General emergency situation** |
| 3 | Installation accident leading to a delayed and long-term release:<br>From a nuclear installation (BNI), a threat of a release followed or not by a delayed release (more than 6 hours after the start of the incident), of long duration (up to a few days or even a few weeks), with potentially severe consequences likely to have an impact on areas that may exceed that of a PPI.<br>Activation of the PPI | • Primary circuit break with or without damage to the fuel.<br>• Loss of cooling of the fuel building pool | **General emergency situation** |

This change is also reflected in the operating documents of the on-call staff concerned by this development. The accident follow-up message in the event of a Radiological Safety PUI (SR

PUI) or Climate and Similar Hazards Safety PUI (SACA PUI) has been updated to provide a link between the National Response Plan reference situation, the INES severity scale and the IAEA classification. As a result, the procedure for the on-call staff member (PCD2.1) in charge of drafting this message includes, in an associated document, a guide to help characterize the situation in relation to these classifications.

**IAEA comments**:

The plant applied radiological criteria for declaring the emergencies that were based on the radioactivity releases rather than on the effective dose estimates. The decisions on the protective measures for plant personnel and the population are based on the radioactivity levels and on the precalculated dose estimates of typical accident sequences that provide basic envelope scenarios. The process of resource prioritization in case of challenges on the multiple units had been described. The prioritization depends on the prevailing conditions during the emergency.

The team noted that the changes to the assessment and application of the radiological conditions had already contributed to improve the concerns presented in the issue. However, the resolution of the items related to multiple unit events (facts concerning guidance on interaction criteria with unaffected units and prioritization of resources in the multi-unit event as well as the use of the PSA level 2 for assessing external hazards to challenge multiple units simultaneously) depended on the resolution of issue related to accident management (AM10.5(1)) that is foreseen to take place during 2022.

**Conclusion:** Satisfactory progress to date.

## 9.3. EMERGENCY PREPAREDNESS

**9.3(1) Issue:** The training, drill and exercise programme does not cover all aspects of the activation and coordination of the emergency response organization to ensure response actions are performed in a prompt and effective manner.

The team noted the following:

- When a potential indication of emergency is identified by the duty shift, the Shift Manager contacts the duty Emergency Director to declare the emergency based on identified conditions. This needs to be done from off-site if the emergency arises outside of working hours, using procedures which must always be immediately available for the emergency director. However, this part of the process has never been tested in exercises from off-site.
- Although the ‘in-function’ and the ‘not-in-function’ roles in the emergency organization are actually different and performed according to different procedures, the requirement for minimum frequency of participation does not take into account the role that each participant takes.
- There is no written requirement on executing emergency response organization activation tests at different times and at weekends, and no evidence of executing emergency response organization activation tests in a time period other than 19:00-20:00 on working days was provided.
- Only two mobilization drills are required to be performed each year, and there is no requirement for each person, and, therefore, someone may never participate in a mobilization drill.
- Regarding exercises under extreme conditions, only one exercise has been performed (in 2016), considering the isolation of the plant for a 24-hour period, which is a postulated condition. The exercise lasted only four hours and did not include the organization of shift relief to demonstrate the capability of avoiding disruption in the deployment of response actions during the first 24 hours.
- No pre-defined objectives exist to ensure a systematic assessment of performance during exercises.
- There is no written requirement to include radiological implications in fire exercises; only one exercise which included some radiological considerations has been performed so far.
- There is no written guidance or form to assess the need to provide training to Emergency Response Organization staff following changes in emergency response implementation procedures.
- Regarding the location of emergency plan implementing procedures in the main control room, it was stated that currently there are some slight differences in the configuration between this room and the simulator. As a result, the final location is not defined yet.
- During an emergency, the field operators are to stand by for instructions in the main control room area, which is protected with ventilation, and equipped with protective equipment. However, no exercises have been performed involving contamination of field

operators and the need to take them to the emergency management centre for decontamination.

Unless the training, drill and exercise programme covers all aspects of the activation and coordination of the emergency response organization, some response actions may not be performed in a prompt and effective manner during an actual emergency.

**Suggestion:** The plant should consider enhancing the training, drill and exercise programme to cover all aspects of the activation and coordination of the emergency response organization.

**IAEA Bases:**

GSR Part 7

6.28. The operating organization and response organizations shall identify the knowledge, skills and abilities necessary to perform the functions specified in Section 5. The operating organization and response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel selected have the requisite knowledge, skills and abilities to perform their assigned response functions. The arrangements shall include arrangements for continuing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities in an emergency response undergo the specified training.

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).

6.33. The conduct of exercises shall be evaluated against pre-established objectives of emergency response to demonstrate that identification, notification, activation and response actions can be performed effectively to achieve the goals of emergency response (see para. 3.2).

SSR-2/2 (Rev.1)

5.5. A training programme for emergencies shall be established and implemented to ensure that plant staff and, as required, staff from other participating organizations possess the essential knowledge, skills and attitudes required for the accomplishment of non-routine tasks under stressful emergency conditions.

NS-G-2.8

4.34. Training should be provided for all staff members who have assignments under the emergency plan. The training for emergencies should include the periodic performance of emergency drills and exercises. Training should also include conventional safety, in particular in firefighting and medical first aid. Periodic drills and exercises should be held to reinforce training and to assess the effectiveness of the emergency response capability. There should be full scale exercises involving external organizations such as the police, fire services, ambulance teams, rescue teams and other emergency services.

**Plant response/Action:**

To improve the site's emergency management training and drills programme, the multi-annual planning has been updated, in particular by incorporating the new developments resulting from the overall redesign of the emergency response procedure. For example, the site now carries out, at least every 3 years, an emergency drill implementing phased build-up of the local emergency response organization. This type of drill makes it possible to test the site's emergency response organization in the face of extremely adverse situations taking into account the fact that not all the on-call staff can reach the site quickly, which requires a significant reorganization of the emergency response management procedures, pending an improvement in site access conditions. This reorganization of the emergency response team is set out in specific procedures made available to the team members.

In addition, since the IAEA assessment at the end of June 2019, the Flamanville site has carried out 21 emergency drills allowing it to cover a number of different situations including extremely adverse situations such as, for example: management of a severe accident, management of a fire including taking care of a radiation contamination victim, management of a PUI with phased build-up of the emergency response organization, carrying out a SACA PUI calling on the services of the Nuclear Rapid Reaction Force (FARN).

Since July 2019, the following drills have been carried out:

| DATE OF DRILL | TYPE OF PUI |
|---|---|
| 29 AUGUST 2019 | SR PUI mainly affecting the 1300 MW series units |
| 05 SEPTEMBER 2019 | SR PUI mainly affecting the 1300 MW series units |
| 15 OCTOBER 2019 | SR PUI affecting the EPR unit following break-out of fire with evacuation of a radiation contaminated casualty |
| 21 NOVEMBER 2019 | Casualty rescue (SAV) PUI which required dealing with one death and 4 serious injuries from an accidental explosion. |
| 13 DECEMBER 2019 | SR PUI mainly affecting the 1300 MW series units following a fire. |
| 03 MARCH 2020 | SR PUI affecting the EPR unit including reaching the Severe Accident threshold. |
| 11 JUNE 2020 | A technical support team deployment and support plan (PAM GAT) affecting the EPR unit and change of governance following the reaching of an SR PUI criterion on the 1300 MW series units. |
| 18 JUNE 2020 | Toxic Internal Emergency Plan (TOX PUI) following damage to a chemical tanker off the coast of Flamanville. |

| | |
|---|---|
| 03 SEPTEMBER 2020 | SR PUI mainly affecting the EPR unit. |
| 15 OCTOBER 2020 | Casualty rescue and radiological protection event deployment and support plan (PAM SAVER) deteriorating into a SAV PUI requiring the management of one casualty with severe radiation contamination and 4 with severe conventional injuries. |
| 29 OCTOBER 2020 | SACA PUI with the National Emergency Response Organisation and the Nuclear Rapid Reaction Force and with handover to local emergency response teams. |
| 24 NOVEMBER 2020 | SR PUI mainly affecting the 1300 MW series units. |
| 11-12 JANUARY 2021 | SACA PUI with phased build-up of the emergency response organization at night. (Unannounced drill by the French Nuclear Safety Authority, ASN) |
| 16 FEBRUARY 2021 | PAM SAVER deteriorating into a SAV PUI following a steam line break on the EPR unit requiring the management of 2 deaths and 3 seriously injured casualties. |
| 30 MARCH 2021 | Environmental deployment and support plan (PAM ENV) following a spill from a road tanker causing pollution on site. |
| 20 APRIL 2021 | SR PUI mainly affecting the 1300 MW series units. |
| 22 APRIL 2021 | SACA PUI with phased build-up of the emergency response organization following heavy snowfall and with the EPR unit mainly affected. The emergency response director could not be reached. |
| 17 SEPTEMBER 2021 | PUI SR with a fire breaking out in the RCA mainly impacting the 1300 MW series units. |
| 30 SEPTEMBER 2021 | PUI SR mainly impacting the EPR unit with assembly of the personnel and emergency response team (ERO) turnover. |
| 12 OCTOBER 2021 | PUI SR mainly impacting the 1300 MW series units. |
| 16 NOVEMBER 2021 | PUI SACA with progressive rebuilding of the emergency response organization and initiation of the emergency by the shift manager. The emergency response team leader could not be reached. |

The reports of all these exercises are available in our documentation management tool.

**IAEA comments**:

The updates of multi-annual planning of exercises and drills as well as the restructuring of the emergency response procedures contribute to the resolution of the training-related concerns by increasing the number and variety of the drills. The plant had carried out twenty-one exercises and drills since July 2019, and they included testing of the emergency declaration, extended drill duration to exercise the shift handover, performance assessment and fire exercises with radiological considerations.

The team noted that these developments have been implemented effectively to address the issue for the training, drill and emergency exercise programme.

**Conclusion:** Issue resolved

**9.3(2) Issue:** Administrative checks for documentation traceability and the emergency response organization on call arrangements are not always sufficient to ensure adequate emergency resources are maintained at all times.

The team noted the following:

- There is no instruction to notify the Emergency Director on call if a person on call is not reached during a test, so a replacement can be found.
- Although there is a process to manage the replacement of the emergency response organization personnel on call, when it is known that they will be unavailable during their assigned period, there is no procedure for this process.
- There are three communication means to activate the emergency response organization: pager, cell phone and land line, but all of them rely on conventional infrastructures and it is not mandatory for members of the emergency response organization to have a cell phone.
- There is no written instruction for emergency response organization members on call to proactively try to communicate or travel to the site in the event of a situation being identified near the plant that may have affected the site, and may have caused a loss of conventional communications, therefore impeding the activation of the staff.
- Emergency responders must agree to receive doses above occupational limits when performing emergency tasks. However, there is no official form to record the willingness of emergency responders and no expectation is set to have a written agreement.
- A fitness-for-duty checking programme is in place for the operating organization, but it does not consider explicitly the assessment of fitness for duties performed during emergencies.
- There is no procedure in place to provide for dedicated information to emergency responder relatives during an emergency.
- There is no official distribution list for each emergency response procedure and there is no official form to record the effective replacement of revised documents in emergency folders.

Without having appropriate administrative checks for documentation traceability and arrangements for the emergency response organization on call, the adequacy of some resources may be challenged, reducing their effectiveness during emergency response.

**Suggestion:** The plant should consider enhancing the administrative checks for documentation traceability and the arrangements for emergency response organization on call to ensure that these are maintained at an adequate level at all times.

**IAEA Bases:**

GSR Part 7

6.9. Personnel who are assigned to positions in all operating organizations and response organizations to perform the functions necessary to meet the requirements established in Section 5 shall be qualified and shall be assessed for their initial fitness and continuing fitness for their intended duties.

6.10. Appropriate numbers of suitably qualified personnel shall be available at all times (including during 24 hour a day operations) so that appropriate positions can be promptly staffed as necessary following the declaration and notification of a nuclear or radiological emergency. Appropriate numbers of suitably qualified personnel shall be available for the long term to staff the various positions necessary to take mitigatory actions, protective actions and other response actions.

GSR Part 7

6.18. The appropriate responsible authorities shall ensure that Emergency plans and procedures are periodically reviewed and updated

GSR Part 7

6.36. Arrangements shall be made to maintain, review and update emergency plans, procedures and other arrangements and to incorporate lessons from research, operating experience (such as in the response to emergencies) and emergency exercises.

