NSNI/OSART/179F/2016
ORIGINAL: English

IAEA
International Atomic Energy Agency

REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM

(OSART)

MISSION

TO THE

FLAMANVILLE 1&2

NUCLEAR POWER PLANT

FRANCE

6 – 23 OCTOBER 2014

AND

FOLLOW UP MISSION

28 NOV– 2 DEC 2016

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/179F/2016

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Flamanville 1&2 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 OSART follow-up visit which took place 16 months later. The purpose of the follow-up visit 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 nine operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; operating experience feedback; radiation protection; chemistry; and emergency planning and preparedness. 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 the best international practices and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Standards and the expertise of the OSART team members form the basis 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.

CONTENT

INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of France, an IAEA Operational Safety Review Team (OSART) of international experts visited Flamanville 1&2 Nuclear Power Plant from 6 to 23 October 2014. The purpose of the mission was to review operating practices in the areas of Management, Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Planning and Preparedness and Severe Accident Management. 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 1&2 Nuclear Power Plant is located at Flamanville, Manche, France on the Cotentin Peninsula. Flamanville NPP is one of the 19 French sites in the EdF Group. Flamanville NPP houses two PWRs that each produces 1300 Mwe and came into service in 1986 and 1987 respectively. Construction of a new EPR reactor at Flamanville 3 began on 4 December 2007. The new unit is an evolutionary type and is planned to have 1650 Mwe capacity.

The Flamanville 1&2 NPP OSART mission was the 179th in the programme, which began in 1982. The team was composed of experts from Belgium, Germany, Hungary, India, South Africa, Slovak Republic, Sweden, Russian Federation, United Arabic Emirates (UAE), United Kingdom (UK), and the United States of America (USA), together with the IAEA staff members and observers from Brazil, UAE and Russian Federation. The collective nuclear power experience of the team was approximately 350 years.

Before visiting the plant, the team studied information provided by the IAEA and the Flamanville 1&2 plant to familiarize themselves with the plant's main features and operating performance, staff organization and responsibilities, and important programmes and procedures. During the mission, the team reviewed many of the plant's programmes and procedures in depth, examined indicators of the plant's performance, observed work in progress, and held in-depth discussions with plant personnel.

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

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

MAIN CONCLUSIONS FROM OSART MISSION

The OSART team concluded that the managers of Flamanville 1&2 NPP are committed to improving the operational safety and reliability of their plant. There is clear evidence that the plant has gained benefit from the OSART process. The IAEA Safety Standards and benchmarking with other French NPPs, recently hosting OSART missions, were used by the plant for self-assessment during the preparation for the mission.

The OSART team found several good practices, including the following:

- operational limits and conditions (OLC) display screens available in the main control rooms and tagging offices at each unit;
- comprehensive plant component tracking system (AIC) that is used at power and during outages, allowing operations personnel to easily track components that are not in the required position;
- maintenance logistical support teams, known as “Wrench time worksites” taking care of preparatory and post maintenance related activities and thus helping to improve the “hands-on-tool-time” of qualified maintenance workers;
- evident benefits to Flamanville 1&2 plant from availability of EdF nuclear rapid response team (FARN), set up following the Fukushima accident, to respond within 24 hours at a nuclear power plant affected by a severe accident in order to limit further deterioration of the situation;
- dispensers called "Radiabox" for small objects installed in dedicated places to provide quickly and easy dose rate meters to the workers outside the radiation controlled areas (RCA), thus reducing the need for entrance in the RCA to pick up dose rate meters needed for work performed outside of the RCA, as it used to be in the past.

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

- ensure adequate preparedness for the evacuation of the Flamanville and reinforce the preparation for protection of emergency workers;
- improve the management process for the preparation and revision of plant procedure and for control of staff adherence to plant procedures to ensure that the plant is always operated within established limits;
- enhance the rigor and supervision in the main control room during operator’s actions that impact important primary parameters;
- enhance maintenance work processes and practices to ensure high quality of plant maintenance;
- enhance the process of root cause analysis and perform analysis of operational events in sufficient depth.
- improve operational practices to ensure plant deficiencies are systematically identified and tagged adequately;

Flamanville 1&2 NPP management expressed a strong determination to address the areas identified for improvement and indicated a willingness to accept a follow up visit in about eighteen months.

FLAMANVILLE 1&2 PLANT SELF ASSESSMENT FOR THE FOLLOW-UP MISSION

This chapter of the report presents the information received from the plant prior to the follow-up mission. The detailed plant responses for all corrective actions implemented are given after each issue in the respective part of the report. The text is included as written by the plant and has not been edited.

At the end of 2014, an international OSART assessment review was conducted at the Flamanville 1-2 NPP for the second time since its construction. The station was assessed against the highest international standards, represented by the IAEA bases.

The OSART mission highlighted good practices, which shall continue to be applied, and resulted in seven recommendations and seven suggestions. Addressing these weaknesses has enabled the station to continue progress along the path to excellence, with ever-safer operations at the plant.

For more than 18 months, the different suggestions and recommendations issued were analyzed and action plans were set up in the different areas concerned (nuclear safety, industrial safety, radiological protection, maintenance, chemistry and organization). The creation of these roadmaps was facilitated by commitment from all station personnel, paving the way for solid and effective actions for progress.

Some of the fourteen recommendations and suggestions required support from corporate EDF entities, particularly those relating to Emergency Response. Others required the combined efforts of several technical departments and roll-out of the subsequent improvement actions is in progress. This is the case of work into procedure adherence and work document updates, the results of which are starting to be felt.

All levels of management are involved in, and committed to, eradicating maintenance and operations quality deficiencies (NQME). There is now visible progress in terms of maintenance work practices and control room monitoring quality. Progress has been made in processing industrial safety and radiological protection deviations and station results show an upward trend.

The Follow-Up is one of the most important events of the year for the station, where this external view is eagerly-awaited. It will help us measure progress made since the last assessment review.

FOLLOW-UP MAIN CONCLUSIONS

An IAEA Operational Safety Review Follow-up Team visited Flamanville 1&2 NPP from 28 November to 2 December 2016. There is clear evidence that NPP management has gained benefit from the OSART process. The plant has analysed in a systematic way the OSART recommendations and suggestions and developed corrective action plan to address all of them.

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 is a clear indicator of the plant strong safety commitment. During the follow-up mission the plant staff demonstrated openness and transparency. Sustainable positive results were obtained in many areas subject to the follow-up mission. 36% of the issues were fully resolved, 50 % of the issues were found to have achieved satisfactory progress and 14% were found to have insufficient progress.

The plant resolved issues regarding industrial safety programme, rigour and supervision in the main control room during evolutions impacting important primary parameters; management of changes to plant equipment; radiation protection practices to prevent contamination; and chemistry quality assurance programe.

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

To improve the adherence to the procedures the plant set a working group in 2016 that proposed a categorization of plant procedures and defined requirements to address: completion of procedure implementation documentation; attitude to be adopted when a procedure is found wrong or inaccurate; and process to follow when a procedure amendment is performed. Three categories of procedures were defined, e.g. for continuous use, reference use, and information use. The categorization for all plant procedures should be completed by the end of 2016. A plant policy on application of requirements for handling of plant procedures of different categories was drafted in November 2016 and a training on the compliance with this policy is planned for December 2016. The plant has replaced the SYGMA software used for control of plant procedure revisions with a new database SDIN developed by the Corporate. SDIN was made operational at the plant on 4th November 2016, however the effectiveness of SDIN use still needs to be demonstrated.

In improve identification of deficiencies in the field, concerning leaks, labelling and operator aids, the plant has developed a strategic plan, however several of the activities are in intitial stage of implementation. The activity for resolving labelling issues only started in April 2016 with introduction of a new computational monitoring tool, and respective indicators to assess the action plan progress have not yet formally been developed and introduced. Despite of the fact that the plant has made considerable progress in reducing the amount of leaks, a modified process for identification, trending and qualitative analysis of the plant's leaks has not yet been fully implemented. The plant has made efforts to reduce considerably the amount of informal signage and inscriptions on the plant's equipment (graffiti) using some tools embedded into the MEEI process, however further actions are needed to demonstrate effective control of use of operator aids.

To resolve the deficiencies in the maintenance work processes and practices the plant has developed and implemented an action plan. This has resulted in tangible improvements concerning: quality of maintenance work, reduced amount of maintenance rework; lifting and rigging, parking of lifting equipment, foreign materials exclusion measures. Several of the deficiencies indentified during the original mission, however are not yet fully resolved. This include equipment calibration practices; consistent use of adjustable wrenches, adequately performed bolted connections, securing the position of loose trolleys. Further actions are needed to resolve the issue completely and to demonstrate sustainable results for improved maintenance practices.

To reduce the backlog of corrective and preventive maintenance, the plant has defined and implemented a comprehensive action plan. In the planning process different modules with clear deadlines were developed to assure availability of spare parts, to avoid late appearance of work orders and to check the quality of work preparation. Performance indicators to monitor different maintenance backlogs were developed and reported weekly to the senior plant management.

During the follow-up mission the team noted the positive trend to reduce the volume of corrective and the backlog of preventive maintenance for different categories of equipment, eg the volume of corrective maintenance was reduced from 1545 to 845; overdue corrective maintenance on equipment important to safety was reduced between the original mission and the follow up mission from 142 to 81 for priority 3, 56 to 7 for priority 2 equipment. Although improvements in maintenance backlogs are visible, further work is needed to fully demonstrate the effectiveness of the implemented measures.

To improve the quality of plant Root Cause Analyses (RCA) special emphasis was put on RCA methodology training. More than 30 staff members involved in analyzing and drafting the event reports were trained in 2015&2016 or are being scheduled for training in 2017. Special training sessions with emphasis on correct application of RCA methodology and RCA decision making process were developed for the OE plant strategic coordinators and such a training was completed for 3 persons in 2016. The plant took the initiative in 2016 to send for review 3 event reports to EdF Corporate and received in general positive answer on increasing the quality of plant RCA. A special session to provide a feed back on this EdF evaluation is planned on the site for January 2017. As the official EdF methodology for RCA was not revised after the original OSART mission the issue related to determination of "contributing causes" was not addressed. The plant has progressed with strengthening the training for RCA and improving the quality of the RCA, some positive signs are already evident, however the effectiveness of the applied actions still need to be monitored and demonstrated.

To improve emergency workers protection the plant has implemented several activities. The persons in the main control room, the field teams dispatched in an emergency and those staying within the controlled area are now provided with electronic dosimeters. The ventilation system of the main control room has been equipped with a dose rate measurement system which switches to filtered iodine ventilation automatically if some gamma radiation is detected. Electronic dosimeters are available in the emergency centre (BDS). A gamma dose-rate measuring and displaying device has also been provided in the BDS building to continuously measure the dose rate, although it is not yet described in the procedures by whom and how this will be implemented in an emergency and it has not been exercised. Training for using the device is planned in the near future. The new emergency centre (CCL) that will satisfy all requirements in terms of protection of emergency workers is still under construction and will be completed in 2018. Despite the above improvements, there are still some issues that have not been addressed by the plant. In line with the EDF Corporate requirements, the plant does not provide electronic dosimeters for each emergency worker. Exercises for the protection of emergency workers does not involve the response in the field using protective equipment, the use of electronic dosimeters, the recording of the dose nor a pre-job dose assessment.

The plant has taken several actions to resolve the issue concerning sever accident management training. The scope of the refresher training courses for the operational positions, including the crisis manager and the safety engineer has been modified. Training now takes place during a full day and consists of theoretical part and a table-top drill tailored to the specific roles of the participants within the organization. The frequency of the refresher training remains every 3 years. The training material (specification, scenario, description presentations) is provided by the EDF corporate. Currently, one scenario is available for the training, and it is not known whether further scenarios are planned to be developed. In addition to the full day training, it is planned to implement a simulator training session using the existing plant simulator, following a request by the trainees who have already taken part in the training sessions. The exact scope and frequency of the simulator training are not yet defined. It is expected to take place between 2017 and 2019.

The issues related to effective evacuation of site personnel in case of emergencies and approach to management of concurrent accidents affecting multiple units were found to be with insufficient progress to date.

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1.1. ORGANISATION AND ADMINISTRATION

The organizational structure is defined and documented in a comprehensive integrated management system. There are eight defined main management processes (macro-processes), including a nuclear safety process. There is a yearly review of each macro-process where the effectiveness is reviewed and new programmes and actions are defined. Yearly performance agreements (contracts), are signed between the corporate organisation and the plant manager, as well as between the plant manager and the department managers with objectives, programmes and actions.

The integrated management system, the continuous improvement programme and a standardized information system are used to coordinate plant programmes and activities. All site-wide activities are defined and coordinated based on action plans related to the macro-processes. Tracking of these action plans, performance indicators and trending of the findings reported are in the continuous improvement programme. These elements are used in the reviews so that effectiveness of the processes can be assessed. In addition, each department develops a department objectives agreement. This document contains an analysis of the results from the previous year, a SWOT analysis and the department actions linked to the plant-wide priorities included in the annual performance contract. An action plan for each department supplements this document which lists the actions, the owner of each action and the corresponding indicators or deliverables. The department programs are therefore coherent and monitored during the year by each department. The information system also allows information entered by the departments into the macro-process programmes to be fed back, enabling effective sharing of information.

Each process is defined, coordinated and led in a uniform manner. The annual cycle ensures a continuous improvement loop, via committees, commissions and process reviews. The link with the continuous improvement programme facilitates the identification of areas for improvement. At the end of the annual review, the plant has all information needed to write its annual performance contract, which constitutes the performance agreement between the Corporate Nuclear Power Generation Division and the plant manager. Department agreements are standardized, of good quality and the way in which they are developed and approved ensures that plant and department objectives are consistent. A plant “coordination” culture is gradually becoming instilled and reinforced via training and awareness programmes relating to plant-wide coordination of objectives and activities.

This integrated management system was considered by the team as good performance.

1.2. MANAGEMENT ACTIVITIES

The managers are regularly in the field to assess and discuss the conduct of work and the compliance with management expectations and objectives. There is also a dedicated field team consisting of four managers that will spend two full days each week in the field doing observations and coaching workers. This task rotates between managers and is seen as complementary to line managers being present in the field supporting their staff. This contributes to organizational learning and was identified by the team as a good practice.

The plant produces a movie every year targeted at all personnel in which managers and personnel act and, in a humorous way, focus on the results that were achieved during the year.

This contributes to all employees understanding the main goals and achievements and was considered by the team as good performance.
The plant has, for several years, had a programme to improve the material condition and housekeeping of the plant. The plant has a map which is continuously revised, on which the actual status, on a seven-grade scale, is shown for each building. This gives a good overview of the management expectations on general material condition and was considered by the team as good performance.

The production and control of documentation are standardized. An appropriate document identification system is established and maintained and documents are reviewed and approved before they are issued. A large part of all procedures are issued by the corporate organization according to reactor type and adopted by the plant. However, the team found procedures that were not always corrected and revised according to the plant or corporate rules. The team also noted examples of procedure quality flaws and incorrect use by several plant departments' staff. The team made a recommendation in this area.

1.3. MANAGEMENT OF SAFETY

A strong safety culture is comprised of many attributes that collectively demonstrate the safety culture of an organization. The overall experience of the OSART team was utilized to capture, during the review period, those attitudes, behaviours and practices that characterize safety culture at the plant. The team identified a number of facts related to strengths and weaknesses of safety culture that could assist the ongoing management efforts regarding safety culture at the plant.

The team identified that the plant management team representatives, at different levels, have demonstrated a proactive approach with regard to safety culture. The team observed plant leadership correcting behaviours of plant personnel in the field. In addition, the plant staff was very open in providing documents, answering questions and making sure that the reviewers had a full understanding of the information provided. These behaviours were supported by plant senior management at the plant. These are characteristics that safety culture is highly valued by the plant leadership team.

There are other attributes that the team believes could be strengthened to improve the overall safety culture and safety performance at the plant. The team observed that not all site personnel are fully aware of the plant important policies. This manifested itself in indications that plant personnel sometimes accept low standards at the plant; for example a tolerance to long-standing leaks and failure to adhere to personal protective equipment requirements.

1.4. INDUSTRIAL SAFETY PROGRAMME

The plant process for industrial safety includes accident reporting, monitoring and trending, as well as reporting and trending of risk observations and near misses. The process also includes a relative grading of risks, such as electrical hazards, falling objects, tripping etc. Programmes and actions are defined based upon the risk analyses results, responsibilities are assigned and any resulting actions tracked. In addition, the corporate organization has a fleet-wide system to follow up on industrial safety accidents and take action when judged appropriate. While the plant shows a favorable, decreasing trend in accidents, the team also noted industrial safety risks in the field and cases of non-conformance to industrial safety rules. The team therefore suggests that the plant should consider improving the programme for industrial safety to reduce risks to plant personnel.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.2(1) Issue: The plant management process to control the preparation and revision of and adherence to plant procedures is not always adequate.

During the mission, the team identified the following facts:

- In surveillance test procedures:
  - EP ARE1029 issued 21.01.2010 to calibrate flow meter ARE203MD. Pages 4 and 5 were diagonally lined-out without a date, name and reference. It was communicated that these steps are no longer relevant because there is a revised decision tree (D5330-10-0257) that has been in place at the plant for approximately 6 months. However, the instructions have not been revised and still have the old decision tree. This is the case for many periodic test procedures in the maintenance departments. Other examples are EP RCP1024 and EP DVK 004;
  - EP KRT 001: p2/7, it is not clear whether two steps of the equipment functional test are applicable only for St Alban or for all plants except St Alban. These steps were not performed in some cases;
  - EP KSC 001, date of test 05.10.2014: Some of the boxes for level checking were completed without a signature. Some of the values were noted without signatures. A decision tree and an analysis page were lined-out as non applicable without a date, signature or reference. Tables had some lines lined-out as non applicable without a date, signature or reference.

- In fuel handling procedures:
  - D5330-14-0112; test records dated 15/06/14 states Boron concentration should be between 2385 and 2575 ppm, concentration is documented as “2” without any explanation, date, signature or reference. The actual measure was not known but the test was judged as completed successfully;
  - In D5330-14-0108; test records dated 14/08/14 two steps were noted as not applicable without a date, signature or reference and were not performed.

- In maintenance procedures
  - Procedure D5330-88-2408, dismantling and reassembly of intake trash rake Unit 2: In §2.1, the as-found condition should be described in step 8. According to the technician performing the action, this can only be done after §2.2;
  - In maintenance procedures produced by plant, there are no check boxes to document performed steps (examples include D5330-88-2408);
  - Procedure D1300EPA01645, for a measurement check on reactor instrumentation system 1RPN020MA: Page 2 contains a table in which acceptance values are printed. The procedure requires that actual values are documented, but only OK/NOK was checked by the technician. Actual values were not measured or documented.
  - In procedure 2SAP280SZ, dated 01/04/2005, to perform a check of a sensor on 2SAP001CO compressor, a handwritten note was found without a date, signature or reference noting that the test might not work;

  - In procedure EP DVS3000 to calibrate DVS061ST pages 3 and 4 were not applicable. Page 3 was lined-out once in blue without a date, signature or reference. Page 4 was not lined-out.

- Anomalies in completing result tables:

  - Work order OI A0133235: value noted with pencil (non-permanent writing);
  - Procedure D5330-86-1079 for 2TEP702BA: White correcture paint has been used (not allowed by plant procedures);
  - Procedure D5330-86-1079 (2TEP702BA): Four water flow counter indications values are required to be noted in litres. One box was lined-out, in one box a value was noted without indicating the unit and in one box "litres" were documented without a value;
  - Procedure D5330-85-1036, for maintenance on the starting air compressors for the diesel generators, is valid for four different configurations of equipment. In a table, 3 out of 4 lines are not applicable. 3 of the 4 lines in the table were lined-out without a date, signature or reference;
  - In procedure 1DEG033GF, for maintenance of the nuclear island cooling water system, values are required to be noted on 6 drawings. The 2 that should be noted after 3 hours in service had no values noted and were lined-out without a date, signature or reference. The test was judged as completed successfully.

Inappropriate control and adherence to plant procedures could result in unsafe actions, damage to equipment and injury of personnel.

Recommendation: The plant should improve the management process for the preparation and revision of plant procedure and for control of staff adherence to plant procedures to ensure that the plant is always operated within the established limits and conditions.

IAEA Basis:

SSR-2/2

4.26. All activities important to safety shall be carried out in accordance with written procedures to ensure that the plant is operated in accordance with plant rules.

GS-R-3

5.12. Documents shall be controlled. All individuals involved in preparing, revising or approving documents shall be specifically assigned this work, shall be competent to carry it out and shall be given access to appropriate information on which to base their input or decisions. It shall be ensured that document users are aware of and use appropriate and correct documents.

5.13. Changes to documents shall be reviewed and recorded and shall be subject to the same level of approval as the documents themselves.

NS-G-2.2

8.1. All safety related activities shall be performed in conformity with documents issued in accordance with approved administrative procedures. The availability and correct use of written OPs, including surveillance procedures, is an important contribution to the safe operation of a nuclear power plant.

NS-G-2.6

4.23. Procedures and work related documents should specify preconditions and provide clear instructions for the work to be done, and should be used to ensure that work is performed in accordance with the strategy, policies and programmes of the plant.

Plant Response/Action:

The recommendation had been taken into account on two axes: adherence to plant procedures and the process of updating procedures.

First subject is adherence to plant procedures
A – Causal analysis

Procedure adherence is mainly based on the setting up of appropriate procedures by factoring in all the site specific features. The setting up of shared documents at plant series level, requires, in the event of an error being detected in the procedures, relatively long processing times to integrate all the comments and implement the changes. In addition, due to the fact that the documents are shared, there are plant series specific features (P4 or P'4) to be factored in or not depending on the site concerned. The current site practice, pending integration of amendments or in the event of plant series specific features, is to modify in real time the differences observed or steps that are not required (for example, P'4 specific feature) by stipulating SO (not applicable) for the parties concerned or by rectifying the deviation. This does not cast any doubt on application of the document for implementation but the lack of quality assurance observed on the amendments (date, name and signature) is deemed non-compliant with the IAEA basis which stipulates:

5.13. "Changes to documents shall be reviewed and recorded and shall be subject to the same level of approval as the documents themselves."

This finding stems from the lack of stated requirements for changes to procedures.

Concerning procedure adherence, it was observed that procedures were wrongly filled or that steps had been missed out. This involves blatant violation of the procedure adherence principles, which could also be attributed to the lack of stated requirements for application of the documents. In addition, the fact that no distinction is made between the various types of procedures used prevents the worker from knowing the requirements for application and filling in of these documents.

B – Strategy adopted to resolve the recommendation or suggestion

First of all, assessment was performed with the other sites to find out their arrangements and progress made concerning procedure adherence.

A working group was then set up at site level, with participation of the different departments and a coordinator appointed, to define the actions to be taken and how to obtain buy-into the solution. This working group developed different actions with definition of the various requirements and setting up of documents at departmental level so as to be able to list the different types of procedure according to three categories.

At the same time, the working group coordinator joined the corporate working group on procedure adherence, set up in September 2016, to collect all the work conducted on this matter, factor in site progress into the discussions and define with the other sites on a collective basis a joint method to validate the initiative.

An action plan defining the upcoming phases was drawn up at the first working group meeting. It was supplemented with new actions and due dates at the working group meeting of 28/09/16.

C – Method used to check that the action plan is appropriate

The action plan was presented to the operating and maintenance quality deficiency committee to validate the different priorities and ascertain if the due dates proposed were in keeping with expectations and feasible.

D – Scheduling of the actions taken and added value for problem solving

Setting up of a working group (run since 14/03/2016)

This working group is made up of members from the different departments and is focused on procedure adherence. Its purpose is to discuss the upcoming actions, problems that can be encountered during implementation of these actions and means of induction to be set up so that this initiative is understood and accepted by all the personnel.

1) Classification of the documents into three categories (underway in the departments)

Not all the procedures used on the site have the same level of nuclear safety impact in the event of inappropriate application. It is thus necessary to make a distinction between them. The purpose of this classification is to list the different types of documents used for every department, according to the consequences of inappropriate application.

The three categories adopted by the working group are:

- Category 1: continuous use;
- Category 2: reference use;
- Category 3: information use.

This classification reflects that defined in INPO 11-003 issued in June 2011. This use was deemed to match the site initiative at the working group meetings. Its purpose is to clarify for all the personnel the expectations related to use of their procedure by identifying in advance to which type of use it corresponds.

Definition of the requirements for each category (approved at the working group meeting of 28/09/16):

Once the documents have been classified into the different categories, the requirements need to be defined for each category. As the safety impact is not the same, for example, the requirements for continuous use cannot be identical to those for information use.

The different points covered are mainly what the requirements are concerning:

- filling in of procedures
- attitude to be adopted when a procedure is wrong or inaccurate
- amendment of documents

These different requirements are then discussed at departmental level so as to stipulate the site requirements, according to the type of procedure, and enable managers to perform on-the-job evaluation.

2) Formalisation of the requirements in an instruction

Once all the uses have been defined, with the related requirements, an instruction will be drafted to notify the entire site of all the principles adopted. This phase is essential for stating the requirements and acts as the starting point for integration of procedure adherence in the departmental internal checking plans, manager presence in the field and observations.

3) Tracking of the findings concerning document change requests

As stipulated in point A) Procedure adherence is mainly based on the setting up of appropriate procedures.

It is essential for the worker to trust the procedure that he applies, and in order to do so, any error observed in a procedure needs to be promptly addressed so that the same finding does not arise the next time it is applied.

The purpose of tracking of the number of findings concerning document change requests is to check that the different deviations picked up during application of the procedures have been factored in and to chase up the request, if the response time is deemed too long.

4) Checking of application of the requirements as part of the internal checking plan and manager presence in the field

The purpose of this phase is to develop operating experience on procedure adherence by reporting good practices and deviations with field findings. This enables the site to identify any problems encountered in the field further to setting up of the various requirements and to compile indicators to assess the level of buy-into this initiative in the different departments.

