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REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM

(OSART)

MISSION

TO

BUGEY

NUCLEAR POWER PLANT

FRANCE

2 to 19 October 2017

And

FOLLOW-UP MISSION

30 September to 4 October 2019

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/197F/2019

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Bugey 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 36 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 by the

Director General

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

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

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

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

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

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

EXECUTIVE SUMMARY

This report describes the results of the OSART mission conducted for Bugey Nuclear Power Plant in France from 2 till 19 October 2017.

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

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

The team noted the implementation of a new Integrated Management System at the end of 2016 for the plant and confirmed that further actions are needed to demonstrate sustainable safety improvement results.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader. The team was composed of experts from Belgium, Bulgaria, Canada, the Czech Republic, Germany, Slovakia, Spain, Sweden, the United Kingdom, the United States of America and the IAEA staff members. The collective nuclear power experience of the team was approximately 360 years.

The team identified 16 issues leading to 6 recommendations and 10 suggestions that, if addressed, will assist the plant in their drive for continuous improvement in safety. The examples of outstanding practices and performance identified by the team during the mission will be disseminated to the rest of nuclear community via the IAEA OSMIR data base.

Several areas of good performance were noted:

- The use of 3D digital technologies in an innovative way to enhance the training and performance of plant personnel;
- The environmentally-friendly way of treating plant cooling water to remove scale and sludge;
- The use of a computer system equipped with personnel badge recognition for easy control of access to the radioactive sources present on the site.

The most significant issues identified were:

- The plant should improve the rigor and supervision of its conduct of operations;
- The plant should consistently ensure proper preparation and high quality of its maintenance work;
- The plant should ensure adequate training is implemented for all the personnel responsible for the implementation of the severe accident management guidelines at the plant.

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

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 Bugey Nuclear Power Plant from 2 to 19 October 2017. The purpose of the mission was to review operating practices in the areas of Leadership and Management for Safety; Training & Qualification; Operations; Maintenance; Technical support; Operating Experience Feedback; Radiation protection; Chemistry; Emergency Preparedness and Response; Accident Management; interactions between Human, Technology and Organization; and Long Term Operation. In addition, an exchange of technical experience and knowledge took place between the experts and their plant counterparts on how the common goal of excellence in operational safety could be further pursued.

The Bugey OSART mission was the 197th in the programme, which began in 1982. The team was composed of experts from Belgium, Bulgaria, Canada, the Czech Republic, Germany, Slovakia, Spain, Sweden, the United Kingdom, the United States of America and the IAEA staff members. The collective nuclear power experience of the team was approximately 360 years.

The Bugey Nuclear Power Plant is located in Bugey in the Saint-Vulbas commune (Ain), about 65 km from the Swiss border. It is on the edge of the Rhône River, from where it gets its cooling water, and is about 30 km upstream of Lyon. The site houses 4 operating units, employing pressurized water reactors of the EDF CP0 design, each having a design electrical output of 900 MW. The units were commissioned between 1978 and 1979. Some of the cooling comes from direct use of the Rhône water (units 2 and 3) while some is done by the use of cooling towers (units 4 and 5). There are about 1,200 EDF employees at the site.

Before visiting the plant, the team studied information provided by the IAEA and the Bugey 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 these 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 emphasis was placed on assessing the effectiveness of operational safety rather than simply the content of programmes. The conclusions of the OSART team were based on the plant's performance compared with the IAEA Safety Standards.

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

MAIN CONCLUSIONS

The team noted the implementation of a new Integrated Management System at the end of 2016 for the plant and confirmed that further actions are needed to demonstrate sustainable safety improvement results.

The team found several areas of good performance, including the following:

- The use of 3D digital technologies in an innovative way to enhance the training and performance of plant personnel;
- The environmentally-friendly way of treating plant cooling water to remove scale and sludge;
- The use of a computer system equipped with personnel badge recognition for easy control of access to the radioactive sources present on the site.

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

- The plant should improve the rigor and supervision of its conduct of operations;
- The plant should consistently ensure proper preparation and high quality of its maintenance work;
- The plant should ensure adequate training is implemented for all the personnel responsible for the implementation of the severe accident management guidelines at the plant.

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

BUGEY FOLLOW-UP MAIN CONCLUSION (Self-Assessment)

In October 2017, an OSART mission was performed at Bugey power plant. The plant was assessed against IAEA safety standards during this review.

The IAEA team identified 4 good practices, 10 suggestions and 6 recommendations.

In response to this OSART mission, the action plan issued from the recommendations and suggestions has been embedded in the overall integrated management system in order to provide supervision on the expected progress, ensure consistency with other ongoing actions and ensure sustainable performance. The corporate was also involved in addressing the issues related to long-term operation.

Progress against this action plan resulted in an upturn in site performance since 2017 as observed by the internal inspection in 2018 and the other external peer reviews.

Suggestion 1.1 (Leadership for Safety): Bugey plant has reinforced its KPI management with the extended use of dashboard at every level of the integrated management system. Progress of the plant on this area has been identified by the nuclear inspection conducted in 2018.

Recommendation 3.4 (Conduct of Operations): Progress were identified by the external peer review in 2018 on the management of operations fundamentals. The ‘Operator Fundamentals Weaknesses’ has been assessed as satisfactorily. This has also been assessed by the nuclear inspection of the corporate conducted in 2018 which pointed out progress made in supervision and reinforcement of the Operations fundamentals.

Recommendation 4.5 (Conduct of maintenance work): The other external peer review also assessed positive progress to reduce the number of quality issue related to maintenance.

Suggestion 8.2 (Chemistry Control Programme): The nuclear inspection of the corporate conducted in 2018 highlighted the progress made by the plant in this area.

Recommendation 9.2 (Emergency Preparedness): The plant has redefined its strategy for personnel evacuation in coherence with national directive for public protection.

Most of the actions defined to address the recommendations and suggestions of the OSART in 2017 have been closed out. The incoming follow-up mission to be conducted by the IAEA is viewed as a very beneficial opportunity for reviewing our progress and helping us continuing our journey towards excellence.

OSART FOLLOW-UP MAIN CONCLUSION

An IAEA Operational Safety Review Follow-up Team visited Bugey Nuclear Power Plant from 30 September to 4 October 2019. There is clear evidence that the plant has gained significant benefit from the OSART process. The IAEA Safety Standards and benchmarking activities with other NPPs were used by Bugey NPP during the preparation and implementation of their corrective action plans.

The plant thoroughly analysed the OSART recommendations and suggestions and developed appropriate corrective action plans. In some instances, these corrective actions cover a broader scope than the original OSART recommendations and suggestions. The willingness and motivation of plant management to use benchmarking, consider new ideas and implement a comprehensive safety improvement programme was evident and is a clear indicator of the potential for further improvement of the operational safety of Bugey Nuclear Power Plant.

The plant has fully resolved issues regarding handling and use of hazardous chemical substance, application of the chemistry quality control programme, and preparation for the safe evacuation of site personnel.

The following provides an overview of the issues where satisfactory progress towards resolution has been made but further work is necessary.

Regarding the plant’s use of challenging performance indicators to drive performance improvement, the plant developed and published a strategic business plan covering the period of 2018 to 2023, more challenging targets of safety performance indicators were adopted in this strategic business plan. The plant senior leadership team conducted periodic performance review meetings against these new targets of performance indicators. Performance indicators in several focus areas improved visibly from October 2017 to October 2019 in the areas of: fire safety, number of quality related issues, and outage execution. However, cyclic performance was still observed by the team in some important areas, such as number of scrams and events related to use of Human Performance (HU) tools.

Concerning implementation of the systematic approach to training (SAT), the plant continued to implement the corporate-led programme for the implementation of SAT for all job profiles with a target completion date of 2022. There was evidence that the SAT approach was being used to enhance training and identify skill gaps with the role of work coordinator for the electrical and mechanical department being the first role to fully implement the SAT approach. There was a significant improvement in the completion of operator refresher training from 91% in 2017 to 98% in 2019. The SAT process was being rolled out for instructor training, but no target completion date had been set.

As for the issue on conduct of operation, the plant decided to add an additional person ‘Lead Operator’ to the main control room crew to improve the monitoring and oversight of compliance with plant rules, coordination of work, and also for the management of emergency situations. The plant sub-management system process, operational quality elementary process, was recognised as the most relevant to the deficiencies listed in this issue. Significant improvement in operations related events was achieved in this elementary process in the last two years. However, the plant had not implemented a corrective action to address the gap in protected equipment. The corporate decided the current approach in the fleet was adequate and additional measures were not required to mitigate the risk of not implementing a protected equipment process, however the plant intends to look further into the issue of protected equipment and analyse potential implementation by benchmarking with high performing plants in this area.

As for the plant's preparation and conduct of maintenance work, the plant took actions to improve the process of work preparation and the competence of workers for work execution. The plant improved their identification of critical tasks by developing standard risk assessments, periodic meetings were held to identify risks and develop mitigation measures. Training, such as maintenance fundamentals and HU tools use were given to plant and contractor staff. The number of events related to the quality of work activities and days of loss generation due to quality of work activities was notably reduced from 2018 to 2019. However, during a field visit by the OSART follow-up team, it was observed that some potential risks associated with an electrical work on a battery bank were not properly recognized and mitigated.