**Plant Response/Action:**

As the suggestion brought together a variety of facts on different topics, it was decided to provide a point-by-point response in the table below.

| Facts identified by IAEA | Site response |
|---|---|
| There is no instruction to notify the Emergency Director on call if a person on call is not reached during a test, so a replacement can be found. | A new form for acknowledgement tests has been deployed to include notification of PCD1 by Site Protection staff in the event that an on-call staff member does not reply during the acknowledgement test. This action is tracked in the site's action monitoring tool, namely Caméléon |
| Although there is a process to manage the replacement of the emergency response organization personnel on call, when it is known that they will be unavailable during their assigned period, there is no procedure for this process. | When a staff member has to be replaced on the on-call rota, the replacement form must be filled in according to the process defined in the site SharePoint database. This form is then sent to the generic FLA-ASTREINTE mailbox to ensure that all on-call staff have the information. In addition, the local on-call schedule management unit ensures that the form is correctly filled in and sends it to the national unit. The national unit acknowledges receipt and returns the modified on-call schedule.<br><br>The replacement of the staff member on the on-call rota is taken into account the same day if it is sent to the local unit before 12 noon. After 12 noon, notification of the replacement is given in the same mail and the replacement is detailed in the SharePoint with the following information: |

<table>
<tr><td></td><td>

- PUI round
- Replacement start date
- Replacement end date
- Last name of person replaced
- First name of person replaced
- Last name of replacement
- First name of replacement
- Home phone number of replacements
- DECT number of replacements
- EDF mobile number of replacements
- Pager number of replacements

The modification is taken into account in the following day’s on-call schedule at 2 p.m.

This process is currently being updated with the operational implementation of the new system for managing on-call schedules and alerts (GUEPARD). This new system allows EDF’s local and national on-call team members to be alerted by a single call, simplifying the process currently in place.
</td></tr>
<tr><td>There are three communication means to activate the emergency response organization: pager, cell phone and land line, but all of them rely on conventional infrastructures and it is not mandatory to have a cell phone.</td><td>

During the week they are on call, each emergency response team member is equipped with the following means to be alerted to activation of the PUI:

**On site:**

- DECT/RDP: This means of communication is electrically backed up by the unit emergency generators.
- SONO: This means of communication is electrically backed up by the unit emergency generators.

**Off site:**

- Mobile phone for staff members who opt for it (to date, 100% of staff members have opted for this)
- Land-line phone
- PAGER

Staff members are required to remain within the specified perimeter if they have opted to be equipped with a mobile phone. Otherwise, they are required to stay at home outside working hours.

If an event occurs on site and it is necessary to activate a PUI, the operations shift manager (PCL1) calls the on-
</td></tr>
</table>

| | |
|---|---|
| | call manager (PCD1) to ask him to activate the PUI. The following 2 cases may then arise:<br><br>**Case 1:**<br><br>PCD1 cannot be reached. PCL1 must therefore activate the PUI himself by calling the GUEPARD interactive voice server with the aid of document D5330-12-0962. This call can be made using any means of telecommunication, depending on what is available. In the worst case scenario, PCL1 can activate the PUI using the last-resort satellite telephone available in the control room. The interactive voice server triggers the phones (land-line and mobile) and pagers of local and national on-call staff. This procedure is taken into account in the PUI action sheet for PCL1.<br><br>**Case 2:**<br><br>PCD1 can be reached. PCD1 therefore activates the PUI by calling the interactive voice server with the aid of document D5330-12-0962.<br><br>If the on-site situation allows activation of a PUI in the conventional way, then all local on-call staff must be operational at their Command Post (PC) within 1 hour. For this type of situation, it is considered that there is no difficulty in contacting the on-call staff.<br><br>If the situation on site and in the region makes it potentially difficult to get on-call staff on site then the PUI in “Phased approach” mode is activated. EDF at national level compensates for difficulties on sites and may call in FARN to facilitate access to the site if necessary. For this type of situation, it is considered that there may be difficulties in contacting the local on-call staff. The emergency response organisation and the “Phased approach” booklets allow this type of situation to be handled by taking into account partial staffing with on-call team members.<br><br>If the situation on site and in the region is said to be “Extreme” then the site is isolated. FARN is called in to respond on site and the first responders arrive in 24 hours, in particular to allow local on-call staff to access the site. In the meantime, it is the shift operating team that manages the situation. |

| | |
|---|---|
| There is no written instruction for emergency response organization member on call to proactively try to communicate or travel to the site in the event of situation being identified near the plant that may affect the site and may have resulted in a loss of conventional communications, therefore impeding the activation of the staff. | There are 2 types of situations:<br><br>**Situation 1:**<br><br>The event that occurs on site and in the region makes it difficult to staff the site with on-call team members. It is therefore considered that some on-call staff may not receive the alert. In this case, the on-call staff who receive the alert do their best to get to their command post. The organization in "Phased approach" mode makes it possible to deal with this situation, particularly with EDF at national level making up for actions that are not feasible locally.<br><br>**Situation 2:**<br><br>The event on site and in the region means that the site is completely isolated. It is thus considered that the site is in an "extreme" situation. FARN is called to the site to initiate actions to make site access possible. On-call staff will be contacted once the site is no longer isolated, to allow them to get to their command post. |
| Emergency responders must agree to receive doses above occupational limits when performing emergency tasks. However, there is no official form to record the willingness of emergency responders and no expectation is set to have a written agreement. | In the event of the need to take action in a highly irradiating area to rescue victims, to carry out operational maneuvers or for exceptional work on a highly irradiating object, the emergency response director (PCD1 EF) must carry out the following actions:<br>• Consult the national EDF emergency response director (PCD-N) and an EDF doctor before deciding to carry out work in a radiological emergency;<br>• Retrieve the "list of Group 1 workers for radiological emergencies",<br>• Consult the emergency instruction sheet attached to his PUI action sheet;<br>• Designate the workers with PCL1 EF and/or PCM1 EF among the staff members selected on the list;<br>• With the support of an EDF doctor, inform workers about the risks and precautions to be taken during the work;<br>• Collect confirmation of the willingness of each worker prior to carrying out the work in the presence of a third party;<br>• Have the "list of Group 1 workers for radiological emergencies" signed off by each willing worker; |

| | |
|---|---|
| | • Ensure that the workers are equipped with means for individual dosimetry appropriate to the situation.<br><br>This procedure is an integral part of the PUI action sheets for PCD1 EF and PCL1 EF, and the "Phased approach" booklet for the management command post (PCD) and the "Phased approach" booklet for the local command post (PCL).<br><br>This new procedure is the result of a change in the French regulations governing emergency occupational exposure. |
| A fitness-for-duty checking programme is in place for the operating organization, but it does not consider explicitly the assessment of fitness for duties performed during emergencies. | Each staff member is seen periodically by the occupational health doctor. The doctor ensures that the staff member is medically fit for duty, including on-call PUI duties. |
| There is no procedure in place to provide for dedicated information to emergency responder relatives during an emergency. | This point has been referred to EDF at national level for investigation. |
| There is no official distribution list for each emergency response procedure and there is no official form to record the effective replacement of revised documents in emergency folders. | All documentation used in the event of a PUI is part of the PUI ancillary documentation. To define the documentation needed for each command post and its location, the following 5 notes have been drafted:<br>• Management command post (PCD) documents and equipment, reference D5330-12-1430;<br>• Local command post (PCL) documents and equipment, reference D5330-12-1431;<br>• Local emergency team (ELC) documents and equipment, reference D5330-12-1432;<br>• Resources command post (PCM) documents and equipment, reference D5330-12-1433;<br>• Assessment command post (PCC) documents and equipment, reference D5330-12-1434.<br><br>All documents used by the emergency response teams members in a command post are spread out over different folders. They are all identified by a package code and sealed once a thorough check of their content has been carried out by the documentation service. If a folder is not sealed, the documentation service is notified, checks |

| | |
|---|---|
| | the content of the folder, updates it if necessary, and re-seals it.<br><br>For each document included in this list, the associated package codes are recorded in the computerised document database (ECM). Hence, when a document is updated in the ECM, the documentation service identifies the folders that must be updated with the new version of the document. This package code also identifies the location of the folders to be updated.<br><br>If new documents are to be included in the emergency response folders, the 5 notes are updated. |
| Key positions have a package of procedures and documents that they must carry with them at all times when they are on call. However, there is no official form to record the transfer of emergency folders from the outgoing to the incoming person on call. | For PCD1 EF and PCD1 NEF, the emergency response folders are managed in a similar way to all other emergency response folders. A package code is defined for each folder (see note D5330-12-1430).<br><br>If a document changes, the documentation service uses the package code to identify the folder to be updated. The documentation service notifies the staff member and replaces the document in the folder.<br><br>Finally, when on call, PCD1 staff must ensure that they have all the necessary documents. |

**IAEA comments**:

The plant responded to the issue by analyzing the facts and identifying the causal factors. The plant had taken actions to enhance the activation and replacement processes of the on-call emergency response organization. The actions include introduction of a new form for notifying the emergency director of a non-reply of on-call members, and a new form for supporting communication of a replacement in on-call positions.

The EDF practices for sending volunteers to the tasks leading to extended radiation dose were modified in October 2021. The process of replacement of the revised documents in the emergency folders is in accordance with the contract stipulations for the contractor carrying out the work.

The team noted that the actions have been implemented effectively.

**Conclusion:** Issue resolved

**9.3(a) Good Practice:** On-site Emergency Control Centre designed with long-term habitability capability without any restrictions to withstand extreme external hazards and adverse radiological conditions.

The Flamanville 3 On-Site Emergency Control Centre (CCL) houses the facilities from where the teams perform their emergency response tasks. It also provides protection from radiological hazards.

The CCL is designed to resist any type of extreme external hazard (earthquakes, flooding, natural phenomenon associated to flooding and tornadoes).

The CCL is also self-contained in the eventual need for:

- Electrical supply: the CCL has an emergency backup generator (GES) for electrical supply. This GES can run at full load for 72 hours before refueling.
- Food and water: the CCL contained a supply of drinking water and a stock of food that can last 72 hours;
- Protective equipment for the staff.

The CCL is designed to ensure the protection of the staff and equipment inside against radiation, irradiation and contamination, caused by events that have led to the on-site emergency response plan being triggered.

Since high efficiency filter to filer air from outside, the intake flow can always be maintained, there is no need to isolate the CCL building, which means that habitability is ensured in the long term without any restrictions even under severe accident conditions.

The CCL can accommodate the 120 on-site command posts that are needed to manage an emergency situation. A large amount of information concerning the unit parameters arrives to the facility, directly sent from the installations through secure communication links. The size also makes it possible to accommodate the command post of the FARN (Rapid Response Nuclear Task Force).

Lastly, the CCL is used to store the on-site mobile emergency equipment to ensure its protection from any external hazards and minimize the movement of responders for its deployment. It is also equipped with telecommunication systems and support equipment for the command posts, body contamination monitoring and radiological condition measurements.

# 10. ACCIDENT MANAGEMENT

## 10.4. DEVELOPMENT OF PROCEDURES AND GUIDELINES

The plant applies a single tool from the entry into the mitigatory domain up to the stabilization of a severe accident that allows the plant state to be determined and tracked by means of concise and simple diagnostics. The aim is to identify the necessary mitigation actions and enable their execution. This new concept of diagnosis contains an easily used framework such as a looping flowchart for continuous monitoring of the three severe accident safety functions. This framework, called the 'mitigation matrix', allows parallel consideration of the actions and sets the priorities to avoid conflict issues. The team considered the mitigation matrix as a good practice.

## 10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

The baseline accident management approach of the Flamanville 3 EPR has been defined. It contains the preventive domain with focus on ensuring sufficient core cooling. If the core heats up, the transition takes place to the mitigatory domain, where the focus is set on mitigating the releases, ensuring the containment integrity and cooling of the core debris. Concurrent severe accidents affecting multiple units simultaneously are considered to be highly unlikely and therefore they are not considered in the baseline SAM. Consequently, the SAM procedures do not consider coping with the concurrent severe accidents, and exercises and drills have not covered the situations of the units on-site having severe accidents simultaneously. The team made a suggestion in this area.

## DETAILED ACCIDENT MANAGEMENT FINDINGS

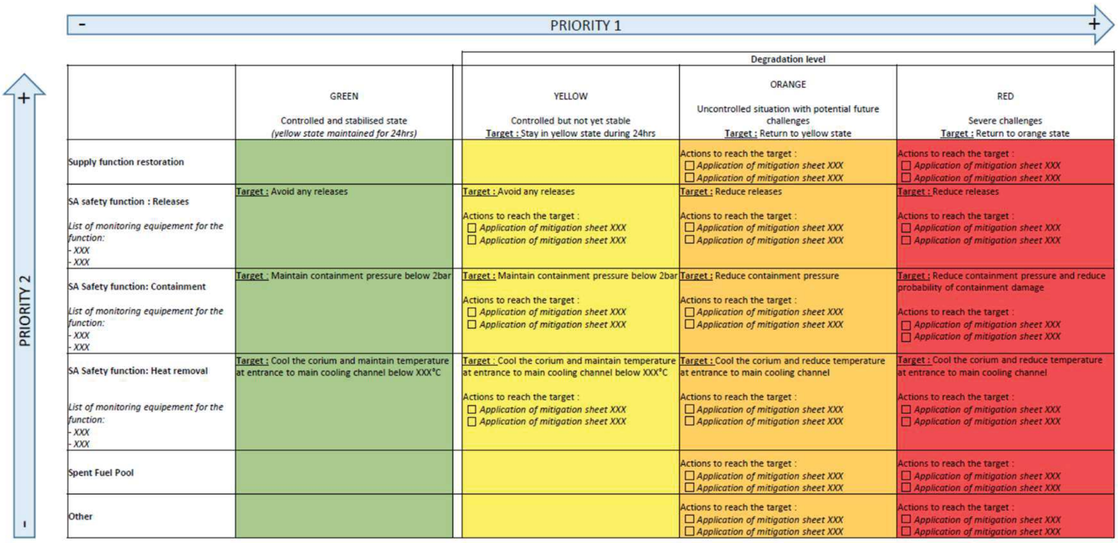
### 10.4. DEVELOPMENT OF PROCEDURES AND GUIDELINES

**10.4(a) Good Practice:** Mitigation matrix

The mitigation matrix is a tool used to prioritize mitigation sheets and to provide a summary of plant conditions. This matrix can be accessed by members of the technical support group (ELC), ETC-N (corporate technical support team) and PCD1 (Emergency Director).