The simple findings reported can thus be used to adjust the action plan and observe the problems encountered during application of the requirements.

5) Identification of the category adopted for the different procedures

The entire procedure adherence process is based on classification of the various documents applied at site level according to the three uses adopted during the working group meetings.

Identification of the type of use adopted shall thus be mentioned in every document so as to notify the worker of the requirements for application of the procedure.

The following principles have been adopted:

- Set up a means of stipulating the use adopted on the procedures (further to classification by the specialisations);
- Provide the workers with the sheets stipulating the requirements for the different uses (practices adopted, additional clarification and requirements).

E – State of action plan progress and reporting procedure

The action plan described below was formally approved at the working group meeting of 25/09/16. It is of a progressive nature and is reassessed in terms of progress and new actions at every working group meeting. The working group coordinator reports to the operating and maintenance quality deficiency committee twice a year, when progress of the defined actions is assessed and any new avenues to be explored are discussed.

Action	Due date	Progress
Setting up of a working group	01/03/2016	3 working group meetings held
Classification of the documents into 3 categories	30/11/2016	CO: the documents have virtually all been classified AEI: Classification underway (I & C). MRC: Classification underway STE: Classification started. SPR: No feedback
Validation of the 3 main requirements + processing of documentation operating experience with simple findings	Validated at the working group meeting of 28/09/2016	Closed out
Formalisation of the requirements in an instruction	30/10/2016 Written by: A. Pouliquen Checked by: S. Lelong Approved by F. Vantouroux	Ongoing
Include in the departmental internal checking plan (or manager presence in the field) checking of compliance with the requirements	30/12/2016	To be formalised
Track the number of findings concerning document change requests in the continuous improvement programme, by displaying at the weekly continuous improvement programme managerial meetings the percentage of the requests pending.	30/10/2016 Coordinator: Continuous improvement programme coordinator (PiPAC)	To be formalised
Study the technical feasibility of displaying the category on the document from the ECM system	30/11/2016 Coordinator: DOC Section	Ongoing

F – Evaluation of action plan effectiveness

At present, 1 action has been closed out and 3 are ongoing. Action plan effectiveness will mainly be visible when the internal checking plans and manager presence in the field are set up from the various simple findings reported and the deviations observed under the code CHA05 (procedure deviations). However, an increase in the number of field findings on this matter has already been observed.

The second subject is updating procedures :

A – Causal analysis

Related documents: Quality-controlled documents, in this case class-4 documents (surveillance test procedures, maintenance instructions, etc.)

With regard to their preparation, revision, validity

A number of shortfalls were noted during the OSART in 2014.

This also covers any changes made to these documents so as to bring them into line with updates to corporate operations and maintenance guidance.

B - Strategy adopted to address the recommendation/suggestion

The EDF Nuclear Generation Division has implemented a programme to standardize documents used across the nuclear fleet ("PHPM"). This has involved the creation of a Nuclear Information System (SdIN), the purpose of which is to standardize practices on all NPPs or more specifically on all NPPs of the same reactor type. Flamanville 1&2 come under the P4 category (within the scope of this programme). Maintenance instructions, operating procedures and work orders, etc. are being standardized. These standardized documents are being managed by corporate groups who define validity criteria for each site. They are also managed by standardization structures who oversee the implementation of these standards and procedures by the different stations.

The standardization programme seeks to discontinue the use of locally written documents and replace them with standardized procedures for the performance of equipment maintenance, surveillance tests and fuel maintenance across all units of the same reactor series. A special quality-control programme has been implemented for all documents produced within the scope of the SdIN project (BMA: French acronym for "Approved Template Library", which has since been transposed by the SP1300 standardization structure).

All NPPs using these standardized documents are required to issue a document amendment request if any abnormalities are found. These requests are discussed by different functions (1 group per function, comprising personnel from all NPPs of the respective reactor type). The requests are reviewed and then processed.

In accordance with its quality-control process, the standardization structure sends out an OE document (ref. DI001) for NPP to make the necessary changes.

Flamanville NPP has transposed this document into a PADOCN (Corporate Procedure Action Plan), which keeps a record of station documents brought into line with corporate standards.

After reviewing these corporate OE documents, the procedures group approves the validity of the document versions and instructs the document section to endorse/cancel their validity, once again checking that the correct document version has been provided. The user departments also check that the documents are valid.

Flamanville NPP has decided to apply this method to class-4 documents (surveillance test procedures, maintenance procedures, fuel procedures, chemistry procedures and standard operating procedures) to ensure that the valid versions are being used. These documents are checked by each department's procedures group, which compares them with the plant's technical and regulatory status.

Depending on station operating experience and/or pending the response to amendment requests for documents used by plants of the same reactor type, Flamanville NPP has issued a set of "station-specific" documents to cover a small number of station-specific differences.

The SDIN database (EAM, ECM, BI, GPS, etc.) has been fully operational at Flamanville since 04/11/2016.

As far as procedure changes are concerned (following design modifications), Flamanville NPP has adopted a cycle processing system. In addition to this cycle processing system, it also uses a batch processing system (e.g. a number of changes are scheduled prior to the 3rd set of ten-year outages: RGE9 on 01/01/2017, unit-2 RGE3 and RGE9 at the end of refuelling outage 2R2217, RGE6 on 31/01/2017).

Since 2015, administrative checks are carried out whenever procedures are revised. The purpose of these checks is to identify any errors and review the status of each procedure and version before changing over to the new reference base. An on-line safety review committee meeting is held when transitioning to the new safety-related reference base.

C – Method used to verify adequacy and effectiveness of the action plan

Procedure quality is assessed during in-field observations and findings are raised to evaluate the effectiveness of the SDIN system over the medium term.

D – Action plan schedule and contribution of each action to resolving the issue

The SDIN database (EAM,ECM, BI, GPS, etc.) has been fully operational at Flamanville since 04/11/2016.

E – Action plan status and reporting method

The implementation of corporate specifications is tracked on a weekly basis. Flamanville NPP uses the PADOCN system (Corporate Procedure Action Plan) to keep a record of station documents brought into line with corporate standards

Once a week, corporate correspondence on the implementation of corporate standards is examined by the technical planning committee. Document owners are briefed on their content each time such correspondence is received. A recap of due dates is provided on the occasion of these meetings.

Monthly meetings are held to validate amendment requests raised by the station. The procedures engineer checks whether the station has implemented a compensatory plan in the form of station-specific procedures to address specific issues.

– Action plan effectiveness review
It will only be possible to assess the effectiveness of the SDIN system with regard to maintenance quality after a representative period of time.

IAEA comments:

In order to resolve the issue the plant has analysed the findings, determined the root causes and has taken actions to resolve the deficiencies. In 2015 the plant assessed the practices for the use of plant procedures in different departments and made a benchmark with other EdF plants. Special attention was paid to the observation of the adherence to plant procedures during the management field tours in 2016, which resulted in collection of more detailed information on the reasons for non-adherence to procedures. In 63 observed cases, deficiencies in the implementation of procedures was noted and analysed in 20 cases.

To improve the adherence to the procedures, the plant set a working group in 2016 that proposed a categorization of plant procedures and defined the requirements to address: completion of procedure implementation documentation; attitude to be adopted when a procedure is found wrong or inaccurate; and process to follow when a procedure amendment is performed. Three categories of procedures were defined, e.g. for continuous use, reference use, and information use. This work is in line with the Corporate expectations and actions taken to improve the adherence to plant procedures. Several of the plant departments have completed the categorization of the procedures used by their personnel, e.g. Risk Prevention Department, Operations, etc. The categorization for all plant procedures should be completed by the end of 2016. A plant policy (Document D454116010434) on application of requirements for handling the plant procedures of different categories was developed and was available in a draft form during the follow–up. Training on the compliance with this policy has been initiated by some departments and formal training for the “trainers” is planned by the training department for December 2016.

With respect to the need to improve the plant practices for revision of plant procedures, the plant has contributed and has taken advantage of a work performed at Corporate level to ensure consistency and accuracy of EdF plant procedures. The plant has replaced the SYGMA software used for control of plant procedures with a new database SDIN, developed by the Corporate. SDIN was made operational on the plant shortly before the follow-up mission, on 4th November 2016. More than 15000 documents have been integrated in the new database and all of them will be checked step by step; currently 6000 documents have been controlled and the “electivity” is assigned to those that have been controlled. The validation that the plant procedures are adequately revised under the new arrangements is still underway and the effectiveness of SDIN use still needs to be demonstrated.

During the follow-up, some procedures and records from their implementation were reviewed. It was noted that non-adequate adherence to procedures was the root case of a failed Unit 2 DG surveillance test performed on 13/01/2016. Records from unit 1 DGs surveillance tests EPLHQ201/ 18/11/2016 were reviewed and the following was found:

– Although there were “ tick boxes” to confirm the initial plant conditions before the test, those were not filled; Wrong evaluation of plant initial conditions was the cause of DG surveillance test failure on 13/01/2016;
– The field operator judged as successful a measurement which was on the upper limit of the acceptable range. This deviation was evaluated as not safety significant by the field operator, but was not questioned or analysed by the MCR operator or shift supervisor when making conclusions on the successful completion of the test.

In a test procedure EPRCP 007 there is an Annex 4, while there is no reference to this annex in any part of the procedure.

The records from implementation of EP ARE 1029 and EP DVK004 procedures in 2016 were found well prepared, however pages diagonally lined-out without date, name, and reference were still present in EP RCP 1024 records of 19/02/2016.

The plant has implemented systematic approach to resolve the issue, however some of the planned actions are not yet completed or their effectiveness can not be fully demonstrated.

Conclusion: Satisfactory progress to date

1.2 (a) Good practice: Dedicated field team

The plant has a dedicated field team, EDT, consisting of four managers at different organizational levels that, within one week, will spend two full days in the field, observing activities and correcting behaviour that is not aligned with management expectations. This task rotates between managers and is seen as complementary to the line managers being present in the field supporting their staff as part of their job. The team writes a report that is presented to the plant management team. The dedicated field team is an effective communication tool for reinforcing management expectations to the line workers and provides management feedback from the field. This process contributes to cross-functional organisational learning.

1.5 (1) Issue: The plant programme for industrial safety is not always effective in reducing risks to personnel.

During the mission, the team identified the following facts:

- Tripping, slipping and falling hazards

  - In Unit 1 turbine hall, water on the floor, loose or missing floor tiles and a raised walkway area with a height difference to floor of about 0.5m which has no marking or protection;
  - Unsecured fire hose crossing the pathway just outside entry to Unit 1 turbine hall;
  - Local storage of material not always secured to prevent falling, in Unit 2 turbine hall;
  - Auxiliary building, a step in floor height has no marking.

- Improper use, or lack of, personal protective equipment

  - Worker not using hard hat in Unit 1, room KB1104;
  - Workers not using hearing protection in Unit 2 pumping station;
  - Hearing protection dispensers are located inside entry to turbine halls of both Units, thus, workers have to enter into the high noise area- room before reaching dispenser.

- Electrical hazards

  - Earth connections corroded, loose or missing on several electrical motors , cubicles and boxes. Examples: Box 0DNX101CR, Unit 1 turbine hall, electrical motor GHE151ZV, 2ARF004MO;
  - Electrical cabinet 1STE181CR left open;
  - Damaged extension cable plugged in to socket, Unit 2 pumping station;
  - Extension cable/cable rolls with no evidence of periodic safety checks, Unit 2 pumping station and auxiliary building;
  - Worker was allowed to immediately continue to work after electrical shock without physical condition check (Plant report from event is D5330-13-0473).

- Other hazards

  - Unit 2 turbine hall: Temporary fencing not wide enough to prevent workers from coming in contact with steam leak. This could expose worker to risk when using local control panel located near the leak;
  - Unit 1 turbine hall: Several examples of missing heat insulation.

A programme for reducing industrial safety risks that is not always effective could result in injury to personnel.

Suggestion: The plant should consider improving the effectiveness of the industrial safety programme to reduce risks to the plant personnel.

IAEA Basis:

SSR-2/2

Requirement 23: The operating organization shall establish 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.

5.26. The non-radiation-related safety programme shall include arrangements for the planning, implementation, monitoring and review of the relevant preventive and protective measures, and it shall be integrated with the nuclear and radiation safety programme. All personnel suppliers, contractors and visitors (where appropriate) shall be trained and shall possess the necessary knowledge of the non-radiation-related safety programme and its interface with the nuclear and radiation safety programme, and shall comply with its safety rules and practices.

Plant Response/Action:

A – Causal analysis

- Equipment: There are slip/trip/fall hazards in some areas on the station. Some equipment is not adequate for the mitigation of electrical hazards. Electrical accessories could be controlled more effectively;
- Setting and enforcement of standards: Standards relating to the mitigation of electrical risk are not clearly established;
- Human factor: Workers are not sufficiently aware of the risk (accustomed). Industrial-safety culture needs to be improved in the field.

B - Strategy adopted to address the recommendation/suggestion

- Reinforce our industrial-safety expectations in the field through greater management reinforcement and presence in the field;
- Enhance management observation skills with regard to industrial-safety hazards (life-saving rules + slips, trips and falls);
- Make workers more aware of hazards, particularly with regard to life-saving rules (purpose of these rules). Disciplinary response to violation of life-saving rules;
- Take measures to mitigate slip and trip hazards; minimise the number of electrical cables that are routed through doors, particularly in the RCA (link with EVEREST) (inventory, modifications);
- Provide the appropriate electrical equipment and procure the appropriate signage for visually identifying hazards.

C – Method used to verify adequacy and effectiveness of the action plan

- Trending of frequency rate

  - Number of field observations relating to industrial safety; multiple-year trend;
  - Quantitative analysis of CAP findings (managers/others);
  - Qualitative analysis of CAP findings (compliant behaviours/shortfalls, type of deviation identified, type of injury).

- Monthly performance indicators:
    - Slips, trips, falls and critical hazards
    - Hazardous situations/near-misses

D – Action plan schedule

	Due date	Status – Effectiveness
MEASURES TAKEN TO ENHANCE INDUSTRIAL-SAFETY CULTURE IN THE FIELD		
Knowledge of rules - Observations in the field – Industrial-safety culture in the field		
Walk-downs by the dedicated in-field management team (EDT) including members of station senior management, department managers, first-line leaders and team leaders, accompanied by subject-matter experts (since January 2015) to gain a better understanding of expectations.	End 2014 ➔	157 industrial-safety findings raised during EDT walk-downs (since January 2014)
Provision of in-field observation guides focusing on industrial safety	Mid-2016 ➔	Completed for the following areas: lifting and rigging, work at height, electrical hazards, slips/trips/falls, material handling. Positive feedback regarding the adequacy of management's industrial-safety observations, content of CAP findings and leadership behaviours in the field.
Implementation of life-saving rules (since summer of 2014): communication, ownership and disciplinary response to violation of these rules – Consistency and alignment	2014 ➔	Consistent standard regarding communication and reinforcement since 2014, with regular communication on the subject (by management), communication on major fleet events. Graduated disciplinary response to violation of rules: interview with department manager, interview with station senior management, contractor reappraisal.

Review of CAP data relating to life-saving rules by the risk-prevention review committee	2015 ➔	Standard tool for focusing on life-saving rules and slips/trips/falls
Reinforcement of expectations during contractor induction sessions; method updated to make it more interactive and reliable in preparation for the maintenance and ten-yearly outages	1st quarter of 2015 Ongoing Completed	The expectation has been reset to once a year at Flamanville before security passes are issued (pre-requisite) Positive contractor feedback
Communication as an immediate response to events or near-misses – Personnel encouraged to report hazardous conditions/near-misses. In-depth event analyses extended to injuries/near-misses	2015 ➔	Examples of condition reports Senior management reports Trend in the number of reported hazardous conditions/ near misses Examples of near-miss analyses
Monthly meetings to discuss risk-prevention plans during normal plant operations, focusing on current circumstances, recurring shortfalls, concurrently scheduled work, exchanges among contractors Same applies to outage, weekly frequency	2015 ➔	Re-adjustment of content to make these meetings less top-down and to promote the sharing of good practices (e.g. each contract company delivers a presentation on one topic). Email sent to contract companies informing them of concurrently scheduled work in outside areas, if this work could potentially affect them.
Appointment of "area managers" within the risk-prevention department	2015 ➔	Round-the-clock presence of risk-prevention personnel in different geographical areas for the duration of the outage – The aim is to provide valuable advice to contractors on the subjects of industrial safety, radiation protection and fire protection

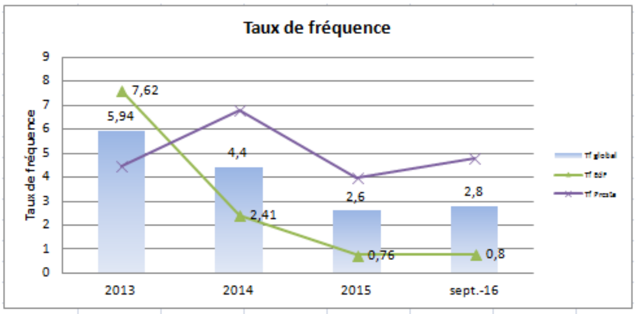
Introduction of Peer-to-Peer Coaching (Vigilance Partagée): establishment of station roadmap – first actions taken in 2016	2016 - 2018	First version of roadmap established Communication campaign during the refuelling outage
Planning of work from an industrial-safety perspective		
Establishment of work areas with industrial-safety hazards	January 2015	Implementation during outages in 2015 and 2016. Thorough preparation of work areas involving a higher level of industrial-safety risk. These areas are closely monitored by industrial-safety area managers to ensure implementation of countermeasures.
SLIPS/TRIPS/FALLS		
Inventory of industrial areas with slip/trip/fall hazards. Measures taken to mitigate these hazards.	1st quarter of 2015 Completed	61 hazards mitigated (25 falling hazards and 36 knock/bump hazards
Red cut-outs placed in strategic plant areas to reinforce awareness of slip/trip/fall hazards	Summer 2015 Completed	Eye-catching
Change to parking-lot layout by adding pavement ramps, painting or repainting pedestrian crossings, road maintenance	2015 – 2016	
A range of communication initiatives focusing on trip/slip/fall hazards	2015-2016	Corporate communication campaign on trip/slip/fall hazards from 18 to 22/04/2016 (1 day = 1 email sent to all workers by the senior advisor)
Identification and mitigation of trip/slip/fall hazards by the housekeeping team when these hazards are reported by site security contract personnel	2016	Result of actions taken to identify and mitigate trip/slip/fall hazards
Gradual mitigation of trip/slip/fall hazards by the housekeeping team (EXOCET/CAP database)	2015-2016	Report on completed actions

ACTIONS RELATING TO ELECTRICAL HAZARDS (in addition to fundamental actions regarding the implementation of life-saving rules)		
Installation of additional electrical sockets for connection of Everest equipment	2016-2018	Inventory of needs drawn up in 2016 Budget requested for year 2017 in order to complete design work and implement the first set of modifications
Delivery of new training on the subject of electrical hazards (M2000, M3000, etc.)	2015 ➔	

E – Effectiveness review

<u>Performance</u>

The EDF/contractor frequency rate (lost time and non-lost-time) has been steadily dropping for the past several years. This was not yet evident at the time of the OSART. The same applies to the severity rate.



Results have been improving since 2013. The possibility still exists for the 2016 frequency rate to drop below that of 2015. This will depend on end-of-year results.

This positive trend in frequency rate also applies to the number of lost-time accidents:

2014	2015	sept-16
10	8	5

This is not related to the volume of hours worked, but rather to a decrease in the number of people having to take time off work after sustaining an injury in the workplace.

It should also be noted that in the past 3 years, Flamanville has not recorded any lost-time or non-lost-time accidents due to the violation of life-saving rules. This is a noteworthy point as this type of injury can have serious consequences. However, adverse conditions are still being found in the field so there is still room for improvement.

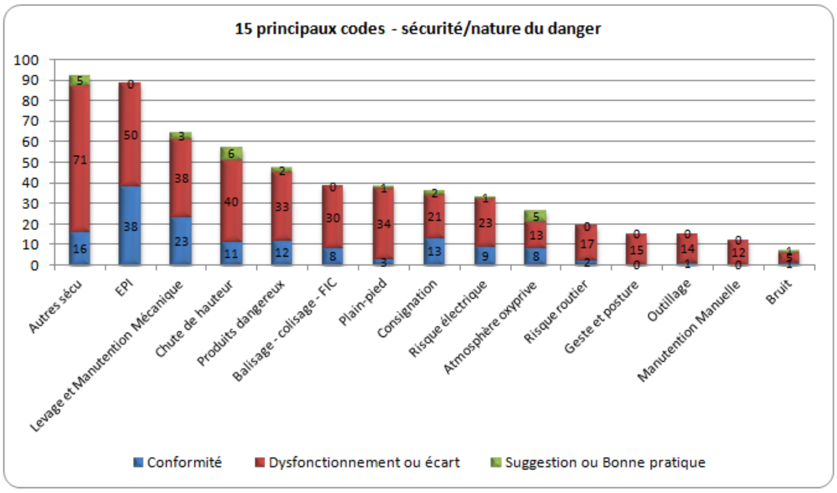
<u>In-field observation techniques</u>

Findings raised on the occasion of the aforementioned walk-downs are recorded and processed via the CAP.

2015 – as at 31 October – 793 condition reports – 2 busy maintenance outages lasting 6 months in total

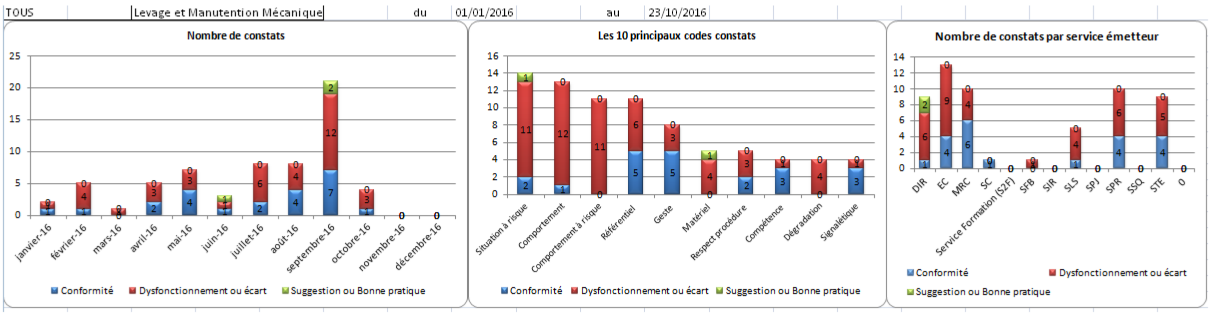
2016 – as at 23 October – 604 condition reports – 1 refuelling outage lasting 32 days

Condition reports are raised by all departments. Below: the 15 biggest hazards observed with the number of condition reports:



Fewer deviations from life-saving rules due to a less work-intense year in 2016, but industrial safety still remains a focal point.

The graphs below are discussed on the occasion of risk-prevention committee meetings. Where appropriate, departments can thus be challenged on industrial safety issues where they need to improve.



EDT (in-field management walk-down team) reports are discussed on the occasion of senior management meetings. This provides an opportunity to focus on adherence to life-saving rules in the field and to exchange views with the departments in charge of the worksites concerned.

Deviations from life-saving rules are systematically addressed.

CAP reports feed into the annual industrial-safety improvement review.

IAEA comments:

In response to the suggestion made by the OSART team during the original mission, the plant has made efforts to identify causes of the issue that involved stumbling, slipping, bumping hazards, electrical risks and general workers safety. Causal factors identified by the plant include lacking of attention to industrial harmful factors, such as stumbling, slipping and bumping in industrial areas, standards relating to the mitigation of electrical risk, lacking control on electrical accessories and insufficient awareness of workers on potential risks in industrial and non-industrial areas. The plant has adopted a strategy and a method for resolving the suggestion and imposed an action plan that is routinely monitored and regularly evaluated on efficiency.

The plant has reinforced communication on the industrial safety subject by introducing an approach in informing the workers on in-house and external industrial safety accidents. This campaign is conducted periodically to stress the workers attention on the personal safety during and outside working hours.

The plant has introduced dedicated personnel from the risk prevention department responsible for the plant's industrial areas in terms of compliance with industrial safety rules and standards. These personnel patrol the plant areas on the regular basis and use a modern computational tool (a "tablet") that facilitates effective identification and qualification of deficiencies in the field and is used to introduce countermeasures to remedy the status of the working area. This activity is reinforced during outages by introducing additional personnel from the corporate organization. The plant departments, specifically maintenance, appreciate such support provided by the risk prevention department, and recognize its effectiveness. Industrial safety deficiencies identified during the plant tours are fed up to the plant's corrective actions programme for further treatment.

The plant has been conducting regularly training on electrical risk with specific attention to the compliance with the rules and the correct use of personal protective equipment. The plant management regularly conducts plant observation tours to check the compliance with electrical rules and standards when using electrical equipment.

In 2015, the plant has introduced an approach of 5 Vital Safety Rules and widely communicated it to the personnel using a diversity of means such as posters, notes, pocket books. Implementation of 5 Vital Safety Rules and the personnel practices to follow the rules are monitored by the plant management and respective corrective actions are done, if necessary.

The plant statistics in industrial safety accidents have been improving since 2013. As of November 2016 the industrial safety accidents frequency rate dropped below that of 2015. This positive trend in frequency rate also applies to the number of lost-time accidents.

Conclusion: Issue is resolved

2. TRAINING AND QUALIFICATIONS

2.1. TRAINING POLICY AND ORGANISATION

The planning of training, together with monitoring and updating training requirements on the plant, is assisted by the use of two computer based applications: the web training tool and a skills mapping tool. The OSART team has identified the skills mapping tool as a good practice, and the web training tool as an example of good performance.