Regarding the issue on temporary modifications (TMs), Bugey NPP appointed a strategic pilot manager and an operational project manager to reinforce the management of TMs. Since 2016, the operational project manager led a working group to review on a quarterly basis TMs status. The action plan for the removal of TMs was presented annually to management. A one-time working group was set up in February 2019 to initiate the process of changing existing long-term TMs into permanent modifications. Training was performed to reduce the inflow of new TMs. The total number of TMs had decreased from 450 to about 330 however, this was still significantly above the EDF target of 120 TMs for a site with 4 units. An overview of TMs showed that currently there were still 30 open TMs since 2010 and 148 TMs which were originated in 2011-2017 but most of them had associated actions to remove them. The trend of inflow of new TMs opened every year did not yet show significant improvement.

Regarding the issue of effectiveness reviews of corrective actions, the plant did not clearly distinguish between 'extent of cause' and 'extent of condition' based on the corporate approach. The plant adopted methodology for corrective action effectiveness reviews and created an organization for corrective action effectiveness evaluation and started to roll out formal effectiveness review of corrective actions. The plant also started to evaluate previous 'similar events' during significant event investigations.

Regarding the improvement of the existing emergency response facility, between 2017 and 2019, efforts were directed to improve the conditions in the current emergency response centre (BDS) as far as possible considering the limitations of the existing facilities. However, the plant recognized that the existing emergency response facilities were not fully adequate to protect the emergency response personnel in the event of a radiological emergency, and therefore there was a plan in place to build a new robust On-Site Emergency Centre (CCL) based on a Corporate resolution. The actual construction of the new CCL will start in the second half of 2021 and the CCL is expected to be functional by 2023.

As for the training and drills for implementing Severe Accident Management Guidelines (SAMGs), the plant conducted an emergency response exercise considering accident conditions in 2 units in December 2018. The scenario was devised so that unit 2 would enter severe accident conditions whereas unit 3 would reach a controlled state before entering severe accident conditions. Severe accident management guidelines (GIAG 3B) as well as one of the strategies of the emergency response guidelines (GAEC) were used during the exercise. Emergency response exercises including the use of GIAG are now scheduled to be performed once every 3 years. The plant received the new severe accident management guidelines, however, the corresponding training material is still being developed by the Corporate. Nonetheless, between November 2019 and June 2020, refresher courses with the new GIAG will be given to all relevant plant staff.

Concerning the scope of SAMG, the plant received the new version of GIAG, version 6A, developed by the Corporate. The plant will conduct the validation of the new guidelines in October 2019, and the new GIAG will be implemented at the plant at the beginning of 2020. GIAG version 6A addresses accidents with a closed and partially open primary system. The procedures for shutdown conditions with the primary system open will be covered by version 6B that is planned to be implemented at the plant’s 10-year outage. The plant follows the Corporate directives and has developed a comprehensive plan for the implementation of the updated GIAG (version 6) and corresponding training programme. In response to the OSART findings, the plant and the corporate organization will analyse the existing operational differences and limitations related to SAMGs as part of the crisis organization and will implement a relevant initiative within a reasonable timeframe.

Regarding the scoping of Structures, Systems and Components (SSCs) for Long Term Operation (LTO), EDF decided to publish two technical notes at a fleet-level and two technical notes for Bugey NPP to provide guidance to develop the list of SSCs for LTO evaluation. One technical note was issued on 6 February 2019 and three others on 27 September 2019. They provided guidance for scope setting of SSCs in line with IAEA Safety Standards. An update of the scope setting for Bugey NPP using revised guidance was initiated in 2019 and is planned to be completed in 2020. An update of SSCs not important to safety and PSA relevant will be done in 2020. Bugey NPP migrated from SYGMA database to SDIN database which allowed identification of in-scope and out-of-scope SSCs. The SDIN database contained fields important for ageing management of in-scope SSCs but the majority of data was still missing.

Regarding the proactive approach to technological obsolescence, the main actions for the whole EDF fleet were to update the organizational structure for obsolescence management, to implement proactive monitoring of obsolescence, to develop and maintain a fleet-wide obsolescence status overview, and to develop a user-friendly tool for managing proactive obsolescence. Fleet-level documents were updated recently in July to September 2019, some are pending final approval. Currently, a pilot for electrical boards was being prepared, obsolescence solutions are planned to be initiated in January 2020. A new computer-based tool (Obsolescence Portal) to improve the management of obsolescence was launched in July 2019 for all EDF units but was not populated with data such as the list of monitored items.

As for the identification and revalidation of time limited ageing analyses (TLAAs), EDF launched training for 40 to 50 equipment experts responsible for writing FAVs on identification of TLAAs which will be completed in 2020. Trained equipment experts had started to review and update identification of TLAAs in FAVs with completion date in December 2020. Only one mistake in reviewed FAVs was found during the follow-up review, otherwise TLAA were properly identified. Identified TLAAs would be checked if their revalidation was being properly addressed by existing processes. This activity had started for mechanical components and was planned to be completed in 2020 for all SSCs. No action to update EDF processes and procedures connected with identification and revalidation of TLAAs was identified.

The following issue was assessed as having made insufficient progress to date.

Regarding the review of operating documents, the plant shift managers now check the signatures confirming familiarization of the procedure changes by the main control room personnel weekly. However, they do not check the operator’s understanding of the document changes. The plant management provided additional human resources to address the backlog in procedures revision. The plant significantly decreased the backlog from 1200 in 2017 to 250 in September 2019. The plant expects that they will be able to reduce the backlog to less than 200 in 2020 and to eliminate the backlog completely in 2021. The comprehensive check of all operator aids in main control room had not been performed because the relevant procedure was not issued and was still in validation process. Unauthorized operator aids were still present in many places and progress was not visible over the last two years.

In 2017, the original OSART team developed six recommendations and ten suggestions to further improve operational safety of the plant. At the time of the follow-up mission, some 24 months after the OSART mission, 19% of issues had been resolved, 75% had made satisfactory progress and 6% had made insufficient progress to date.

The team received full cooperation from the Bugey NPP management and staff and was impressed with the actions taken to analyse and resolve the findings of the original mission. The team was able to verify all information considered relevant to its review. In addition, the team concluded that the managers and staff were very open and frank in their discussions on all issues. This open discussion made a significant contribution to the success of the review and the quality of the report.

1. LEADERSHIP AND MANAGEMENT FOR SAFETY

1.1 LEADERSHIP FOR SAFETY

The plant implemented an Integrated Management System at the end of 2016 which includes a set of performance indicators that are monitored routinely. The plant has introduced and implemented several improvement initiatives such as specific activities that drive manager presence in the field ('VMT' and 'EDT'), the 'Shared Vigilance' or 'Vigilance Partagée' initiative and a common site phone number ('6000') to enable staff and contractors to report any immediate safety hazards on site. While the overall safety performance has improved on site, the team noted that several of the key performance indicators goals have not been challenged since 2014 and there continue to be injuries. Further work is needed to demonstrate sustainable performance improvement. The team made a suggestion in this area.

1.2 INTEGRATED MANAGEMENT SYSTEM

One of the ways in which the plant ensures that nuclear safety is the overriding priority is through the utilization of the 'Safety Engineer' whose primary function is to perform an independent daily review of the nuclear safety status of the operation and do a challenge meeting with the plant Shift Manager. In case of disagreement between the Safety Engineer and the Shift Manager, the matter is escalated to an arbitrator. The team considered this as a good performance.

The plant has a comprehensive talent management review process. The Succession Planning committee (or 'COCAR') utilizes a systematic annual agenda which looks 1, 3 and 5 years ahead to ensure that all critical roles are reviewed with respect to upcoming attrition and to identify any needs to the Corporate organization The team considered this as a good performance.

DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY FINDINGS

1.1. LEADERSHIP FOR SAFETY

1.1(1) Issue: The plant is not fully utilizing and challenging the key performance measures, processes and results in order to ensure sustainability of the many improvement initiatives they have launched.

The team noted the following:

- The goals for 4 of 14 key performance indicators (excluding those related to finance or staffing) have not changed since 2014. For one of these indicators (ESS N3C = Significant Events due to system misalignment), the target has stayed the same since 2014 despite the target having been met in 2014 and 2015.
- The goal for serious fires is still maintained as 0.25 per unit even though performance from 2014 to 2016 was 0 annually.
- The number of safety significant events due to Technical Specification (ESS NC STE) violations has not improved between 2014 and 2016 (remaining at between 6 and 7 per year). The plant has implemented a new Integrated Management System as of the end of 2016 that includes processes to proactively address Technical Specification violations and foster plant performance improvements. However, it is too early to demonstrate that sustainable results have been achieved.
- There continues to be safety significant events related to human performance. There were 40 such events in 2016 and 18 so far in 2017. Taking into account the much higher level of outage activities during 2016, it is too early to demonstrate that sustainable results have been achieved.
- The industrial safety performance at the Bugey site is worse than the global nuclear industry average. There were 15 lost time injuries and 57 medically treated injuries in 2016 for EDF employees and contractors. There have been 5 lost time injuries and 15 medically treated injuries in 2017 for EDF employees and contractors.
- Despite the high number of injuries to contractors on site, the plant nuclear safety culture assessments conducted in 2015 and 2017 did not include the approximately 400 permanent site contractors.
- Some human performance errors by contractors were not reported in the plant corrective action programme database (‘TERRAIN’), and therefore, they are not included in human performance trend analysis.
  - The event captured in event reporting ‘Fiche de Suivi et d’Analyse Evènement’ N° 2017 1506 was not included in the ‘Terrain’ system, and therefore not included in the human performance trend analysis, even though it resulted in a lost time injury by a contractor at the plant.
  - An event, documented in FAC SEM-EL-TEM 2017-1, related to non-compliance with plant expectations regarding potential check before electrical work by a contractor was not entered in the ‘TERRAIN’ system, and therefore, the event is not included in the human performance trend analysis.
- 17 of 58 managers have not met their required target for manager site visits (‘VMT’) with a focus on site priorities as of the end of September 2017.
- The refresher course on severe accident management guidelines (GIAG) for the staff responsible for executing the SAMGs in the control room is mandatory every 3 years. The last refresher course in 2015/2016 was attended by only 1 out of 14 shift teams. This discrepancy was not identified or effectively challenged by the management.