The matrix is composed of a dual input table: the severe accident safety functions (having the priority order: Release, Containment, Cooling) and the plant conditions. The colours designate the degradation levels:

- Green: conditions controlled and stabilized (post-accident phase);
- Yellow: conditions controlled but not stabilized (objective: remain in yellow status for 24 hours);
- Orange: potential hazard, anticipated risk (objective to return to yellow status);
- Red: confirmed hazard (objective: return to orange status).




| | | Degradation level | | |
|---|---|---|---|---|
| | GREEN<br>Controlled and stabilised state<br>*(yellow state maintained for 24hrs)* | YELLOW<br>Controlled but not yet stable<br>Target : Stay in yellow state during 24hrs | ORANGE<br>Uncontrolled situation with potential future challenges<br>Target : Return to yellow state | RED<br>Severe challenges<br>Target : Return to orange state |
| **Supply function restoration** | | | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |
| **SA safety function : Releases**<br>*List of monitoring equipement for the function:*<br>*- XXX*<br>*- XXX* | Target : Avoid any releases | Target : Avoid any releases<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Reduce releases<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Reduce releases<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |
| **SA Safety function: Containment**<br>*List of monitoring equipement for the function:*<br>*- XXX*<br>*- XXX* | Target : Maintain containment pressure below 2bar | Target : Maintain containment pressure below 2bar<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Reduce containment pressure<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Reduce containment pressure and reduce probability of containment damage<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |
| **SA Safety function: Heat removal**<br>*List of monitoring equipement for the function:*<br>*- XXX*<br>*- XXX* | Target : Cool the corium and maintain temperature at entrance to main cooling channel below XXX°C | Target : Cool the corium and maintain temperature at entrance to main cooling channel below XXX°C<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Cool the corium and reduce temperature at entrance to main cooling channel<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Target : Cool the corium and reduce temperature at entrance to main cooling channel<br>Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |
| **Spent Fuel Pool** | | | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |
| **Other** | | | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* | Actions to reach the target :<br>☐ *Application of mitigation sheet XXX*<br>☐ *Application of mitigation sheet XXX* |

The matrix also targets priorities: priority 1 is assigned to the highest level of degradation and priority 2 to the 'Release' safety function. In addition, the matrix indicates the criteria for transition from one degraded level to another. For example, containment pressure is a criterion that is used to visualize any changes in the ‘containment’ safety function. Human and Organizational Factor testing showed that the matrix provided emergency response managers with a shared and synchronized representation of the severe accident management status, assisting with the objectives of controlling off-site release and of returning to a controlled state.

**Benefit:** The matrix enables emergency staff to visualize plant conditions more rapidly. It helps in selecting the appropriate mitigation sheet to be used once the diagnosis has been performed.

## 10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

**10.5(1) Issue:** The current scope of the severe accident management programme does not consider concurrent multiple unit accidents on-site.

The team noted the following:

- Multiple unit concurrent severe accidents are not considered as a baseline for Flamanville 3 severe accident management (SAM).
- The procedures do not consider coping specifically with the concurrent multi-unit severe accidents.
- There have been exercises on the Flamanville site involving all three units, but with only one of the units facing severe accident conditions. The plant has not carried out exercises that cover concurrent severe accidents in all three units on-site.
- The accessibility estimates for local SAM actions do not consider concurrent severe accidents. In the event of a severe accident in Flamanville 3, dose estimates are only produced for Unit 3. However, the habitability design of emergency response rooms (site emergency centre CCL and main control room) considers a severe accident on Unit 1 or 2.
- FARN's practices to ensure diesel fuel usability might be challenged, since the fuel's useable temperature range is not sufficient for external hazards such as extreme cold.
- PSA level 2 does not cover all external hazards which could affect multi units. The PSA level 1 already includes loss-of-offsite power and loss of ultimate heat sink that are often consequences of an external hazard. Thus, considerations in those parts expands implicitly to PSA level 2 domain.

By not considering that severe accidents may occur concurrently on-site, where the three units are located near to each other, some mitigation actions may not be performed in a prompt and effective manner.

**Suggestion:** The plant should consider enhancing the severe accident management programme with consideration of concurrent multiple unit accidents on-site.

**IAEA Bases:**

SSR-2/2 (Rev. 1)

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.

2.70. The effectiveness of equipment and the emergency response facilities (e.g. the main control room, the technical support centre) that are shared by different units should be assessed for cases in which accidents, including accidents more severe than the design basis accidents, occur simultaneously at several units.

2.72. When other units are located at a neighbouring site close to the site at which a severe accident has occurred, the sharing of information with the operating organizations of those neighbouring units should be considered. Such communication would help to determine whether expected dose rates and other environmental conditions due to dispersion of radioactive material from the site at which the accident has occurred might affect access to units at the neighbouring site.

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.

3.66. 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.

**Plant Response/Action:**

The organization at the Flamanville site for crisis management, and more specifically severe accident management, is derived from the national organization and was approved by the French nuclear safety authority (ASN).

Besides, the Flamanville site has a specific organization due to the presence of nuclear units using different technologies (1300 and EPR). The emergency response team and the emergency management resources are shared. The site emergency response team comprises:

- Technical and command functions specific to the EPR plant series for the Flamanville 3 plant,
- Technical and command functions specific to the 1300 MW plant series for the Flamanville 1-2 plants,
- So-called "common" functions, whose activities are independent of the design of the reactor.

In total, there are 113 functions divided among the 7 command posts of the emergency response team.

Notably, the on-site emergency plan provides for multi-unit accident situations via the SACA (Climate and Assimilated Contingency Safety) on-site emergency plan. This covers all external climatic or assimilated contingencies which may affect multiple units on a given site. The assimilated event concept may cover situations which are not part of a pre-established scheme. These "assimilated" events lead to consequences (called "hazards") comparable to those of climate contingencies.

To date, each unit potentially in a severe accident situation will apply its mitigation procedures in liaison with the crisis team.

In the event of a severe accident involving more than one unit, the plant follows the corporate directives and relies on the nuclear rapid action force – FARN that, when on site, would be able to support the plant and manage severe accidents on all reactors.

At the same time, crisis team members will manage the organization required for multiple accidents (management of releases, prioritization between teams of workers including FARN, calling on external needs, etc.).

This organization allows for implementation of prevention, anticipation and mitigation actions on all site units during a major hazard to avoid an accident and its drift towards core meltdown.

To this date, EDF has not considered management of multiple unit severe accidents on-site in its emergency plan.

In the event of a severe accident involving more than one unit, the plant would follow the corporate directives and relies on the nuclear rapid action force – FARN to support the plant and manage severe accidents on all three reactors on site.

Simultaneously, emergency response members would manage the organization required to cope with multi-unit accidents (management of releases, prioritization between emergency entities – including FARN – resort to external support organizations…).

Nevertheless, the plant and corporate organization will start looking into any organizational and operational improvements which could be considered to enhance the severe accident management programme with consideration of concurrent multiple unit accidents on-site. The study will start in 2022.

Exercises:

Exercises are carried out on the Nuclear Fleet units. These wide-ranging exercises test the ability of the Nuclear Rapid Response Force to cope with a severe accident and its coordination with the site. For example, during this type of exercise, the Nuclear Rapid Response Force deployed a helicopter, hundreds of meters of hose, pumping systems or all-terrain lifting equipment at different locations: rear base, water reservoir and on site. The objective was to resupply the power plant with water, air and electricity following a large-scale earthquake. During these exercises, FARN also mobilises available teams during major climate events without impact on nuclear facilities (such as floods) to support the rescue teams.

**IAEA comments**:

The plant responded that the multi-unit accident situations at the Flamanville site are considered in the SACA on-site emergency plan that covers external hazards that could challenge the multiple units simultaneously. These organizational arrangements make execution of preventive and mitigative actions possible on all site units during major hazard conditions and contribute to avoiding individual units from going simultaneously into core meltdown. The plant has implemented emergency response arrangements including severe accident management in accordance with the national organization and these arrangements have been approved by the French regulator, ASN.

In the case of a severe accident affecting more than one unit at the same time, the plant follows the EDF corporate directives and relies on the FARN nuclear rapid action force. After arriving at the site FARN is capable of supporting the plant in supplying necessary fuel, power, and water for managing the accident conditions on all reactors. Each unit potentially approaching to a severe accident situation will apply its mitigation procedures.

The plant and corporate organization have informed their intention to investigate further organizational and operational improvements that would enhance the SAM programme and consider multiple units facing progress towards core melt conditions simultaneously.

**Conclusion:** Satisfactory progress to date

# 11. HUMAN-TECHNOLOGY-ORGANIZATION INTERACTION

## 11.2 HUMAN FACTORS MANAGEMENT

The team noted that the plant, together with the corporate organization, has implemented a comprehensive and holistic Human Factors approach. Experts in multiple disciplines including designers; human factors specialists; future operators; and instructors have been consulted to improve design, human-machine interfaces (HMI), documentation and the plant organization. Furthermore, socio-organizational and human analyses have been used to anticipate which activities of plant personnel will be affected by specific changes, how the work practices will alter, what risks are incurred or caused by the change and the future work quality for affected employees. The Human Factors achievements of the plant were considered by the team as a good practice.

The plant has been running a Human Performance programme since 2010 and six Human Performance (HU) tools have been chosen by the corporate organization for use across the EDF fleet. The requirements on use of HU tools are documented in an organizational note and there are three different levels of training. Level one training is given to all employees, while managers and HU champions also receive level two and three training. Good examples of the use of HU tools were identified during the review, but the team also identified some situations where the tools were not used in an appropriate manner and some situations where the tools should have been used but were not. The team encouraged the plant to improve the use of the HU tools.

## 11.4. CONTINUOUS IMPROVEMENT/LEARNING ORGANIZATION (MONITORING AND ASSESSMENT)

The Plant has not established a knowledge management programme to ensure the effective retention and transfer of specific knowledge to support the prolonged safe operation of the plant. There were no relevant management expectations, processes and procedures on how to collect, retain and share critical safety-important knowledge within the plant. In many cases, Just-In-Time sessions and one-off commissioning activities were not captured in training databases as unique knowledge and know-how for further use. The plant has no practice to interview experienced staff to define unique knowledge not included in formal lists of professional competences. The team made a suggestion in this area.

## 11.5 SAFETY CULTURE

The self-assessment of safety culture should cover the entire organization and several different self-assessment tools should be used to determine the status of the safety culture of the plant. According to the IAEA standards, the independent assessment of safety culture should follow a similar approach and the independence of the members of the assessment team is considered crucial. Several initiatives, such as an annual safety assessment, have been implemented by the plant and corporate organization to assess safety and safety culture. The team noted however that neither the corporate nor the plant procedures include requirements that ensure the systematic use of multiple data collection tools when conducting a safety culture self-assessment. No independent safety culture assessment, other than by the EDF corporate organization, has been conducted at the plant and there are no clear requirements for such assessments in the management system. The team encouraged the plant to conduct fully independent safety culture assessments and ensure that broad and diverse sources of information are systematically utilized in the self-assessments, to ensure that safety culture issues are identified.

## DETAILED HUMAN-TECHNOLOGY-ORGANIZATION INTERACTION FINDINGS

### 11.2 HUMAN FACTORS MANAGEMENT

**11.2 (a) Good practice:** Effective implementation of a holistic Human Factors approach throughout the life cycle of the plant to ensure safe operation.

In cooperation with the corporate organization, FLA3 has ensured that Human Factors aspects will be considered throughout the life cycle of the plant. Human Factors has not only been taken into consideration in control room modifications, but also in maintenance activities and in the development of severe accident management (SAM) documents. Experts in multiple disciplines including designers, human factors specialists, future users/operators and instructors have been consulted for more than 18 years. The consultations and assessments have resulted in corrective actions such as Human-Machine Interfaces (HMI) advancements, clearer documentation, improvements related to ergonomic aspects and organizational improvements to ensure safe operation. Examples of improvements made by the plant:

Control room

- Better defined functionalities of operational HMI, such as the degree of automation, operator aids and the design features of operational displays for: plant status, control systems, electronic procedure visualisation also allowing management supervision, alarm visualisation and prioritization, etc.
- Improved ergonomics of the main control room with 4 wall mounted screens which make it possible to perform real-time monitoring and allows the shift manager to have an immediate understanding of both reactor mode and operating conditions.