2.2. QUALITY OF THE TRAINING PROGRAMME

The plant produces training programmes to organize the training of its staff, part of this is the implementing a company initiative called the"Skills Development Programme". This initiative is sponsored by the Plant Manager and emphasizes training to strengthen the skills and competences required for the safe and efficient operation of the plant. The management and organization of this initiative at the plant, is seen by the OSART team as an example of good performance.

2.3. TRAINING PROGRAMMES FOR FIELD OPERATORS

Field operators receive initial training depending on their plant experience, and in the case of new recruits it is supplemented by mentoring training in the workplace by experienced workers, and a manager within the department keeps oversight of the process. Details of the mentoring are documented in a training log book, which becomes part of training records and is retained on the individual's training file. The systematic analysis and implementation of this aspect of professional development on the plant, is seen by the OSART team as an example of good performance.

2.4. TRAINING PROGRAMMES FOR TRAINING GROUP PERSONNEL

Training personnel receive additional training in delivering training to persons undertaking work on the plant. The staff selected to act as trainers are very experienced in the area of training they will cover, and the additional training they receive should help them be more effective trainers. The training is designed to provide, maintain, and develop the skills necessary to be a competent trainer, and this is assessed each year. This systematic approach to training trainers is seen by the OSART team as an example of good performance.

2.5. GENERAL EMPLOYEE TRAINING

All employees receive initial fire training, and they must also meet the requirements for refresher training according to their particular duties. The fire training is provided in conjunction with the local fire service, and the OSART team sees this as an example of good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1(a) Good practice: A skills mapping application is provided that employs a polar chart illustration to provide managers with a clear graphical presentation of the current status of skills in departments on the plant to identify skills availability, including critical areas, which makes a significant contribution to effective skills management and planning of staff training for up to a 5 year period (Skills Mapping Tool).

The plant has implemented and developed a generic computer based skills mapping application to illustrate the skills available on the plant, which includes the following features:

- Graphical presentation using a polar chart of personnel skills by department and team;
- Clear illustration of availability of skilled persons in each area;
- Graphical comparison of current skills levels with future values, and identification of gaps;
- Data is collected for a 5-year period;
- Graphical presentation of skills variation with time.

The benefits of the process are that it allows management to present data graphically to:

- Compare current skills to critical and optimum levels, and future skills targets;
- Identify skills shortages, scarce skills and skills that will be lost in the future;
- Inform the staff recruitment profile;
- Illustrate the effect of retirements/transfers on skill levels;
- Balance skills within departments and teams etc;
- Develop individual skills to meet local needs;
- Identify skilled individuals who could make a contribution in other areas (professional development);
- Identify future training requirements within departments.

The plant considers that, by using a graphical illustration of the data, the plant has improved the management of skills on the site including the identification of training requirements. The tool co-ordinates and presents data graphically in a way that is easily assimilated and reduces the amount of time needed to interpret the data.

3. OPERATIONS

3.1. ORGANISATION AND FUNCTIONS

The team observed several examples of equipment changes to the plant that were not controlled. The team made a recommendation in this area (see issue 5.3(1)).

Operational goals and objectives are well defined using comprehensive inputs. There is strong collaboration between human resources and operations management to maintain the desired staffing levels. Operations managers have high expectations about who is hired for the initial field operator programme, and there is a comprehensive interview process before candidates are selected. There is a robust operations support structure that minimizes administrative tasks for the on-shift crew, such as a safety tagging group, online project group, and outage project group. In addition, communication is effective among work groups. The team considers this to be good performance.

Main control room operators in the initial training program are not trained in the full-scope simulator with the same standards for human performance behaviours and professional conduct that are expected in the main control room. For example, on several occasions, the team observed operators trainees sitting on the simulator control panels—the management expectation is that this should not occur in the main control room. The team encourages the plant to apply the same behaviour standards in the simulator that apply to the plant.

Operations managers and supervisors have implemented a programme to observe operator performance in various areas that are selected based on risk. The feedback from this programme is reviewed weekly and trended quarterly to identify areas for additional focus. However, one newly qualified operator who was interviewed had not been formally observed for 18 months (except for annual re-qualification). The team encourages the plant to consider using the observation and coaching programme to develop the proper behaviours of less experienced operators, in addition to the existing objectives of the programme.

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

Operations managers recently improved the control of operator aids; however, the team identified some operator aids that were not controlled, such as vendor data for a chiller compressor and hand-written markings on an emergency diesel lube oil tank. In addition, operations personnel are tolerating several low-significance plant defects, active leaks, and labeling issues. The team issued a recommendation in this area.

The shift supervisor office is located outside the main control room and minimal written guidance exists for when the shift supervisor is required to be in the main control room. The team encourages the plant to enhance the guidance for when the shift supervisor is required to provide oversight.

A process or method does not exist to assess the collective amount of distractions to operators, such as lit annunciators, main control room deficiencies, and operator compensatory actions (field and main control room), to recognize that several low-level distractions could collectively be important. The team encourages the operations managers to collectively assess these distractions to fully understand the overall burden to operators from these distractions.

3.3. OPERATING RULES AND PROCEDURES

Risk is generally managed well, and operators apply effective behaviours and tools to prevent scrams. There are comprehensive technical specifications that govern plant equipment. The technical specifications are well integrated with the work management and planning processes. In addition to main control room operators, field operators receive extensive training on technical specifications. The team considers this to be good performance.

Real-time technical specification limiting conditions of operations are displayed on a large monitor in the main control room and safety tagging office, which are visible to operators at all times. The team considers this to be a good practice.

There is no abnormal operating procedure to address internal flooding and the team encourages the plant to develop an operator procedure to assist in mitigating this type of event.

The protected equipment programme is only used during outages. The team encourages the plant to also protect equipment important to safety and reliability during at power operations when all redundant equipment is not available.

3.4. CONDUCT OF OPERATIONS

The team noted that main control room evolutions that may impact important primary parameters are sometimes not conducted with strict supervision and control. The team made a recommendation in this area.

The shift has several efficient tools to enhance response to disturbed operations. Problems are communicated effectively between shifts during the shift turnover and shift briefings. Also, problems are reported and prioritized to non-operations personnel through the work control database as well as during the daily operational focus meeting. The team considers this to be good performance.

The status of plant equipment and components is managed well. The plant has developed and implemented a comprehensive programme to track component status, and plant personnel behaviours were influenced positively to benefit from the programme. The team considers this to be a good practice.

3.5. FIRE PREVENTION AND PROTECTION PROGRAMME

The plant has developed emergency response plans for use by external emergency response teams. These plans contain information on firefighting resources such as floor plans, locations of access points, locations of fire protection equipment, risk assessments for each area, fire scenarios possible in each area, and illustrations of large equipment. The team considers this to be a good practice.

DETAILED OPERATIONS FINDINGS

3.2 (1) Issue: The plant operational practices are not always adequate to systematically identify plant deficiencies.

During the mission the team observed deficiencies that were not identified by the plant staff. These shortfalls are in four areas: plant defects, labeling, leak management and operator aids. The following were noted in each area:

Plant defects

- In the Unit 1 Turbine Hall, rainwater is running down high-voltage cables and collecting in a drip tray;
- In the chemistry laboratory, the fire door HA0651 is defective and the closing mechanism does not work;
- In the Unit 2 diesel generator room, thermometer 2 LHQ 747 LT is installed in such a way that it cannot be read;
- In the Unit 1 diesel generator building, there is a missing hand wheel on valve 1 LHQ 114 VR;
- In the Unit 2 Auxiliary Building, the indicating needle on pressure gauge 2 KRG 196 CQ is broken.

Labelling

- On the diesel generator in Unit 2 train B there is a hand-written identification for valve LHQ 204 VR;
- In the Unit 1 Auxiliary Building, there is a hand-written identification for pressure gauge 549 LP;
- In the Unit 2 Auxiliary Building rooms LA 0463 and LA 0454, there is a hand-written identification on a pipe;
- In the Unit 1 turbine hall, there is a broken label on a pipe and only "GSS 189" is visible;
- In the Unit 1 turbine hall, there is a label that is corroded and not legible (AFR 205).

Leaks

- In room KA 0505 there is an active boric acid leak;
- In the Unit 2 pumping station, there is an oil leak from the drive system for the rotating drum screen 2 CFI 332 MO;
- In the Unit 1 turbine hall, oil is accumulating from leaks at bearings 1 DVM 002 ZV and 1 DVM 003 ZV;
- In Unit 2 room NA 0506, there are oil leaks from charging pumps 2 RCV 171 PO and 2 RCV 191 PO;
- In the Unit 2 turbine hall, there is a leak under the turbine driven feedwater pump motor 2 AFR 004 MO;
- In the Unit 2 turbine hall, there is an oil leak from the main generator oil system.

Operator aids

- In the Unit 2 turbine hall there is an unauthorized operator aid on control rod measuring device 2 RGL 002 CR;
- There is an unauthorized operator aid on a Unit 1 chiller compressor;
- In the Unit 2 diesel building there is an unauthorized operator aid on a manometer for the diesel lubrication oil tank;
- In the Unit 2 turbine hall there is an unauthorized operator aid on a manometer for component 2 CEX 201 BA.

Not having sufficient work practices to ensure that high standards of material condition are maintained in all working areas could result in a reduction in the reliability of safety related plant components.
Recommendation: The plant should improve its operational practices to ensure that deficiencies are systematically identified.

IAEA Basis:

SS/R-2.2

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, reported and 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

4.36 Factors that should typically be noted by shift personnel include:

- Deterioration in material conditions of any kind, corrosion, leakage, accumulation of boric acid and deficiencies requiring maintenance;
- Indications of deviations from good housekeeping, for example the condition of components, sumps, thermal insulation and painting, obstructions, posting of signs and status of doors.

5.1 A consistent labeling system for the plant should be established, implemented and continuously maintained throughout the lifetime of the plant. The system should permit the unambiguous identification of every individual component in the plant.

5.49 All deviations in the status of the plant or its systems and equipment should be reported and evaluated.

6.17 The system for controlling operator aids should prevent the use of unauthorized operator aids or other materials such as unauthorized instructions or labels of any kind on equipment, on local control panels in the plant, boards and measurement devices in the workplace.

6.18 The system for controlling operator aids should ensure that operator aids include correct information, that has been reviewed and approved by the relevant competent authority.

6.20 Working areas should be kept up to standard, well lit, clean of lubricants, chemicals or other leakage and free of debris. The effects of intrusions of foreign objects or the long term effects of environmental conditions (i.e. temperature effects or corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) should be evaluated as part of the plant housekeeping programme.

6.21 Administrative procedures should be put in place to establish and communicate clearly the roles and responsibilities for plant housekeeping in normal operating conditions, post-maintenance conditions and outage conditions. For all areas of the plant it should be made clear who bears the responsibility for ensuring that an area is kept clean, tidy and secure. Operations personnel should periodically monitor housekeeping and material condition in all areas of the plant and should initiate corrective action when problems are identified.

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.

6.25 Temporary tags such as those marking deficiencies, temporary modifications or temporary warnings are important sources of information for operators in supervising the work areas. Their proper use should be governed by a policy that is consistent with the overall labeling policy at the plant.

Plant Response/Action:

A – Causal analysis

Operational practices for identifying and resolving deficiencies are not adequately implemented.

B – Strategy adopted to resolve the recommendation or suggestion

- Identification of deficiencies: Enhanced requirements for monitoring plant areas
- Resolution of deficiencies: Added impetus to the ‘upkeep of plant condition’ project (MEEI)

C – Method used to check that the action plan is appropriate and to check effectiveness

Plant condition is monitored by the MEEI project.

D – Scheduling of the actions taken and added value of problem solving

Timelines		Equipment deficiencies	Shortfalls in labelling	Operator aids
2014	**Resolution of discrepancies**	Study plant monitoring practices in the field	Implement a process for labelling	Remove uncontrolled aids
2014-2017	**Action plan**	Roll-out expectations and good practices for plant monitoring	Deploy the new process and upgrade existing labels	Review and approve essential signage (QA)
2017 onwards	**Sustainability of outcomes**	Detection: coordination of the 'plant monitoring' policy Management, processing and tracking: deployment of MEEI action plan		

E – State of action plan progress and reporting procedure

Status reports are included in the MEEI reviews.

F – Evaluation of action plan effectiveness

The yearly MEEI reviews provide an opportunity to assess the effectiveness and sustainability of the actions that are undertaken.

IAEA comments:

In response to the recommendation made by the OSART team during the original mission, the plant has made efforts to identify causes of the issue that involved identification of deficiencies in the field, including leaks, labelling and operator aids. Causal factors identified by the plant include some programmatic and performance gaps; namely operational practices for identifying and resolving deficiencies have not been fully implemented. The plant has adopted a strategy and a method for resolving the issue and imposed an action plan that is supposed to be routinely monitored and regularly evaluated on efficiency via the MEEI (Housekeeping) process. However, the activity for resolving labelling issues only started in April 2016 with introduction of a new computational monitoring tool, and respective indicators to assess the action plan progress have not yet formally been developed and introduced. The first evaluation on effectiveness for the labelling issue is planned for the year 2017. Despite of the fact that the plant has made considerable progress in reducing the amount of leaks, a modified process for identification, trending and qualitative analysis of the plant's leaks has not yet fully implemented. The plant has made efforts to reduce the amount of informal signage and inscriptions on the plant's equipment (graffiti) using some tools embedded into the MEEI process, however, during the field observations in the Diesel Generator compartment the team has noted informal signage on an equipment. The plant needs to continue this activity.

Conclusion: Satisfactory progress to date

3.3 (a): Good Practice: Operational limits and conditions (OLC) display screens have been installed in the main control rooms and tagging offices at each unit.

Display screens have been installed in the main control room and tagging office of each unit making it possible to display the same information in both rooms. The screens display information regarding active LCO's; equipment required in extended design conditions (MDC) and chemistry specifications. Display screens with real time information in both the main control room and the tagging office means that the operators and the tagging supervisor has real time information on the status of the unit and, in particular, real time details of all active LCO. This guarantees the safe release of tagging authorizations. Personnel using the tagging office have a real time overview of each LCO on the unit, the scope of the LCO, the date it was raised, the dates of isolations and the isolation strategy.

3.4 (1) Issue: The plant evolutions that impact important primary parameters are sometimes not conducted in the main control room with the expected levels of rigor and supervision.

During the mission, the team identified the following facts:

— During a power ascension on October 13, all plant parameters were maintained within operating limits; however, the team noted the following vulnerabilities:

  — The technical manager left the main control room for 25 minutes to attend a routine work planning meeting. While the technical manager was away, the primary and secondary main control room operators continued to raise power 160 Megawatts and performed one dilution without supervision;
  — The primary operator performed three dilutions without a peer check from the technical manager or secondary operator and without the use of a procedure in-hand;
  — The primary or secondary main control room operators went to the back of the main control room on several brief occasions to troubleshoot computer software for the technical specification tracking program. On a few of these occasions, the technical manager was not present in the main control room;
  — After the power ascension was intentionally stopped for 45 minutes to investigate a feedwater flow control malfunction, main control room operators did not perform an update briefing to discuss plant conditions nor obtain concurrence from the technical manager to continue the power ascension. The technical manager was not in the main control room at this time;
  — On several occasions, the secondary operator placed procedures on the control board panels adjacent to switches and other components;
  — One field operator entered the main control room surveillance area abruptly to request an authorization for hot-work, momentarily distracting the primary operator's attention from important plant parameters. The primary operator approved this request. Another field operator entered the main control room surveillance area to report to the technical manager that the paperwork filing was complete, momentarily distracting the technical manager's attention to oversight;
  — After reactor power reached 90 percent, maintenance personnel conducted a briefing with the secondary operator in the back area of the main control room, and were

granted permission by shift supervision to conduct troubleshooting in an attempt to isolate a small leak on the low pressure feedwater system. This evolution distracted the secondary operator's attention from monitoring important plant parameters during the remainder of the power ascension;

- There were numerous distracting phone calls to the main control room that were answered by the primary or secondary main control room operators. On one occasion, a main control room operator stated that the phone calls were a distraction.

- The technical manager is not procedurally required to observe reactivity manipulations;
- Operators perform turbine load manipulations and reactor coolant system makeup dilutions/borations without reference to step-by-step procedures;
- In April 2014, during startup to synchronize the turbine-generator to the electrical grid, the secondary operator withdrew too much steam from the steam generator, resulting in primary temperature dropping below the acceptable region of the operating limit. This issue was investigated by the station, and corrective actions were taken to address skill-related deficiencies among operators and to enhance rules for operators who perform first-time evolutions.

Performing plant evolutions that impact important primary parameters without the highest levels of rigor and supervision has the potential to result in unintended power transients and operating parameters outside of design limits.

Recommendation: The plant should enhance the rigour and supervision in the main control room during evolutions that impact important primary parameters.

IAEA Basis:

SSR-2/2

7.20 The operating organization shall be responsible for establishing a safe reactivity management program under a strong management system for quality.

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

NS-G-2.14

3.1 The shift supervisor should manage plant operations on each shift and should be responsible for overall safety at the plant, protection and safety of personnel, coordination of plant activities and performance of the assigned shift. In addition, the responsibilities of the shift supervisor should normally be to oversee closely activities that support complex and infrequently performed plant evolutions, such as plant heat-up, startup and shutdown, physical tests, cooldown and refueling.

5.23 Planned reactivity changes should only be performed in accordance with written operating instructions and the explicit permission of the shift supervisor. The supervisor should monitor the reactivity of the plant evolution and the reactor operator should be free from other duties and free from distractions while planned reactivity changes are carried out.

5.24 Any planned major changes to the reactor power or to any other operations relating to reactivity should be initiated only after a pre-job briefing on the expected effects of the change.

5.25 Self-assessment and error prevention techniques, such as stop, think, act, review methodology and peer checking, should be used during reactivity manipulations.

Plant Response/Action:

A – Causal analysis

- Control room ergonomics do not ensure an optimum disruption-free environment;
- Management of control room access is not always complied with;
- The remits and roles of control room personnel do not cover permanent managerial supervision.

B – Strategy adopted to resolve the recommendation or suggestion

- Reinforcement of the control room access rules;
- Application of operations core consistency with setting up of the operator unit coordinator;
- Renovation of the control rooms during the third ten-yearly outage.

C – Method used to check that the action plan is appropriate and to check effectiveness

Specific observations are focused on control room monitoring and sensitive activities within the framework of coordination of the operations fundamentals.

D – Scheduling of the actions taken and added value for problem solving

	Disruption-free environment in the control room	**Control room monitoring**	**Control room supervision**
2015	Badge access approach continued Identification of the work permits signed by the control room Study of hot work permit management	Overall review of control room monitoring practices. Structuring of the Shift Supervisor panel walkdown Deployment of the baseline requirements and self-assessment sheets as part of cyclical coordination of the fundamentals	Study of application of operations core consistency Initial experimentation with the posts of operator unit coordinator and Shift Supervisor
2016	Granting of hot work permits transferred outside the control room	Setting up of just-in-time training for activities flagged up as sensitive Continued application of cyclical coordination of the baselines	Changeover to operations core consistency

2017	Renovation of the control rooms within the framework of the third ten-yearly outages with factoring in of the restrictions	Sustain the benefits obtained from setting up of the operator unit coordinator (OPPT).	Setting up of the operator unit coordinator and Shift Supervisor working groups

E – State of action plan progress and reporting procedure

Progress of the actions is tracked with the Operations Department targets contract (COS) on an annual basis.

F – Evaluation of action plan effectiveness
Reporting of significant safety events under Operations responsibility involving control room monitoring and excursion from the operating range provides objective measurement of effectiveness of the actions taken.

IAEA comments:

In response to the recommendation made by the OSART team during the original mission, the plant has made efforts to identify causes of the issue that involved the main control room (MCR) ergonomics, management of the MCR access, leadership and permanent supervision of the MCR staff. Causal factors identified by the plant include programmatic and performance based aspects of the MCR activities.

The plant has adopted a strategy and a method for resolving the recommendation and imposed an action plan that is routinely monitored and regularly evaluated on efficiency.

The plant has made efforts to establish a disruption-free environment by introducing a badge access to the MCR and a method for granting work permits (for example, hot work permits) and making briefings outside the MCR. Renovation of the MCR during the 3rd ten-year outage that is planned for the beginning of 2017 will further contribute to the serenity of the MCR, providing calm, quiet and business environment.

In April 2016 the plant has modified the MCR team composition and introduced a position of a Pilot Operator who is now fully responsible for all of the activities in the MCR. The Pilot Operator provides leadership and supervision to the MCR operators and is present in the MCR all the time. The plant has also developed respective guidelines, providing clear responsibilities and rules of behaviour for the MCR staff covering all of MCR operators' activities including the plant evolutions that impact important primary parameters, such as turbine load manipulations and reactor coolant system makeup dilutions/borations. The MCR operators have been provided an appropriate training and an opportunity to discuss and enhance the MCR guidelines. The recent outage conducted with the new MCR organization has demonstrated tangible benefits.

Additionally, the plant has started updating and enhancing coordination between the operating group (MCR staff) and supporting group (authorization for the operating activities) to ensure safe and reliable operation of the plant.

Conclusion: Issue resolved

3.4 (a) Good Practice: Plant component status tracking system

The plant has developed and implemented a comprehensive plant component tracking system (AIC) that is used during on-line and outage operations. The system uses a database that receives inputs from other station software systems, such as safety tagging and work authorization permits. These collective inputs are used to maintain the status of all plant components in one database, allowing operations personnel to easily track components that are not in the required position at power or shutdown conditions because of maintenance or other scheduled activities. In addition, the system analyzes component positions to determine the status of important functions, such as the capability of a shutdown cooling pump to provide flow to the reactor vessel.

This plant component status tracking system has several benefits. The system enhances the risk awareness of operations personnel because it displays the impact of out-of-normal-position components and their corresponding impact to important functions. The database displays information in a visually meaningful manner that is easy to access. Also, it provides additional defense-in-depth and efficiency to ensure that all components and functions are available before an operational change is authorized. In addition, it improves the efficiency and rigour of post-outage valve line-ups because it allows operations personnel to focus on systems and components that were manipulated during maintenance.

Since the plant component status tracking system was implemented in 2012, there have been no significant component mispositionings that require reporting to the regulator, and the number of low-level component mispositionings has been significantly reduced.

3.6(a): Good Practice: The station has developed emergency response plans for use by external emergency response teams.

The station has developed emergency response plans for each building for use by external emergency response teams. The plans contain the following information:

- Firefighting resources such as floor plans; locations of access; locations of fire detection & protection equipment;
- Risk assessment for each area;
- Fire scenarios possible in each area;
- Illustrations of large equipment.

These emergency response plans facilitate easy, accurate exchange of information between the station's on-call director of the senior management command post (PCD2) and the emergency response operations commander (off-site response). The response plans speed up the deployment of external firefighting resources and helps the emergency response operations commander to define the SOEIC (Situation – Objective –Concept of operations – Execution – Command).

4. MAINTENANCE

4.1. ORGANISATION AND FUNCTIONS

A contract that includes challenging department goals is made between the department heads and the plant manager. Each maintenance department manager is responsible for implementing corrective actions from comprehensive self assessments of the eight macro processes and his own internal assessment. The team considers this a good performance.

The department heads translate the contract into goals for their direct reports. However, from a technician's perspective, it is not always clear how their day-to-day field activities contribute to the plant and department objectives. The team encourages the plant to communicate the department objectives more directly to the worker level.

There is a periodic meeting ("comité inter enterprise") where plant management meets the managers of the eight most important contractors to discuss industrial safety issues, informs them of upcoming projects, and discuss the five year strategy of the plant. This creates long-term engagements and is beneficial both for industrial safety as well as the time and effort contractors spend on specialized training. The team considers this as good performance.

Contractor evaluations are performed by the plant in a systematic way using an extensive questionnaire. Rewards can be given when evaluation scores excel (good quality of work, timeliness and improvement recommendations) or penalties (issues in adhering to plant requirements or industrial safety shortfalls) for poor performance. The team considers the methodology used, including consequences for the contractors, as good performance.

Corrective actions are only developed for major deviations identified during evaluations. Therefore, the team encourages the plant to lower the threshold for corrective actions.

4.2. CONDUCT OF MAINTENANCE WORK

Maintenance work processes and practices are not always implemented and performed to ensure high quality work. The team observed weaknesses in the foreign material exclusion (FME) program and implementation; in managing measurement and test equipment; lifting and rigging practices; improper worksite fencing; inappropriate personnel behavior and improper tool use; extraneous objects on electrical equipment and ineffective scaffolding kickboards that have led to events in the past. The team made a recommendation in this area.

4.3. WORK CONTROL

During the past few years, the plant has made strong efforts to improve equipment material condition and has reduced the maintenance backlog. The team recognized the plant upgrade project; the leak management program; the introduction of a fix-it-now-team and ongoing material condition improvement program that have been in progress for several years and have resulted in improved equipment reliability. However, the team noted that schedule adherence, a flat trend in work order backlog reduction efforts, and delays to completing preventive and corrective maintenance may result in equipment degradation, safety system unavailability or unplanned plant shutdown. The team suggests that the plant considers enhancing the maintenance work management practices to improve timely completion of preventive and corrective maintenance work requests.

4.4. SPARE PARTS AND MATERIALS

Into the long term outage planning process, the outage management team included the availability to check for spare parts when the delivery time exceeds the normal outage preparation time. This results in these spare parts being available at the time of the outage. The team considers this a good performance.

In the warehouse, the plant does not perform preventive maintenance on spare parts such as turning large electrical motors and preventive maintenance on assembled valves or pumps. The team encourages the plant to evaluate the necessity of preventive maintenance on stored spare parts.

4.5. OUTAGE MANAGEMENT

Outage preparation is conducted by a clearly defined, separate outage organization that starts outage preparation five years in advance with a focus on staff and contractor availability. It turns over outage preparation to a dedicated organization, which is separate from day to day maintenance. The team considers this as a good performance.