- As of July 6, 2017, there were 1,444 documents overdue for review (beyond their review cycle). As of August 24, 2017, there were 1,394 documents overdue for review which included 27 new ones. As of end of September 2017, there were 1,235 documents overdue for review. The plan to address the necessary revisions is not yet fully developed.
- The 2017 independent safety culture assessment identified a lack of focus on organizational weaknesses to improve performance.

Without a constant self-critical focus on performance indicators, processes and results, performance improvements may not be sustained and this may result in a decline in safety performance.

Suggestion: The plant should consider implementing challenging key performance measures and using the performance results to determine opportunities for further improvement of plant performance.

IAEA Basis:

GSR part 2c

3.1. The senior management of the organization shall demonstrate leadership for safety by:

(c) Establishing behavioural expectations and fostering a strong safety culture;

(d) Establishing the acceptance of personal accountability in relation to safety on the part of all individuals in the organization and establishing that decisions taken at all levels take account of the priorities and accountabilities for safety.

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

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

4.8. The management system shall be developed, applied and continuously improved. It shall be aligned with the safety goals of the organization.

SSR-2/2 (Rev. 1)

3.2 The management system, as an integrated set of interrelated or interacting components for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner, shall include the following activities:

(e) Review activities, which include monitoring and assessing the performance of the operating functions and supporting functions on a regular basis. The purpose of monitoring is: to verify compliance with the objectives for safe operation of the plant; to reveal deviations, deficiencies and equipment failures; and to provide information for the purpose of taking timely corrective actions and making improvements. Reviewing functions shall also include review of the overall safety performance of the organization to assess the effectiveness of management for safety and to identify opportunities for improvement. In addition, a safety review of the plant shall be performed periodically, including design aspects, to ensure that the plant is operated in conformance with the approved design and safety analysis report, and to identify possible safety improvements.

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

GS-G-3.1

6.2 To avoid any decline in safety performance, senior management should remain vigilant and objectively self-critical.

6.4. The management system should ensure that standards of performance are established. These standards should be directly related to the product provided by the organization and based on the objectives set by senior management. Once the standards have been established, performance should be measured against them. These measurements should be monitored at regular intervals to ascertain whether or not improvements in the quality of the product or process are necessary. Performance indicators should be used and other appropriate methods of measurement should be developed.

Plant Response/Action:

<u>A / Analysis of causes</u>

- <u>Cause 1</u>: The plant's Business Plan, which delivers a multiyear overview of performance targets, was in the process of being validated at the time of the OSART, while the preceding Business Plan had expired at the end of 2016. There was therefore a cyclical gap in long-term strategic insight at the time of the IAEA's presence on site.
- <u>Cause 2:</u> The new Integrated Management System (IMS) at the time of the IAEA's review meant that it was not yet able to guarantee sustainable performance results in the long run. As a matter of fact, the remodelled IMS and related reinforced management were rolled out in February 2017, in other words, only 6 months before the OSART review.

<u>B / Strategy adopted to solve the recommendation/suggestion</u>

Since the OSART, we have implemented our Business Plan, run a communication campaign on its contents, and regularly steered its progress. This provides us today with a multiyear commitment to improving our performance results and ensuring that we stay on course to do so.

In parallel with this Business Plan, we have reinforced yearly performance management on site by consolidating our Integrated Management System (IMS). The IMS delivers a continuous improvement loop throughout the year:

- Every year, our processes are called into question and challenged via our process reviews and our Plant Strategy Review, which – based on results, low-level events, and feedback from the past year etc. – help define the key risks for the coming year, and the actions needed to counter these risks and improve performance;
- Every quarter, we oversee the progress of the action plan that was established through different reviews;
- Every month, a performance review drives improvements to our main performance indicators, to pinpoint any negative trends as early as possible and implement corrective actions if necessary;
- At mid-year, we take a step back to assess progress in a 'Mid-year Plant Strategy Review'. This entails analysing in detail the changes to our action programme that will be applied in the second half of the year, in response to a changing environment or deteriorating performance results.

<u>C / Action plan</u>

- <u>Cause 1: Lack of multiyear strategic overview</u>
- <u>Action 1:</u> Validate the Business Plan and provide consistent oversight of the Plan in order to ensure that the plant stays on course to reach the results set in the Plan.
- Deadline: Completed, annual oversight
- <u>Cause 2: Reinforced oversight on site</u>
- <u>Action 2:</u> Apply a management approach focused on the high-stakes Basic Processes (enhanced management and oversight of processes that appear to be the main contributors to site performance).
- Deadline: Completed
- <u>Action 3:</u> Set up management meetings focusing on OPEX, to optimise the use of operating experience.
- Deadline: Completed
- <u>Action 4:</u> Set up a system for measuring action effectiveness, for those actions associated with corporate directive DI100, to ensure that the corrective actions implemented are bearing fruit.
- Deadline: Completed
- <u>Action 5:</u> Broaden the use of performance dashboards and KPIs across all sub-processes, to enhance oversight at all levels of management.
- Deadline: Completed
- <u>Action 6:</u> Re-examine every year the format of reviews, to confirm the relevance of our diagnoses and the suitability of our annual action plan.
- Deadline: Completed, annual re-examine

<u>D / Progress of action plan as of to date</u>

<u>Action 1:</u> Implementation of the action is progressing as expected. Seminars on stewardship of the Business Plan are scheduled to take place annually.

<u>Action 2:</u> The action was closed out in 2018. In 2019, further improvements were made by enhancing the link between the high-stakes Elementary Processes and requirements for management field walkdowns.

<u>Action 3:</u> The action was closed out in 2018.

<u>Action 4:</u> Effectiveness measurement actions have been in place since the end of 2018 for all actions derived from significant event reports.

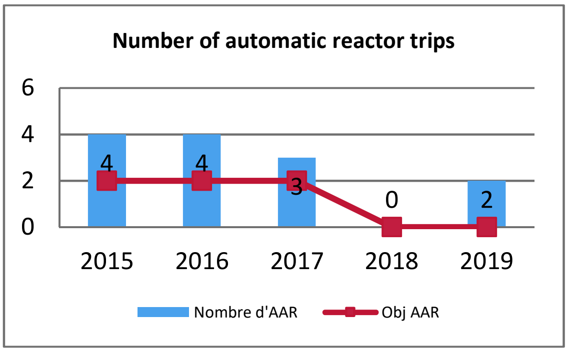
<u>Action 5:</u> Dashboards are in the process of deployment for all sub-processes.

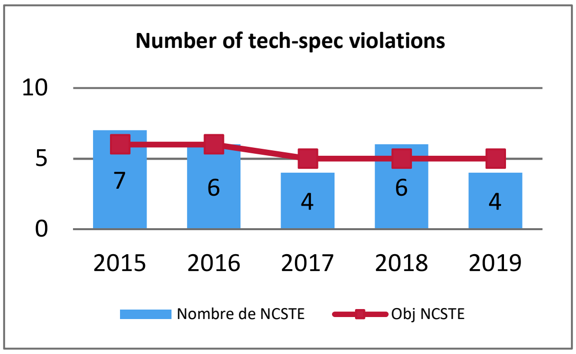
Action 6: Implementation of the action is progressing as expected. Every year, the format of reviews is improved to ensure that our actions are fit for purpose.

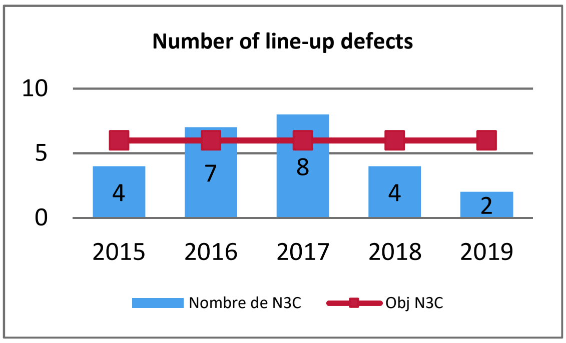
E / Measuring action effectiveness

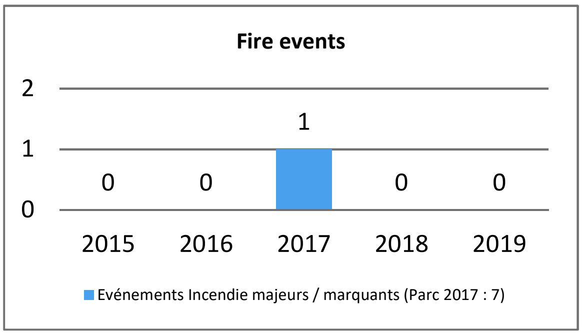
Our multiyear objectives are defined in the Business Plan and target gradual and continuous improvement.