Maintenance activities

- To avoid having to climb down a ladder to the reactor and fuel cavities wearing a fully ventilated breathing suit, special doors have been designed and installed at the bottom of the cavities
- Increased diameter of steam generator manholes for easier access to steam generators and for reduced radiation exposure
- Improved lighting conditions for safer maintenance activities and reduced radiation exposure thanks to increased efficiency and reduced working hours
- To prevent people from going to the wrong train, room or piece of equipment, the signage rules have been changed to ensure easier and safer plant orientation and equipment identification

Severe Accident Management

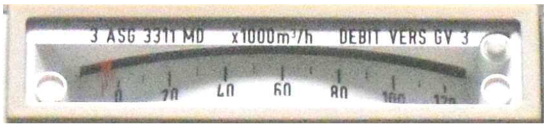
- Creation of a Severe Accident Operating Guidelines orientation document that can be used for the entire SAM process and guide the operators to the procedure that is most suited to the unit conditions.

Furthermore, socio-organizational and human (SOH) analyses have been used to anticipate which activities of plant personnel will be affected by specific changes, how the work practices will alter, what risks are incurred or caused by the change and the future work quality for affected employees. Other SOH activities include studies during Crew Performance Observation (CPO) and emergency preparedness drills to evaluate safety related factors to improve human performance. In-depth event investigations have been performed to identify, and correct weak lines of defense and socio-psychological studies have also been conducted to guarantee a work environment which supports safe performance.

Photos of some of the improvements made at the plant:

Before improvements - Standard display unit (difficult to read for people of shorter stature)

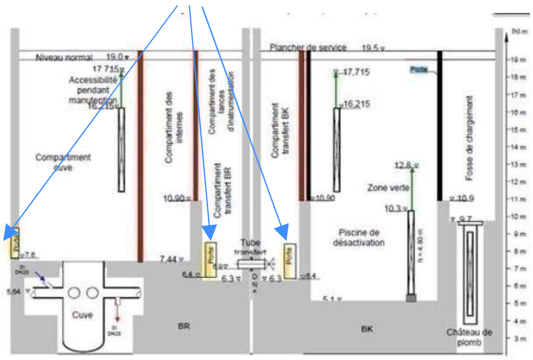
After improvements - New display units with the requested modifications




Alarm list menu and headers before improvements - Standard menu


Alarm list menu and headers after improvements - EPR FA3 menu


This picture illustrates the three special doors that have been installed at the bottom of the cavities.



Signage improvement (colour specific) to prevent people from going to the wrong safety train (before the improvements there was only a number)

Picture of the main control room with 4 wall mounted screens which make it possible to perform real-time monitoring.

## 11.4. CONTINUOUS IMPROVEMENT/LEARNING ORGANIZATION (MONITORING AND ASSESSMENT)

**11.4(1) Issue:** The plant has not established a knowledge management programme to ensure the effective retention and transfer of specific knowledge to support the prolonged safe operation of the plant.

The team noted the following:

- There were no plant expectations regarding a knowledge management programme.
- There was no plant procedure, which described how to collect, retain and share critical safety-important knowledge within the plant.
- There was no documented knowledge management process within the Integrated Management System (IMS). In addition, planned and coached knowledge transfer was based on ad hoc solutions, and inconsistently applied based on individual management decisions when one employee planned to leave the organization.
- There were no plant-level KPIs for the knowledge management process.
- The plant has no practice for systematically capturing knowledge related to one-off commissioning activities and safety-related work such as embedded structures in the reactor building, and critical contractor activities such as testing of safety-related equipment. The related expectations were therefore not considered as elements of knowledge management and were not consistently documented and stored.
- Just-in-time training (JIT) on specific topics was not captured in training databases as knowledge and know-how for further use.
- In some cases, the plant staff did not know how to find construction design data gathered from the company’s own plants and from similar plants.
- The plant has no practice of interviewing experienced staff to capture individuals’ knowledge not included in formal lists of professional competences.
- There was no list of experts as owners of important safety-related knowledge.

Without an effective knowledge management programme, retention and transfer of specific knowledge to support prolonged safe operation of the plant could be challenged.

**Suggestion:** The plant should consider establishing a programme for specific knowledge management to support the prolonged safe operation of the plant.

**IAEA Bases:**

GSR Part 2

4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.

4.2. The information and knowledge of the organization shall be managed as a resource.

5.22. Retention times of records and associated test materials and specimens shall be established to be consistent with the statutory requirements and knowledge management obligations of the organization.

GS-G-3.1

4.2. To improve the performance of the organization, consideration should be given to the way resources are managed. This should include:

- Effective, efficient and timely provision of resources in the context of the opportunities and constraints;
- Use of information management, knowledge management and the corresponding technology.

4.4. Data should be converted to information for the continual development of an organization's knowledge, and senior management should treat information as a fundamental resource that is essential for making factually based decisions and stimulating innovation. To manage information and knowledge, senior management:

- Should identify the organization's information needs;
- Should identify and access internal and external sources of information;
- Should convert information to knowledge of use to the organization;
- Should use the data, information and knowledge to set and meet the organization's strategies and objectives;
- Should ensure appropriate security and confidentiality;
- Should evaluate the benefits derived from the use of the information in order to improve the management of information and knowledge;
- Should ensure the preservation of organizational knowledge and capture tacit knowledge for appropriate conversion to explicit knowledge.

NS-G-2.8

4.1. The operating organization is responsible for training its own staff and ensuring that contractors' staff are suitably trained and experienced so that all work is carried out safely.

**Plant Response/Action:**

The plant has completed analysis and identified the major weaknesses (causes) that led to this IAEA suggestion. The main drivers for the weaknesses are organizational and programmatic and was determined to be:

There is no formal process describing the overall management of the activities that are carried out with respect to the transfer of knowledge between the Testing phase and the Operations phase, to ensure its effectiveness.

An action plan was developed to support knowledge management and transfer during the transition from construction to commissioning and to the final operational phase. The action plan is based on four principles:

The plant operator is involved as far as possible and as early as possible in the equipment assembly and commissioning activities, to collect knowledge of the new plant, which will be required for safe operation:

- Operational staff participate in the pre-handover assembly and testing phases,
- The plant operator takes direct charge of activities on behalf of the construction and testing team, activities such as chemical analyses, fuel handling operations, temporary plant operation, or particular maintenance tasks,
- Equipment or buildings are handed over to the plant operator so that operational staff can learn and internalise their mode of operation, with the procedures that will be used during plant operation (line-up procedures, operating instructions, alarm sheets, etc.).
- For the Operations Department, two off-shift operators are involved with the handover of systems to take ownership of these systems and cascade their learning down to the other Operations teams,
- Transfers of knowledge between the manufacturer and the plant operator are identified in certain contracts, such as for the use of specific tools in the case of the Maintenance Department, and the refueling machine interface in the case of the Technical Support Department
- The OneFLA3 organization has the option of pooling personnel or taking full responsibility for some areas, to conduct activities regardless of the progress status of handovers, such as pooling activities relating to nuclear safety, industrial safety, and quality, or having operational departments like the Engineering Support Department perform activities on behalf of testers
- The Engineering Department provides support for technical malfunctions, and the Maintenance Department for the implementation of certain activities

Each operational department has identified the skills needed for fuel loading. An action plan, approved by Senior Management, has been developed and is being implemented.

This action plan has led to:

- The development of learning tools (set-up of a “compact” simulator in the Operational Service Centre, available to the Operations teams in addition to the training sessions on the two “full-scale” simulators, and used in conjunction with the testers to prepare the system performance tests, develop e-learning, and deliver “just-in-time” training, etc.)
- The development of career paths tailored to EPR specificities, in addition to the conventional career paths that already exist in the EDF nuclear fleet
- The development of contracts with some manufacturers to train our staff
- The establishment of a worksite training centre with mock-ups, to train our staff

The NPP supports the creation of learning communities and networks of knowledge-owners:

- The secondment of many staff has made it possible to create and maintain ties between assemblers, testers, and plant operators, as a source of knowledge sharing
- Networks have been set up between EPR operators (Taishan in China, Olkiluoto 3 in Finland, and Hinkley Point C in the UK) to share good practices as well as common EPR-specific issues

- There are networks of Maintenance Department specialists and corporate engineering support centre staff, to gather knowledge on identical or similar equipment used in the operating fleet

In addition, provisions are in place to ensure that information that will be useful during plant operation is captured in our information systems

- Operating experience is being shared to consolidate the learning from EDF's operating fleet, from Taishan (China) and from Olkiluoto (Finland)
- Classification plans have been drawn up to collect the various technical elements needed for plant operation (classification of the various maintenance products, information in databases, study documents, etc.)
- The different modules of the Chameleon database allow each entity of the Project Directorate and of the Nuclear Generation Division to put the testing and operational OE to effective use. Furthermore, the Engineering Department has developed a database to centralise the monitoring and the case history of plant systems (Notebook) as soon as they are started up.

The skills management processes applicable to the operating fleet are adopted and implemented at FLA3:

- Skills mapping, and advanced planning for jobs and skills
- Coaching logs
- Employee involvement in their professional development through the Training Committees for each team (CF1)
- Department level (CF2) and Senior Management level (CF3) Training Committee meetings
- Management of skills and resources that are in short supply, as defined by the fleet

This covers the initial skills that need to be acquired and maintained for fuel loading and for safe plant operation.

Remaining actions:

Based on the note "Summary of the provisions implemented for the transfer of knowledge from the construction and testing phase to the operating teams of the Flamanville 3 /EPR power plant (ref D455121010098)" which describes the actions carried out, and in progress, to ensure the transfer of knowledge between the Testing phase and the Operating phase, a governing document will be written to describe the overall organization:

- Expectations and performance indicators
- The reporting and steering body (e.g., CF3)
- Effectiveness measurement methods (e.g., self-assessment, overall performance, analysis of feedback from events)

**IAEA Comments:**

The Pre-OSART Follow-up team determined that the causes have been clearly identified and that the action plan, when completed, will provide the needed improvements to address the suggestion. While progress has been made, the following key actions need to be completed to fully address causal factors and ensure effectiveness and sustainability:

- The facts documented in the original issue noted that there was no governing procedure and that activities were performed in an ad hoc manner. To address this, a governing document should be created that describes all the various methods that are in place to capture knowledge and operating experience and identify the specific skills and training needed to effectively perform remaining tasks as the plant transitions from construction, to commissioning, and then to the operational phase. Currently many methods have been established by various groups to support this effort such as System Notebooks, Event Database, CAP data, DAP training software, E-learning in E-Campus, E-learning available in "MyHR", sharing of EPR operating experience, and the Document Management and Work Management Systems. However, there is no governing document that describes how these are integrated to achieve the desired outcome.
- Formalize oversight of the knowledge management programme using existing training committees such as CF2 which looks at department training needs and CF3 which looks at plant-wide training needs. This should include performance indicators or other means to assess progress and confirm effectiveness.

Evidence of the progress made was recognized by the successful receipt, inspection, and transfer of new fuel into the Spent Fuel Pool. In this major activity, training needs including equipment and system knowledge were assessed for all groups supporting fuel handling activities. Management team was actively engaged to ensure that all groups were prepared and proficient prior to the start of fuel handling activities.

**Conclusion:** Satisfactory progress to date

# 13. COMMISSIONING

## 13.1 THE COMMISSIONING PROCESS

The plant has implemented some processes to support the interaction in-between Operations and Commissioning. However, the team observed that the interface between Operations and Commissioning is not always adequate to ensure proper control and oversight by the control room operators of operating activities related to handed-over systems that are in progress. The team made a suggestion in this area.

## 13.2 ORGANIZATION AND MANAGEMENT OF COMMISSIONING

The plant has developed a complex fire safety programme to ensure fire safety both in construction and operational areas. However, the team noted that fire scenarios that are supposed to be used by the external fire brigade have not yet been tested or approved for use in the most hazardous fire areas. Arrangements for the evaluation of fire loads do not take into consideration the total fire load inside the compartment and fire suppression systems' capacity. Compensatory measures are not always in place in areas where fire protection features important for safety are not yet fully operational. Multiple cases of deviations from fire protection requirements were noted in the field. The plant should improve the arrangements and practices targeting the integrity of fire barriers and prompt fire suppression to ensure that fire risk is always minimized. The team made a recommendation in this area.

The station has put some arrangements in place to keep the serenity in the Main Control Room (MCR) by implementing an additional guard outside the entrance. However, the team observed that the arrangements in place during the commissioning period, was not always adequate to ensure the control room serenity during conduct of operating activities. On several occasions, people were entering the MCR without asking for permission. The team encouraged the plant to improve in this area.