Outage operational centre personnel use role-playing training to prepare the outage operational team to manage emergent issues during outage shifts. The team considers this a good performance.

The team recognized two good practices in outage management:

- The plant uses special outage maintenance logistic teams to support important maintenance with a goal of improving the “wrench-time” of maintenance workers;
- The plant uses a coordinator of critical tasks or high-risk tasks and employs a methodology that consists of a set of tools to identify expectations and initial conditions required for successful execution of high-risk tasks during outages. The coordinator uses an aid that summarises all the stages and hold points that need to be validated.

DETAILED MAINTENANCE FINDINGS

4.5(1) Issue: The plant maintenance work processes and practices are not always implemented and performed to ensure high quality work.

During the mission, the team identified the following facts:

- Maintenance processes:

  - In the Sygma database used for work management, only lost measurement and test equipment is administratively prohibited from use. Measurement and test equipment with overdue calibration dates are not controlled to prevent use in the field. At the time of the review, the following was noted:

    - 5 measurement and test equipment tools that needed recalibration were reported missing and expired;
    - 21 tools have not been returned to the tool shop;
    - 26 equipment were past their calibration dates in the week of the OSART review and were not returned.

  - The plant does not have a Performance Indicator on maintenance rework. As a consequence, the plant does not analyze if plant maintenance has been effective in preventing systems, structures and components (SSC) unavailability. The plant identifies “non quality maintenance” issues, but these do not cover all rework required to be done within a certain timeframe;
  - In the plant, no plastic FME plugs and caps are available. As a result, FME plugs were missing on Unit 2 essential service water pump. In addition, FME covers were missing on tubing and a valve in the maintenance shop. Soft FME bags are only present in the warehouse and not in cabinets in the plant. In the Unit 1 turbine hall, on the pumping station side, a pump was found at ground level that had loose and improperly installed FME covers. Lifting eyes which are available in the warehouse have a yellow plastic tie wrap placed directly in the area where it may contact with rigging. When lifting parts or equipment with these lifting eyes, the plastic tie wrap might break and fall into the system;
  - Only the electric overhead traveling cranes in the turbine hall and the pumping station have defined parking positions. All other lifting equipment (up to several tonnes of lifting power) have no defined parking position and may be parked at locations in the vicinity of safety related equipment. Not all of the lifting mechanisms are in a safe parking position (example: crane turbine hall U2);
  - There were over 20 adjustable wrenches in different sizes (up to +/- 40cm) in the tool warehouse and the same amount were available in the hot tool rooms in the plant. The plant has no clear guidance on when or how to use adjustable wrenches. Instrumentation technicians were observed using adjustable wrenches on the essential service water system pressure indicator. They did not use the wrenches in a correct way and they were not aware that there is only one correct way to use adjustable wrenches. The bolt that was being manipulated by the technicians was damaged.

– standards of work:
  - Lifting and rigging: While a 300kg ventilator was being lifted with a 100T crane, the “chef de manoeuvre”, who is responsible for the lifting activity and signalling to the crane operator, did not give any signal while the load was lowered from the turbine building roof to the ground. Two technicians were observed guiding the load hanging approximately 50cm above ground level without proper tools to keep a safe working distance between them and the load. Additionally the fencing provided was inadequate to prevent people from entering the lifting area.
    - Several examples of incorrectly assembled bolted connections were seen on the following systems: Unit 1 auxilliary feedwater system (ASG); Unit 1 safety injection system and Unit 2 low pressure feed water pump; Other systems in the turbine hall Unit 2 (condensate extraction system); In addition, on the lid of a recently revised condenser vacuum system cooler, a nut was missing.
    - During corrective maintenance on a Unit 1 trash rake, the limit switches were not attached properly to the rail. The technician found under the electrical box the 2 unattached metal parts which fix the limit switches into position. When repositioning the plastic wheel that should follow the cable position, a maintenance technician pulled the guiding shaft of the wheel instead of loosening the positioning screws of the shaft. Additionally, once the wheel had been adjusted, a technician tested its position using his foot.
    - In the turbine hall and in the fuel pool building, trolleys were found that either had no brakes, or brakes that were not engaged or attached to a fixed structure.
    - In the procedure to check the seismic supports on Unit 2 essential service water pump, one of the stems should be bolted to a torque of 4dNm. On the stem was written “2”. The technician decided not to follow the procedure, but to use the handwritten number and to bolt it to 2dNm.

Improper maintenance processes, practices and the use of improper maintenance tools may result in degradation of structures systems and components (SSC) important to safety, emergent corrective maintenance, rework and injury to personnel.

Recommendation: The plant should enhance its maintenance work processes and practices to ensure high quality of plant maintenance.

IAEA Basis:

SSR-2/2

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.

8.1. Maintenance, testing, surveillance and inspection programmes shall be established that include predictive, preventive and corrective maintenance activities. These maintenance activities shall be conducted to maintain availability during the service life of structures, systems and components by controlling degradation and preventing failures.

GS-G-3.1

4.14 training should ensure that individuals understand the process and the tools that they are using and understand what constitutes acceptable quality for the products they produce and the processes they control.

NS-G-2.6
2.1. The maintenance programme for a nuclear power plant should cover all preventive and remedial measures, both administrative and technical, that are necessary to detect and mitigate degradation of a functioning SSC or to restore to an acceptable level the performance of design functions of a failed SSC. The purpose of maintenance activity is also to enhance the reliability of equipment. The range of maintenance activities includes servicing, overhaul, repair and replacement of parts, and often, as appropriate, testing, calibration and inspection.

3.8. Contractors should be subject to the same standards as plant staff, particularly in the areas of professional competence, adherence to procedures and evaluation of performance. Suitable steps should be taken to ensure that contractors conform to the technical standards and the safety culture of the operating organization.

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.

Plant Response/Action:

A – Causal analysis

This suggestion addresses shortfalls that result in maintenance quality deficiencies.

The diagnosis performed by the OSART, concurred by the NPP, revealed three areas for improvement:

– Coordination of the ‘Operations and Maintenance Quality Control’ (MQME) initiative;
– Definition of requirements related to the FME risk and related compliance in the field;
– Provision of coaching on seismic risks and implementation of countermeasures in the field.

Operations and Maintenance Quality Control (MQME) is a station priority: it is coordinated through the MQME Committee (part of the ‘Generate’ macro-process) and through work with other related macro-processes.

B – Strategy adopted to resolve the recommendation or suggestion

The objective is to curb the number of quality deficiencies by enhancing the quality of work packages and reinforcing the level of management requirements. The main drivers are as follows:

<u>Operations and Maintenance Quality Control (MQME):</u>

– Coordinate the ‘Operations and Maintenance Quality' (QME) sub-process, part of the ‘Generate’ macro-process (MP2), with the objective of improving operational quality by defining requirements, indicators and work methods and analyzing events and low-level events. A specific action plan to prevent quality deficiencies has been compiled together with the other macro-processes; it is coordinated by the MQME Committee;

- Since 2015, the departments have been developing an MQME roadmap, used to define their objectives and actions to be conducted over the next year;
- Potential Operating and Maintenance Quality Deficiencies (NQME) are tracked using the Corrective Action Programme (CAP) and are characterized for further analysis. Tracking is conducted at several levels:

  - Daily review of any collected findings (findings review meeting);
  - Management operational focus on plant and activities each day (daily CAP managerial meeting);
  - The MQME Strategic Coordinator (PS) and the MQME Operational Coordinator (PO) validate the analyses and the assignment of any related corrective actions;
  - Analyses shared through the MQME commission when lessons learned could benefit other technical departments.

- Sensitive activities covered by the “Definition of the sensitive activities strategy for power operations and outage”, which stipulates the:

  - Characterization of a sensitive activity;
  - Identification of relevant activities in the schedule;
  - Process to control sensitive activities during the preparation and implementation phases.

  - **Defining requirements related to the FME risk and ensuring compliance with them in the field:**

- Creation of an FME network, with periodic meetings scheduled as part of the "Operations and Maintenance Quality" (QME) sub-process, with the objective of clarifying requirements, coordinating the action plan, monitoring indicators, sharing OPEX, identifying equipment requirements and coaching workers in the field;
- Since 2016 awareness-raising initiatives have been set up to draw the attention of EDF personnel and our partners to the FME risk (several CIP training programmes, communication drives, FME info board, presentations made for department management, reactor building coordinator, etc.);
- Since the beginning of 2016, good levels of involvement from Outage Project/Functional Groups during the preparation phase for the 2016 refueling outage (identification of worksites with FME risk, review that includes FME topic, regular reminders issued during the outage implementation phase and activities conducted for outage control);
- Managerial correspondence issued to partner companies before refueling outage in 2016 to reiterate FME risk prevention requirements during outage;
- Low-level events related to FME risk prevention are tracked in the CAP (Corrective Action Plan) and characterized to enable more in-depth analysis. Tracking is performed at different levels:

  - Any findings are reviewed on a daily basis (findings review meeting);
  - Daily management operational focus on plant and daily activities (daily corrective action programme managerial meeting);
  - The MQME Strategic Coordinator (PS) and the MQME Operational Coordinator (PO) validate the analyses and the assignment of any related corrective actions;
  - OPEX shared and developed through the FME network.

Coaching on seismic risk and implementation of countermeasures in the field:

- The seismic risk is addressed within the scope of the "External Hazards" (AGE) sub-process. The action plan includes a section on developing a hazard risk culture, through managerial communication drives and training and/or information for personnel.

All such actions aim to clarify the requirements and facilitate their application by workers in the field. Preventing quality deficiencies is of concern at all levels. The objective is to provide personnel with all necessary means to 'get it right first time'. The Maintenance Quality Deficiency (NQM) action plan contains a communication section that sets our arrangements for the widespread communication of actions designed to eliminate quality deficiencies.

Suitable managerial presence in the field aims to amass good practices, identify streamlining difficulties and requirements, promote and check requirements in the field directly with the workers, in areas such as industrial safety, housekeeping, fire and FME risks, activities with risk of maintenance and operations quality deficiencies, etc.:

- Each department coordinates an annual Manager in the Field programme, based on a departmental risk analysis that factors in departmental results and trend analyses;
- The station's Manager in the Field arrangements were supplemented with the Dedicated Field Team (EDT) in April 2014. The 'field' is defined as all activities contributing to site success. The EDT analyses how the basic processes are actually run. The Dedicated Field Team is composed of four members (senior management team, second line manager, first line manager and expert in the area) and guarantees presence in the field of two days every two weeks.

C – Method used to check that the action plan is appropriate

Site indicators have been set up to track the results stemming from the action plan, namely:

- Number of significant (with nuclear safety and capability impact) and insignificant Operating and Maintenance Quality Deficiencies (NQME);
- The KPI performance indicator is used to assess the control and / or integration of the FME risk as objectively as possible.

Manager field walkabouts, the Dedicated Field Team and the Corrective Action Programme measure the effectiveness of the action plan and detect low level events.

A corporate level tool is used to regularly perform self assessments on Operations and Maintenance Quality Control (MQME). In addition, an annual Peer Review is conducted at the station under the supervision of DPN senior management.

Action plan is define in MP2 programme and working group action plans

D – Action plan progress status and reporting procedure

The different action plans and their progress are tracked in ad'hoc coordination committees: FME working group, Maintenance and Operations Quality Control Commission, Generate Committee.

In 2016, monthly reporting from the departments was set up for the MQME initiative.

E – Evaluation of action plan effectiveness

Action plan effectiveness is assessed within the scope of reviews of the sub-processes and of the 'Generate' macro-process.
IAEA comments:

To address the issue the plant has defined a detailed action plan with three focus areas: Non-quality works (NQME); FME; Seismic risks. The following summarizes the team conclusions on the different deficiencies.

Maintenance processes:

- Although a new tool to manage measurement and test equipment was introduced, and that the procedure describing the process was updated, today the same difficulties as seen in 2014 exist to manage equipment calibration;
- Starting early 2016, the non-quality maintenance works (NQM) were given a high priority in the plant, including focus during planning meetings on possible quality issues, including prevention of quality deficiencies and detailed analysis of observed non quality works. Although the NQM indicator defined is dependant of individual judgement, an important increase in bringing up possible reworks is visible. Improvements are visible in the number of low level NQM and NQE reported and identified since the beginning of 2016. However, the NQM resulting in ESS (report to regulator) was stable at 7 for 2014, 2015 and 2016 and a general rework analysis to look for trends is not performed at the plant;
- The plant puts a lot of effort in improving the FME program, in raising FME awareness of its own staff and contractors and the availability of FME tools in the field. An FME indicator was created and shows improved results. The plant introduced a strict follow up of non renewable parts. The use of tape was limited and put under strict conditions, and substitute products were proposed to plant staff. During an outage, FME focus works were put into place. Application in the field of FME tools was observed during the follow up mission. This part of the issue is resolved;
- No progress has been made on availability of adjustable wrenches. No guidance has been set up, nor was training delivered to plant staff using adjustable wrenches.

Work standards:

- A procedure on management of lifting equipment was created and implemented, a new risk evaluation on lifting activities has been put into place, training and coaching of plant staff and of contractors have been introduced. 4 plant staff is dedicated to the lifting team to help preparation and to observe and coach lifting activities. All lifting plans provided by contractors have to be approved prior to use by plant staff. This part of the issue is resolved;
- Although a training course was developed on "bolted connections" and was given to personnel from electrical and mechanical maintenance and reliability sections and is made available to contractors, and although hold points were introduced in procedures requiring plant staff to perform QC on bolted connections after maintenance, it was observed during the follow up that on a recently maintained feed water pump not all bolted connections were correctly assembled;
- On the evaluation of seismic risks in relation to availability of loose trolleys in the installation, the plant developed a wider action plan and made progress in this area: All seismic risks in the installation (eg. Concerning lamps, fire hoses, …) have been evaluated in 2015 and corrective actions are taken to solve open issues. Parking positions in the plant are defined for all lifting devices. There is a plan to identify them

with signposting in the field by 2017. Training to operations staff has been given to recognise seismic risks in the plant. During the contractor days, a field simulator was installed to improve awareness with contractor supervisors. However, trolleys are not a specific focus area and are not even included in the seismic risk analysis document. No actions to check all trolleys on site have been performed.

Conclusion: Satisfactory progress to date

4.7(1) Issue: The plant maintenance work management practices do not always result in the timely completion of corrective and preventive maintenance.

During the mission, the team identified the following facts:

Since 2009, the plant has invested resources to upgrade the material condition of the plant. Several improvements were observed. However, there still is a large backlog of corrective and preventive work activities in the work management system, e.g.:

- As of October 10th, 1545 corrective maintenance work requests (DI) were open (unsolved). Out of these, 662 were defined by the plant as important for safety (IPS). Out of the 662 open IPS work requests, 345 were overdue:

  - 247 were older than 1 year and 34 were older than 3 years;
  - 2 that had priority 1 (required to be completed within 24 hours) were open and overdue and took +/- 10 days to solve;
  - 56 were overdue that had priority 2 (required to be completed within 1 week);
  - 142 were overdue that had priority 3 (required to be completed within between 2 and 16 weeks)

- There were 6 work requests dating from 2012 out of 28 on Unit 1 that were scheduled for repair during the weekly work request meeting observed by the team in October 2014;
- Although the plant has a Fix-it-Now team on-site to increase planning stability, the indicator on planning stability week for the week prior to work execution compared to the week of execution from the period of January 2014 to July 2014 is on average approximately 79%. This indicates there are weaknesses in work week stability;
- By the end of September 2014 the Instrumentation & Control (I&C) maintenance department indicator on overdue preventive maintenance orders was 214 (goal was set at <80), and the Mechanical Maintenance department was 755.
  In addition, in the Sygma database, due dates connected to in-service inspections required by boiler and vessel inspection regulations and some electrical regulations are even more conservative. This creates an inaccurate portrayal of the backlog of +/- 200 preventive maintenance items in the mechanical maintenance department and 170 items in the I&C department. This makes the focus on actual overdue preventive maintenance difficult;
- In September 2009 a leak was identified on the nuclear island vent and drain system that was categorized as priority 3, requiring corrective maintenance by the end of December 2009. However, the leak still exists;
- There are five work requests on safety-related ventilation systems initiated between 2009 to 2011. Although these work requests were designated for completion by March 2011, the corrective maintenance has not yet been completed;
- In March 2010, a work request was identified for three leaking chemical and volumetrical control system valves that was categorized as priority 3, requiring corrective maintenance by April 2010. The leaks still exist.

Untimely completion of preventive and corrective maintenance activities may result in equipment degradation, important safety related systems unavailability or unplanned plant shutdown.

Suggestion: The plant should consider enhancing the maintenance work management practices to ensure timely completion of preventive and corrective maintenance work requests.

IAEA Basis:

SSR-2/2

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, reported and corrected in a timely manner.

NS-G-2.6

5.14 A comprehensive work planning and control system applying the defence in depth principle should be implemented so that work activities can be properly authorized, scheduled and carried out by either plant personnel or contractors, in accordance with appropriate procedures, and can be completed in a timely manner. The work planning system should maintain high availability and reliability of important plant SSCs.

5.17 The work control system should be used to ensure that plant equipment is released from service for maintenance, testing, surveillance and in-service inspection only upon authorization of designated operating personnel and in compliance with the operational limits and conditions. It should also ensure that, following maintenance, testing, surveillance and in-service inspection, the plant is returned to service only upon completion of a documented check of its configuration and, where appropriate, of a functional test.

5.19 The effectiveness of the work control process should be monitored by appropriate indicators (such as repeated work orders, individual and collective radiation doses, the backlog of pending work orders, interference with operations) and by assessing whether corrective action is taken whenever required.

9.41 The operating organization should ensure that all necessary test equipment, whether called for in the design or otherwise required for the surveillance programme, is available, operable and calibrated. So far as is practicable, test equipment should be permanently installed.

9.41 A programme should be established and maintained for the calibration and control of test equipment and reference standards used in surveillance. This programme should provide for the prompt detection of inaccuracies and for timely and effective corrective actions.

Plant Response/Action:

A – Causal analysis

The main reasons behind delays in processing of corrective actions (including by Fix-it-Now (EIR) team):

Short-term:

- Priority 1 & 2 requests, the great majority of which are issued by operations (diagnosis requests). However, despite being addressed by the Fix-it-Now team, these requests are not closed out and/or tracked in the database containing findings and/or processing completed by the technical department;
- Re-prioritizations would also be required further to some diagnoses that do not necessitate immediate processing, but could be incorporated in the milestone planning process;
- Lack of rigor when filling in SYGMA tool further to diagnoses and/or processing: thus "polluting" the volume of work requests by adding anomalies that are sometimes already closed out.

Medium-term:

- Priority 3 or 4 activity requests that are not managed effectively (regular reviews and fresh analyses) within the technical departments so they can be scheduled in parallel with preventive maintenance activities;
- Lack of foresight and control of activity preparation (spare parts, logistics, risk analyses, etc.) that generates a significant number of renunciations during the implementation phase and reduces reliability of the schedule during this phase.

Main reasons behind delays in processing of preventive activities:

- Preventive activities for which preparation lacked foresight from the technical departments, even though the activities began at 20 weeks**;**
- Shortfalls in monitoring of preparation activities, meaning a satisfactory level of control is not achieved sufficiently in advance (reservation of spare parts / compiling work packages / logistics requests, etc.);
- Lack of foresight in activity scheduling to ensure the latter is in step with the electrical train control schedule (within scope of the functional equipment groups (GEF), as well as critical activities in the cycle (maintenance batches, regulatory inspections, etc.)).

B – Strategy adopted to resolve the recommendation or suggestion

Processing corrective actions:

Short-term:

- Multiple-phase action plan for reactive processing of delayed priority 1 & 2 work requests *(in place since 01/09/2016):*

  1. Updates of work request volume by refreshing the SYGMA tool to take account of all closed-out corrective work requests;
  2. Prioritization of work request processing to target safety-related equipment;
  3. Strengthened coordination of processing of “P1/2” work requests, with weekly reporting (including statistics) in the senior management meeting.

- Power Operations reorganized to increase reliability of how anomalies are processed and how activities are implemented over the long-term (*implementation deadline 15/11/2016):*

1. Reinforced coordination of activities assigned to the Fix-it-Now team, with clear priorities and weekly reporting within the Power Operations project;
2. Weekly review of processing of priority 1 & 2 work requests. .

Medium-term:

– Priority 3 (and other lesser priority levels) corrective work requests are incorporated into the milestone planning approach. They are scheduled by ensuring electrical train control is performed, whenever possible, in parallel with preventive maintenance activities: thus curbing equipment unavailability (volume and duration (*deadline for transition to SDIN - 04/11/2016).*

– **Processing preventive activities (*in progress since 01/09/2016):***

1. Reinforcement of milestone planning with “long-term” coordination set up by the sub-process manager from the Power Operations project:

– Identification of preventive activities that are consistent with train control activities completed within the scope of functional equipment groups (GEF) and that comply with implementation deadlines;
– Identification of work requests that are in line with upcoming preventive activities, so they can be incorporated with the latter to optimize equipment unavailability;
– Weekly meeting with technical departments to identify the activity groups from D0-15 onwards with the objective of controlling the schedule at D0-10 weeks;
– Implementation of a long-, mid- and short-term handover to the Project to ensure monitoring consistency of the different milestones in the milestone planning.

2. Causal analysis of activities that are not conducted as part of OPEX related to milestone 5 in the milestone planning;
3. Implementation of weekly meetings to control activities, held with technical departments and support functions (logistics, spare parts, risk prevention).

C – Method used to check that the action plan is appropriate and to check effectiveness

Results indicators discussed by senior management:

– Changes in corrective work request volumes per priority (*weekly monitoring);*
– Changes in volume of preventive activities with delayed implementation (*monitored monthly);*
– Schedule stability in construction phase (ERI 5.0 & 5.1) and its reliability in the implementation phase - ERI 5.2. *(monitored weekly);*
– Compliance with work package deadlines making it possible to control their validation by operations (*monitored weekly)*

Meeting with departmental management *(in progress):*

– Identify suitable means to resolve problems common to the various technical departments;
– Validation of ability of technical departments to follow action plan proposed by the Power Operations project.

D – Scheduling of the actions taken and added value for problem solving.

2015

- Implementation of milestone planning and related coaching within project and technical departments as per recommendations from Management Guide 296;
- M0: define activity scope, agreed between the project and the technical departments, by W-10 at the latest;
- M1: prepare work packages in line with the scope of activities scheduled at W-7;
- M2: freeze implementation resources (HR, spare parts, logistics, etc.) at S-3;
- M3: Operations analyze consistency between activities/schedule/resources at W-2;
- M4: perform activities in accordance with schedule.

⇨ ***Structured methodology for preparation, checks and implementation of maintenance and operation activities with regard to performance.***

2015 – 2016

- Work on integrating corrective work requests in parallel with preventive activities.
  - Optimize maintenance phases by curbing the volume and duration of equipment unavailability
  - Reduce equipment anomalies with the objective of increasing equipment reliability.

2016

- Improve efforts to process corrective work requests by targeting safety-related equipment with reinforced coordination of "P1/2" work requests.
  - Gain a realistic oversight of the work request portfolio so that activities can be prioritized with the objective of increasing the reliability of safety-related equipment and providing a short and reactive feedback loop on task force progress.
- Power Operations reorganization based on strengthened coordination of activities assigned to the Fix-it-Now team, with a weekly review of priority 1&2 work requests.
  - Provision of robust organization to process priority anomalies within the deadlines fixed by Operations.
- Reinforcement of milestone planning by controlling work over the long-term, including support functions (logistics/spare parts).
  - Compliance must be ensured with the content of each milestone within the milestone planning and each associated deadline must be met
  - Systematic checks must be performed to ensure coherence between Schedule – Work packages – Risk analysis.
- Provide a rapid OPEX loop for activities not completed as per schedule.
  - Make progress with regard to weaknesses that result in non-completion of activities
- Control the SCRAM risks at each phase of a corrective or preventive activity

– Detect at risk activities right from their scheduling phase

– Communicate and implement countermeasures related to activities with a SCRAM risk in the implementation phase.

E – Action plan progress status and reporting procedure

All actions are initiated and coordinated with a frequency and prioritization level that is in line with the needs and capacities of the technical departments.

The indicators are systematically discussed in weekly managerial meetings (senior management level).

SCRAM risk prevention is now considered from milestone M0 onwards.

More recently, an OPEX milestone has been implemented and must pave the way for understanding and addressing any malfunctions that cause implementation deviations.

F – Evaluation of action plan effectiveness

Overall volume of equipment anomaly-related work requests has fallen by 40% since 01/01/14 (*1500 in 2015 / 900 in September 2016)*

Equipment anomaly-related /Power operations-related work requests have fallen by 35% since 01/01/14 (950 in 2014 / 625 in September 2016)

Overall volume of “P1/P2” equipment anomaly-related work requests has fallen by 50% in six months in 2016 (W14 (114) to W40 (57)

An ERI indicator that has improved in terms of the number of activities completed in line with the schedule
The volume of delayed preventive activities has decreased.

IAEA comments:

To address the issue the plant has performed a detailed analysis of the root causes on delays in the different priority corrective maintenance works and on delays in preventive maintenance activities. The plant then defined an action plan to resolve the issue.

Several important process and organizational modifications were put in place in the last 2 years. In the planning process, different modules with clear deadlines in the preparatory phase of preventive maintenance work orders and of corrective work orders of priority 3 and 4 were introduced shortly after the mission. 6 months prior to the follow up, additional modules were introduced to help the plant staff plan preventive and corrective maintenance at the same time, assure the availability of spare parts, avoid late injection of work orders and check the quality of work planning.

Additionally, a focus was placed on limiting the backlog of corrective maintenance works and a weekly reporting on different performance indicators for the plant senior management was set up 6 months before the follow up mission. These indicators include a number of open corrective work orders, priority 1 and 2 corrective work orders, overdue preventive maintenance and planning stability.