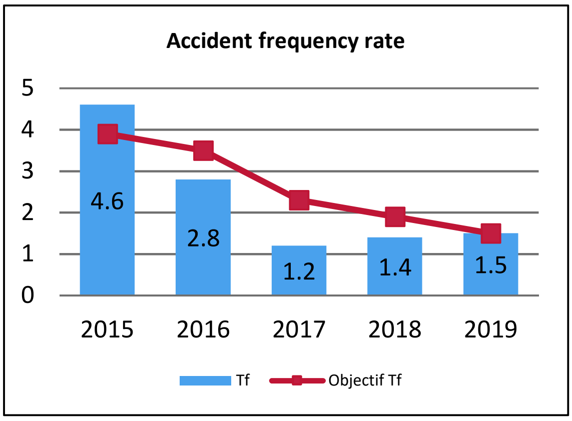
The multiyear performance trajectory for the plant’s key indicators is aligned with the goal set out in our Business Plan.











IAEA comments:

The plant had carefully analysed this recommendation and determined that the main causes of the issue were a lack of a multi-year strategic business plan at time of the OSART mission and insufficient reinforcement and oversight on site.

The plant developed and published a strategic business plan covering the period of 2018 to 2023, and this had been communicated to the plant staff via different channels since the end of 2017. More challenging targets of safety performance indicators were adopted in this strategic business plan. For example, the target number of scrams was reduced to 0.25 per unit in 2023 compared to 1 per unit in 2016; the target number of significant fire events was reduced to 0 per unit in 2023 from 0.25 per unit in 2017, the target number of line-up events was reduced to 0.5 per unit in 2023 from 1.25 per unit in 2017, and the target number of technical specification violations was reduced to 0.5 per unit in 2023 from 1.5 per unit in 2016.

The plant senior leadership team has been conducting periodic performance review meetings against these new targets of performance indicators, and focused actions were taken when performance declined against these targets. For example, the plant was planning to conduct a focused review on scrams due to equipment reliability issues to identify causes and measures to prevent and minimize future scrams.

The plant senior leadership team had been consistently reinforcing their top four priorities to the plant staff and contractors via daily meetings and other venues: improving the quality of operation and maintenance activities, sharing vigilant on safety, maintaining high housekeeping standards, and being a role model for safety. These activities were coupled with an improved programme on leadership with a focus on managers in the field. Training on how to conduct observations were delivered to managers, and more emphasis was put on the quality of observations and feedbacks to the observed staff.

The plant conducted a safety culture survey recently, and the results were compared with the previous survey result in 2017, and the diagnostic results and gaps identified during the survey were used to align the current plant focuses and to develop the business plan in the coming years.

Performance indicators in several focus areas had improved visibly from October 2017 to October 2019:

- For fire events:
  - The number of major fire event was reduced from 1 to 0.
  - The number of minor fire event was reduced from 11 to 1.
- For the number of quality related issues:
  - The number of quality related issues in maintenance and operation was reduced from 22 to 13.
- For outage execution:
  - The average outage extension days was reduced from 28 days in 2016 to 5 days in 2019 at the time of the follow-up mission.
- For document reviews overdue:
  - The number of overdue documents for review was reduced from 1444 in July 2017 to 380 in August 2019.

However, the team also observed that some key performance indicators were still showing cyclic performance over the past few years, for example: the plant has experienced four scrams in 2019 due to equipment reliability related issues compared with zero in 2018; the plant also experienced two significant events related to improper use of HU tools in 2019. The actions taken after the OSART mission in 2017 will need more time to demonstrate their full effectiveness.

During the field visit by the OSART follow-up team, it was observed that two air-conditioning units were stored adjacent to two reactor protection instrument cabinets in an electrical equipment room without proper seismic constraints. Other equipment stored in the area was properly constrained.

Conclusion: Satisfactory progress to date

2. TRAINING AND QUALIFICATIONS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

The EDF fleet is renewing its training programme based on the Systematic Approach to Training (SAT) methodology, however it is not yet fully implemented at the plant. The team noted several deficiencies in the plant training programmes. For example some training courses are not evaluated or are not completed by the staff as required. The team made a recommendation in this area.

The plant training facility for maintenance, operations and other departments is equipped with a large number of mock-ups, various training spaces, laboratories and classrooms. The team considered this as a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

2.2(1) Issue: The Systematic Approach to Training (SAT) is not fully implemented at the plant to ensure the quality of training programmes and some required training courses are not always completed by all the targeted audiences.

The team noted the following:

- The Systematic Approach to Training (SAT) process is only fully implemented in 30% of the plant departments and:
  - The SAT is not fully implemented in the Operations, Maintenance, Radiological Protection (RP) department or for the safety engineers.
  - The SAT process is not implemented in the Training department. The plant does not maintain the appropriate skill levels for trainers. The skills upkeep for trainers is currently only done through experience sharing (1 week), pedagogical and technical meetings and personal work in order to prepare the training materials.
  - The gaps identified in the management of training programmes are not captured in the CAP (corrective action programme).
- The required training courses are not always completed by all the targeted audiences, such as:
  - The refresher training programme for operators is done in cycles of 4 years. Although all the content of this programme (UFPI/OP5/ERQ/16-03029) should be completed by all operators, a few of them did not. For instance, only 81% of operators completed the G2 scenario and only 73% of operators completed the G1.2 scenario.
  - Based on the 2016 Operations training report (UFPI/OP5/ERQ/16-03029), in the L6-L7 theme 'RTV containment exterior', although mandatory, only 44% of operators were trained.
  - Based on the 2016 Operations training report (UFPI/OP5/ERQ/16-03029), the theme G.3.1 'criticality', although mandatory, was only completed by 73% of shift managers.
  - Some topics in the training programme are considered as recommended training but it is not clear whether these topics should be completed. For example: some parts of the emergency training programme (D5110/NT/08504) were considered as optional or recommended. It is unclear whether this should be completed or not. For some topics, it is not clearly defined whether they need to be refreshed and how (mandatory or optional), such as 'training course for emergencies concerning environmental releases' (PCC2631).
- Evaluation of training is not always performed, such as:
  - The theoretical continuous training (APPRNCPIL) done in Operations is not assessed and ranked, this is only done for initial training.
  - The emergency training (APPUI2631) regarding environment releases is not formally assessed at the end of the training.

Without a fully implemented Systematic Approach to Training (SAT) process, the plant cannot guarantee the full effectiveness of the training programme.

Recommendation: The plant should complete the implementation of the SAT process to improve the effectiveness of the training programme and ensure that all the targeted audiences always complete the required training courses.

IAEA Basis:

SSR-2/2 (Rev. 1)
5.32. The operating organization shall maintain liaison, as appropriate, with support organizations (e.g. manufacturers, research organizations and designers) involved in the design, construction, commissioning and operation of the plant in order to feed back information on operating experience and to obtain advice, if necessary, in the event of equipment failure or in other events.

NS-G-2.8
4.13 A systematic approach to training should be used for the training of plant personal training. The systematic approach provides a logical progression, from for identification of the competences required for performing a job, to the development and implementation of training towards achieving these competences, and to the subsequent evaluation of this training. The use of a systematic approach to training offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control, leading to greater reliability of training results and enhanced safety and efficiency of the plant.

4.14. A systematic approach to training should include the following phases:

- Analysis. This should comprise the identification of training needs and of the competences required to perform a particular job;
- Design. In this phase, competences should be converted into training objectives. These objectives should be organized into a training plan;
- Development. In this phase, training materials should be prepared so that the training objectives can be achieved;
- Implementation. In this phase, training should be conducted by using the training materials developed;
- Evaluation. In this phase, all aspects of the training programmes should be evaluated on the basis of data collected in each of the other phases. This should be followed by feedback leading to improvements in the training programmes and to plant improvements.

4.21. All progress made in training should be assessed and documented. The means of assessing a trainee’s ability include written examinations, oral questioning and performance demonstrations. A combination of written and oral examinations has been found to be the most appropriate form of demonstrating knowledge and skills. In the assessment of simulator training, predesigned and validated observation forms and checklists should be utilized in order to increase objectivity. All assessments of simulator training sessions should include an evaluation of the trainees, the feedback given and further measures considered as a result of the evaluation. Assessment should not be regarded as a one-off activity. In some States, reassessment of individuals by instructors and their immediate supervisors is undertaken at regular intervals.

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

Plant Response/Action:

A / Analysis of causes

Cause 1: The SAT process is not completely embedded on the Bugey site. There is no roadmap for applying the SAT process.

Cause 2: The Joint Training Department (SCF) does not maintain instructor skills at the appropriate level; the SAT process has, in fact, not been rolled out in the Joint Training Department.

Cause 3: The Operations Department personnel do not complete all of the compulsory topics listed in memo NT201. The training sessions are correlated in such a way that not all target groups can complete the compulsory topics.

B / Strategy adopted to solve the recommendation/suggestion

Coordination for rolling out the SAT process has been reinforced for all of the site departments. A roadmap is being used to specify not only how the corporate reference standards will be applied to each craft on site, but also the rolling out of the relevant skills management tools: Standard Training Plans, Job Skills Observations, and Skills Mapping, etc.

Work on Instructor skills needs to be finalised, on the same lines as for the other crafts on the NPP.

Lastly, all of the compulsory topics for Operations are provided by the corporate Skills Advisory Team (PCC) and then incorporated into a site-level memo: NT201. The way that the training sessions listed in this memo are correlated needs to be reviewed to be sure that all the compulsory topics are correctly completed by each member of the Operations crews.