## 13.3. IMPLEMENTATION OF THE COMMISSIONING PROGRAMME

The plant has a large number of open modifications, emergent work activities, open deviations, and rework that has challenged the ability to safely manage remaining work. Interviews with members of the plant staff indicated that they have little confidence in the schedule and often only look 1-2 weeks ahead. Contributing to these delays is rework required due to inadequate verification of quality during and after work performance. This includes verification of the physical installation and verification of documentation. The team made a suggestion in this area.

The plant uses a proactive approach to demonstrate regulatory compliance prior to startup. The DPN (Operating Organization) accomplishes this in a methodical and comprehensive manner. Each regulatory requirement is identified in a database and validated. Approximately 10,000 requirements were extracted from French law for environmental protection matters alone. If compliance has not been achieved, follow-up actions are systematically tracked. The team identified this as a good performance.

## DETAILED COMMISSIONING FINDINGS

### 13.1. THE COMMISSIONING PROCESS

**13.1(1) Issue:** The interface between Operations and Commissioning does not always ensure proper control and oversight by the control room operators of safety related activities in progress on handed-over systems.

The team noted the following**:**

- When performing commissioning tests that could affect systems already handed over to the station, the last barrier to prevent manipulations of faulty components, is the Lead Operator (LO) in the Main Control Room (MCR). When tests are performed in the MCR, the Test Leader (TL) is supposed to inform the LO before starting the test. However, there is no clear process on what the LO should control or what documentation is to be used to avoid tests being performed on faulty equipment. According to an MCR operator an Excel spreadsheet being used for this purpose was not fully reliable because information could be missing due to late up-dating and the database being used could show a system as handed over even though it was only partly handed over.
- During commissioning tests there is no expectation for test leaders to inform the MCR Operators before starting the test, unless it might affect other systems already handed over. Moreover, on these occasions there is no requirement for Peer Check by a licensed Operator.
- In the MCR, the audible alarm from the fire detection panel was reduced to a hardly hearable level. Only when standing approximately 1 meter away was it possible to hear the alarm. The reason given was to reduce the disturbance for the Operators, and the adjustment was made by the contract worker in charge of the fire detection panel.
- There is no formalised Pre-Job Brief or Post Job Debrief between Commissioning and Operations, when performing a test that could affect already handed over systems. As a result, changes could be made that affect handed over systems yet not known to the operators. In addition, if changes are made to the systems, this could affect the validity of the temporary procedure.
- In the MCR, the contract worker in charge of the fire detection system, left his position without handing over the responsibility (contrary to station expectations) and went to the reactor building. While absent, an alarm appeared, which was detected by an Operator in the MCR. The Operator tried to contact the responsible person and the Fire Coordinator. Neither of these could be contacted. To mitigate this, the Operator sent a Field Operator to verify if the fire was real.
- A Temporary procedure (2019 00025) to be used during a gaseous filling had a hand amendment which had no signature or traceability of the origin. This deviation was not noted by the shift crew during the Pre-Job Brief.
- The operations team together with commissioning team defines the boundaries to be tagged out for the test work permits. However, the tagging office doesn't have a commissioning procedure for the system and consequently does not have the full information on what is planned to do. Example: operations staff do not know where the water after flushing will be discharged to.

- The temporary operating procedure for the stator cooling system (GST) refers to the use of alarm sheets in hard copy in MCR in case of alarms. These alarm sheets have not been found in the designated folder in the MCR.

Lack of an effective interface between Operations and Commissioning, could hamper the control and oversight by the control room operators of activities related to handed-over systems that are in progress.

**Suggestion:** The plant should consider enhancing the interface between Operations and Commission groups to ensure proper control and oversight by the control room operators of safety related activities in progress on handed-over systems.

**IAEA Bases:**

SSR-2/2 (Rev.1)

6.12. The operating organization shall ensure that the interfaces and the communication lines between different groups (i.e. groups for design, groups for construction, contractors, groups for commissioning and groups for operations) shall be clearly specified and controlled.

SSG-28

3.36. Many other activities are performed in parallel with the commissioning of the plant, such as activities relating to construction, operation and maintenance.

3.37. The interface between these activities should be adequately managed to ensure the safety of the plant and the protection of personnel, and to allow for an adequate commissioning programme.

3.38. The interrelationships between tests, between systems and between units on the same site should be considered.

3.39. Appropriate work control processes should be established to coordinate the activities of all groups involved in commissioning and to cover the major work activities, including post-work testing. These processes should provide for the proper channeling of the work to the persons responsible for the systems and for ensuring notification and awareness by the control room operators of all the work activities that are in progress.

**Plant Response/Action:**

The commissioning phase and the gradual transfer of plant main system to the plant operator involves the co-existence of two areas of responsibility, namely:

- A temporary operating area, in which the plant operator is fully responsible for operating the systems.
- An area not transferred to Temporary Operations because the plant main systems are not yet in a mature operating condition to allow temporary operation from the control room, and for which the test supervisors carry out the commissioning tests.

Organizational improvements concerning the operator/tester interface on the operation of these two areas have been identified following the Pre-OSART and implemented for the Hot Functional Test phase:

Taking account of test risks:

For each test procedure to be carried out, the testers carry out a documented risk assessment. The risk assessment template has evolved since the Pre-OSART to better identify the impacts and risks generated in the areas managed by the operators. In the event of an impact or risk detected as a change in an operating state (e.g. change in the parameters of an automatic control), the occurrence of an alarm or drainage of a circuit to the effluent collection system), these impacts or risks are analyzed and the countermeasures identified. This analysis is then shared with the operators in advance of the test and is the subject of a joint pre-job briefing for operators and testers, to ensure proper appropriation and implementation of the necessary countermeasures. In addition to these targeted testing procedures, specific provisions have been implemented for testing of assemblies, such as testing the loss of electrical power sources, which require the configuration of a large number of systems, whether or not they are transferred to the plant operator under PVEP. In this case, a risk analysis note is drawn up by the testers and distributed to the operators for comment and identification of the necessary countermeasures in advance of the tests. Here too, a joint pre-job briefing for operators and testers is held just before the activity.

Monitoring in the control room:

To improve monitoring in the control room, an action plan has been defined and implemented. It is structured around 4 areas:

– Calm atmosphere: the rules have been redefined in order to guarantee calm in the control room and are set out in a common application note (NAC) for operators/testers and a management procedure. These notes also apply to anyone wishing to enter the control room. This was communicated to the entire site through a specific information note (NIS). The commissioning of the door blocking access to the control room also helps to ensure a calm atmosphere. All actions in this area are closed.

– Alarm management: actions have been taken by the testers to reduce the number of alarms present in the HMI. This has allowed audible alarms to be installed in the control room, which was not the case at the time of the Pre-OSART. Requests made at the Operational Focus (daily meeting) regarding flickering alarms have been dealt with at the request of the Operations Shift Manager.

– Monitoring round: A method has been defined to allow flexibility in the monitoring rounds carried out by operators according to the moving state of the unit, while guaranteeing consistency between shifts. All actions in this area are closed.

– Temporary Operating Instructions (CTE): the large number CTEs did not allow proper control of the facility. Several actions have been carried out to limit their number (limited to 20), but also to better frame their content in the field of monitoring and limiting the actions to those ensuring the safety of the facility. A weekly check worksheet has also been put in place to ensure that these CTEs are properly taken into account by the operating teams.

Fire monitoring:

During the inspection, the contractor's worker in charge of monitoring the fire detection panel in the control room was also in charge of maintenance of the system, which explained occasional absences from the control room. This way of working has changed since 2020. Monitoring of the fire detection panel in the control room is now carried out by a dedicated person, present over extended hours in order to ensure proper disabling/re-arming (operation in 2 shifts). Outside these hours, the operators ensure management of the fire detection panel. This person is no longer in charge of maintenance (another person is responsible for this), which allows continuous presence in the control room over the required time period. For all of the above items, the Operations Shift Manager can also use the Operational Focus to give notice of any difficulties or alerts as well as the time taken to handle requests.

**IAEA Comments:**

The plant analyzed the issue and identified that improvements to the arrangements for effective communications, commissioning, and operations were required. The plant introduced new arrangements to ensure that a risk analysis was undertaken for all commissioning tests which included a step to analyze the potential for the test to have an impact on equipment which had been handed over to operations. During the recently completed hot functional tests there were no events raised for issues with the coordination of activities between the commissioning and operations organizations.

Where commissioning tests have the potential to have an impact on operational equipment, joint pre-job briefs between the operations and commissioning personnel take place. The commissioning organization produces a rolling 20-day schedule of commissioning tests which was used to inform the Tagging Supervisor (DSE) which permits were required.

The alarms for all equipment which has been handed over to operations are fully functional in the control room and the corresponding alarm response instruction sheets were in operation. The plant improved the quality and limited the number of temporary operating instructions to 20 to minimise the burden to control room operators. A walkdown in the main control room confirmed that there were 18 temporary instructions in place, and none had any handwritten amendments. The control room serenity had been improved with the installation of a waiting area to prevent personnel from directly entering the control room. This was confirmed during a visit to the control room, where there was a calm atmosphere, and the access arrangements were strictly adhered to. However, some minor housekeeping deviations were identified, and the plant had ordered some additional storage cabinets to further improve housekeeping standards within the main control room.

The monitoring of the fire control panel was carried out by dedicated personnel working double shifts and handed over to operations for monitoring during night shifts and this was confirmed during a visit to the control room. There had been a significant improvement in the number of unexpected and spurious fire alarms caused by commissioning tests, of the 291 spurious fire alarms which occurred from January 2021 to November 2021, only 7% were from unexpected alarms generated during the commissioning tests.

The routine monitoring of plant status by control room operators had been improved by the introduction of a procedure defining which plant status should be monitored and at what frequency. The instruction contained details of the expected status of the system which the operator then compared with the actual status and any deviations were reported to the shift manager for further investigation.

The Common Application Note (NAC) was updated to incorporate any lessons learnt from the joint commissioning/operations activities to improve the coordination between these two groups for future commissioning tests. The Common Application Note was updated prior to the start of the hot functional testing sequence and was expected to be updated prior to fuel loading.

**Conclusion:** Issue resolved

## 13.2. ORGANIZATION AND MANAGEMENT OF COMMISSIONING

**13.2(1) Issue:** The plant arrangements and practices to protect the integrity of fire barriers and ensure effective fire suppression have not been fully developed and implemented to minimise fire risk.

The team noted the following:

- The plant has developed fire response sheets for the plant fire team for the individual fire compartments inside buildings handed over to operations, but the external fire brigade uses ‘fire scenarios’ which cover the most hazardous buildings. Out of 19 scenarios needed only one was approved for use (for transformers). For other areas including those already handed over to operations (such as diesel generator building) the prototypes of scenarios had been developed but have not yet been tested and approved for use.
- The plant has no procedure in place to define which compensatory measures should be taken when fire hazards (such as unavailability of fire protection systems) are identified.
- In construction and commissioning areas:
  - The fire detection and fire suppression systems in operation do not cover all plant areas because construction and commissioning are incomplete. There is no requirement to have a fire suppression system in operation before putting fire loads in place (cables into cable trays, oil, diesel fuel etc.). No specific compensatory measures to ensure effective fire detection and extinguishing are in place (except those which are prescribed by the testing procedures).
  - The plant has no requirements to perform a quantitative risk analysis prior to introduction of fire loads into the construction and commissioning areas.
  - The plant has no requirement to perform periodic assessments of the cumulative effect of fire safety deviations (such as open fire doors or unsealed penetrations in fire compartment barriers) in construction and commissioning areas.
  - Fire response sheets are not in place to aid fire teams in the construction and commissioning areas.
  - There was a localized ignition event during the train 4 diesel generator 3LHS7101GE test on 27 June 2018, the test procedure does not prescribe the requirement to check readiness of the fire water spray system (i.e. pressure in the pipeline) or the actions required in the event of fire. The test procedure requirement to have fire protection systems ‘operational’ is ambiguous as it is not clear if these must be in automatic or manual modes or if they should already be handed over to operations.
  - Cable penetrations in fire protection barrier (walls) in multiple locations inside the safety systems building are not sealed.
  - Fire suppression system pipelines were observed with no handle on the water supply valves.
  - Temporary communications (cables, ventilation hoses) are routed through open fire protection doors in several locations in the safety systems building.

  - A fire extinguisher was absent from its designated place in the safety systems building.
  - The manual fire alarm actuator 3JDT3449AUJ3047 in the safety systems building is broken.
  - Fire barrier bags blocking cable penetrations were not positioned correctly for fire protection in the effluent treatment building (room HQ3 1775).
  - There was a combustible load without extinguisher in the effluent treatment building (room HQ3 1777).
  - One of the fire extinguishers in the safety systems building had not been checked between August 2017 and June 2019.
- In handed over to operations areas:
  - The approved version of the fire safety analysis is not available at the plant. The procedure allows authorization of the storage of transient combustibles without additional risk assessment if the fire load does not exceed 400 MJ/m2 (except for highly inflammable materials). The total fire load inside the compartment and fire suppression systems’ capacity are not taken into consideration.
  - While there is no nuclear fuel at the plant there is no requirement in place to set priorities and time limits to fix fire barrier defects. A defect in the pumping station related to an unsealed cable penetration that connected rooms related to the different safety trains was not fixed for 92 days.