As a result, the overall volume of corrective maintenance was reduced from 1545 at the time of the original review to 845 during the follow up mission; the volume of corrective maintenance to be solved during plant operation was reduced from 1100 at the end of 2014 to 571 at the end of 2016. Overdue corrective maintenance on IPS (important to safety) equipment was reduced between the original mission and the follow up mission from 142 to 81 for priority 3, and from 56 to 7 for priority 2.

Improvements in backlogs are visible, however a backlog in preventive maintenance and in corrective maintenance is still present. On priority 1 corrective maintenance on IPS equipment, the number has increased the week of the mission from 2 to 5 overdue, with the longest taking approximately 10 days to be solved. On the total amount of overdue corrective maintenance on IPS equipments, 80 are currently older than 1 year (247 at end of 2014) and 17 are older than 3 years (34 at end of 2014). The indicator on planning stability is unchanged at 79%.

Conclusion: Satisfactory progress to date.

4.9(a) Good Practice: Maintenance logistical support teams, known as “Wrench time worksites”

The plant uses special outage maintenance logistic support teams to support important maintenance: The teams are based on the idea of a “surgeon being supported by a team of nurses”, and the goal of the technical support team is to improve the “hands-on-tool-time” of maintenance workers.

During outage planning, maintenance activities that are critical or near-critical to completing the outage schedule on time are selected for special support.

Then four months to work execution, the logistics section and the maintenance trades assess the exact needs of these selected work activities in terms of logistical support, special or standard tools, handling equipment, waste management, worksite tooling, RP advice and other logistical considerations.

A dedicated maintenance logistical support team handles all these support activities. On the work execution day, the worksite is ready for use, a satellite store has been set up, handling equipment has been selected, scaffolding is present, waste disposal is organized from start to finish, and ‘runners’ are available to help the operational maintenance team.

For example, the maintenance logistical support teams were used for inspections of train A and B diesel generators, residual heat removal system valves and for primary valves.

Benefits:

- Significant time-saving for operational maintenance teams;
- Maintenance teams only need to focus on the technical aspects of their work;
- Maintenence activities have more specialized workers.

4.9 (b) Good Practice: Preparation and implementation of operational countermeasures to ensure first-time successful execution of high-risk tasks

The plant uses a CARDEN* methodology that consists of a set of tools to identify expectations and initial conditions required for successful execution of high-risk tasks during outages. This initiative is coordinated by the trade section responsible for the task; all preparations must be validated by both the sub-project manager and the outage project manager through a review.

During the outage, the coordinator who prepared the review must then coordinate all the different actions that will ensure the task is carried out safely. The coordinator uses an aid, that summarises all the stages and hold points that need to be validated.

These requirements are recorded in a tracking document DSI CARDEN.

* CARDEN = *Coordinateur Activite Reperee Dimensionnante ou a Enjeux Notable* = Coordinator of critical tasks or high-risk tasks

Advantages

- Summarises all the steps that are required to ensure successful execution of tasks that are often cross-functional and multi-disciplinary;
- Places ownership and responsibility in the hands of the trade section carrying out the work, and ensures ownership of results;
- Enhances the safety of upcoming critical or sensitive activities;
- Focuses department managers on complex activities.

5. TECHNICAL SUPPORT

5.1. PLANT MODIFICATION SYSTEM

The plant has developed a system for managing DMPs (a specific type of temporary modifications such as plugs, tools, used during maintenance, operations and testing activities). This system involves stands with shelves, colour-coded labels and catalogue. The team identified this as a good practice.

Several years ago the plant faced an increasing rate of deterioration of the equipment having contact with e sea water or operating in a saline environment. A renovation program to solve the problem was developed. The plant installed permanent shields and movable curtains in several locations to keep saline mist away from the equipment. The team identified this as a good practice.

Currently the plant has 175 temporary modifications, 18 of which were identified as safety significant. EdF Corporate has developed a program for reducing the number of temporary modifications to an acceptable level by the end of 2020. The team encourages the plant to reduce the number of safety significant temporary modifications over an appropriate period.

The plant follows a procedure developed by corporate which governs permanent and temporary modifications. The plant implements most modifications in accordance with the existing procedure. However, the team noted some changes to the plant that were not controlled. The team made a recommendation in this area.

5.2. HANDLING OF FUEL AND CORE COMPONENTS

The plant's refueling supervisor uses a standard refueling log book. The team witnessed, that in some cases, the refueling supervisor needed more pages than were provided for to make all the records needed during one shift, and the number of pages in the log book is insufficient for the entire refueling of the reactor. The team encourages the plant to take into consideration the possibility of developing a more flexible design for the refueling supervisor's log book.

The plant uses a training course for management of abnormal situations during refueling. One to two weeks before a refueling campaign, the plant conducts just-in-time training for staff. A mobile simulator is used for the training. The team identified this as a good performance.

DETAILED TECHNICAL SUPPORT FINDINGS

5.3(1) Issue: The programme for managing changes to the plant equipment is sometimes not adequate.

During the mission, the team identified the following equipment changes to the plant which had not been classified and were not being controlled:

- Each charging pump room on both units has a temporary space heater that is not being controlled as a modification. These heaters have been in place for more than a year. Existing oil leaks from the charging pump motors may collect in the space heater and cause a fire hazard;
- In Unit 1 there is a portable air conditioning unit in the turbine hall relay room which is used to supplement the installed air conditioning. The door to the relay room is propped open to allow heat removal. The air conditioning unit has been in place for more than a year;
- The power supply for the EVEREST monitor at the exit of Unit 1 RCA is provided by an extension reel that is laid through a door.

Inadequate control of changes to the plant, could cause uncontrolled deviations from the assumptions and intent of the design.

Recommendation: The plant should improve its programme for managing changes to the plant equipment.

IAEA Basis:

SSR-2/2

4.38 Controls on plant configuration shall ensure that changes to the plant and its safety related systems are properly identified, screened, designed, evaluated, implemented and recorded. Proper controls shall be implemented to handle changes in plant configuration that result from maintenance work, testing, repair, operational limits and conditions, and plant refurbishment, and from modifications due to ageing of components, obsolescence of technology, operating experience, technical developments and results of safety research.

4.39 A modification programme shall be established and implemented to ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded. Modification programmes shall cover structures, systems and components, operational limits and conditions, procedures, documents and the structure of the operating organization.

NS-G-2.3

2.3 No modification to a nuclear power plant, whether temporary or permanent, should affect the plant’s ability to be operated safely in accordance with the assumptions and intent of the design.

2.11 Plant modifications should be performed in accordance with established procedures, with due consideration being given to quality assurance provisions.

2.13 The modifications should at all times be under the control of the plant management and should be managed in accordance with established procedures.

Plant Response/Action:

A – Causal analysis

Mobile equipment, such as air-conditioning and heating units, are implemented as countermeasures in periods identified with risks of heat waves or very cold spells.

This equipment is not clearly identified or tracked.

B – Strategy adopted to resolve the recommendation or suggestion

'One-off' deviations observed during the OSART have been resolved.

Ideas into how this temporary equipment should be identified and managed were then discussed, with a view to ensuring its use is properly controlled.

These discussions led to identifying and managing this equipment in the "Heat wave" and "Cold Spell" operating instructions, which now stipulate when it is to be used.

C – Method used to check that the action plan is appropriate and to check effectiveness

When the temporary equipment is in use, it is tracked during periodic walkdowns that are to be performed in accordance with the operating procedures.

D – Scheduling of the actions taken and added value for problem solving

Date	**Activity**
01/2015	Discussions into the management of temporary heating or air-conditioning equipment
06/2015	One-off deviations resolved in the field
10/2015	Management of temporary equipment incorporated into operating procedures

E – Action plan progress status and reporting procedure

The action plan addressing temporary equipment used during "Heat waves" and "Cold Spells" has now been fully implemented.

F – Evaluation of action plan effectiveness

Specific walkdowns are completed (as per the operating procedures) to check temporary equipment compliance.

IAEA comments:

To resolve the issue the plant has defined the causes and implemented systematic approach to strengthen the management of equipment changes. The inventory of all equipment changes, which have not been covered by any plant control process, has been performed and resolution of different cases has been determined.

Plant control of the use of temporary heaters or air-conditioning devices because of extreme weather conditions was reinforced, as all of the relevant equipments were incorporated in 2015 in the procedures for the management of plant configuration readiness for “Heat wave” (D5330-04-0974) and “Cold spell” (D533-06-2430). The requirements for installation and periodical control of operability of such equipment were defined and during the mission the plant demonstrated the effectiveness of the implemented actions.

The plant has optimised its preventive maintenance activities in 2015&2016 and significantly reduced the number of cases when temporary installation of heaters or air-conditioning devices is needed. The procedures for control of equipment changes were also reinforced.

The installation of temporary air conditioning equipment as a compensatory measure in case of other equipment malfunction is now limited to three months and such cases are also controlled by a plant procedure.

Deficiencies identified in the field during the original mission were resolved. The plant demonstrated the effective implementation of actions, thus resolving the issue.

Conclusion: Issue resolved

5.3(a) Good practice: System for management of temporary modifications (DMPs) specific to outages.

The plant has developed a system for managing a specific type of temporary modifications (DMPs - plugs, tools and other devices mostly used during maintenance, operations and testing activities).

The system developed includes stands with shelves. Racks of suitable size for small items are placed on the shelves. Each item has its own position, and positions are color-coded. The stands are separated by of a cage, and the door of the cage is locked. A catalogue with colored pictures is placed on the outside of the cage. Every page has its own plastic sleeve, and the sleeves are easy to browse. If any item is in use, a special tag is placed in this item's plastic sleeve.

The system allows all DMPs to be well controlled, enables the location of every DMP to be traced at all times, and reduces the probability of using inappropriate devices.

5.3(b) Good practice: Arrangements for reducing the impact of saline mist causing corrosion in Flamanville Unit 1 and 2 pumping stations.

The pumping stations are situated in the vicinity of the sea, and as a result the equipment is surrounded by saline mist, which causes corrosion of both stainless steel and carbon steel components.

During renovation of the pumping stations, the plant installed permanent shields and movable curtains in several locations to keep saline mist away from the equipment.

These shields and curtains are made of composite materials. The movable curtains allow easy access to equipment for operation and maintenance purposes.

This decision has reduced the level of humidity and salinity in the air in areas of the pumping station, thereby reducing the rate of corrosion significantly.

6. OPERATING EXPERIENCE FEEDBACK

6.1. INVESTIGATION AND ANALYSIS

Root cause analysis of events is not always performed in sufficient depth. In some cases it was observed that not enough 'WHY's were asked before arriving at the root cause. Also the existing root cause analysis template does not contain certain important elements such as; review for repeat events and applicability of internal and external OE. Without an in-depth identification of the root causes of events, their recurrence cannot be prevented. The team has made a recommendation in this area. The team also recognized that the plant has undertaken enhancement of their event investigation process and a modified methodology of analysis has been introduced.

6.2. CORRECTIVE ACTIONS

After analysis of events, corrective actions are developed to address the root causes. The team observed that no effectiveness review of implemented corrective actions is conducted at the plant. Lack of an effectiveness review could result in repetition of the same problems. The plant is encouraged to start reviewing effectiveness of corrective actions to prevent recurrence of events.

6.3. TRENDING AND REVIEW OF OPERATING EXPERIENCE

A comprehensive trending tool for analysis and review of the Corrective Action Program data, which includes both positive and negative inputs, exists at the plant. This trend analysis tool contains automatic data export, presentation of trends using graphs, standardized template format and electronic guidance on how to use the template. Implementation of this tool has resulted in measurable safety improvements at the plant. The team recognized this as a good practice.

6.4. UTILISATION AND DISSEMINATION OF OPERATING EXPERIENCE

Approximately 95% of the external OE reviewed at the plant originates from the EDF fleet. In order to prevent recurrence of events and learn from experience, it is essential to screen the large volume of international OE. The plant is encouraged to widen its external OE scope to include more OE from the industry.

DETAILED OPERATING EXPERIENCE FINDINGS

6.5(1) Issue: Root cause analyses of events at the plant are not always performed in sufficient depth.

During the mission the team identified the following facts many of which involved safety significant events:

- Reactor scram during work on power range neutron monitors (ESS# 010, dated 21 May 2013):
  - Maintenance was aware of the fact that there were no labels on the equipment, but still they went ahead with the work. This aspect was not addressed in the root cause analysis (RCA) report;
  - Absence of a dedicated cable replacement procedure was identified as one of the root causes of the event. However, no extent of cause was conducted in the RCA to look for similar problems in other safety related equipment;
  - The work package was checked by a 2nd person who didn't identify that the work location specified was incorrect. The cause of such a failure was not covered in RCA;
  - One of the corrective actions was to install equipment identification labels outside the room. However this action still leaves the possibility of working on the wrong equipment, especially given that the room is dark and cramped;
  - The RCA report under the section "applicability of the event to other units in the fleet" indicates that this event is not applicable, but later in the same report, applicability for other unit is identified.

- Event regarding metal shavings in the reactor coolant system (ESS#17, dated 18 August 2012):
  - While drilling the reactor coolant system (RCS) pipe, the contractor had taken short cuts and also had not conducted the inspection of the pipe by boroscope as mandated in the work order. This contractor has been working at the plant for several years. The RCA does not address the possibility of similar unauthorised changes to the procedures by the contractor while conducting work on previous occasions;
  - The depth of analysis did not ask enough "WHYs" such as: why did the contractor not stop and get help when the boroscope would not fit?, why did the contractor sign off that he had completed boroscopic examination when he had not? and why did the EDF supervisor not seek clarification of his own role?

- Event involving loss of 30 cubic meter of water from the RCS (ESS#16, dated 24 October 2012):
  - Field operators, while carrying out valve manipulations, were not aware that the circuit was not designed for high pressure and temperatures. This lack of awareness is not addressed in the RCA

- A similar event had occurred at two other plants in EDF, however, this information was not available to the plant.
- The RCA template does not require a review for repeat events and on applicability of internal and external OE. The existing template has been revised by EdF Corporate and even the revised version does not contain these important elements;
- The new RCA procedure does not include the concept of contributing causes, therefore all causes get identified as root causes. This could result in difficulties with prioritization of corresponding corrective actions and allocation of resources.

Without in-depth identification of the root causes of events, their recurrence cannot be prevented.

Recommendation: The plant should enhance the process of root cause analysis and perform analysis of events in sufficient depth.

IAEA Basis:

SSR-2/2

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

NS-G-2.11

4.3. … "The level of the investigation carried out should be commensurate with the consequences of an event and the frequency of recurring events. Significant factors that would influence the magnitude of an investigation may include the following:

Whether a similar occurrence has taken place earlier at the same installation"

Appendix III.3. Training (both initial and refresher) should be provided for the staff who might take part in an investigation. This should include training in investigation techniques, documentation needs, witness interviews, conflict resolution and dealing with confidentiality issues……..Whereas all investigators should receive some basic training in event investigation, including root cause analysis, for more difficult and complex investigations there may need to be at least one expert facilitator who is familiar with such methods of investigation.

Plant Response/Action:

A – Causal analysis

The distribution of roles between PS and PO is not sufficiently explicit. They tend to interfere in the analysis. They tend to interfere in the analysis.

The Operational Coordinators are not trained or do not have enough experience, and are too frequently involved in the events.

The appropriate support structure between Strategic Coordinator and Operational Coordinator is poor; the Operational Coordinators do not show much objectivity during the in-depth event analysis. No support for the Operational Coordinators (from the Human Factors Consultant/ Safety Engineers)

B - The strategy chosen to resolve the recommendation/suggestion

- Skills: Work on the skills of the people involved in In-Depth Event Analysis, through ad-hoc training (Strategic Coordinators, Operational Coordinators and Safety Engineers);
- Organisation: Restructure the Event Analysis Committee with the creation of a pool of analysts.

Safety Engineers will provide more support for the Operational Coordinators

C – Method used to check that the action plan is adequate and effective

Indicator based on the number of analyses postponed due to low quality

D – Schedule of actions taken and how each action has contributed to resolving the issue

Theme / Deadline		Action	Coordinator	Progress
Skills	2016	Additional In-depth Event Analysis training sessions at Flamanville	UFPI	11/03/2016: 6 people trained 28//12016: 4 people enrolled 10/03/2017: 4 people enrolled
Skills	2016	Training for Strategic Coordinators	UFPI/Human Factors Consultant	Completed for Safety Quality Senior Advisor, Industrial Safety, Environment and Radiological Senior Advisor and the Deputy Plant Manager

Skills	2017	On-site support from corporate (GPSN (Corporate Nuclear Safety Committee)-MSN)	JP BARGE	On-line conference on 26/10/2016 for the main support guidelines On-site support scheduled for January 2017
Quality	2016	1 reviewed every 2 months	JP BARGE	3 reviewed in 2016 for Safety Significant Events with Human Factor elements
Organisation	2016	Department Managers report on analyses in the weekly CAP management meetings	Direction Team	Done on 22/02/2016

E – Action plan progress and how this is reported

Reported in Direction Team meetings.

F – Assessment of action plan effectiveness

Indicators relating to depth of analyses
Analyses reviewed in Nuclear Safety Committees (GPSN MSN)

IAEA comments:

In order to resolve the recommendation the plant has performed casual analyses and identified an action plan to improve the quality of its Root Cause Analyses. The training on RCA methodology applications was strengthened and more than 30 staff members involved in analysing and drafting the event reports (so called "operational coordinators ") were trained in 2015&2016 or are being scheduled for training in 2017. Special training sessions with emphasis on correct application of RCA methodology and RCA decision making process were developed for the OE plant strategic coordinators. Such a training was completed for 3 persons in 2016, however one of these persons moved to another EdF site. The need to extend this training to other plant management staff members involved in the review of event analyses quality will be determined based on the actual plant needs. The plant took the initiative in 2016 to send for review 3 event reports (eg. as of 06/01; 18/01 and 15/06) to EdF Corporate and received in general positive answer on the quality of plant RCA. A special session to provide a feed back on the EdF evaluation is planned on the site for January 2017.

As the official EdF methodology for RCA was not revised after the original OSART mission the issue related to determination of "contributing causes" was not addressed.

During the follow-up mission three RCA of 2016 were reviewed. The extent of causes were addressed in the analyses for event: 2RRI 135VN valve unavailability due to maintenance failures (17/03/2016). Root causes seem to be well defined for an event of 13/01/2016 when the surveillance test of unit 2 DG was not performed correctly due to lack of adequate plant expectations regarding adherence to procedures. Plant request to include repeat events in

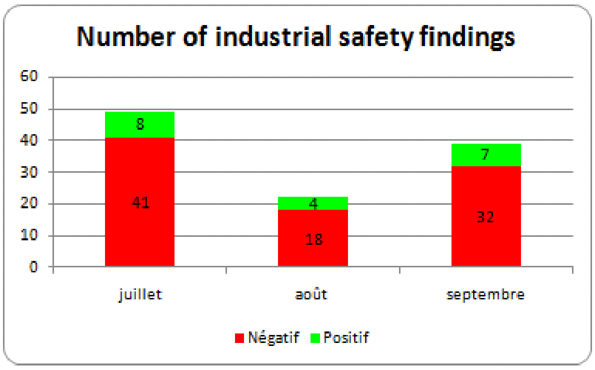
RCA was evident for event of 02/10/2016” Spent fuel level alarm 1PRT103AA2 failure”, however the result of such consideration was not yet available.

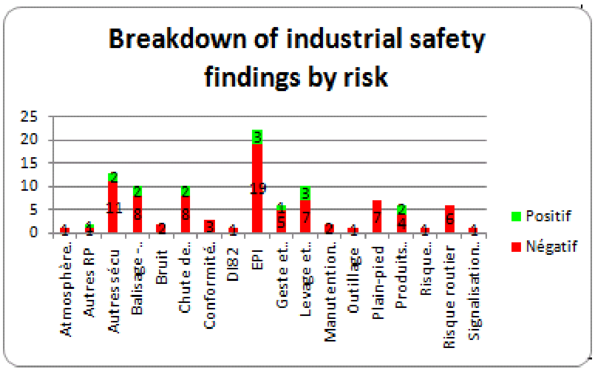
The plant has significantly progressed with strengthening the training for RCA and improving the quality of the RCA, some positive signs are already evident, however the effectiveness of the applied actions still need to be monitored and demonstrated.

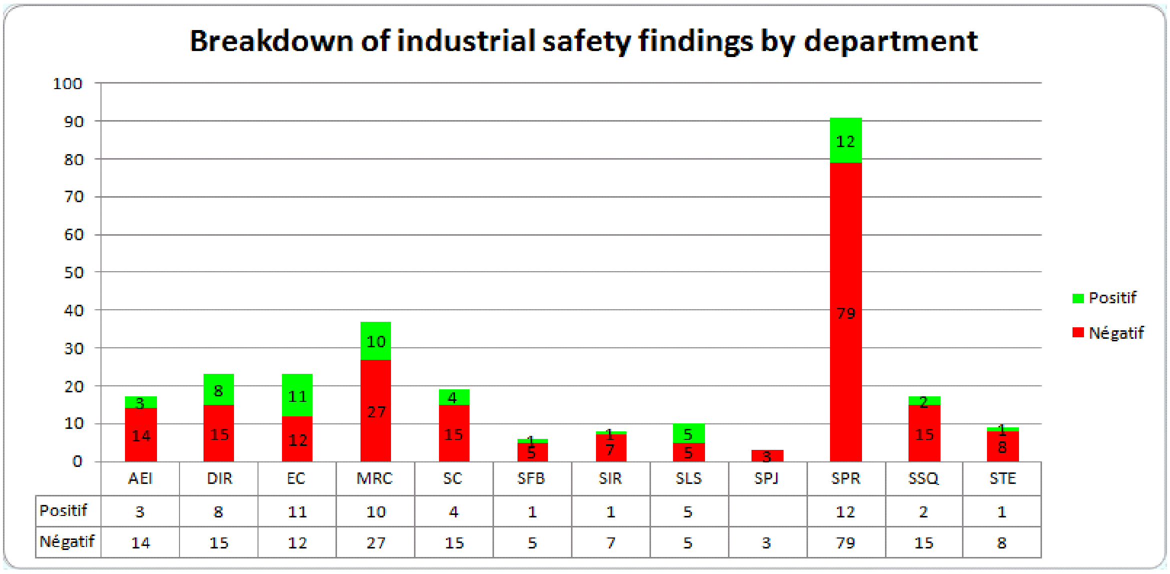
Conclusion: Satisfactory progress to date

6.6 (a) Good Practice: The plant has developed a unique electronic tool for trending of the corrective action programme data that does not require any manual manipulation/sorting. The tool provides a mechanism for consistent reporting using defined templates. The database is user friendly and includes live time electronic guidance to further assist the user. Trending can be easily performed at various levels from the macro process down to department level.

Examples of Trend Data Graphs







Benefits:

This tool enables plant departments and process owners to have easy and prompt access to trends in relevant areas. The stakeholders can proactively identify and manage issues before they become actual discrepancies and deviations. The plant has developed and implemented this tool independent of the fleet to help them improve in trend analysis. This process has resulted in measurable improvements. It has been assessed by the local French regulator as 'meaningful and promising'.

7. RADIATION PROTECTION

7.1. RADIATION WORK CONTROL

A variety of labeling and posting is in use providing comprehensive information to workers about the radioplogical hazards. The conditions for access to RCA work areas listed in written form on sheets has been replaced by the stickers which provide a simple illustration of the equipment to be worn for entering the area. The team recognized it as a good practice.

At the plant every activity in the RCA is subjected to prior radiation protection risk assessment as expected. The radiation work permit (RWP) programme complies with the corporate requirements and works efficiently. However several observed radiation protection practices as well as setting of the alarms in the electronic personal dosimeters indicate that the preventingthe spread of contamination and application of the ALARA principles are not always implemented properly. The team made a suggestion in this area.

7.2. CONTROL OF OCCUPATIONAL EXPOSURE

Managers and supervisors are intensively involved in the RP optimization analysis process. Set of measures in the RCA has been applied to optimize personal exposures. The plant has improved the control of access to very high risk radiation areas (so called red areas) by using 2 plates secured by tamper-proof screws which eliminates the risk of unauthorized opening of the resin bunker. The team identified this as a good practice.

7.3. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

The storage of tools for use in the RCA is available, comprehensive and well maintained. Moreover the plant has installed small tool dispensers called "Radiabox" in dedicated places. The distributors provide dose rate meters to the workers even outside the RCA thus saving the working time for the workers. In such a way workers are not obliged to go to the RCA to pick up the RP instruments or to return them. The use of these distributors is considered by the team to be a good practice.

DETAILED RADIATION PROTECTION FINDINGS

7.2(1) Issue: Radiation protection practices to prevent the spread of contamination and ensure application of ALARA principles are not always implemented properly.

During the mission, the team identified the following facts:

- The alarm of the contamination meter at the exit from a contamination controlled area to the clean area (with maximum 0.4 Bq/cm^2) in the hot workshop building is set to 4 Bq/cm^2. The plant is aware of the deficiency and has specific plans to replace old monitors with new ones;
- The same color vinyl bags are used in the RCA for collecting potentially contaminated material as for transport of clean (non contaminated) material. A bag dedicated to clean (washed) laundry was seen being used for contaminated overshoes;
- The labels stuck to the bags with used personal protective equipment did not always contain radiation data, and the colors of the stickers did not always correspond to the plant rules concerning contamination practices;
- The sample tank for gammaspectrometry of the gaseous effluent was taken out of the radiation controlled area (RCA) to the laboratory without a contamination check before leaving the RCA;
- After a planned survey, the plant reported a contamination spot of 3.2 MBq of Co60 as well as a contaminated spot of 280 kBq. Several others with contamination with approx. 3000 Bq were found by the plant outside the RCA, fixed in asphalt;
- The alarms set in the personal electronic dosimeters (EPD) are calculated from the average individual dose forecasts. However, the dose and dose rate alarm set on EPD are not always within the ALARA requirements. For example: the average daily exposure specified on the radiation work permit (RWP) was 0.006 mSv, but the alarm, set on the EPD, was 1.000 mSv. The average dose rate on the RWP was 0.010 mSv/h, but the alarm on the EPD was 1.6 mSv/h. The plant is aware of the shortfall and is planning to change the present policy within one month.