C / Action plan

- Cause 1: The SAT process is not completely embedded on the Bugey site. There is no roadmap for applying the SAT process.
  - Action 1: Issue and validation of the roadmap for applying SAT by the site Training Committee (CF3 – Level Three Training Committee)

  Deadline: 31/03/2018
  - Action 2: Coordinate and sequence the rolling out of SAT in three stages:
    - Analyse baseline documents
    - Update tool
    - Align tools used for skills management.

  Deadline: 31/12/2022
  - Action 3: Record analyses of the craft baseline documents and send them to corporate level to be inserted and, if necessary, used to update the corporate baseline documents.

  Deadline: continuous tracking
- Cause 2: The Joint Training Department (SCF) does not maintain Instructor skills at the appropriate level; the SAT process has, in fact, not been rolled out in the Joint Training Department.
  - Action 4: The API Department in UFPI (corporate Central Training Services) is creating a SAT baseline that is well suited to the job function of an instructor.

  Deadline: 15/09/2019
  - Action 5: Establish a Standard Training Plan for the instructors in the Joint Training Department, to act as a framework for professional development (training, sharing expertise, etc) in career management.

  Deadline: 31/08/2019

    - Action 6: Enrol the BUGEY Joint Training Department Instructors on some of the training sessions followed by Operations Department, to help them assimilate any baseline evolutions (examples: 10-yearly outage training, Criticality, etc)
      Deadline: 31/12/2018
- Cause 3: The Operations Department personnel do not complete all of the compulsory topics listed in memo NT201. The training sessions are correlated in such a way that not all the target groups can complete the compulsory topics.
    - Action 7: Distribute the topics differently in the training sessions to optimise completion of compulsory topics.
      Deadline: 31/12/2017
    - Action 8: Improve coordination by the Operations Department with a comprehensive centralised data collection based on a single tracking sheet, thus making reported data more reliable
      Deadline: 31/08/2019
    - Action 9: Remove the notion of Recommended/Advised from memo NT201.
      Deadline: 31/12/2017

D / Progress of action plan as of to date

Action 1: The action is closed out. The roadmap for applying SAT was validated during the March 2018 Site Training Committee meeting (CF3).

Action 2: The UFPI training process is based on the 5 steps of the SAT approach (Needs Analysis, Design, Development, Implementation, Evaluation). The site process for Just-In-Time training (skills development programme) is also based on these 5 steps. The craft departments and the Teaching and Methods Support (APM) analyse the needs transmitted in the form of a statement of requirements by the Training Committees. Just-in-Time training is designed through a simplified mission statement that uses the SAT approach (Identification of Training and Pedagogical Objectives to be implemented, Activity, Knowledge, Expertise, etc). Members of the Joint Training Department and crafts could be required to develop training material, such as mock-ups, to respond to a specific craft need (just-in-time training or exercises for work specific to one craft).

This action is in progress, as the deadline is fixed for 31/12/2022. The CF3 committee tracks progress of the roadmap 3 times a year and carries out a review at the end of the year. The Standard Training Programmes (PTF) are being rolled out as per the roadmap. Progress on the coaching booklets and the Job Skills Observation tool is in line with expectations, whether they need to be updated or started with the craft departments.

Action 3: For this action, the Teaching and Methodology Support is in contact with the corporate level and transfers any remarks as and when the baselines are implemented on site, for eventual inclusion in the corporate baseline documents.

Action 4: The SAT baseline for the job function of instructor is in the process of being drafted by the corporate Central Training Services (UFPI).

Action 5: The Standard Training Plan for Joint Training Department instructors is in the process of being developed.

Action 6: Action is closed out. If necessary, instructors take part in Operations training.

Action 7: The action was implemented for the 2017/2018 and 2018/2019 versions of plant memo NT201.

Action 8: The action was implemented in 2018/2019 and reviewed in the summer of 2019 to assess tool effectiveness.

Action 9: The action was implemented for the 2017/2018 and 2018/2019 versions of plant memo NT201.

E / Measuring action effectiveness
Rolling out the SAT:
Since January 2019, the Joint Training Department has been providing support for all the NPP craft departments (as per the SAT roadmap) in their work on Standard Training Plans: their task consists of methodical reconstruction and mainly in-depth studies. This will then help them identify all the compulsory training courses with a view to increase the skills level of a worker in one specific craft, based on the SAT approach.
The monthly update in May 2019 showed that 58% of the Priority 1 baselines had been completely rolled out and 60% of the Priority 2 baselines had been completely rolled out, which is in line with the Bugey 2018-2020 SAT roadmap:

- Of the 9 Operations Department craft baselines to be rolled out, 2 have been completed, 2 will be completed by the end of 2019 and 5 others will be completed by the end of 2020
- Of the 16 Maintenance baselines to be rolled out, 10 have been completed, 3 will be completed by the end of 2019 and 3 others will be completed by the end of 2020
- The 3 Radioprotection Guidelines to be rolled out have been completed.
- The Safety Engineer Baseline is in the process of being rolled out.

The progress of SAT deployment on the BUGEY site is in line with the roadmap established by the plant.

Completion of compulsory topics:
We can see an improvement over 2017-2018 on the rate of compulsory training sessions completed, which is now close to 100%.
Looking at the topics where gaps were observed:

- Scenario G2: progressing from 81% of operators to 97% in 2017/2018
- Topic G.3.1 'Criticality': progressing from 73% of operators to 92% in 2017/2018

As a general rule, 92% to 100% of the generic topics were completed by operators, Deputy Shift Managers and Shift Managers in 2017/2018; which goes to show that the actions undertaken have been effective.

IAEA comments:

The issue was divided into three parts: implementation of the SAT process, improving completion rates for operator refresher training and implementation of the SAT methodology for instructors.

The plant continued with its programme to implement the SAT. This 5-year programme was scheduled to be completed in 2022. The first stage of the programme was the implementation of 54 fleet-developed job role baselines, 46 of which were due for completion by the end of 2021 and the remaining 8 due in 2022. Of the 46 baselines due by the end of 2021, 34 were being rolled out at the plant, 7 more were to commence roll out before the end of 2019 and the remaining 5 to commence roll out in 2020. The baselines were at various stages of completeness, for example for the 34 baselines being rolled out, 6 had approved Training Plans, 26 training plans should be complete by end of 2019 and 14 to be completed in 2020. The production of the training booklets was at a similar state with 5 in use, 21 to be approved by end of 2019 and 20 to be produced by the end of 2021. The work coordinator role for the electrical and mechanical department had just completed all the various phases for the implementation of the SAT process for this role.

The plant identified that one of the main reasons for operators not completing mandatory refresher training was limitations on simulator availability. Since July 2019, the plant had a second simulator which increased simulator availability. However, the plant also improved communications between the operations and training departments and enhanced the process for defining the required operator refresher training requirements via its NT201 document. Consequently, in 2017 there were 30 instances (9% of total operator planned training) of planned operator training which were not completed and in 2018-2019 only 8 (2%), even though only one simulator was available throughout this period.

The plant continued to follow the requirements of the corporate training department programme for the implementation of the SAT process for instructors. The baseline document was approved in October 2019 and the training plan approval was scheduled for January 2020. There was no target date for the full implementation of the SAT process for instructors, but it was expected to take until 2021.

The plant was continuing with the implementation of the SAT process in accordance with the schedule with an expected completion date of 2022. Demonstrable improvements in operator refresher training compliance were observed and implementation of the SAT process for instructors was proceeding in accordance with the schedule, though no target date for full implementation had been defined.

Conclusion: satisfactory progress to date

3. OPERATIONS

3.1. ORGANIZATION AND FUNCTIONS

The team noted that there is no rule at the plant defining the time period during which the operators are required to familiarize themselves with all new changes in procedures and the plant status after an extended absence from duty (less than six months). The team encouraged the plant to improve in this area to ensure that operators are fully familiarized with the plant status before they return to normal duties after an extended absence from duty.

The introduction and implementation of the 'operational fundamentals' is planned and monitored within the operations department with regular trending and field observation scheduled for the operations management team. Five focus areas are identified as special areas. These areas are reviewed by the shift managers and operations lead team meeting and modified based on results from trending and observations. The team recognised this process as a good performance.

3.2. OPERATIONS EQUIPMENT

The team noted that during shift turnover active alarms in the main control room are consistently recorded and discussed. The alarms which are related to safety related limits and conditions and emergency operating procedures are well identified to ensure quick response of the personnel. The team recognised this as a good performance.

3.3. OPERATING RULES AND PROCEDURES

The team noted that the plant operating documentation is not always regularly reviewed, kept up-to date and operators are sometimes not familiarised with the changes in operating procedures. The team made a suggestion in this area.

3.4 CONDUCT OF OPERATIONS

The team noted that several identified expectations within conduct of operations were not complied with. The operator responsible for overall monitoring in the main control room did not retain an overview of the control room whilst briefings were taking place in the common unit area. Personnel sometimes do not meet requirements related to use of mobile phones near I&C panels sensitive to radio frequency interference. The team made a recommendation in this area.

3.6 FIRE PREVENTION AND PROTECTION PROGRAMME

All firefighting equipment is covered in the plant maintenance schedule. All laydown areas are classified by fire risk and are regularly checked by plant staff. Plant fire response staff work in conjunction with the local fire service and they are trained together. Information about conditions of fire systems is easily available on plant information system. All modifications are assessed and controlled for their effect on plant fire loading. The fire command vehicle is well equipped to assist the oncoming fire service. The team recognised this as a good practice.