Without fully developed and implemented arrangements and practices to protect the integrity of fire barriers and ensure effective fire suppression the safety of personnel and equipment can be jeopardized.

**Recommendation:** The plant should improve the arrangements and practices that protect the integrity of fire barriers and ensure effective fire suppression to ensure the safety of personnel and equipment.

**IAEA Bases:**

SSR-2/2 (Rev.1)

5.21. The arrangements for ensuring fire safety made by the operating organization shall cover the following: adequate management for fire safety; preventing fires from starting; detecting and extinguishing quickly any fires that do start; preventing the spread of those fires that have not been extinguished; and providing protection from fire for structures, systems and components that are necessary to shut down the plant safely.

NS-G-2.1

2.12. Procedures should be established for the purpose of ensuring that amounts of combustible materials (the fire load) and the numbers of ignition sources be minimized in areas containing items important to safety and in adjacent areas that may present a risk of exposure to fire for items important to safety.

2.13. Effective procedures for inspection, maintenance and testing should be prepared and implemented throughout the lifetime of the plant with the objective of ensuring the continued minimization of fire load, and the reliability of the installed features for detecting, extinguishing and mitigating the effects of fires, including established fire barriers.

6.2. Written procedures should be established and enforced to minimize the amount of transient (i.e. non-permanent) combustible materials, particularly packaging materials, in areas identified as important to safety. Such materials should be removed as soon as the activity is completed (or at regular intervals) or should be temporarily stored in approved containers or storage areas.

6.3. The total fire load due to combustible materials in each area identified as important to safety should be maintained as low as reasonably practicable, with account taken of the fire resistance rating of the compartment boundaries. Records should be maintained that document the estimated or calculated existing fire load as well as the maximum permissible fire load in each area.

6.4. The use of combustible materials in the furnishings of the power plant should be minimized. Combustible materials should not be used for decorative or other non-essential effect in areas identified as important to safety.

6.5. Administrative controls should be established and implemented to ensure that areas important to safety are inspected periodically in order to evaluate the general fire loading and plant housekeeping conditions, and to ensure that means of exit and access routes for manual fire fighting are not blocked. Administrative controls should also be effected to ensure that the actual fire load is kept within permissible limits.

7.3. Minimum acceptable levels of availability should be established and documented for all fire protection features identified as important to safety. Interim compensatory measures should be defined for each fire protection feature identified in this way. These compensatory measures should be implemented on a temporary basis in the event that the minimum level of availability for a given fire protection feature is not maintained or the fire protection feature is determined to be inoperable. Both the compensatory measure to be implemented and the allowable time schedule for its implementation should be determined, documented and reviewed. If the minimum acceptable level of availability of a fire protection measure has not been specified, it should be assumed to be 100%.

SSG-28

3.33. The responsibilities of the commissioning group should include, but are not limited to, the following:

- To ensure that the commissioning procedures comply with the appropriate rules and regulations, and requirements for safety (including those for radiation protection, nuclear safety, fire safety, industrial safety and protection of the environment);

3.47. Personnel should adhere to normal operating rules such as those relating to access to the control room, access to control cabinets and switchboards, control of information, communication with the control room about abnormalities and changes to plant configuration.

4.28. In determining the sequence of testing, the following four points should be considered:

(ii) Certain specific support systems (e.g. compressed air system, electrical system, service water system, system for supply of demineralized water, system for the management of radioactive waste, ventilation system, drainage system) should be commissioned prior to other systems so that they are available for the testing of other systems.

(iii) Certain specific systems should be operational to ensure that other systems can be tested without jeopardizing personnel, the plant or nuclear safety (e.g. fire protection systems, radiation protection systems, emergency power system, system for the management of radioactive waste).

4.31. In a satisfactory pre-operational test, the proper sequence of tests of electrical systems, instrumentation systems and other service systems such as cooling water systems and fire protection systems should be taken into account to ensure the availability of the necessary services for the entire commissioning programme.

SSG-38

2.15. Necessary fire protection measures at the construction site should remain available until the fire detection, protection and suppression systems for the installation are operational. Details of these measures should be included in the arrangements for emergency preparedness and response.

5.35. Storage areas should be established with account taken of aspects such as:

(a) Cleanness and housekeeping practices;

(b) Requirements for fire protection;

(c) Protective requirements relating to coatings, preservatives, covers and sleeves;

(d) Prevention of physical damage;

**Plant Response/Action:**

Following the findings of the Pre-OSART, the plant has initiated a major action plan on all the worksite with the aim of significantly increasing the level of fire risk control. The current state of play and the main actions launched on the four fire themes (Management, Training, Intervention and Prevention), taking into account the facts from the previous assessment, are presented below:

Management:

A comprehensive action plan to improve the control of fire risk at the site and to move from a site culture to a plant operator culture was developed with the participation of all departments under the impetus of line management. During the period from October 2019 to March 2020, a performance indicator was put in place to monitor weekly progress with the actions defined. As a result of this “crackdown”, which has raised awareness and initiated cultural change on the site, a new fire performance indicator, was developed to provide improved coordination on this subject.

Finally, during the inspection by the Nuclear Inspectorate in September 2020, “fire risk control” received a “B” score on the handling of the recommendation, confirming the progress made in this field. The Nuclear Inspectorate awards a score according to the following classification:

- A (satisfactory progress has been made).
- B (progress is being made and should be continued).
- C (more attention from line management is required).
- D (little progress has been made).

Training / Staff culture:

On the staff skills and culture aspect, a communication plan ("All together for safety" sent to all site staff and developed during the Monday morning 15-minute meeting, posters, etc.). This was deployed across the site and made it possible to give a reminder of the requirements of the reference procedure on all themes linked to the control of fire risk. Fire experts have developed a support plan to maintain focus among line management and the key players in charge of promoting the requirements on the ground (Dedicated Field Team for the line management, Zone Facilitator, Emergency Response Directors, Storage unit, etc.).

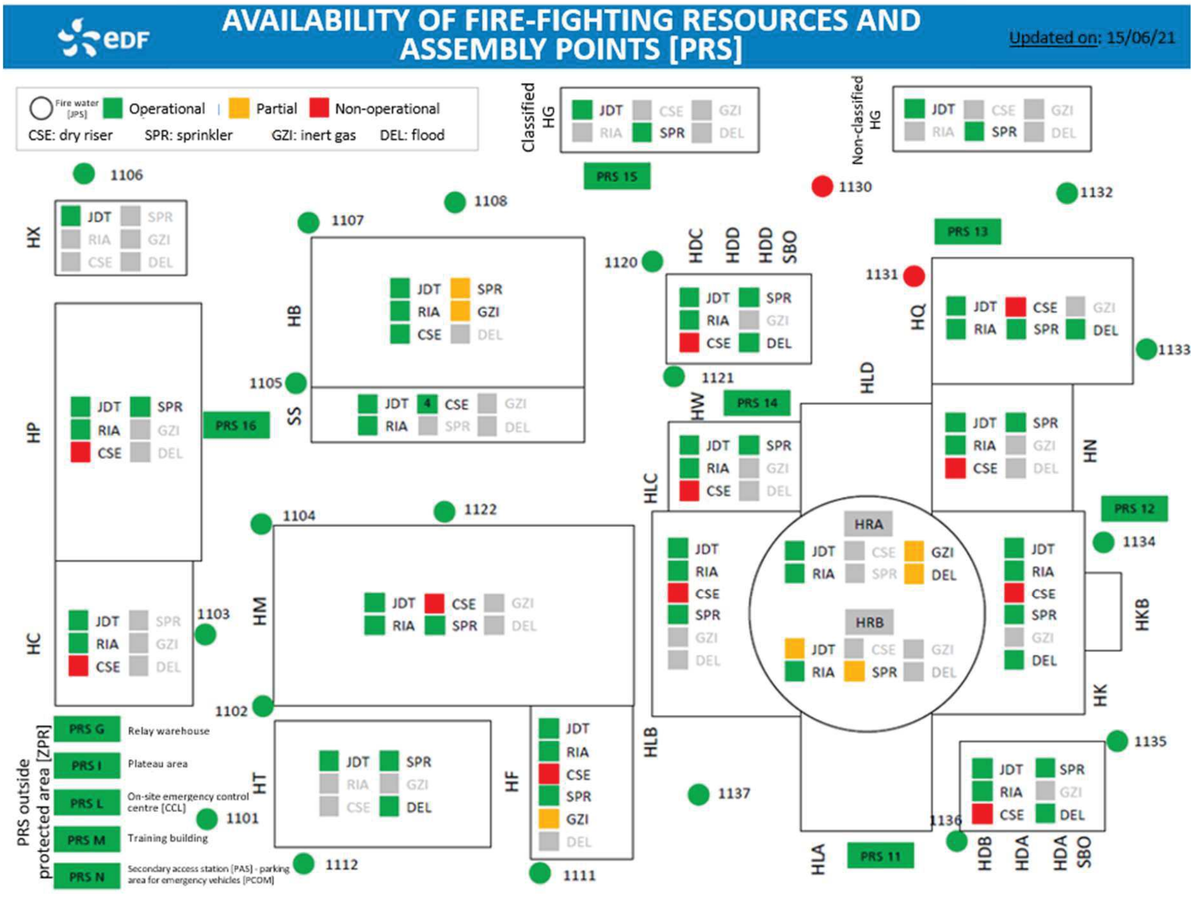
During drills and training of the site intervention teams (EDF staff) with or without outside responders, observers, including a member of senior management, monitor the key players (operator in the control room, first responders, head of emergency response, director of emergency response, emergency response vehicles [PCOM], outside responders, etc.). They evaluate the actions carried out according to an observation grid. At the end of the drills, a debriefing is organized to share good practices identified but also areas for improvement. In addition, some drills were performed in a "simulated" radiologically controlled area, to prepare the plant operator for this future constraint. All reports are available and archived in the documentary databases.

Finally, the fire training material (initial and refresher training) has been completely reworked to ensure the proper distribution/incorporation of the key messages on fire risk control in relation to the industrial risks at Flamanville 3.

Intervention:

The Fire scenarios have been finalised, approved and distributed to the relevant players. The Listed Establishment Plan, drawn up with the help of outside responders, has also been finalised, approved and distributed. This is a summary document for outside responders. It provides an overview of the site (access, water points, special risks, etc.) and each fire scenario is described in simple terms. In addition, all fire action sheets for field operators in the event of a fire have been deployed and tested in the field.

Finally, the means of fire-fighting and fire detection are subject to special monitoring with the creation of a map reflecting their availability. This is updated and each new version is distributed to emergency response teams and Directors. In addition, a reinforced system has been set up to handle work requests on the fire systems, now all transferred to the plant operator.




Prevention:

Many anomalies were observed during the inspection, particularly outside the buildings transferred to the operator. Hence, a campaign to re-plug fire ducts was carried out as part of the fire action plan with the aim of securing at least the stairwells allowing staff to evacuate, as well as certain areas identified as being at particular risk, such as rooms containing a high quantity of oil or fuel oil. Particular attention was also paid to the battery rooms, which were the subject of feedback from Taishan.

In addition, the plant operator manages sectorisation through its operational routines on all the transferred buildings according to the dedicated operating procedure and a specific communication has been issued to clarify the management of sectorisation anomalies outside the transferred buildings.

Heat Loads:

Since the previous inspection, the organization of heat load management has been the subject of many developments listed below. In response to the inspection, several temporary storage areas have been created in the facility. At the same time, study notes reflecting the temporary storage capacities of each room have been reworked and adapted by considering the monitoring of heat loads as an activity important for protection of interests within the sectorised buildings. On the exteriors, a storage plan is monitored monthly with the definition of certain fire risk exclusion zones to be used only as a last resort and under the cover of a specific fire risk analysis.

To ensure the monitoring of these arrangements, a service provider is responsible for monitoring compliance with these rules on site. In addition, management inspections now also incorporate these various observables. Findings, whether positive or negative, are recorded using dedicated software for processing.

Hot work permits:

The organization around hot work permits was not the subject of specific comments from the IAEA. Communication and simplification of the process have, however, been carried out in this area to maintain the momentum. During the inspection by the Nuclear Inspectorate, the NPP was held up as a good example in relation to other sites in the fleet.

Sites with a high fire risk:

The organization around work sites classified as posing a “high fire risk” is now deployed. In particular, a support note presents the risks and provides the criteria for whether or not the work site should be classified as “high fire risk”. Ongoing weekly meetings have been set up to bring together all the trades involved in preparing and carrying out this type of activity. A specific risk analysis is systematically documented and approved by a Level 3 Risk Prevention Officer and the on-call Emergency Response Director.

**IAEA comments:**

The plant analyzed the issue and set corrective actions to improve the integrity of fire barriers and the fire suppression arrangements.