Inadequate radiation protection practices as well as inadequate implementation of ALARA principles could result in the spread of contamination or unjustified personal exposure.

Suggestion: The plant should consider enhancing radiation protection practices in order to prevent the spread of contamination and reinforce the application of ALARA principles.

IAEA Basis:

GSR Part 3

3.90 (d) Registrants and licensees shall establish measures for protection and safety, including, as appropriate, physical measures to control the spread of contamination and local rules and procedures for controlled areas;

3.92 (c) … shall periodically review conditions to assess whether there is any need for further measures for protection and safety or any need for changes to the boundaries of supervised areas

3.76 (d) Policies, procedures and organizational arrangements for protection and safety are established for implementing the relevant requirements of these Standards, with priority given to design measures and technical measures for controlling occupational exposure

NS-G-2.7

2.14. The optimization of protection and safety measures, or the application of the ALARA principle (to keep doses as low as reasonably achievable, economic and social factors being taken into account), should be carried out at all stages during the lifetime of the equipment and installations …

3.12 Equipment is required to be provided, as appropriate, for the monitoring of persons at exits from controlled areas in order to ensure that contamination levels on their clothing and body surfaces are below a specified level

3.13. Before items are removed from any contamination zone, and in any case before they are removed from controlled areas, they are required to be monitored as appropriate

3.24. The main objectives of radiological monitoring and surveying are: to provide information about the radiological conditions at the plant and in specific areas before and during a task …

Plant Response/Action:

A – Causal analysis

Contamination control: the contamination points identified in walkways are mostly located in the transit areas for outsized equipment (hot workshop – equipment hatch), and on the route used to transfer concrete hulls to the waste auxiliary building.

For the radiological controlled area, contamination control means regaining control of contaminated rooms to reduce the number of barriers and limit the risk of spreading contamination. The message on expectations for waste collection and sorting must be reiterated to work coordinators.

ALARA principles: Lowering collective and individual dosimetry must be part of the ongoing drive for continuous improvement. The work that began several years ago must continue, particularly regarding the problem of hot spots. Reductions in dose alarm thresholds, deployment of remote monitoring stations (PSPR), presence in the field of managers and area owners, are all key drivers that will ensure RP standards are applied on a daily basis.

B - Strategy adopted to resolve the recommendation or suggestion

- Establish an action plan for the transfer of concrete hulls from the units to the waste auxiliary building, and for evacuating ‘outsized’ equipment;
- Work to regain contamination control in the plant in order to limit the risk of spreading contamination and reduce the number of EVEREST barriers (EVEREST: campaign to enable RCA entry without full changeout of clothing);
- Help managers improve their skills in identifying RP-related risks => RP checksheets of observable elements;
- Deploy area owners in the field, as from the outages in 2015;

– Reinforce expectations for waste collection and sorting among work coordinators;
– Lower the dose alarm threshold in a drive to further improve ALARA principles;
– Draw up a multiyear schedule for addressing hot spots, so as to reduce the total number of hot spots in the plant.

C – Method used to check that the action plan is appropriate and to check effectiveness

– Monitor the indicators for contamination control (activation rate of C2 portal monitors, number of activated C3 portal monitors, number of contamination points on walkways, number of rooms classified as NP - 'nuclear clean' i.e. kept < 0.4Bq/cm^2);
– Track individual and collective dosimetry, particularly via fixed dose targets for the power operation and outage projects;
– Establish a hot spot tracking table, and hot spot history records.

D – Scheduling of the actions taken and added value for problem solving

	Deadline	Status of progress - Effectiveness
ACTIONS ON RP CULTURE IN THE FIELD		
Knowledge of the rules – field observation – industrial safety culture in the field		
Establish field observation guides for industrial safety	Mid 2016 ➔	Completed for RP - Compliance with radiation protection rules - Contamination control
Optimise use of CAP data	2015 ➔	Standardised computer-based tool to select the topic of RP and elementary processes (radiography surveys, contamination control, orange- and red-classified areas, etc.)
Issue a reminder of expectations for EVEREST (RCA entry without full changeout) during external contractor company inductions on working in the RCA (PP58); provide improved, more interactive and robust induction training in preparation for maintenance and ten-year outages	1st quarter 2015 Sustainable Closed-out	Requirement for induction reset to once a year for Flamanville, before delivery of ID badges (mandatory for access clearance) Positive feedback from contractors

Deploy the initiative to designate area owners in the risk prevention department	2015 ➔	Continuous presence of representatives from the risk prevention department in all areas and for the whole duration of an outage – professional advice and support to contractors regarding industrial safety, RP, fire protection - industrial safety and RP hold points for challenging worksites
Contamination control		
Action plan for transferring concrete hulls (from the units to the waste auxiliary building) and for evacuating 'outsized' equipment during outages	Launched in 2015 and completed in 2016	Ensures more rigorous tracking of equipment as regards contamination control, and reduces the risk of spreading contamination outside the RCA
Regain contamination control	Launched in 2015 (specifications & conditions) Ongoing	Cleaning operations were focused on unit 1. To date, 42 rooms had been reclassified as NP ('nuclear clean').

Modify the C2 portal monitors	April to May 2015	Replacement of beta foot detectors N°1 and 2 by gamma foot detector N°1. Replacement of beta ankle detectors N° 3 and 5 by gamma ankle detectors N°5 and 6. Replacement of beta detector N°4 by a beta + gamma detector. Addition of ankle sum-total channels N°1 and 5. The modifications implemented have helped reduce the ankle detection threshold from 200 Bq to 175 Bq and the feet detection threshold from 400 Bq to 200Bq. These modifications were made to all the C2 portal monitors.
ACTIONS ON THE ALARA APPROACH		
Establish remote monitoring stations for risk prevention department personnel (RP monitoring of worksites)	Sep 2016 during the refuelling outage	This was trialled during the unit 1 refuelling outage in 2015.
Manage hot spots	Initiative launched in June 2014	35 hot spots have been eliminated: • June-Dec 2014: 12 hot spots removed; • Jan-Dec 2015: 17 hot spots removed; • Jan-Dec 2016: 6 hot spots removed, against a target of 10 hot spots to eliminate in 2016; • Installation of T-Flex shielding. T-Flex shielding has been fitted around 30 hot spots.

Install fixed shielding as part of seismic qualification works	2016 Ongoing	CVCS line in room 1NA0723 – completed. CVCS line in room 2NA0723 – scheduled for Nov 2016.
Lower dose alarm thresholds	01/01/2016	Immediately optimises individual dosimetry. • For works involving low doses, workers will be alerted much earlier about abnormal conditions, thereby optimising individual dosimetry.

E– Evaluation of action plan effectiveness

Concrete results:

The activation rate of C2 portal monitors and the number of activated C3 portal monitors have fallen continuously since 2014.

Year	2014	2015	2016
Rate of C2 monitors as %	1.54	0.91	0.42*
Nb of C3	4	2	1

*Indicator as at end Sept.

The action plan to address the contamination points found on walkways in 2014, which was launched in 2015 and completed in 2016, has yielded positive results.

Year	2014	2015	2016
Contamination points on walkways	8	7	1

Management of hot spots:

35 hot spots have been eliminated:
- June-Dec 2014: 12 hot spots removed;
- Jan-Dec 2015: 17 hot spots removed;
- Jan-Dec 2016: 6 hot spots removed against a target of 10 hot spots to eliminate in 2016.

Installation of T-Flex shielding

– Since 2014, T-Flex shielding has been fitted around 30 hot spots.

IAEA comments:

To address the issue the plant has made an in-depth analysis of the issue and defined a detailed action plan in two parts: contamination control and ALARA.

Concerning Contamination control, process changes and awareness raising activities have significantly improved the performance: Specific procedures have been created to measure, pack and transport very large equipment from the reactor building to the hot workshop and for concrete casks from the units to the waste auxiliary building. As a result, contamination points found outside the RCA dropped from 8 events in 2014 to 1 (minor) in 2016 so far. On all 17 plant C2 monitors the foot and ankle detectors have been changed to enable a lower contamination detection threshold.

Concerning ALARA principles, positive trends can be observed. Dose alarm thresholds were lowered on dosimeters. Specific and challenging individual doses are set and met. During outages, additional RP personnel are available at specific locations inside the reactor building to check RP rules and to further improve adherence to ALARA principles. Since 2015, 42 rooms have been made “nuclear clean” on unit 1. Work has started to do the same on unit 2. RP checklists on observable RP behaviours have been created and made available to managers observing work in the RCA.

AlthoIn addition, the plant has created a multiyear schedule for addressing hot spots to support the other ALARA actions. Additional resources have been attributed to this plan. Since the original mission, 35 hot spots have been removed by flushing, modifying or replacing parts of the installation. 30 hot spots have been shielded. Further targets for reducing the number of hot spots have been set for the coming years.

As a result of the above, C2 monitor activation rate has decreased from 1.54% in 2014 (with 4 C3 alarms) to 0.42% (with 1 C3 alarm) in 2016.

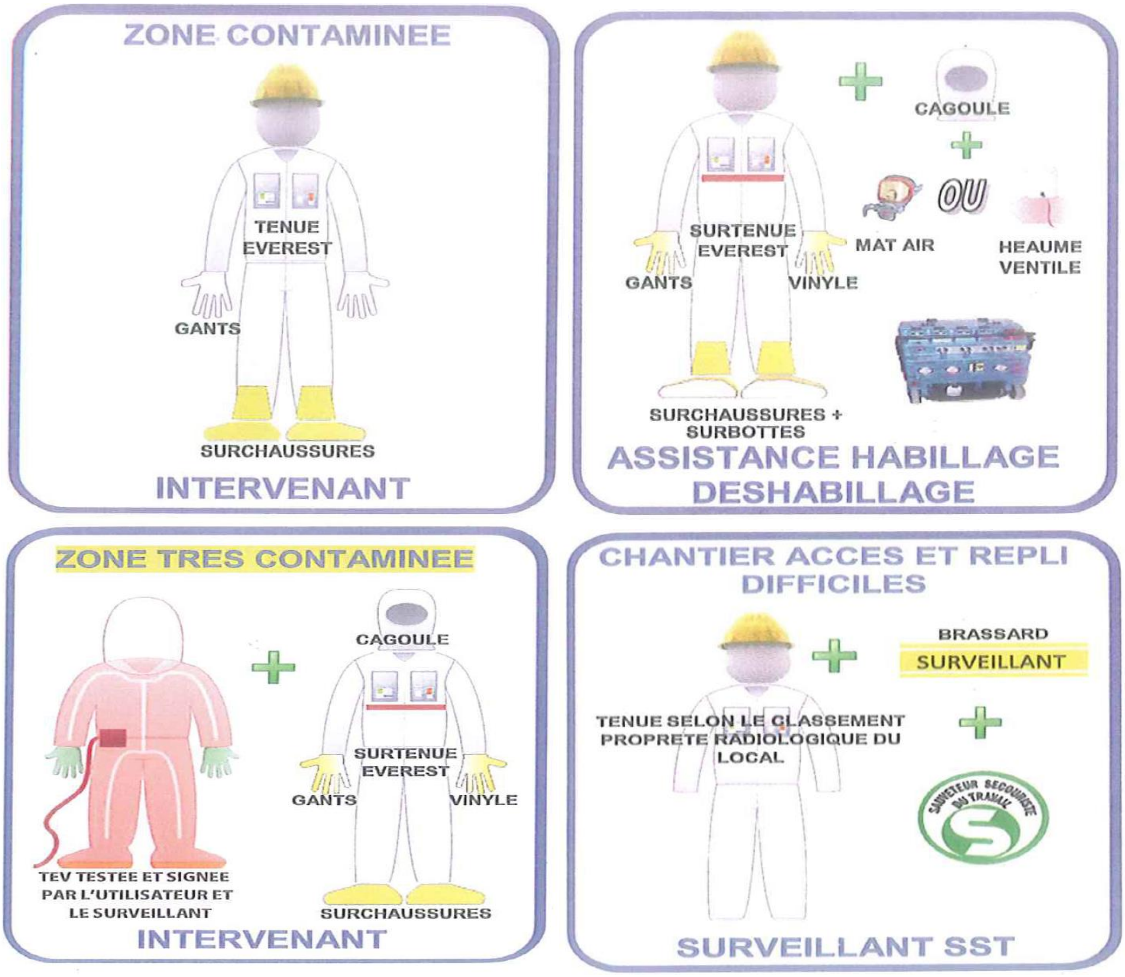
Expectations on waste identification are reinforced, tracked and feedback is given to the line management or contractor line management. All the above contributed to an increased ALARA awareness on site.

Conclusion: Issue resolved

7.2 (a) Good Practice: Stickers for radiation protection work areas

In the past, access conditions for RP work areas were listed in written form on sheets, parts of which had to be completed by hand depending on the area's classification.

These sheets have been replaced by stickers, which correspond to the different types of predefined working conditions: the sticker is affixed to the worksite identification sign and stipulates prerequisite conditions for entering the work area.

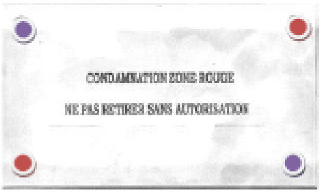


Clearly legible stickers provide a simple illustration of the equipment to be worn for entering the area (PPE + other appropriate equipment).

This stand-alone worksite identification sign eliminates potential errors and omissions associated with handwritten information. It also promotes consistent work practices.

7.3 (a) Good Practice: Preventing access to very high risk radiation areas

Some rooms containing primary circuit demineralizers are classified as red areas (very high risk radiation areas) as they contain active resins. As it is not possible to physically lock the shielding providing access to these red areas, the plant has developed a system using 2 plates secured by tamper-proof screws that are fixed on the bunker slab, thereby preventing access to embedded lifting rings.



- Vis inviolable SPR
- Vis inviolable DIRECTION

Appropriate control of access to the red area is thus guaranteed The first key is managed by senior management and the second is managed by the RP department with 2 different tamper-proof screws.

This practice eliminates the risk of unauthorized opening of the resin bunker without having required authorization and without using the red area access process.

7.4 (a) Good Practice: Automatic radiation instrumentation dispensers

The plant has installed dispensers called "Radiabox" for small objects in dedicated places. The dispensers provide dose rate meters to the workers even outside the radiation controlled areas (RCA) that save the working time for the workers. Workers are not obliged to go to the RCA to pick up the RP instruments or return them if the work is performed out of the RCA. The other advantage is that radiation instruments are available 24 hours a day. Oxygen analysers and other small items of equipment will eventually also be available.

The plant assessed saving in time of around 15% to 25%. Interviews with the workers confirmed their satisfaction concerning the added value of this system .

8. CHEMISTRY

8.1. ORGANISATION AND FUNCTIONS

The team observed an effective interface between the chemistry and operations departments through formal and documented meetings, as well as sharing lessons learned and joint training sessions. Special training has been developed and is delivered to mixed groups of Chemistry and Operations staff (examples include training on the liquid waste treatment system, and outage chemistry). The team recognized this as a good performance.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

During shut down “hideout return” measurements are performed. The results are given to CEIDRE for analysis. Startup procedures include a program for flushing all systems, but there is no control of particles, neither in the circuits, nor in the steam generator blow down. The team encourages the plant to perform particle analysis during flushing process.

8.3. CHEMISTRY SURVEILLANCE PROGRAMME

Analyses and calibrations are performed according to chemical procedures and are verified by using control cards. The use of control cards is not always performed to the required standards, so the team made a suggestion to improve the plants quality control of analyses.

8.4. CHEMISTRY OPERATIONAL HISTORY

Trending of increased sodium concentration on the secondary circuiton one of the units was observed, but the requirement to exchange the filter was not performed in a timely manner. The team encourages the plant to react timely as to avoid accumulation of unnecessary impurities.

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

All necessary procedures to perform analyses are available in the laboratories. There is not always sufficient redundancy of analytical facilities and equipment available. In July 2013 a zinc-analyzer was broken. Analyses could not be performed as long as the analyzer was out of service. Zinc injection was immediately stopped and no analyses for zinc were performed until the beginning of October 2013 when the analyzer was repaired. The team encourages the plant to make sure that chemical equipment is always available to support chemistry requirements.

In 2013, the plant modification team had set up two storage areas to minimize chemical and fire risks:

- Storage area A, storage in fire-proof cabinets for fluid bulk chemicals like hydrazine, hydrogen peroxide or purification solutions;
- Storage area B, a 2-hour fire resistant bunker, with fire detection and sprinkler based on the first in first out (FIFO) principle. Storage for solid bulk chemicals like resins, tri-sodium-phosphate or combustible products.

The team found the use of resin and hazardous chemical storage areas to minimize fire and chemical risks as good performance.

Atmospheric dust sampling analysis is simplified by using a new sampling head and a new alarm system which reports deviations to the on-call chemist by phone. This assures early awareness of deviations. The team recognized this as a good practice.

DETAILED CHEMISTRY FINDINGS

8.3(1) Issue: The plant chemistry quality assurance program does not always provide a guarantee that all procedural requirements and control systems are being used adequately.

During the mission the team identified the following facts:

- In October 2014 during low power operation, the ammonia reference level was out of range, but the results of the measurement were used to allow release of effluent;
- There is a general corporate procedure on the use of control cards and how corrective actions are to be performed when deviations occur or when limits are exceeded. This process has not been implemented completely in chemistry;
- Lists of calibration data opened from a PC in an office were not displayed correctly. There is a transformation problem when using a different PC;
- The standard data in the annual (2014) control card of ammonia, nitric acid and nitrous acid are not always verified by the chemist;
- The electronic standard data in the annual (2014) control card of ammonia, nitric acid and nitrous acid are not always shown as being completely analyzed;
- A quality control summary document was not completed as required after calibration of the conductivity meter.

Without a reliable quality assurance program the plant may not meet the safety goals regarding chemistry analyses.

Suggestion: The plant should consider enhancing its chemistry quality control program to ensure that all chemical procedure requirements and control systems are being used adequately.

IAEA Basis:

SSR- 2/2

7.15. The chemistry programme shall include chemistry monitoring and data acquisition systems. These systems, together with laboratory analyses, shall provide accurate measuring and recording of chemistry data and shall provide alarms for relevant chemistry parameters. Records shall be kept available and shall be easily retrievable.

SSG-13:

6.18. 'Check standards' (measurements made at specified time intervals) should be analysed and control charts should be maintained to show that the methods applied continue to give accurate results. The establishment of an interlaboratory comparison programme may be considered.

6.10. Written procedures should be developed for all on-line and laboratory analyses and such procedures:

(c) Should provide a summary of analytical methods used, indicating possible interference, accuracy, linearity and range of the methods and the precision of the measurements in order to show ways of validation;

(d) Should state equipment, reagents and standards required to perform analysis;

6.11. A calibration and maintenance programme should be established and applied to all on-line and laboratory monitoring instrumentation. The responsibilities for calibration and maintenance should be clearly defined.

6.12. Reagents and sources used for calibration should be valid (e.g. all standards applied should be traceable to certified standard solutions or reagents).

Plant Response/Action:

A – Causal Analysis:

Control charts were introduced in the laboratory in 2013, but it is now necessary to perfect the use of these new practices in the field (observation of an out-of-range calibration point with no trace of recalibration) but progress has been made (tracked calibrations but there are still gaps). This way of working was put into place with no adequate support training or awareness-raising sessions.

B The strategy chosen to resolve the recommendation/suggestion

The strategy focuses on three areas:

- Skills development;
- Organisation;
- Equipment checks.

C – – Schedule of actions taken and how each action has contributed to resolving the issue

Area	Action	Deadline	Status	Additional Comments
Skills	Level 1 and 3 Metrology training for part of the section	January 2016	completed	Training done at Flamanville NPP
	Individual training	August 2016	Completed	Quantitative review to be done
	Routine questions included in the test sheets	June 2016	Completed	Project Coordinator/HIM Technician test sheets completed
	Metrology module added to Craft Academy training	SO	In progress	Not tracked on the site as this is part of the corporate academy programme: requested by corporate training committee 2, transmitted by CC3

Area	Action	Deadline	Status	Additional Comments
Organisation	A second Metrology Engineer to be named to fill the post in case of absence	December 2017	In progress	
	Implementation of the equivalent to ISO 17025 Norms for liquid waste	January 2017	Delayed	Action within the Macro-process MP5 programme and COS STE. The Review took place on 14th October 2016. 80% of action plan completed.

	Apply the guide for the setting up of a measuring activity management system in the DPN (Nuclear Production Division) Chemistry Laboratories	December 2017	In progress	Unit laboratories
	Controls integrated into the Department Internal Control Plan	December 2015	Completed	

Area	Action	Deadline	Status	Additional Comments
Equipment	IT software undergo risk assessments and are managed through the quality assurance process.	Before using the equipment for the first time	Completed	Waiting for IN 26
	The operating method for any new equipment is validated before installation	Before using the equipment for the first time	Completed	Evidence needed of equipment undergoing Quality Assurance
	Transition from paper control charts to an electronic version		Completed	

D – Assessment of action plan effectiveness

The training is completed for 70% of the team; the first Skills Observations in the field are satisfactory. The Internal Control Plan actions that have already been implemented confirm that the personnel are now using the equipment correctly.

IAEA comments:

In response to the suggestion made by the OSART team during the original mission, the plant has made efforts to identify causes of the issue that involved identification and development of appropriate metrological skills amongst the chemistry department personnel, some organizational changes and enhancements in dealing out with equipment. Causal factors identified by the plant include organizational, programmatic and performance based aspects of the activities in the chemistry department. The plant has adopted a strategy and a method for resolving the suggestion and imposed an action plan that is routinely monitored and regularly evaluated on efficiency.

The subject of metrology has been identified as problematic at the corporate level as a result of regular discussions among the heads of chemistry departments and outcomes from the inspections made by the corporate organization. The plant has invited a contractor to conduct training in the area of metrology for the chemistry department personnel. 36 technicians, specialist and management staff have successfully passed through the training course and enhance the sustainable knowledge and skills in the subject. This comprises 83% of the chemistry department concerned staff. A training package on the same subject made by the corporate Craft Academy is currently at the stage of the trial application at the EDF nuclear power plants and will be fully implemented in 2017.

The plant has introduced a position of a second metrology technician, firstly to support the primary chemistry metrologist during routine operations and secondly to facilitate implementation of the equivalent to ISO 17025 norms for effluents. The second technician will get authorisation for work by the end of 2017. The implementation of this norm is in the stage of completion and will be fully introduced in 2017. At the same time implementation of a new guide for setting up of a measuring activity management systems imposed by the corporate organization and involved the plant's environment, effluents and process laboratories is also in the stage of implementation and is going to be finished in December 2017.

Operation of the plant chemistry equipment is currently improved and followed according to the new quality requirement in terms of metrological service; namely operating methods for any new equipment is validated by the technicians before installation and commissioning. The plant has also switched to an electronic control charts from the paper copies to facilitate data analysis and trending. However data collection is still done manually with a need to introduce it later into electronic data sheets. The plant needs to continue activities for finalization of all the undertakings focused on the enhancement of the operation of the chemistry equipment and evaluation of the personnel to get a global overview of the efficiency when the action plan is completed.

Conclusion: Resolved

8.5(a) Good practice: A new aerosol sampling system providing alarm, which reports deviations to on call chemist.

New sampling heads on external aerosol sampling stations were installed so that chemists can easily exchange filters in the laboratory.

A phased approach using a delay enables automatic start-up of the suction pump after a certain length of time.

A local alarm system (a warning light) has been installed, which is transmitted by mobile telephone, to identify certain faults such as: the presence of two filters, a missing, clogged or damaged filter or an issue with the leak tightness of the sampling system.

Advantages/Benefits: Filters are replaced inside the laboratory in an appropriate working environment. This removes the problems caused by changing the filters in the open air (e.g. wind, rain, etc.). This reduces the risk of compromising the analysis results. The alarm system ensures more easy and efficient operation of atmospheric dust sampling due to the fact that faults are identified and communicated immediately.

9. EMERGENCY PLANNING AND PREPAREDNESS

9.1. RESPONSE FUNCTIONS

During the mission, the team observed that the plant has implemented measures to minimize the potential delays for the declaration of an emergency and provided the authority of declaration to the shift manager after consultation with the manager on duty (PCD1) or without consultation if the PCD1 is not available. At the time of the OSART review, the IAEA standards still required a person on-site at all times with the authority to declare an emergency without consultation. However, a new revision of GSR Part 7 Preparedness and Response for a Nuclear Radiological Emergency is to be published soon. The team encourages the plant to review its compliance with the new IAEA standard on this issue.

Plant personnel should assemble at the designated muster points when a radiological emergency is declared. Since the muster points are not designed to provide sufficient protection for site personnel for a protracted time after a radiological release, the urgent evacuation of personnel could be required before a release occurs. This may be a challenging operation due to the potentially large number of people involved (a total of 4300 people could be at the two Flamanville sites). The plant has no detailed plan on how to manage the evacuation. In addition it is not clear what equipment would be available for evacuation and how the protection of the personnel would be ensured during the operation. The arrangements for evacuation have not been fully tested. The team issued a recommendation in this regard.

9.2. EMERGENCY PROCEDURES

In emergency preparedness documentation, the physical separation of binders to be used during emergency and exercise, the identification used and the preparedness to promptly make-up all documentation eliminate the risk of documentation failures and provide an effective documentation management system. The team recognized this as a good practice.

9.3. EMERGENCY RESPONSE FACILITIES

The workers who perform emergency response activities in the plant may be subjected to health risks after a radiological release. However, the preparedness for protection of these workers is not sufficiently robust. The emergency dosimetry control and the training and exercises do not cover the preparation for harsh situations. Although a new emergency response centre is being built, long term habitability of some emergency facilities is currently not provided. The team therefore made a suggestion in this regard.