DETAILED OPERATIONS FINDINGS

3.3. OPERATING RULES AND PROCEDURES

3.3(1) Issue: Plant operating documentation is not always reviewed, kept up-to date as required and operating staff are sometimes not familiarised with the changes in operating procedures.

The team noted the following:

- The plant has a requirement that shift personnel should sign the document ‘Document changes and approvals’ for attesting their familiarisation with the monthly changes in operating procedures. However, the following was observed by the team:
  - No shift manager or deputy shift manager on units 4 and 5 has signed the ‘Document changes and approvals’ in 2017.
  - Only a few operators signed the document that they had read the changes in the operation documentation this year, e.g. no one from shift A’ in unit 4 and 5 and less than 10% of units 2 and 3 operators.
  - Among the changed documentation the following documents found by the team are examples of safety related ones: ‘Reactor cooling system’ for unit 4 and 5, ‘Fire orientation procedures’ and ‘Plant start after the outage’ for unit 2 and 3.
  - The plant does not have a requirement about the time limit within which operators have to read new changes in all operational documentation.
  - Periodical checks on the operators’ familiarisation with new documents is not performed and coaching is not established.
- The plant has a rule that the review of all procedures (with the exception of emergency operating procedures) should be done at least once every 5 years. However, the following was observed by the team:
  - 361 out of approximately 1200 procedures relating to unit 3 exceeded the time limit for the 5 year review.
  - About 30% of the operating procedures in unit 2, 4 and 5 exceeded the time limit for the 5 year review.
  - Among the outdated documentation examples of safety related documents were found by the team: ‘Alarm of loose parts in reactor cooling system’ and ‘List of electric actuators for common plant systems’ for unit 5.
- There is no time limit for replacing the outdated operator aids at the plant when they are modified. The responsible person stated that sometimes the operator aids are replaced immediately and sometimes later because of high workload.
- Three operator aids in the main control room of unit 2 (lifts and power supply for lifts, list of important phone numbers and low pressure reheaters operation diagram) and two operator aids in the main control room of unit 3 (list of important phone numbers and schedule of outages) have been placed under the glass cover of the tables. None of the documents have been approved or controlled.
- There was no list of documentation available to assess the completeness of documentation for the field operators working in the ‘boiler room’. Among these procedures, the team found procedure (10LAA149LA) without a controlled documentation stamp.
- Operator aid: chemistry instruction for injection of nitrogen (4CVI001ZE) with hand written drawings was found close to condenser vacuum system in turbine hall of unit 4.

Without keeping the documentation up to date and operators familiarised with the operating procedure changes, the plant could experience an increase in errors during the operational activities.

Suggestion: The plant should consider improving its processes to ensure that all operating procedures are kept revised and up to date and that operating staff familiarise themselves with them in a timely manner.

IAEA Basis:

SSR-2/2

7.4. Operating procedures and supporting documentation shall be issued under controlled conditions, and shall be subject to approval and periodically reviewed and revised as necessary to ensure their adequacy and effectiveness. Procedures shall be updated in a timely manner in the light of operating experience and the actual plant configuration.

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

NS-G-2.14

2.13. A comprehensive programme of continuing training and requalification for all operations personnel should be established. Additional briefing and, if necessary, training should be provided when an individual has been away from the plant for a significant period of time (e.g. owing to illness). Additional training or briefing may also be necessary for operations critical to safety or for infrequent operations, or for some routine operations that are carried out rarely owing to improved operational performance (e.g. startup of the plant). Changes to regulations and procedures, modifications to plant equipment and changes to the organizational structure should be addressed in continuing training. Special training should be provided on internal and external events relevant for the safety of the plant.

4.22. Procedures, drawings and any other documentation used by the operations staff in the main control room or anywhere else in the plant should be approved and authorized in accordance with the specified procedures. Such documentation should be controlled, regularly reviewed and updated promptly if updating is necessary, and it should be kept in good condition. Emergency operating procedures should be clearly distinguished from other operating procedures.

4.24. A controlled copy of all operations procedures should be available in the main control room for reference by operators. Controlled copies of selected procedures should be located at other working places where they are used or will be used in appropriate situations (for example in the emergency control room). Administrative controls should be put in place to ensure that only valid operating procedures are in use and that outdated procedures are not used by mistake. The plant procedures should be kept in such a way as to ensure their rapid retrieval. Operators should take special care when new procedures are introduced and used for the first time.

6.16. An administrative control system should be established at the plant to provide instructions on how to administer and control an effective programme for operator aids. The administrative control system for operator aids should cover, as a minimum, the following:

- The types of operator aid that may be in use at the plant;
- The competent authority for reviewing and approving operator aids prior to their use;
- Verification that operator aids include the latest valid information.

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, local control panels in the plant, boards and measurement devices in the work areas. Operator aids should be placed in close proximity to where they are expected to be used and posted operator aids should not obscure instruments or controls.

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. In addition, all operator aids should be reviewed periodically to determine whether they are still necessary, whether the information in them needs to be changed or updated, or whether they should be permanently incorporated as features or procedures at the plant.

Plant Response/Action:

A / Analysis of causes

With regard to the revision of documentation in the Operations department, the causes are as follows:

- An imbalance between workload and resources in the documentation group within the Operations department, leading to priority being given to document changes relating to modifications in reference requirements and equipment modifications (due to their essential nature), while systematic five-yearly document revisions are considered less of a priority.
- An increase in the number of changes in reference requirements and changes associated with equipment modifications, and limited staffing in the documentation group due to a shortfall in the pool of available operators, and the priority given to staffing of shift crews (for the Operator/Operator Coordinator/Lead Operator roles).

With regard to shift crews familiarising themselves with document changes, the documentation group in the Operations department produces a monthly document summarising the new document revisions for that month and distributes it to the control room. However, members of the shift crews do not systematically familiarise themselves with this document (evidenced by missing signatures on the document). This is due to the fact that some crew members are not aware of the existence of the document, and more generally to the fact that the requirement is not reinforced to crews by Shift Managers and Operations department management.

Finally, with regard to operator aid documents not subject to quality assurance present in the control room, there is no organisation in place to monitor their relevance and ensure that their number does not increase.

- Cause 1: A lack of Operator resources in the documentation branch in Operations to handle document revisions.
- Cause 2: Shortcomings in management of document changes.
- Cause 3: A lack of management reinforcement regarding familiarisation with document changes.

- Cause 4: Absence of an organisation for monitoring operator aids in the control room.

B / Strategy adopted to solve the recommendation/suggestion

The Operations department has implemented a new organisation for handling of document changes:

- Members of shift teams (on shift or on day duty) are involved as authors or reviewers of document changes.
- Organisation and tracking of document changes are coordinated by a dedicated person in the documentation group.
- Management reinforcement regarding familiarisation with document changes is being strengthened.

C / Action plan

- Cause 1: A lack of Operator resources in the documentation branch in Operations to handle document revisions.
  - Action 1: Define organisation to enable implementation of document changes by members of shift crews (first stage: on-shift personnel; second stage: personnel on day duty)

  Deadline: Completed
  - Action 2: Implement this organisation (coordination, tracking of document changes made by shift crews or personnel on day duty, up to computerisation of documents),

Deadline: Completed

- Cause 2: Shortcomings in management of document changes.
  - Action 3: Create and fill a new post in the documentation group dedicated to management of document changes by shift crew personnel (or personnel on day duty)

Deadline: Completed

  - Action 4: Introduction of indicator to track the number of documents overdue for revision

Deadline: Completed

- Cause 3: A lack of management reinforcement regarding familiarisation with document changes.
  - Action 5: Monthly distribution of new document revisions in control room (sheet in a dedicated folder in the control room)
    Deadline: Completed
  - Action 6: Reminder to Shift Managers by the manager of the documentation group, at Operations department management meetings, of the importance of members of shift crews familiarising themselves with document changes.
    Deadline: Completed
  - Action 7: Addition to the Shift Manager's log of a weekly check of familiarisation with document changes by each shift crew
    Deadline: Completed
  - Action 8: Periodic tracking, at Operations department management meetings, of familiarisation with new document revisions by each shift crew
    Deadline: On going
- Cause 4: Absence of an organisation for monitoring operator aids in the control room

- Action 9: Modification of surveillance test 'DIVE 13', carried out every six months, to check that all operator aid documents present in the control room are reviewed and approved
  Deadline: 30/09/2019

D / Progress of action plan as of to date

Since the last OSART, the Operations department has defined an organisation for implementation of document changes by members of shift crews (first stage: on-shift personnel; second stage: personnel on day duty). This organisation was rapidly implemented, with the associated oversight (tracking of document changes made by shift crews or personnel on day duty up to computerisation of documents, creation of an indicator). To ensure that this organisation is robust, a dedicated post was created and filled in the documentation group to manage document changes by shift crew personnel (or personnel on day duty). Revisions to be implemented by shift crews have been prioritised as follows:

- Documents not relating to surveillance test requirements, which are not the subject of a modification request (FRDC)
- Documents not relating to surveillance test requirements, which are the subject of a modification request (FRDC)
- Documents relating to surveillance test requirements, which are not the subject of a modification request (FRDC)

New document revisions are distributed to the control room every month. The information is provided to shift crews via a sheet added to a dedicated folder in the control room. To ensure that this sheet is viewed by shift crews, a regular reminder is provided to Shift Managers, at Operations department management meetings, of the importance of members of shift crews familiarising themselves with document changes. Finally, a check point has been added to the Shift Manager's log every Friday night covering familiarisation with document changes by shift crews.