The plant produced, approved, and had deployed all the fire response sheets at the locations of the fire panels. These contained locations maps for fire detection and suppression systems together with information on main fire hazards within the fire zones.

The plant developed procedures to identify fire risks and to ensure that appropriate mitigation measures were put in place. Work in areas with high consequences if a fire occurred were independently assessed by a fire specialist to identify mitigation measures. For work in other areas with the potential for fire risk, the Fire Work Permit system identifies compensatory measures when fire hazards were identified. The cumulative effect of fire safety deviations was also considered within the fire risk assessment process.

A plant walkdown did not identify any defects with fire penetrations and all fire extinguishers checked were within the valid dates. Four fire extinguishers within buildings handed over to operations were not labelled correctly but were operational.

The plant developed a fire status map which shows the availability of the fire detection and suppression systems across the whole plant. For example, in November 2019 out of the 21 exterior fire hydrants only 5 were operational whereas in November 2021, 15 were operational and 6 were unavailable. At the time of the Follow-up, all the fire detection systems were operable throughout the plant, but the dry-riser systems were not operable within six buildings, but fire hose reels and hydrants were operable.

The plant had established a fire performance indicator. This contained a total of 26 fire performance measures and as of November 2021, 12 were in green status, 8 in yellow and 6 in red (not met the target) status. Some examples of where the plant had not met the target values (red) for the following indicators were: number of evacuations of the administrative building, number of false fire alarms and the number of observed deviations in high fire risk areas. Furthermore, the plant had set an overall fire performance target of 70% and as of November 2021, the value was 60% (at the time of the Pre-OSART, this value was 20%).

The plant was developing a fire exercise schedule which was expected to be available before the end of 2021 and exercises based on these scenarios, would take place in 2022.

The plant had four minor fire events in 2021, three related to burning of electrical sockets and one for burning of a plant label.

The 2020 and 2021 annual review of the fire risk process identified the management of fire load indicator was red for both years. The plant had completed the analysis of the permissible combustible storage limits for each building and was preparing the documentation to reduce the fire loads to within these limits. It was expected that the new building fire load arrangements would be in place by first quarter 2022.

**Conclusion:** Satisfactory progress to date

## 13.3. IMPLEMENTATION OF THE COMMISSIONING PROGRAMME

**13.3(1) Issue:** The large number of open modifications, emergent work activities, open deviations, and rework are not always adequately managed to minimize the potential impact on safety and quality.

The team noted the following:

Inappropriate control of contractors and verification of their documentation has resulted in some errors and affected implementation of the project. These have occurred in different phases of the construction and commissioning process.

Management of non-conformances and deviations is not always rigorous:

- Non-conformance report related to deviations of the SBO Diesel Generator (in the construction phase) was initiated two years after the deviation occurred.
- Testing identified non-conformances in some welds. As a result, construction was interrupted, and an extensive action plan launched. However, the committee for characterizing deviations, did not conduct a timely assessment of the full extent of the issue.
- The multifunctional group that evaluates all deviations and non-conformances from commissioning and construction only meets on a monthly basis which may be insufficient to ensure progress is made and challenges do not exist.
- More than 10 databases are used to track deviations in the construction and commissioning phase making it difficult to a get clear picture of the level of work needed to be completed prior to handover. Four databases are used to track deviations after handover of systems and buildings from the AFA (Construction) to DPN (Operating Organization).

There is a large amount of work that must be completed to meet key milestones such as Phase 2 of Hot Functional Testing and Fuel Loading. For example:

- For Hot Functional Test Phase 2:
  - 140 modifications have been installed but not yet contractually verified in the field;
  - 100 modifications are in progress;
  - As of June, 26 2019, 476 commissioning tests are in progress and need to be finalized;
  - 212 deviations need to be resolved, about 100 of these are considered significant.
- For fuel loading:
  - 300 modifications have been installed but not contractually verified on the field;
  - 1000 modifications are in progress;
  - As of 26 June 2019, 8437 activities from the ‘tracking databases for balance of work’ need to be completed.

An integrated resource loaded schedule has deliberately not been developed by the Project for remaining work, though this schedule exists on a craft-by-craft basis. Interviews with Operations Staff members indicated that they are typically able to look ahead two weeks. Interviews with other members of the plant staff indicated that schedules are not routinely updated.

The CES (Field Test Commission) is responsible for checking that the objectives set by the start-up test programme have been achieved and enabling the next phase to get underway. The CES serves as the final barrier of validation and its effectiveness can be challenged when there is many open work activities and deviations that must be reviewed to determine whether commissioning activities can proceed.

The installed quality assurance during and after performed works is not always capable to guarantee component's or equipment's faultless installation and repair. The following are some examples of issues identified by the OSART Team during plant walkdowns and not recorded in plant databases:

- Grounding is not connected to the cable tray with cables in the medium pressure safety injection pump 3RIS4420PO room.
- Damaged insulation casing on the Safety Injection System. Damaged insulation was found on RIS 2510 TY-F05/P4A and RIS 2510 TY F05/P3A, and on valve RIS2292.
- Connections of the grounding cable for the safety injection pump 3RIS4420POM motor are painted.
- Several scotch tape rolls were found used in reactor and turbine building without being marked with PMUC (safe to use). Use of tape with unknown substances in the glue can cause chlorine induce corrosion on safety related stainless steel components.

If the large number of open modifications, emergent work activities, open deviations, and rework are not adequately managed, the potential exists to impact safety and quality.

**Suggestion:** The Commissioning and Operating organizations should consider enhancements to the oversight and verification of remaining work activities to ensure safety and quality.

**IAEA Bases:**

GSR Part 4

4.6 A safety assessment shall be carried out at the design stage for a new facility or activity, or as early as possible in the lifetime of an existing facility or activity. For facilities and activities that continue over long periods of time, the safety assessment shall be updated as necessary through the stages of the lifetime of the facility or activity, so as to take into account possible changes in circumstances (such as the application of new standards or new scientific and technological developments), changes in site characteristics, and modifications to the design or operation, and also the effects of ageing.

4.7. In the updating of the safety assessment, account also shall be taken of operating experience, including data on anticipated operational occurrences and accident conditions and accident precursors, both for the facility or the activity itself and for similar facilities or activities.

5.2. The safety assessment in itself cannot achieve safety. Safety can only be achieved if the input assumptions are valid, the derived limits and conditions are implemented and maintained, and the assessment reflects the facility or activity as it actually is at any point in time. Facilities and activities change and evolve over their lifetimes (e.g. through construction, commissioning, operation, and decommissioning and dismantling or closure) and with modifications, improvements and effects of ageing.

NS-G-2.3

4.8. An initial safety assessment should be carried out before starting a modification to determine whether the proposed modification has any consequences for safety and whether it is within the regulatory constraints for the plant design and operation. This initial assessment should be carried out by trained and qualified personnel, taking a systematic approach, and should be reviewed by an independent safety expert.

4.13. The scope, safety implications and consequences of proposed modifications should be reviewed by personnel not immediately involved in their design or implementation. These reviewers should include representatives of the operators and engineering personnel, the design organization, safety experts, and other technical or managerial advisers. The latter may also include independent external advisors, particularly for major modifications, as necessary to ensure that a full and adequately informed discussion of the modification, including all its safety implications for the plant, can be held. These reviews should also include independent validation and verification of software changes for major modifications.

SSG-28

3.12. Arrangements should be made for adequate and, where necessary, independent oversight and control of the quality of ongoing work.

3.67. The provision of a consistent process for the management of non-conformances is a requirement of all management systems. The process for the management of non-conformances should apply to the failure of components to meet their specified performance requirements and to the failure of larger systems to meet their requirements on the basis of the safety analysis or other performance specifications. A robust system for recording and resolving non-conformance and for approving concessions, corrective actions and preventive actions should be in place.

5.7. The purpose of the commissioning manual is to specify the organizational structure and responsibilities for the management and control of testing and commissioning, to meet the requirements for quality, established requirements, statutory obligations and the licence provisions. The commissioning manual should specify the extent and nature of, and the approval process for, the documentation, including procedures and certificates to be used during commissioning.

**Plant Response/Action:**

As explained at the beginning of this document, one of the aims of the “OneFLA3” organisation fully responds to this suggestion by working on the following 5 themes:

- Actions To be Completed (TBCs)
- Planning
- Coordination
- Quality

Actions to be completed (TBCs):

The actions carried out since the Pre-OSART have given an overall vision on what remains to be completed (TBC) which represented a significant workload. The main actions are as follows:

- Setting up a "TBC Web" computerised database that compiles more than 60 source files (contractual TBCs between EDF and the contractors) as well as several EDF databases (GMEC for deviations, WebTransfer2 for reservations and EAM for the TBCs of transferred systems)
- A bimonthly routine to update the data (the specialists send their updated Excel source files), the goal being to have an up-to-date TBC database.
- Putting in place a TBC contact [Co-RAF] at the Project work package level, responsible for TBC within their geographical scope.
- Consolidation and analysis of the TBC Web computer database line by line by the TBC Supervision structure, to identify activities that can be planned.
- Bimonthly TBC indicators according to each project work package (geographical scope).
- During site test committee [CES] meetings (in particular EFCO3 phase) and the plant nuclear safety committee for the Fuel delivery, all blocking TBCs have been identified, managed and closed to allow the milestones to be passed.
- The TBC consists of many sources, but there are 3 large databases: GMEC for deviations, EAM for work requests [DT] and work orders [OT], WebTransfer2 for reservations (represents about 50% of all TBCs). These three databases are managed by dedicated staff and committees have been set up to speed up their reduction:
    - DT Committee: 2500 DTs analysed in early 2021 (with safety milestones validated). Establishment of line management control when new DTs are issued, to guarantee their quality
    - Deviations: all deviations have been analysed with respect to impacts on the Commissioning procedure General Operating Guidelines [RGE DMES]. Cross-functional coordination by the deviations steering committee [COPIL Ecarts] (moving from 16,000 to 8300 deviations between 2020 and 2021). Specific management has been put in place for the preparation of test and safety milestones.
    - Reservations: establishment of a dedicated team with field controllers and local engineering (for complex reservations). Move from 8000 reservations in January 2020 to 3300 reservations in June 2021 and increased numbers of field controllers. Guidance on complex reservations in a monthly committee meeting with decisions on local modifications using a simplified process based on trade-offs led by the Technical Director.
    - All TBCs thus comprise: contractual files with contractors, deviations, reservations on non-transferred equipment or work requests on non-transferred equipment, modifications and temporary modifications [DMP/MTI].

At the beginning of 2021, there were 42,000 TBC lines. This was reduced to 34,000 TBC lines in the first half of 2021.

Planning:

At the time of Pre-OSART, the co-existence of two separate tools according to the transfer status resulted in two separate schedules. This led to regular shortcomings in terms of prioritisation and planning quality. This difficulty has been resolved with the following actions:

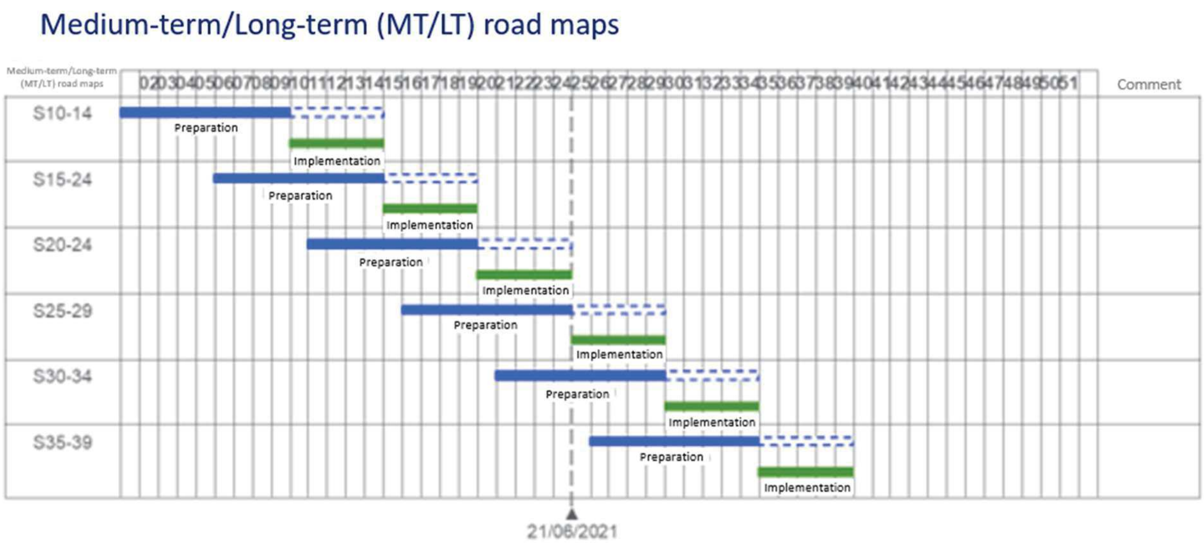
- Setting up a single integrated schedule, including all site activities that can be planned (functional or geographical impact), whether in the transferred area or not (about 1500 scheduling tasks per week)
- All the schedules (except for the specific MSS [CSP] site) have been switched over to a single planning tool (GPS, the tool of the plant operator DPN), with strong support from the methods unit of Performance Management
- The long process of structuring the strategic schedule (with the N1, N2 and N3 milestones) has been put in place, giving better visibility of compliance with the milestones
- For example, the general schedule has been structured around major sections of the electrical divisions (in 2020 and again in 2021) and sections of the heat sink (divisions in the pumping station)
- An essential milestone has been reached, the arrival of the first fuel assembly in the fuel building deactivation pool with the following actions managed by the plant operator:
  - Complete analysis of all TBCs blocking the milestone (including equipment, documentation, skills and organisation)
  - Very frequent routines to secure the remaining blocking reservations, with very strong involvement of the NPP management in particular
  - Setting up a “dry run” start-up safety committee (COMSAD) to complete the regular stages
  - Independent analysis by the Independent Safety Team [FIS]