9.4 EMERGENCY EQUIPMENT AND RESOURCES

The plant has a recruitment policy to encourage employment of disabled persons. In order to assist them in emergencies a specific evacuation plan has been developed and an evacuation chair is provided. The team considers these efforts as a good practice.

The solutions used in the plant to protect the response communication equipment against small seismic events are identified as a good performance.

9.5. TRAINING, DRILLS AND EXERCISES

With the support of the training centre, the plant has carried out unannounced exercises on site, outside of normal working hours, and without first informing the on-call plant management representative. This allows members of the on-call teams to undergo situational training without being informed in advance under conditions which are more representative of reality. The “on-call” plant management representative has to handle the alert phase from home, which could happen in a genuine emergency. The team has recognized these unannounced exercises as good performance.

The team encourages the plant to improve the content and planning of the emergency exercise programme to cover the testing of all lines of communication with the prefecture, to hold common exercises with the maritime prefecture and to provide validation and approval of internal exercise plans.

DETAILED EMERGENCY PLANNING AND PREPAREDNESS FINDINGS

9.2(1) Issue: The preparedness of the plant to effectively evacuate the Flamanville site is not robust.

During the mission, the team identified the following facts:

- There is no detailed plan for the evacuation of site personnel from the muster points;
- There is no specific information on the number of vehicles available for evacuation (number of buses on the site during normal operation and outages, number of buses at the Flamanville 3 site, number of buses to be provided by the bus company);
- One electronic dosimeter is provided per muster point, which is not enough to follow the dose when the evacuation starts using buses, since the dosimeter should remain in the muster point with the person designated for managing the muster point;
- Evacuation would take place mainly using buses, but the procedures do not require that the bus drivers (of the plant and of the company contracted) be provided with electronic dosimeters and personal protective equipment;
- Site evacuation has not been fully tested, a partial test was performed. It did not provide enough information to estimate the time needed for a complete site evacuation;
- The personnel at Flamanville 3 site are not directly alerted in an emergency in the plant: the on-call site manager of Flamanville 3 is automatically alerted and has to call the crisis manager (PCD1) of the plant (at a time when the PCD 1 is likely to be very busy with other duties); the on-call site manager of Flamanville 3 then instructs the entrance security post of Flamanville 3 to alert the construction site;
- The evacuation destination would be the fallback facility in Les Pieux, however the following concerns exists:

  - There are no arrangements to manage the personnel after the contamination check and decontamination, if necessary;
  - Les Pieux is located 7 km from the plant therefore, after a major release, it may be contaminated, so it may become inoperable as an evacuation facility;
  - The decontamination in the fallback facility is not organized in a “move forward” manner, which may cause contamination of the clean personnel;
  - There is no requirement concerning the types and numbers of decontamination supplies to be stored and they are not verified in a documented manner.

Not ensuring a sufficiently robust preparedness for the evacuation of the Flamanville site may subject the site personnel to avoidable health risks.

Recommendation: The plant should ensure adequate preparedness for the evacuation of the Flamanville site to prevent avoidable health effects.

IAEA Basis

GS-R-2

4.51. The operator of a facility in threat category I, II or III shall make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. This shall include arrangements: to notify people on the site of an emergency; for all persons on the site to take appropriate actions immediately upon notification of an emergency; to account for those on the site; to locate and recover those unaccounted for; to take urgent protective action; and to provide immediate first aid. The facility shall provide suitable assembly points for all persons on the site and "shall be provided with a sufficient number of safe escape routes, clearly and durably marked, with reliable emergency lighting, ventilation and other building services essential to the safe use of these routes. The escape routes shall meet the relevant international requirements for radiation zoning and fire protection and the relevant national requirements for industrial safety and… security." (Ref. [11], para. 5.61.) "Suitable alarm systems and means of communication shall be provided so that all persons present in the [facility] and on the site can be warned and instructed, even under [emergency] conditions." (Ref. [11], para. 5.62.)

5.37. The operator of a facility, practice or source in threat category I, II, III or IV and the off-site response organizations shall establish a quality assurance programme, in accordance with international standards, to ensure a high degree of availability and reliability of all the supplies, equipment, communication systems and facilities necessary to perform the functions specified in Section 4 in an emergency (see para. 5.25). This programme shall include arrangements for inventories, resupply, tests and calibrations, made to ensure that these items and facilities are continuously available and functional for use in an emergency. Arrangements shall be made to maintain, review and update emergency plans, procedures and other arrangements and to incorporate lessons learned from research, operating experience (such as the response to emergencies) and emergency drills and exercises (see paras 3.8, 3.16, 5.33 and 5.39).

GS-G-2.1

4.28. Emergencies have occurred in facilities in threat categories I, II and III that have resulted in hazardous conditions on the site.

4.29. Consequently, the Requirements [2] (para. 4.51) require that, for these facilities, specific arrangements be in place to effectively implement urgent protective action for the people on the site. These arrangements should apply to all people in areas controlled by the operator, such as visitors or others (e.g. construction workers, fishermen).

Plant Response/Action:

A – Causal analysis

NPP standards are aligned with corporate guidance (DPN / GPSN / ONC), which has been approved by the French regulatory authority.

B – Strategy adopted to address the recommendation/suggestion

The ultimate solution lies in changes to the personnel evacuation procedure:

– The fall-back facility will no longer be used: personnel will return home in a vehicle to be determined by the emergency preparedness organization;
– Interface with Flamanville 3: A joint emergency-preparedness organization is being set up together with Flamanville 3. It will be operational by mid-2018. This is a pre-requisite for the start-up of the EPR.

In the meanwhile, current arrangements remain applicable:

– Evacuation by bus to the fall-back facility in Pieux (“Les Landettes” building);
– Preparedness is tested by carrying out regular drills;
– Flamanville-3 emergency on-call management (PCD1 AFA Fla3) is informed by Flamanville-2 emergency on-call management (PCD 1 Fla 1.2) if the on-site emergency plan is activated.

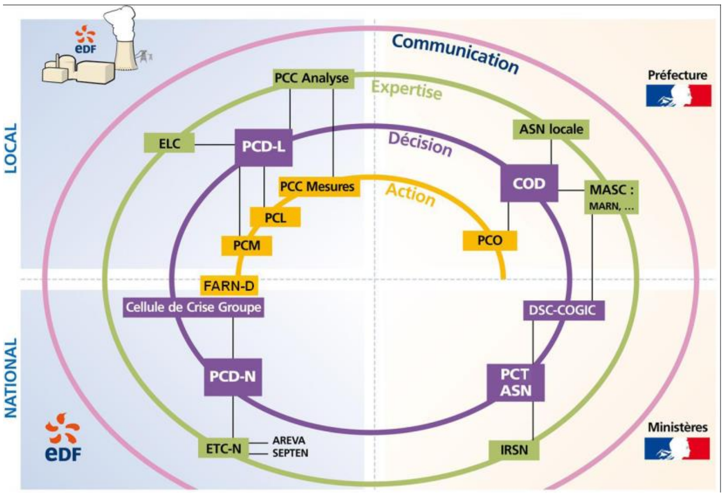
C – Method used to verify adequacy and effectiveness of the action plan

A support requested from the EDF entity in charge of preparing corporate EP guidance had been done. An answer was received on 23 November 2015 (ref. D455015069851). This answer confirms the validity of the procedures approved by the regulatory authority.

D – Action plan schedule and contribution of each action to resolving the issue

Action completed: Establishment of a personnel evacuation strategy from muster points to the fall-back facility.

2016: Partial evacuation drill performed on 10/03. No drills involving full evacuation have been performed, but that would require coordination with the public authorities. The diagram below shows the direct relationship between the site and the public authorities in an emergency situation.



2016: Buses equipped with dosimeters in order to be able to record any dose received by the bus driver.

2017: Corporate procedures amended to indicate that the fall-back facility will no longer be used. Action assigned to the corporate EP organization.

2018: Establishment of a joint EP organization with FLA3. Currently being examined by both entities. Flamanville 3 will be the strategic coordinator whilst FLA1&2 will be the operational coordinator. Once arrangements have been standardized on both sites, the same alert procedures will be used.

E – Action plan status and reporting method

Given the wide range of conceivable situations, it was decided that instead of establishing a standard evacuation plan, it would be better to establish this plan in accordance with plant status (1 unit in outage, 2 units on line), the type of emergency, weather conditions. PCM response procedures include mustering arrangements and evacuation to the Landettes fall-back facility (more specifically PCM 5 PCM 5,2 PCM 3 PCM 3,4).

The three-yearly drill programme submitted to the Nuclear Safety Review Committee on 25/10/2016 makes provision for partial evacuation drills and ensures that they are held at least once every 3 years. These drills will be jointly conducted with Flamanville 3 as of 2018.

On 17/12/2014, the nuclear/radiological emergency scenario ended with an explosion of the CVCS tank and mustering of personnel on FLA1&2 as well as FLA3. 93% of FLA1&2 personnel (862 people) were mustered, as well as 944 members of FLA3 personnel. The evacuation scenario was simulated but was not physically put to the test.

The next drill (25/11/2016) will involve the mustering of FLA1&2 and FLA3 personnel. In such a case, FLA1&2 on-call emergency management (PCD1) would notify FLA3 on-call emergency management. After exchanging information about the event, FLA3 on-call emergency management may instruct FLA3 site security to notify the site under construction, so that steps can be initiated to shelter personnel if required.

The decision to no longer use the fall-back facility was discussed at a three-party meeting (corporate EP organization/regulator/regulator’s technical support branch IRSN) on 25 January 2016. The report will be prepared in 2017 together with the regulator and IRSN.

F – Action plan effectiveness review

During the drill held on 17/12/2014, the emergency response organisation ran a number of evacuation scenarios.

On 10/03/2016, no difficulties were reported during the partial evacuation drill. This was an opportunity to test response arrangements and recommend new measures in procedure ref. D5330131782.

IAEA comments:

The team has concluded that the robust preparedness of the plant to effectively carry out the evacuation process is still not fully demonstrated. The following facts have been identified.

The plant has improved the on-site evacuation procedure. The arrangement has been tested in two drills with the evacuation of a limited number of employees, however only partial time measurements were taken during the exercises which could not provide a reliable estimate of the time needed for a full evacuation. The plant, however, concluded that the evacuation from the muster points could take place within 3 hours.

Bus drivers performing the evacuation within the site are provided with passive dosimeters and respirators in an emergency. The on-site dosimetry of employees during evacuation is measured at group level, which might constitute sufficient data to estimate their dose after the evacuation, but does not provide for their protection during the evacuation. The dose estimation process has never been tested.

A solution to make the decision and to initiate the evacuation of Flamanville 3 site in a more effective manner has been tested and a proposal will be made to include the selected method into the procedures, however timeframe for such action is not yet decided.

The plant determined that an evacuation to the fallback facility using the vehicles of a contracted bus company could be unreliable (this was confirmed by an analysis at corporate level) and it was decided to modify this option after the decision is made by the corporate to shutdown the fallback facilities. This is planned by the end of 2017.

The off-site evacuation strategy of the plant has already changed and now contains the option of evacuating employees by personal vehicles. However, currently there is no detailed procedure on how to carry out an evacuation from the site by car, what aspects should be taken into account when deciding to do so and what could be the timeframes of such an action. Neither has it been described how the necessary decontamination steps should take place before an evacuation using personal vehicles. This arrangement has never been tested, however according to the plant, the end-of-work leave of the site by the employees provides a ground for considering this concept feasible (since within 1.5 hour the employees can leave the centre).

Conclusion: Insufficient progress to date

9.4 (a) Good Practice: Effective documentation management system for ready access to updated EPP documents wherever they are needed.

In EPP some 400 binders are used in approx. 40 rooms/facilities requiring the presence of EPP documentation. A system was set up in 2012 to manage this bank of documentation. At his/her action point, each emergency team member has 2 binders. The red binders are sealed in transparent vinyle to ensure that their content has not been modified since issue by the documentation department. The red binders are used by the EP members in case of an actual emergency, whereas the yellow binders are used during exercises only.

Each binder has a summary of contents describing it as a unique/autonomous document. The binder is referenced with a package code. Some binders can be used by all command post members. If 2 binders have the same content, they are identified by the same package code (e.g. SDD01).

The package code enables the documentation department and the contractor in charge of updating the binders (renewal of binder after a drill, revision of current document, etc.) to locate the binder. In the example mentioned above, SDD01 stands for S (BDS or bunker) as the EP member's first action point, D for (PCD), D for (decision making room for PCD) and 01 as a chronological number of the binder located in the room.

All documents referenced in the document management system are recorded with their package number indicating where there are located in the distribution list.

The documentation department has an EPP reference cabinet and also a backup of the content of each binder. In an emergency, the update of the binder can be done promptly. Following drills or actual emergency situations, the documentation department has the full content of the binder replaced promptly and recovers the container used for document recycling of the binder that has not been hand amended by an EPP member.

Advantages and benefits

- Prompt update of EPP binders that are part of the documentation management system;
- Autonomous and efficient management of EPP documents (if the EPP officer is away from the station, the update can be done promptly and as soon as necessary);
- Documents that are 100% guaranteed updated are a fundamental to emergency management. With this system, the EPP members know that the documents they need are always up-to-date;
- In case of actual emergency during a drill, each EPP member has a complete binder for use during the real emergency situation.

Station results demonstrating that the potential good practice meets expectations:

- Before this new organization, EPP members reported deviations on missing, non updated or incomplete document;
- The organization has been in place for 2 years and all EPP members have expressed satisfaction on the documentation system. They now have full trust in the documentation provided;
- Various verifications at all levels (documentation department, contractors, command post managers, EP officer) have shown that documents are indeed up to date.


EXO
BDS
salle PCD
décision
Classeur
PCD1
SDD01
PUI
BDS
salle PCD
décision
Classeur
PCD1
SDD01

9.5 (1) Issue: The preparedness of the plant for protection of emergency workers following a radioactive release is not sufficiently robust.

During the mission the team identified the following facts:

- Not all emergency workers are provided with electronic dosimeters;
- There is no reader for the electronic dosimeters at the emergency centre (BDS) to register and reset the electronic dosimeters and the registration of dose on paper has not been exercised;
- There is no continuous dose-rate monitoring in the emergency centre and there is no dose-rate display in the main control rooms;
- The emergency centre that should be habitable after a radioactive release cannot be hermetically isolated;
- The backup emergency centre, which has limited capabilities, has no ventilation and isolation system and thus might not be habitable after a radioactive release;
- There are no exercises during which the response actions after a significant release are systematically practiced, for example:

  - Intervention in the field in protective equipment;
  - The use of electronic dosimeters and performing dose registration;
  - Pre-job dose assessment;
  - Decontamination of intervention teams.

- Decontamination in the emergency centre is not organized to avoid re-contamination of the already cleaned personnel;
- There are decontamination supplies in the emergency centre, however there is no plant requirement concerning the types and numbers of decontamination supplies to be stored there and they are not verified in a documented manner.

Without sufficient preparation for protection of emergency workers after a radioactive release they could be exposed to avoidable health risks.
Suggestion: The plant should consider reinforcing the preparation for protection of emergency workers following a radioactive release.

IAEA Basis

GS-R-2

4.56. Arrangements shall be made to protect emergency workers, in accordance with international standards.

4.58. Those called upon to respond at a facility in threat category I, II or III or within the precautionary action zone or the urgent protective action planning zone shall be designated as emergency workers. Such assisting personnel as police, fire fighters, medical personnel and drivers and crews of evacuation vehicles shall be designated as emergency workers. (See Ref.

[3], Appendix V, para. V.27, footnote 31.)54 In addition, the radiation specialists (see para. 4.35), radiation protection officers and radiological assessors (see para. 4.37) who may respond to emergencies involving practices or other hazards in threat category IV shall be considered emergency workers.

4.62. Arrangements shall be made for taking all practicable measures to provide protection for emergency workers for the range of anticipated hazardous conditions in which they may have to perform response functions on or off the site. This shall include: arrangements to assess continually and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance and international standards; and arrangements for the provision of appropriate specialized protective equipment, procedures and training for emergency response in the anticipated hazardous conditions.

5.27. [For facilities in threat category I, an] "on-site emergency control centre, separated from the [facility] main control room, shall be provided to serve as [a] meeting place for the emergency staff who will operate from there in the event of an emergency. Information about important [facility] parameters and radiological conditions in the [facility] and its immediate surroundings should be available there. The room should provide means of communication with the main control room, the supplementary main control room and other important points in the [facility], and with the on-site and off-site emergency response organizations. Appropriate measures shall be taken to protect the occupants for a protracted time against hazards resulting from a severe accident."

5.33. Exercise programmes shall be conducted to ensure that all specified functions required to be performed for emergency response and all organizational interfaces for facilities in threat category I, II or III and the national level programmes for threat category IV or V are tested at suitable intervals. These programmes shall include the participation in some exercises of as many as possible of the organizations concerned. The exercises shall be systematically evaluated and some exercises shall be evaluated by the regulatory body. The programme shall be subject to review and updating in the light of experience gained (see paras 3.8, 3.16, 5.37 and 5.39 for further requirements in relation to exercises).

Plant Response/Action:

A – Causal analysis

NPP standards are aligned with corporate guidance (DPN / GPSN / ONC), which has been approved by the French regulatory authority.

B - Strategy adopted to address the recommendation/suggestion

The dose uptake of all emergency response personnel mustered in emergency-response facilities is monitored by PCM 3.7 and PCM 5.x. Once an hour, PCM 3.7 is responsible for monitoring dose rate in the emergency-response facilities, in the local command centre (PCL), in the main control room of the unaffected unit, in the operations emergency centre, in the main control centre and in the main gatehouse. Every 30 minutes, PCM 5.x is in charge of monitoring dose rate in the muster area for which he/she is responsible.

In the main control room, an instruction was recently issued to install 2 gamma dose-rate detectors in the ventilation system in the event of having to apply emergency operating procedures. Plant radiation monitoring channels KRT/DVC 30 and 31 MA monitor activity in the main control room and switch the ventilation system over to iodine-filter mode if the threshold is exceeded.

The new emergency control centre will be equipped with an over-pressure and iodine-filter ventilation system, protecting it fully from outdoor radioactive releases. The facility has been designed to remain habitable in the event of radioactive release, earthquake or loss of power.

During risk-prevention and fire-protection refresher training, personnel practise using the respiratory equipment required in the event of radioactive release. In addition, medical department personnel are fully qualified to attend to contaminated personnel throughout the year.

C – Method used to verify adequacy and effectiveness of the action plan

Support requested from the EDF entity in charge of preparing corporate EP guidance. An answer was received on 23 November 2015 (ref. D455015069851). This answer confirms the validity of the procedures approved by the regulatory authority.

D – Action plan schedule and contribution of each action to resolving the issue

Completed: The risk-prevention department has been provided with autonomous dosimeters (model ref. 75 DMC 3000) which record dose: there is consequently no need to keep a record of dose. Dose is automatically recorded.

2016: The emergency response organization is reviewing site evacuation arrangements. Evacuation strategy is established according to plant status, radiological conditions and the type of emergency. One of the options is to evacuate the site using buses driven by people who are not members of the emergency response organisation. In order for personnel to have prior knowledge of the radiological conditions in which they may have to work, buses were equipped with dosimeters in 2016.

2018: Delivery of the new emergency control centre, which will remain habitable in the event of radioactive release.

Completed: A one-way transit route has been established in the security/emergency building (BDS) in order to decontaminate contaminated members of personnel and prevent them from becoming re-contaminated. A contaminated person would enter the BDS decontamination facility in a paper suit. The person would then undress and take a shower. After having showered, the person would return to a clean area. The person would be given a paper suit before exiting the shower, thus making it possible to contain any residual external contamination.

E – Action plan status and reporting method

The three-yearly drill programme submitted to the Nuclear Safety Review Committee on 25/10/2016 makes provision for nuclear/radiological emergency drills and ensures that they are held at least once every 3 years. A nuclear/radiological emergency drill involving a radioactive release scenario was conducted in 2014 whilst another has been scheduled for November 2016.

F – Action plan effectiveness review

The effectiveness of the BDS "one-way" system will be observed during the drill scheduled for 25/11.

IAEA comments:

The persons in the main control room, the field teams dispatched in an emergency and those staying within the controlled area are now provided with electronic dosimeters. The ventilation system of the main control room has been equipped with an iodine measurement system which switches to filtered ventilation automatically if iodine is detected.

Electronic dosimeters are available in the emergency centre (BDS), of which one is planned to be used to measure the dose of the emergency organization members in the BDS. A gamma dose-rate measuring and displaying device has also been provided in the BDS building to continuously measure the dose rate, although it is not yet described in the procedures by whom and how this will be implemented in an emergency and it's use has not been exercised. Training for using the device is planned in the near future. The doors of the BDS building are currently being replaced with airtight doors which are expected to make it possible to provide overpressure in the building.

The new emergency centre (CCL) is still under construction and will be completed in 2018 (delayed compared to the original plans). The CCL will satisfy all requirements in terms of protection of emergency workers to be housed there (maximum of 98 people for the two Flamanville sites).

A successful decontamination exercise was held that aimed at testing the move forward concept. The process of decontamination, and the types and minimum quantity of decontamination supplies were included in a procedure and the regular checks were covered.

Despite the above improvements, there are still some issues that have not been addressed by the plant. In line with the EDF corporate requirements, the plant does not provide electronic dosimeters for each emergency worker. Exercises for the protection of emergency workers does not involve the response in the field using protective equipment, the use of electronic dosimeters, the recording of the dose nor a pre-job dose assessment.

Conclusion: Satisfactory progress to date

9.6 (b) Good Practice: Training for evacuation of disabled personnel from buildings

The plant deliberately employs disabled persons. In order to assist them in emergencies a specific evacuation plan was established for each disabled member of personnel. It is signed by the disabled person and their line manager.

An evacuation chair is provided for persons with reduced mobility.

This evacuation chair is located in a stairwell which offers fire/smoke resistance of one hour. The chair can be deployed by one person, and enables a person with reduced mobility to be evacuated safely.

The person with reduced mobility and his/her colleagues have been trained in the use of the chair within the scope of the specific evacuation plan.

14. SEVERE ACCIDENT MANAGEMENT

14.1. ANALYTICAL SUPPORT FOR SEVERE ACCIDENT MANAGEMENT

The technical basis for the severe accident management guidelines (SAMG) was developed by the corporate research division, SEPTEN. The supporting analysis includes insights from the Level 1 and Level 2 probabilistic safety analysis (PSA) and considers all known severe accident phenomena. SEPTEN is actively involved, both in France and internationally, in the development of computer simulation codes and experimental programmes related to severe accident phenomena. The team considers this to be a good performance.

14.2. DEVELOPMENT OF PROCEDURES AND GUIDELINES

The plant currently has severe accident management guidance that covers all plant modes with the reactor vessel closed. Guidance exists in the off-site technical support organisation to advise the plant during severe accidents for plant modes with the reactor vessel open (see section 14.7 for further discussion). New accident procedures for spent fuel pool accidents have been developed at the corporate level and are currently being evaluated at the plant; implementation is scheduled for the third 10-year outage. The plant is encouraged to include spent fuel pool level monitoring in the quarter-hourly plant parameter sheet (Message Quart D'Heure) that would be completed in the main control room during a severe accident.

The team noted that the severe accident management guidance at the plant does not make any formal provision for accidents occurring simultaneously on both units, and suggests that the plant should consider developing guidance in this respect.

14.3. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

There is a high degree of reliance from the plant on the corporate technical support centre (ETC-N) in Paris for specialist advice that is not available at the plant level. For example, the emergency response team action guide (GAEC), which contains details on various non-standard plant alignments that may be used during a severe accident, is only available at ETC-N. The ETC-N was designed to support only one unit on one plant in severe accident conditions. Operating experience exists within EdF where ETC-N had to provide support to multiple units at two plants (Cruas and Tricastin) that activated their respective emergency plans at the same time due to a flooding event. While ETC-N succeeded in managing this particular situation, it did not involve severe accident conditions. The potential exists that ETC-N could become a bottle-neck if several units and/or plants were to simultaneously require technical support for severe accidents, and the team encourages an evaluation of the practical coping ability of ETC-N in this regard.

The plant has mobile equipment such as diesel generators, pneumatic pumps, water hoses and an air compressor that can be used during a severe accident. The mobile equipment is stored in a seismically qualified room and surveillance walkdowns are performed every 3 months by the Risk Prevention Department. A preventive maintenance programme exists for all mobile equipment. The team observed a good practice in the storage of keys for the mobile diesel generators in a key box located adjacent to the mobile equipment.

The team identified a good practice in the nuclear rapid response team (FARN) that was established by EdF to support plants with mobile equipment and personnel during a severe accident. The scope of the human resources and the depth of technical expertise that can be mobilised by FARN are commendable. As of the beginning of 2014, FARN has been able to support Flamanville during severe accidents occurring simultaneously on both units. The plant is implementing several post-Fukushima modifications to install additional connection points for mobile equipment to be used during a severe accident.

14.4. TRAINING NEEDS AND PERFORMANCE

The main control room is expected to be able to cope without external support for the first hour of a severe accident when plant conditions can change rapidly. Quick and efficient interventions during the first hour can have a major impact on severe accident progression, especially preventing reactor pressure vessel failure and preventing releases by ensuring containment isolation. The team identified an issue with the scope of severe accident management training for operators and safety engineers, and suggests that the plant should consider including a greater practical component (that emphasises the use of the main control room SAMGs) during training.