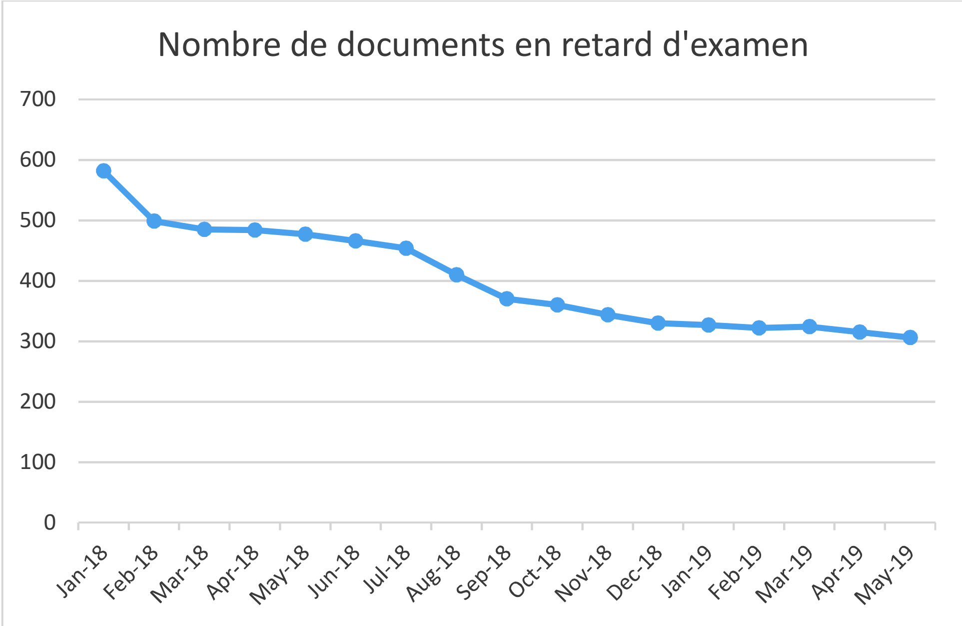
However, the action concerning periodic tracking, at Operations department management meetings, of familiarisation with new document revisions by each shift crew must be given renewed impetus in order to maintain management reinforcement on an ongoing basis.

E / Measuring action effectiveness

Number of documents handled by shift crews or personnel on day duty:

2018: 138 documents
2019 (up to end of May): 127 documents

Tracking of number of documents overdue for review:



IAEA comments:

The plant analysed the recommendation and identified four causes:

- A lack of human resources
- Shortcomings in management of document changes.
- A lack of management reinforcement regarding familiarisation with document changes.
- Absence of an organisation for monitoring operator aids in the control room.

The plant shift managers check the familiarization with procedure changes by the main control room personnel weekly. The information was collected and discussed in monthly operational department meetings. The shift supervisor checks the presence of signatures in the 'Document changes and approvals'. However, he does not check the operator's understanding of the document changes. The plant's expectation is that all operators should confirm by their signature, within a 3 months' time limit, that they were aware of documentation changes, however, the regular check of adherence to this rule was not done at the plant at the time of the follow-up mission. Monitoring of the progress in the familiarization of the main control room personnel with the procedure changes was not performed.

The plant management provided additional human resources to address the backlog in procedure revisions. Operators on day duty were organised to address the backlog. In addition, the plant assigned a dedicated person in the documentation group to coordinate the work. The plant significantly decreased the backlog from 1200 in 2017 to 250 in September 2019. The improvement trend during 2019 was significantly slower (from 320 to 250) than in 2018 (from 600 to 320) because the remaining procedures required much more time to be analysed. The plant expects that they will be able to reduce the backlog to less than 200 in 2020 and to eliminate the backlog completely in 2021.

The plant developed corrective actions to address the presence of unauthorized operator aids only in the main control room. This corrective action - the comprehensive check of all operator aids in main control room - had not been performed because the relevant procedure was not issued and was still at the validation stage. During the plant walkdown in the radiologically controlled area, 18 unauthorized operator aids were identified on the wall in room N208 and two outdated operational diagrams of PTR502 for the spent fuel cooling system were on the wall in the field operator room. During the walkdown in the turbine hall of unit 4, an operator aid for chemistry instruction for injection of nitrogen with hand written corrections was identified which was at a similar location to the one found during the OSART mission. Similar unauthorized operator aids to these were found under glass on a table in the main control rooms of units 2 and 3 during the main OSART mission two years ago and were identified again in the same places of units 4 and 5. Examples of such unauthorized operator aids in main control rooms were:

- a guide on how to issue a work request
- an ‘important phone number’ list with handmade corrections at unit 5,
- an outage schedule and an ‘important phone number’ list with handmade corrections at unit 4.

A member of the plant staff explained that the plant does not recognise documents on the table under glass in the main control room as operator aids.

Conclusion: Insufficient progress to date

3.4 CONDUCT OF OPERATIONS

3.4(1) Issue: The plant conduct of operations is not always implemented with the expected levels of rigour and supervision.

The team noted the following:

- During the shift turn over activities:
  - During the shift turnover for the Main Control Rooms (MCRs) of unit 2 and unit 3 on the 11th October 2017, all reactor operators were in the common area for both units for the shift briefing. The team noted that the MCRs for unit 2 and for unit 3 were left unattended for approximately 15 minutes. This was raised as a concern by the team and was deemed allowable by the concerned shift staff.
  - During the shift turnover for the MCRs of unit 4 and unit 5 on the 4th October 2017, the team observed that 1 operator stayed in the MCR during briefings and was later updated on the briefing by his counterpart and the shift manager on completion of the shift turnover brief. There would appear to be a misunderstanding of what the standards / expectations are for the shift turnover. This expectation is described in conduct of Operations document D511/NT/08125. ('At the briefing held at the beginning of a shift, or a debriefing, or any other meeting within the common unit area, the operator responsible for overall monitoring remains in the control room. They can therefore participate, provided they stay at the door of common unit area, which means they can retain an overview of the control room').
- Following a failed periodic test for the gas turbine system (EP LHT 002) on 9th October 2017, the field operator did not contact the control room operator as per expectations (recorded as deviation CS-2017-10-10423 in the plant corrective action programme).
- During the tagging out for a safety related periodic test on the Reactor Protection System (RPR) on the 9th October 2017, an operator called the control room with the DECT (Digital Enhanced Cordless Telephone) phone in front of a panel with a sticker stating that DECT phones should not be used in proximity with the panel.
- The plant does not implement a protected equipment policy, and this is in line with EDF Corporate standards. However, two events occurred in 2017 due to the plant not being protected: FSE 134-16 Version 0: 2 LHG 070 and 071 ZV locked out and disconnected and FSE 085-16 Version 0: unavailability of boration line further to an error during isolation of 2 REA 011 FI

Failure to comply with management expectation for conduct of operations may result in operators losing oversight of plant equipment status and undertaking inappropriate actions.

Recommendation: Plant should improve the rigour and supervision of its conduct of operations.

IAEA Basis:

SSR-2/2

4.1. The operational policy established and implemented by the operating organization shall give safety the utmost priority, overriding the demands of production and project schedules. The safety policy shall promote a strong safety culture, including a questioning attitude and a commitment to excellent performance in all activities important to safety. Managers shall promote an attitude of safety consciousness among plant staff.

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.

NS-G-2.14

3.7. Irrespective of the reactor type and organizational structure, at least one authorized reactor operator should be present at the controls in the main control room at all times while the reactor is in operation.

5.12. Before equipment is released from service, consideration should be given to testing the redundant trains or single components that remain in service. The need for additional testing to verify availability should be evaluated on the basis of the number of redundancies, the importance to safety of each redundant train or component and the interval since the last test. Operations personnel should evaluate the results of such tests before commencing the process of tagging. Before initiating the tagging process for trains or components, the shift supervisor should conduct a pre-job briefing, which should also cover the status of the plant and non-related components or trains. Additionally, procedures should be established to provide for warning barriers and signs located in the plant close to such redundant systems to alert operators and workers to their special protected status.

5.18. Initiation of a surveillance test should be subject to prior authorization by the shift supervisor and the results of the test should be reported to the operations staff in a timely manner. The shift supervisor should review any observed malfunctions to verify continued compliance with the operational limits and conditions. Any deviations discovered in the course of surveillance tests should be evaluated against the success criteria for the surveillance test.

Plant Response/Action:

A / Analysis of causes

Two main causes emerge regarding this recommendation:

- Cause 1: The role of Lead Operator has not been filled in shift crews
- Cause 2: Management reinforcement regarding Operations fundamentals and operation based on fundamentals needs to be strengthened

B / Strategy adopted to solve the recommendation/suggestion

The following strategy was developed in response to this recommendation.

First, recruitment and training of Lead Operators had to be launched, in order to have two Lead Operators per crew by the end of 2019.

Next, a ‘supervision’ elementary process was created, to incorporate supervision into operation based on operations fundamentals (Fundamental No. 4). The aim is to identify low-level and high-level indicators (‘weak and strong signals’) that result from a lack of supervision, and to build an action plan to deliver improvements in the department in terms of the distribution of roles among shift crew members (by clarifying expectations), and the quality of conduct of operations.