Coordination:

The co-existence of two separate project teams, depending on the transfer status, led to complex routines and inefficiency. A common project structure (DAE) was therefore put in place to complete the facility, as well as a medium-term/long-term (MTLT) management structure to anticipate and prepare plant operator issues:

- Setting up a weekly coordination meeting “RPPH”, to take stock of the activities of each project work package (indicators including a progress report [TPLR], TBCs, scheduling carried out, scheduling stability, and rate of progress with of field and transfer activities). A part is also dedicated to MTLT management.
- Monthly trade-off meetings with the Technical Director, local engineering and the Project for decisions on complex reservations and locally-investigated modifications related to the Transfer process.
- Setting up interfaces between the project structure (DAE) and the medium-term/long-term (MTLT) management structure. MTLT management prepares all operation activities (preventive and corrective maintenance, periodic tests, preservation) for the DAE, several months in advance, who is in charge to put these activities in place. A

convergence meeting allows the creation of a "road map" for these operation activities. Coordination indicators have also been put in place.




Quality Unit:

Several situations (in particular the many malfunctions found in the Qualification Maintained in Accident Conditions [MQCA] process) have highlighted that the plant needed to improve on the quality of the work carried out (traceability, monitoring, methods, etc.)

Setting up a Quality Unit, affiliated to the DAE, to support trade and project work packages in a cross-cutting manner

The Quality unit provides support in the following areas:

- Monitoring (implementation of the Argos tool in particular)
- FME (coordination and support to specialists). Tarlatan is now banned from the work site.
- Traceability in EAM and control of the re-qualification process (cross-functional support to specialists when putting re-qualification in place in EAM)

Monitoring:

Setting up the ARGOS tool, with support from the Quality Unit

Statement on the monitoring requirements for Partial Commissioning procedures [DMESp] (safety requirement)

Support for bringing monitoring back in house, up to the time of fuel loading

Traceability of specialists' activities:

In the face of an increasing number of post-EAC2 assembly activities, post-assembly re-qualification activities should have been carried out as part of an "industrial" process.

Faced with such a challenge, the plant set up a working group to determine the traceability method for all activities requiring re-qualification. All specialists in the FA3 PD have traced all activities requiring re-qualification in the plant operator's EAM tool, using a methodology set down and monitored by the Quality Unit.

– Between November 2020 and June 2021, the plant counted almost 18,740 TOTs (work order tasks) traced in the EAM according to the methodology described above.

**IAEA comments:**

The plant analyzed the issue and identified that improvements should be made to the arrangements for the management, planning, and coordination of deviations arising from the commissioning process. The plant set up a centralised database to collect, sort and manage all the commissioning deviations which were previously held in a series of different databases. They also consolidated the two commissioning planning schedules into one integrated schedule.

In order to improve the quality and monitoring of work packages a Quality Unit was set up within the common project structure (DAE).

The plant had established a dedicated process to ensure that all the required work was completed before key scheduled milestones were reached. This consisted of handover review committee (transfer), work package completion intermediate milestones, Site Testing Committee (CES), and Deviations Committee (CES), and a final review of all safety related activities before fuel loading (COMSAD). This process was used to ensure all relevant commissioning activities were completed prior to granting permission for fuel loading into the spent fuel pool.

At the start of 2021 the plant had 42,000 activities to complete arising from the construction and commissioning work which had been undertaken and this had been reduced to 37,000 at the time of the Pre-OSART Follow-up which included the assessment of emergent commissioning activities. These activities were divided into categories and the main categories were: 1204 scheduled work requests (DT), 11,800 partially unscheduled and unanalysed work orders (TOT), 6,669 deviations (GMEC), 170 engineering deviations (Cameleon), 2,400 temporary modifications (DMP), 773 modifications (FIM), 1589 test execution results which gave rise to an anomaly (REE), 2,072 reservations (Transfer), and 10,000 operational activities.

The plant had enhanced the oversight and verification of remaining work activities to ensure safety and quality such that it now had a clear picture of the remaining unresolved activities. However, it had not completed an analysis to determine which of the 37,000 activities had the potential to impact the fuel loading and therefore had to be resolved before fuel loading can commence. Furthermore, there was no integrated resource loaded schedule showing when and how the analysis was expected to be completed.

The plant was allocating new time windows for the completion of these activities within the new integrated commissioning schedule but not all of the potential activities had been incorporated into the new integrated commissioning schedule (GEF). 30% had been incorporated into the new time windows at the time of the Pre-OSART Follow-up. Work on assessing the impact of the remaining work activities on the overall commissioning schedule was ongoing and was expected to be completed in mid-2022.

**Conclusion**: Satisfactory progress to date

**SUMMARY OF STATUS OF RECOMMENDATIONS AND SUGGESTIONS OF THE PRE-OSART FOLLOW-UP MISSION**

| | RESOLVED | SATISFACTORY PROGRESS | INSUFFICIENT PROGRESS | TOTAL |
|---|---|---|---|---|
| Leadership and Management for Safety | | | | |
| R1.1(1) | X | | | |
| Training and Qualification | | | | |
| S2.2(1) | X | | | |
| S2.2(2) | X | | | |
| Operations | | | | |
| S3.4(1) | X | | | |
| Maintenance | | | | |
| R4.6(1) | X | | | |
| Technical Support | | | | |
| S5.1(1) | X | | | |
| S5.6(1) | X | | | |
| Operating Experience Feedback | | | | |
| R6.7(1) | | X | | |
| Radiation Protection | | | | |
| S7.2(1) | X | | | |
| S7.6(1) | | X | | |
| Chemistry | | | | |
| S8.2(1) | X | | | |
| R8.5(1) | X | | | |
| Emergency Preparedness & Response | | | | |
| R9.2(1) | X | | | |
| S9.2(2) | | X | | |
| S9.3(1) | X | | | |
| S9.3(2) | X | | | |
| Severe Accident Management | | | | |
| S10.5(1) | | X | | |
| Human, Technology and Organization Interaction | | | | |
| S11.4(1) | | X | | |
| Commissioning | | | | |
| S13.1(1) | X | | | |
| R13.2(1) | | X | | |
| S13.3(1) | | X | | |
| TOTAL R | 4 | 2 | | 6 |
| TOTAL S | 10 | 5 | | 15 |
| TOTAL | 14 | 7 | 0 | 21 |
| | 67% | 33% | | 100% |

# 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.

DEFINITIONS - FOLLOW-UP MISSION

**Issue resolved - Recommendation**
All necessary actions have been taken to deal with the root causes of the issue rather than to just eliminate the examples identified by the team. Management review has been carried out to ensure that actions taken have eliminated the issue. Actions have also been taken to check that it does not recur. Alternatively, the issue is no longer valid due to, for example, changes in the plant organization.

**Satisfactory progress to date - Recommendation**
Actions have been taken, including root cause determination, which lead to a high level of confidence that the issue will be resolved in a reasonable time frame. These actions might include budget commitments, staffing, document preparation, increased or modified training, equipment purchase etc. This category implies that the recommendation could not reasonably have been resolved prior to the follow up visit, either due to its complexity or the need for long term actions to resolve it. This category also includes recommendations which have been resolved using temporary or informal methods, or when their resolution has only recently taken place and its effectiveness has not been fully assessed.

**Insufficient progress to date - Recommendation**

Actions taken or planned do not lead to the conclusion that the issue will be resolved in a reasonable time frame. This category includes recommendations on which no action has been taken, unless this recommendation has been withdrawn.

**Withdrawn - Recommendation**
The recommendation is not appropriate due, for example, to poor or incorrect definition of the original finding or its having minimal impact on safety.

**Issue resolved - Suggestion**
Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been fully implemented or the plant has rejected the suggestion for reasons acceptable to the follow-up team.

**Satisfactory progress to date - Suggestion**
Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been developed but not yet fully implemented.

**Insufficient progress to date - Suggestion**
Consideration of the suggestion has not been sufficiently thorough. Additional consideration of the suggestion or the strengthening of improvement plans is necessary, as described in the IAEA comment.

**Withdrawn - Suggestion**
The suggestion is not appropriate due, for example, to poor or incorrect definition of the original suggestion or its having minimal impact on safety.

# REFERENCES

**Safety Fundamentals**

SF-1 Fundamental Safety Principles (Safety Fundamentals)

**General Safety Requirements**

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 7 Preparedness and Response for a Nuclear or Radiological Emergency

**Specific Safety Requirements**

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

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

SSR-5 Disposal of Radioactive Waste

**General Safety Guides**

GSG-1 Classification of Radioactive Waste

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

**Safety Guides**

NS-G-1.1 Software for Computer Based Systems Important to Safety in Nuclear Power Plants

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

NS-G-2.2 Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants

NS-G-2.3 Modifications to Nuclear Power Plants

NS-G-2.4 The Operating Organization for Nuclear Power Plants

| | |
|---|---|
| NS-G-2.5 | Core Management and Fuel Handling for Nuclear Power Plants |
| NS-G-2.6 | Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants |
| NS-G-2.8 | Recruitment, Qualification and Training of Personnel for Nuclear Power Plants |
| NS-G-2.13 | Evaluation of Seismic Safety for Existing Nuclear Installations |
| NS-G-2.14 | Conduct of Operations at Nuclear Power Plants |
| 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 |
| WS-G-6.1 | Storage of Radioactive Waste |
| WS-G-2.5 | Predisposal Management of Low and Intermediate Level Radioactive Waste |


**Specific Safety Guides**


| | |
|---|---|
| SSG-2 | 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-50 | Operating Experience Feedback for Nuclear Installations |
| SSG-54 | Accident Management Programmes for Nuclear Power Plants |

## TEAM COMPOSITION OF THE PRE-OSART MISSION

**MARTYNENKO Yury – IAEA**
Team Leader
Years of nuclear experience: 35

**JIANG Fuming - IAEA**
Deputy Team Leader
Years of nuclear experience: 22

**Experts**

**HARTER Roy Luther - USA**
Years of nuclear experience: 43
Review area: Leadership and Management for Safety

**YUZHAKOV Andrei - RUS**
Years of nuclear experience: 33
Review area: Training and Qualification

**ERIKSSON GRIMGARD Klas-SWE**
Years of nuclear experience: 22
Review area: Operations 1

**TARARIN Alexey - RUS**
Years of nuclear experience:17
Review area: Operations 2

**CRAMER Burkhard - GER**
Years of nuclear experience: 27
Review area: Maintenance

**BILIC-ZABRIC Tea– IAEA**
Years of nuclear experience: 31
Review area: Technical Support

**MAGUIRE Paula – CAN**
Years of nuclear experience: 22
Review area: Operating experience feedback

**LEMAY Francois - CAN**
Years of nuclear experience: 34
Review area: Radiation Protection

**JUERGENSEN Micael - GER**
Years of nuclear experience: 31
Review area: Chemistry

**URUBURU Agustin - SPA**
Years of nuclear experience:12
Review area: Emergency Preparedness and Response

**TUOMISTO Harri - FIN**
Years of nuclear experience: 41
Review area: Accident Management

**KNUTSSON Diana - IAEA**
Years of nuclear experience: 12
Review area: Human Technology Organization Interaction

**OBSERVERS:**

**BELTYKOV Roman – RUS**
Years of nuclear experience: 19

**KIM Hyojin – KOR**
Years of nuclear experience: 34

## TEAM COMPOSITION OF THE OSART FOLLOW-UP MISSION

**MARTYNENKO Yury – IAEA**
Team Leader
Years of nuclear experience: 37
Training and Qualification
Chemistry

**MORGAN Simon – IAEA**
Deputy Team Leader
Years of nuclear experience: 27
Operations
Commissioning

**HARTER Roy Luther – USA**
Years of nuclear experience: 45
Review area: Leadership and Management for Safety
Operating Experience Feedback
Maintenance
Human – Technology – Organization

**TUOMISTO Harri – FIN**
Years of nuclear experience: 43
Review area: Accident Management
Emergency Preparedness and Response

**LEMAY Francois – CAN**
Years of nuclear experience: 36
Review area: Radiation Protection
Technical Support