14.5. SEVERE ACCIDENT MANAGEMENT UPDATING AND REVISIONS

The plant currently uses Version 3B of the SAMG that was developed by EdF for the 1300 MW fleet of reactors. An update has been developed (Version 5) that includes new guidance for open reactor modes, detection of reactor vessel failure and measurement of core exit temperature in station blackout conditions. Version 5 also includes revised guidance on low safety injection flow rates and containment depressurisation using the U5 filtered containment venting system. SAMG entry criteria for shutdown modes with the reactor vessel open will also be included in the appropriate main control room procedure (SPE 0). The team considers the scope of the update, and specifically the inclusion of all shutdown modes, to be a good performance.

Implementation of Version 5 of the SAMG by the plant and the corporate technical support centre (ETC-N) has been delayed to allow for the completion of post-Fukushima modifications in the EdF fleet. Implementation is planned for 2015. Version 5 is however already available at SEPTEN and can be used during a severe accident to provide technical guidance to the plant. The plant is encouraged to ensure the timely implementation of Version 5 at the plant level.

DETAILED SEVERE ACCIDENT MANAGEMENT FINDINGS

14.3(1) Issue: The plant currently does not have severe accident management guidance to manage severe accidents that may occur simultaneously on both units.

During the mission the team identified the following facts:

- In the technical basis for severe accident management developed by SEPTEN, the possibility of having simultaneous severe accidents in more than one unit is not considered to be credible due to the high degree of defence-in-depth and the availability of mobile equipment;
- The guidance documents available to the crisis manager (PCD1) do not specifically include the possibility of multi-unit severe accidents;
- The corporate technical support centre (ETC-N) is not designed to support the plant for severe accidents occurring in more than one unit.

Taking into account the lessons from Fukushima, the ability of the plant to manage simultaneous severe accidents in both units remains uncertain without specific severe accident management guidance.

Suggestion: The plant should consider developing guidance to manage severe accidents occurring simultaneously on both units.

IAEA Basis:

SSR-2/2

Requirement 19: Accident management programme

The operating organization shall establish an accident management programme for the management of beyond design basis accidents.

NS-G-2.15

2.12 In view of the uncertainties involved in severe accidents, severe accident management guidance should be developed for all physically identifiable challenge mechanisms for which the development of severe accident management guidance is feasible; severe accident management guidance should be developed irrespective of predicted frequencies of occurrence of the challenge.

Plant Response/Action:

A – Causal analysis

EDF starting point for the severe accident baseline:

"Given the set of measures in place to manage accident situations, **EDF considers the simultaneous failure of all equipment in several reactors at the same site to be highly unlikely; there are no provisions for accidents occurring simultaneously on several units at a single site** ".

B – Strategy adopted to resolve the recommendation or suggestion

EDF and the Flamanville station meet IAEA requirements with regard to this issue (SSR-2/2 and NS-G-2.15).

– The severe accident baseline has already been implemented at Flamanville, with applicable instructions, stemming from version V3B of a CIPN design report (EMESF040358). An update of the severe accident baseline is currently being implemented on-site (version V6 of baseline - design report D305515001758) and its full application is planned for 2017. This update incorporates several improvements to the management of severe accidents. 19 operating documents have been produced to replace the eight that are currently applicable. These formal procedures apply the state-based approach, with orientation, action and monitoring phases to navigate and manage the severe accident as a function of its effects and consequences (rather than just the initiating event, which could be multiple and difficult to identify).

The main "physically identifiable risks" are still taken into account when drafting the baseline. For example, there is an instruction for reactor operators for accident operations with 'no SBO' (D455016003128) and an instruction for reactor operators for accident operations 'with SBO' (D455016003120).

C – Method used to check that the action plan is appropriate and to check effectiveness

Support for Central Services (ONC)

D – Scheduling of the actions taken and added value for problem solving

EDF's response to this inherent risk of severe accidents occurring on both Flamanville units has several parts:

– The Severe Accident Operating Guidelines (GIAG) are applicable and available at each unit on the site. They are stand-alone and can be used by the Unit 1 and Unit 2 shift teams to manage severe accidents at both Flamanville units in parallel;
– If severe accidents were to occur on both units, the criteria activating the Nuclear Safety and Radiological on-site emergency plan (PUI SR) would be fulfilled before the criteria to activate the Severe Accident Operating Guidelines (on each unit affected). The station could rely on the deployment of site-level and corporate-level emergency organisation arrangements (site emergency team (ELC) and the corporate emergency technical support team (ETC-N)) to manage interfaces between the two units affected by the emergency and thus prioritize actions on a case-by-case basis as the situation unfolds. Even though

the ELC and ETC-N are activated to manage a single severe accident, a "highly unlikely" situation of this type could be managed by exceptional organisation arrangements.

These arrangements are deemed more effective since combined severe situations on both units cannot be effectively or exhaustively conducted using a single instruction and real-time optimization analyses would inevitably be required.

2015: the exercise schedule at Flamanville is such that at least one PUI SACA (external climate-related hazards and similar events on-site emergency plan) exercise is rolled out every three years. The advantage of this type of exercise that is enables an on-site emergency plan to be simulated on both units simultaneously; meaning that in terms of emergency organisation and management the two-unit severe accident is taken into account.

2016: ESE (extreme situation exercises) are starting to be rolled out. A test was performed on 21/10/2016 before being run again on 2/12/2016. These exercises involve two units, including Flamanville 3. As part of these arrangements, no emergency response team members are initially on-site apart from the operations teams and the emergency control centre (BDS) is inaccessible.

2017: the first exercise with the Nuclear Rapid Response Force (FARN) has been scheduled. FARN arrangements provide access to additional human resources and equipment, making it possible to effectively manage the implementation of Severe Accident Operating Guidelines (GIAG) on both units in parallel.

E – State of action plan progress and reporting procedure

The three-yearly exercise programme, presented to the Nuclear Safety Committee on 25/10/2016, is used to schedule SACA on-site emergency plans exercises and to ensure they are rolled out at least every three years. These exercises will cover Flamanville 3 from 2018 onwards. This joint organisation provides an unusual interface since on-call emergency response team members, as well as those not on-call, are present. The role of off-shift ER team members is to support the on-shift ER team members. Consequently, in the event of a severe accident at these units, the activated emergency response team would all be on-call: the robustness in the event of a severe accident could only be more robust as a result.

The FARN exercise shall be implemented at the end of 2017 and is an important milestone in the development of the station's emergency response culture. The exercise scenario has not yet been defined but the use of the Severe Accident Operating Guidelines (GIAG) is likely.

F – Evaluation of action plan effectiveness

OPEX from the PUI SACA exercise on 19/11/2015

OPEX from FARN exercise.

IAEA comments:

Although the plant and EdF Corporate organization actions to manage multiple unit events have been recognized by the team it is not demonstrated that the issue related to addressing multiple units severe accidents is considered in a systematic way.

The following actions have been presented to the team as addressing the management of multi-unit events:

- Introduction of SACA emergency plan to manage external hazards causing multi-unit events;
- An extreme Situation Test to test SACA emergency plan is to take place in the plant on 2nd December 2016 for Flamanville 1, 2 and 3 units (it will be assumed that F3 is already in operation);
- The Nuclear Emergency Response Task Force (FARN) has reached its full capabilities and is able to support 6 units at the same time (2 units within 12 hours);
- The plant has been equipped with MLC capabilities (local emergency equipment), comprising 20 items per unit required to operate for 36 hours.

However, the team noted the following:

- The SACA plan and the multi-unit exercises in the plant do not address multi-unit severe accidents;
- The FARN has not been involved in any exercise where a core melting severe accident occurs on two units;
- The SAMGs currently being updated do not specifically address multi-unit severe accidents.

Furthermore, the facts supporting the original OSART mission issue are still not addressed:

- Multi-unit scenarios are not considered in the technical basis for severe accident management;
- The design of corporate technical centre has not evolved to support the plant in the event of severe accidents occurring on more than one unit;
- The multi-unit severe accidents are not included in the guidance documents for the crisis manager (PCD1).

The plant explanation for the issue not being systematically addressed is “Given the set of measures in place to manage accident situations, EDF considers the simultaneous failure of all equipment in several reactors at the same site to be highly unlikely; there are no provisions for accidents occurring simultaneously on several units at a single site". The plant could not provide substantiation for this approach, which was also challenged (within the scope of PSA applications issue) during the EdF Corporate OSART mission in 2014 and was not found to be fully resolved during the recent follow-up mission.

Conclusion: Insufficient progress to date

14.6(1) Issue: The scope of training exercises and drills for main control room staff on responding to severe accident conditions may not be sufficient.

During the mission the team identified the following facts:

- There is an expectation that main control room staff must be able to cope without external support for up to one hour after entering severe accident conditions. However, refresher training on severe accidents for reactor operators, turbine operators and safety engineers is only scheduled for half a day every 3 years and focuses on theoretical aspects rather than the practical application of the Severe Accident Management Guidelines (GIAG);
- There are several immediate actions that main control room personnel have to perform after entry into the GIAG is authorised by the crisis manager (PCD1). After one simulator exercise for a scenario that evolved into a severe accident, the operators indicated that the speed with which they implement these immediate actions could be improved if they were more familiar with the contents of the GIAG;
- A safety engineer expressed an opinion that the scope of training on the GIAGs for main control room staff could be improved.

Without sufficient practical training and familiarisation with the main control room GIAGs and their implementation, responding to immediate actions in the main control room may be impeded. This could adversely affect accident consequence mitigation during the first hour of the accident.
Suggestion: The plant should consider enhancing the scope of practical exercises and drills for main control room staff on responding to severe accident conditions.

IAEA Basis:

NS-G-2.15

3.109 Exercises and drills should be based on appropriate scenarios that will require the application of a substantial number of procedures and guidelines. Results from exercises and drills should be fed back into the training programme and, if applicable, into the procedures and guidelines as well as into organizational aspects of accident management.
3.110 The effectiveness of an exercise should not be judged on the basis of the manner in which the responsible team was able to regain control of the plant, but in the way that people were able to understand and follow the events in the plant, could handle complications and unexpected events in a controlled way, were able to reach sound decisions, and initiated a series of well founded actions.

Plant Response/Action:

A – Causal analysis

In accordance with the corporate organisation, the site-level project manager (the training department) implements the requirements of the corporate-level project sponsor (the national engineering unit's skills development advice centre UNIE-PCC) under technical memorandum NT200 and pursuant to the EP training programme. These requirements have not revealed, at either corporate or local level, any further needs regarding full-scale simulator SAM training, which is done in accordance with memoranda NT 200 / 201.

B - Strategy adopted to resolve the recommendation or suggestion

"Upgraded" SAM training has been deployed, in keeping with the corporate policy for implementing severe accident documentation following modifications to the 1300MW plant series, carried out during ten-year outages.

As part of the deployment of the 1300MW-severe-accident procedures for reactor/turbine operators, supervisors, shift managers, safety engineers and emergency directors – reflected in internal memorandum DI001 – so-called "upgraded" SAM training will be delivered before any site documentation is revised. This training will take place over one day: half a day devoted to theory and half a day to exercising the practical implementation of operating procedures.

The document revisions must be completed within a period specified in memorandum DI001. For Flamanville NPP, training will begin in the last quarter of 2016.

The training objectives are detailed below:

The following topics are addressed during the training:

- The physical phenomena that are specific to severe accidents (SA);
- The transition from APE (physical state procedures) to SAM procedures;
- Stakeholders and their roles in deploying SAM procedures;
- Nuclear steam supply conditions covered by SAM procedures;
- Equipment modifications associated with SAM.

Two further topics are added for stations that have deployed the new procedure format :

- Changes linked to the new format of SAMG;
- Implementation of SA procedures with justification of actions using a table-top scenario.

Content

The following topics are addressed during the training:

- The physical phenomena that are specific to severe accidents;
- The transition from APE (physical state procedures) to SAM procedures;
- Stakeholders and their roles in deploying SAM procedures;
- Nuclear steam supply conditions covered by SAM procedures;
- Equipment modifications associated with SAM.

Two further topics are added for stations that have deployed the new procedure format and style:

- changes linked to the new format of SAMG;
- implementation of SA procedures with justification of actions using a table-top scenario.

The SAMG will be deployed during EP exercises.

C – Scheduling of the actions taken and added value for problem solving

1- Development of specifications for the training;
2- Delivery of the first SAM training before end 2016;

3- Scheduling of SAM training for 2016-2017;
4- Scheduling of EP exercises incorporating SAM, in collaboration with the national emergency organisation (ONC).

E – State of action plan progress and reporting procedure

1- The training specifications were completed on 08/09/2016;
2- Training was delivered on 20/10/2016;
3- A schedule is in place for the 2016-2017 training programme;
4- An EP exercise incorporating SAM has been organised for 15 November 2017, with the rapid-response nuclear taskforce (FARN). And a corporate exercise is scheduled for 14 March 2017, with a request made to the ONC for inclusion of SAM.

IAEA comments:

The plant has taken several actions to resolve the issue. The team noted the following facts during the mission.

The scope of the refresher training courses for the operational positions, including the crisis manager and the safety engineer has been modified. Training now takes place during a full day. The first part is dedicated to the theory of severe accident management, while the afternoon session consists of a table-top drill tailored to the specific roles of the participants within the organisation. The frequency of the refresher training remains every 3 years. The training material (specification, scenario, description presentations) is provided by the EDF corporate. Currently, one scenario is available for the training, and it is not known whether further scenarios are planned to be developed. The plant supplemented the training material with a self-assessment questionnaire which the participants have to fill at the beginning of the session.

In addition to the full day training, it is planned to implement a simulator training session using the existing plant simulator, following a request by the trainees who have already taken part in the training sessions. The EDF corporate is supporting the plant in the preparation of the training specifications and materials. The exact scope and frequency of the simulator training are not yet defined. It is expected to take place between 2017 and 2019.

Because of the modifications to the SAMGs planned to be introduced in June 2017, a full set of refresher training courses is being implemented. So far, 36 people out of 69 have received the training.

The team concluded that the plant did tangible progress in resolution of the issue, but steps to measure the effectiveness of the training have not been completed.

Conclusion: Satisfactory progress to date

14.4(a) Good Practice: The keys for mobile emergency response equipment are stored in a key box next to the equipment.

The plant currently has 2 mobile emergency diesel generators, 2 pneumatic mobile pumps and 1 mobile air compressor stored in a seismically qualified location on Unit 2. The keys for the mobile emergency diesel generators are stored in a sealed key box next the area where the equipment is stored. Additional sets of keys are available in the emergency control centre bunker and with the maintenance group.

This measure contributes to the operability of the mobile emergency response equipment in severe accident conditions. For example, in case of an earthquake the keys will remain available given the resistance of the storage facility to earthquakes. This measure will also save time by allowing emergency response teams to go directly to the equipment storage area.

14.4(b) Good Practice: Nuclear rapid response task force (FARN). Availability to support FLAMANVILLE

The nuclear rapid response team (FARN), set up following the Fukushima accident, is tasked with responding within 24 hours at a nuclear power plant affected by a severe accident in order to limit further deterioration of the situation, prevent large off-site radioactive releases and prevent core melt if possible.

FARN is able to provide support in terms of personnel and equipment resources to a plant affected by a severe accident. The taskforce is set up to allow it to respond to accidents involving several reactors on a single site (currently 2 units, to be extended to 4 units from the beginning of 2015 and 6 units from beginning 2016), regardless of site access conditions. Flamanville can currently be supported by FARN, and modifications (scheduled for completion by the end of 2014) are in progress to install connection points for FARN mobile equipment.

FARN is composed of approximately 300 EdF personnel that are able to transport and deploy major specific resources to a site affected by an accident. FARN is set up at 4 regional bases located at Civaux, Dampierre, Paluel and Bugey power stations, with the headquarters located in the Paris region. Every regional base has 5 teams of 14 persons each, all on call for immediate action within 1 hour. The first FARN team arrives on the site affected by the accident in less than 12 hours and is fully operational within 24 hours.

The FARN members are all nuclear workers who split their time throughout the year between their original specialisation at their NPP and activities specific to FARN. During the periods of FARN duty, the team members dedicate most of their time to training, drills and maintenance of the FARN equipment. In the event of response operations, FARN has essential skills (operational, maintenance and logistics) to assist or take over from the site teams.

The team members deployed for response to an NPP affected by an accident under FARN command have to carry out the following priority actions as dictated by the crisis manager (PCD1) at the affected site:

- Provide and connect the emergency response equipment (pumps, emergency diesel generators, fuel tanks and air supply);
- Carry out appropriate monitoring of operation of the emergency response equipment and ensure related logistics to guarantee operation, especially fuel supply;
- Participate in assessment of availability and condition of site equipment;
- Participate in maintenance of site equipment, to guarantee (or restore) its operability;
- Support the shift team and ensure targeted handover (assessment of the situation, ongoing and forthcoming actions and status of the safety functions);
- Participate in priority operating actions (in support of or to take over from the shift crew), required by the situation and especially unit safety status;
- Operate vital safety systems (especially the steam dump to atmosphere (GCTa), auxiliary feedwater system (ASG) and station blackout diesel generator (LLS));
- Carry out plant alignments;
- Carry out plant monitoring and checking rounds;
- Deploy the backup means of emergency response communication.

SUMMARY OF STATUS OF RECOMMENDATIONS AND SUGGESTIONS OF THE OSART FOLLOW-UP MISSION TO FLAMANVILLE 1&2 NPP

	RESOLVED	SATISFACTORY PROGRESS	INSUFFICIENT PROGRESS	TOTAL
Management, Organization & Administration				2
R 1.2 (1)		x		
S 1.5(1)	x			
Operations				2
S 3.2 (1)		x		
S 3.4 (1)	x			
Maintenance				2
R 4.5 (1)		x		
S 4.7 (1)		x		
Technical Support				1
S 5.3 (1)	x			
Operational Experience				1
R 6.5 (1)		x		
Radiation Protection				1
S 7.2 (1)	x			
Chemistry				1
S 8.3 (1)	x			
Emergency Planning&Preparedness				2
R 9.2 (1)			x	
S 9.5 (1)		x		
Severe Accident				2

Management				
S 14.3 (1)			x	
S 14.6 (1)		x		
TOTAL	5 (36%)	7(50%)	2 (14%)	14

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

A recommendation is advice on what improvements in operational safety should be made in that activity or programme that has been evaluated. It is based on IAEA Safety Standards or proven, good international practices and addresses the root causes rather than the symptoms of the identified concern. It very often illustrates a proven method of striving for excellence, which reaches beyond minimum requirements. Recommendations are specific, realistic and designed to result in tangible improvements. Absence of recommendations can be interpreted as performance corresponding with proven international practices.

Suggestion

A suggestion is either an additional proposal in conjunction with a recommendation or may stand on its own following a discussion of the pertinent background. It may indirectly contribute to improvements in operational safety but is primarily intended to make a good performance more effective, to indicate useful expansions to existing programmes and to point out possible superior alternatives to ongoing work. In general, it is designed to stimulate the plant management and supporting staff to continue to consider ways and means for enhancing performance.

Note: if an item is not well based enough to meet the criteria of a ‘suggestion’, but the expert or the team feels that mentioning it is still desirable, the given topic may be described in the text of the report using the phrase ‘encouragement’ (e.g. The team encouraged the plant to…).

Good practice

A good practice is an outstanding and proven performance, 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 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 has the following characteristics:

- Novel;
- Has a proven benefit;
- Replicable (it can be used at other plants);
- Does not contradict an issue.

The attributes of a given ‘good practice’ (e.g. whether it is well implemented, or cost effective, or creative, or it has good results) should be explicitly stated in the description of the ‘good practice’.

Note: An item may not meet all the criteria of a ‘good practice’, but still be worthy to take note of. In this case it may be referred as a ‘good performance’, and may be documented in the text of the report. A good performance is a superior objective that has been achieved or a good technique or programme that contributes directly or indirectly to operational safety and sustained good performance, that works well at the plant. However, it might not be necessary to recommend its adoption by other nuclear power plants, because of financial considerations, differences in design or other reasons.

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

- **SF-1**; Fundamental Safety Principles (Safety Fundamentals)
- **GSR Part 3;** Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Interim Edition
- **SSR-2/1**; Safety of Nuclear Power Plants: Design (Specific Safety Requirements)
- **SSR-2/2**; Safety of Nuclear Power Plants: Operation and Commissioning (Specific Safety Requirements)
- **NS-G-1.1**; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)
- **NS-G-2.1**; Fire Safety in the Operation of Nuclear Power Plans (Safety Guide)
- **NS-G-2.2**; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)
- **NS-G-2.3**; Modifications to Nuclear Power Plants (Safety Guide)
- **NS-G-2.4**; The Operating Organization for Nuclear Power Plants (Safety Guide)
- **NS-G-2.5**; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)
- **NS-G-2.6**; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)
- **NS-G-2.7**; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.8**; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)
- **NS-G-2.9**; Commissioning for Nuclear Power Plants (Safety Guide)
- **NS-G-2.11**; A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide)
- **NS-G-2.12**; Ageing Management for Nuclear Power Plants (Safety Guide)
- **NS-G-2.13**; Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide)
- **NS-G-2.14;** Conduct of Operations at Nuclear Power Plants (Safety Guide)

- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power Plants Safety Guide (Safety Guide)
- **SSG-13**; Chemistry Programme for Water Cooled Nuclear Power Plants (Specific Safety Guide)
- **SSG-25**; Periodic Safety Review for Nuclear Power Plants (Specific Safety Guide)
- **GSR**; Part 1 Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements)
- **GS-R-2**; Preparedness and Response for a Nuclear or Radiological Emergency (Safety Requirements)
- **GS-R-3**; The Management System for Facilities and Activities (Safety Requirements)
- **GSR** Part 4; Safety Assessment for Facilities and Activities (General Safety Requirements 2009)
- **GS-G-4.1**; Format and Content of the Safety Analysis report for Nuclear Power Plants (Safety Guide 2004)
- **SSG-2**; Deterministic Safety Analysis for Nuclear Power Plants (Specific Safety Guide 2009)
- **SSG-3**; Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **SSG-4**; Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **GS-R Part 5**; Predisposal Management of Radioactive Waste (General Safety Requirements)
- **GS-G-2.1**; Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
- **GSG-2**; Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency
- **GS-G-3.1**; Application of the Management System for Facilities and Activities (Safety Guide)
- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
- **RS-G-1.1**; Occupational Radiation Protection (Safety Guide)
- **RS-G-1.2**; Assessment of Occupational Exposure Due to Intakes of Radio-nuclides (Safety Guide)

- **RS-G-1.3**; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)
- **RS-G-1.8**; Environmental and Source Monitoring for Purpose of Radiation Protection (Safety Guide)
- **SSR-5;** Disposal of Radioactive Waste (Specific Safety Requirements)
- **GSG-1** Classification of Radioactive Waste (Safety Guide 2009)
- **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
- **WS-G-2.5**; Predisposal Management of Low and Intermediate Level Radioactive Waste (Safety Guide)

▪ **INSAG, Safety Report Series**

INSAG-4; Safety Culture

INSAG-10; Defence in Depth in Nuclear Safety

INSAG-12; Basic Safety Principles for Nuclear Power Plants, 75-INSAG-3 Rev.1

INSAG-13; Management of Operational Safety in Nuclear Power Plants

INSAG-14; Safe Management of the Operating Lifetimes of Nuclear Power Plants

INSAG-15; Key Practical Issues In Strengthening Safety Culture

INSAG-16; Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety

INSAG-17; Independence in Regulatory Decision Making

INSAG-18; Managing Change in the Nuclear Industry: The Effects on Safety

INSAG-19; Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life

INSAG-20; Stakeholder Involvement in Nuclear Issues

INSAG-23; Improving the International System for Operating Experience Feedback

INSAG-25; A Framework for an Integrated Risk Informed Decision Making Process

Safety Report Series No.11; Developing Safety Culture in Nuclear Activities Practical Suggestions to Assist Progress

Safety Report Series No.21; Optimization of Radiation Protection in the Control of Occupational Exposure

Safety Report Series No.48; Development and Review of Plant Specific Emergency Operating Procedures

Safety Report Series No. 57; Safe Long Term Operation of Nuclear Power Plants

- **Other IAEA Publications**

  - **IAEA Safety Glossary** Terminology used in nuclear safety and radiation protection 2007 Edition
  - **Services series No.12**; OSART Guidelines
  - **EPR-EXERCISE-2005**; Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, (Updating IAEA-TECDOC-953)
  - **EPR-METHOD-2003**; Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)
  - **EPR-ENATOM-2002**; Emergency Notification and Assistance Technical Operations Manual

- **International Labour Office publications on industrial safety**

  - **ILO-OSH 2001;** Guidelines on occupational safety and health management systems (ILO guideline)
  - Safety and health in construction (ILO code of practice)
  - Safety in the use of chemicals at work (ILO code of practice)

TEAM COMPOSITION OF THE OSART MISSION

RANGUELOVA Vesselina – IAEA
Team Leader
Years of nuclear experience: 30

MARTYNENKO Yury - IAEA
Deputy Team Leader
Years of nuclear experience: 30

BERGLUND Ingvar - SWEDEN
Years of nuclear experience: 30
Review area: Management Organization and Administration

DAVENPORT Tom - UK
Years of nuclear experience: 37
Review area: Training and Qualification

DUKETTE Matthew Scott - USA
Years of nuclear experience: 16
Review area: Operations I

TYRER Mark Joseph - UAE
Years of nuclear experience: 30
Review area: Operations II

VAN DEN SANDE Sven - BELGIUM
Years of nuclear experience: 15
Review area: Maintence

ERMOLAEV Alexander - RUSSIA
Years of nuclear experience: 28
Review area: Technical Support

FOTEDAR Suresh - INDIA
Years of nuclear experience: 39:
Review area: Operating Experience

DOBIŠ Ľubomír - SLOVAK REPUBLIC
Years of nuclear experience: 35
Review area: Radiation Protection

JÜRGENSEN Micael - GERMANY
Years of nuclear experience: 26
Review area: Chemistry

PETŐFI Gábor - HUNGARY
Years of nuclear experience: 15
Review area: Emergency Planning and Preparedness

BOSMAN Herman Lambert - SFR
Years of nuclear experience: 11
Review area: Severe Accident Management