Finally, following the implementation of operation based on fundamentals in 2016, the department must continue and strengthen the ‘operation based on fundamentals’ approach by annually reviewing the distribution of field visits on the basis of elementary process reviews and fundamentals reviews. This enables the department to analyse a greater volume of weak signals and develop more pertinent action plans for each elementary process.

C / Action plan

- Cause 1: The role of Lead Operator has not been filled in shift crews
  - Action 1: Appoint two Lead Operators per crew

  Deadline: 31/12/2019
  - Action 2: Clarify the division of tasks among Lead Operators and Deputy Shift Manager

  Deadline: 31/12/2019
  - Action 3: Define the scope of the 'supervision' elementary process

  Deadline: 30/06/2019
  - Action 4: Manage the 'supervision' elementary process

  Deadline: starting from 01/06/2019, then on an ongoing basis
- Cause 2: Management reinforcement regarding Operations fundamentals and operation based on fundamentals needs to be strengthened
  - Action 5: Coordinate Management Field Visits focused on operations fundamentals

  Deadline: Ongoing
  - Action 6: Conduct reviews of each fundamental

Deadline: Annual frequency
  - Action 7: Define key elementary processes for the Operations Department, and the distribution of Management Field Visits for the next year in Decision Sheet 01

  Deadline: Annual frequency (in January)
  - Action 8: Define priority expectations to be the subject of management reinforcement during the year in each crew, and on a cyclical basis (Decision Sheet 02)

  Deadline: Annual frequency (in January)
  - Action 9: Implement management reinforcement in accordance with Decision Sheet 02, and conduct Management Field Visits in accordance with Decision Sheet 01 in each crew

  Deadline: according to the defined schedule

D / Progress of action plan as of to date

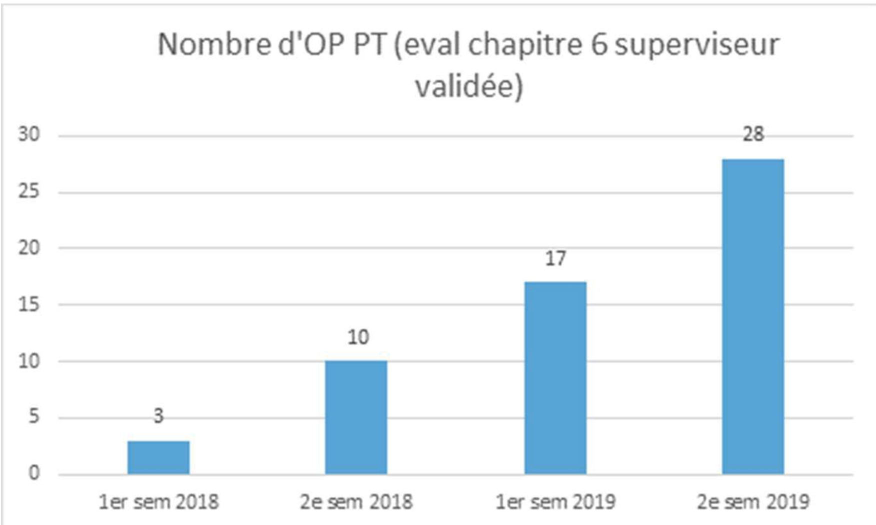
Actions 1 and 2: There are currently no warning indicators regarding the appointment of 28 supervisor-qualified Lead Operators by the end of the year. Work still needs to be done to clarify the division of tasks among Lead Operators and the Deputy Shift Manager. This will be finalised by the end of the year.

Actions 3 and 4: The definition of the 'supervision' elementary process has been finalised. Management Field Visits have been carried out by Operations department management since the start of 2019 (template available in CAMELEON application). Department management will also be carrying out observations on the simulator during shift crew situation-based training sessions (the schedule for this is currently in development). A benchmarking exercise at Hinkley Point B is also being prepared for the second half of 2019, because that site is regarded by the industry as a good performer in terms of supervision. The benchmarking exercise will be one of the inputs that will enable modifications to be made to the department's supervision action plan.

Actions 5 - 9: With regard to management reinforcement and operation based on fundamentals, the initiative is now sustainably implemented, and the reviews provide inputs for the department's action plans. This organisation is considered a strength by EDF's Nuclear Inspectorate, and the external peer reviews also identified a strength in this area during the 2018 Peer Review, particularly in relation to the following:

– Management field presence based on scoping via a Decision Sheet, tracking at department management meetings, feedback provided to personnel observed, and utilisation of findings via the Corrective Action Programme.
– Scoping of field presence (team leaders/Department managers) and monitoring based on sheets dedicated to the fundamentals process (field presence programme focused on fundamentals defined and tracked by Operations department management).
– Definition of field presence programme based on analysis of findings and weak signals, and identification of key processes.
– Targeting of management field presence at key elementary processes.
– Introduction of 'substitute' Shift Managers (15th and 16th Shift Managers) to free time for managers to conduct observations within their crews, improve the quality of field visits, and focus field visits more closely on the behaviour and commitment of their personnel.
– Periodic discussions within crews on practices and the implementation of key fundamentals processes.
– Scoping (based on department Decision Sheet 'Crew commitments on control of quality of operations') of arrangements for familiarisation and execution of activities by workers and validation of knowledge and understanding of the activity by the specifier.
– Implementation of self-assessments in crews on key elementary processes for the department

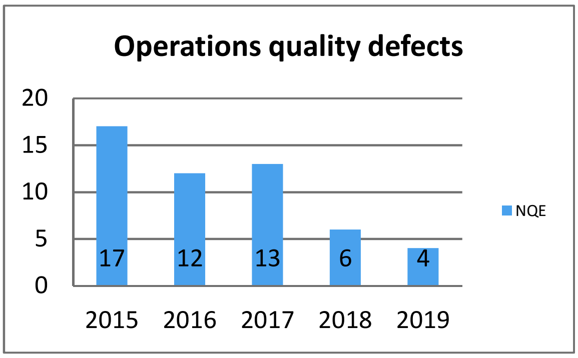
E / Measuring action effectiveness
Change in number of lead operators in Operations department:

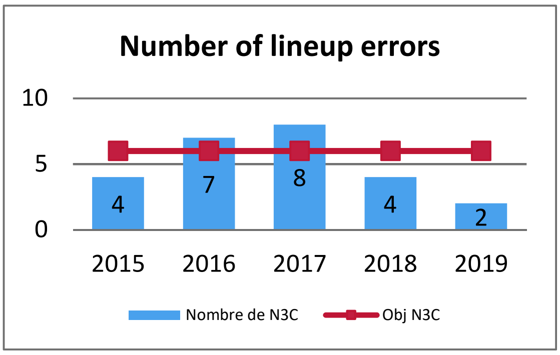


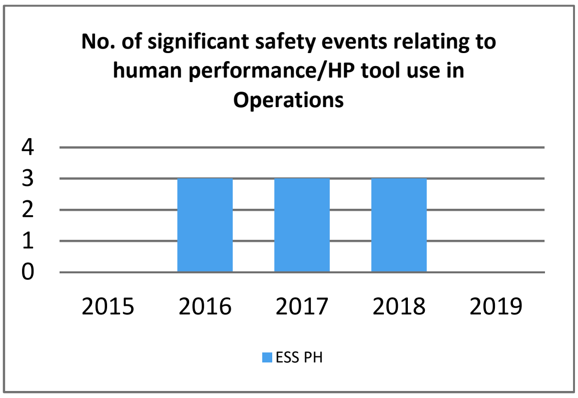
Number of 'on-shift supervision' Management Field Visits in 2019 (as at end of May): 5 visits completed out of a target of 10.

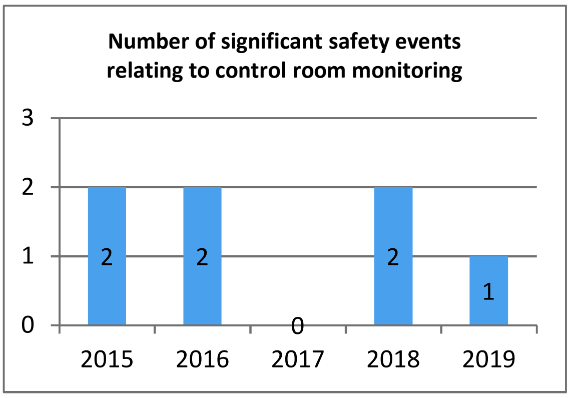
Level of integration of SOER 2013-1, 'Operator fundamentals weaknesses': 80%

<u>Reduction in number of significant safety events characterised as 'operations quality defects' (NQE):</u> 17 in 2015, and 6 in 2018









IAEA comments:

The plant had analysed part of this recommendation. The root causes of deficiencies in operator fundamentals were identified as missing role of lead operator and insufficient managerial reinforcement of operator fundamentals.

The plant developed nine corrective actions based on these two causes. The first four related to the new main control room position 'Lead Operator' implementation and the rest to management reinforcement regarding operator fundamentals. Adding an additional person 'Lead Operator' to the main control room crew was a very significant step to improve the monitoring and oversight of compliance with plant rules, coordination of work, and the management of emergency situations. This corrective action was still in progress. The plant had 22 qualified lead operators out of 28 as required by the new expectation, and it was reasonable to expect that the required 28 lead operators will be available by the end of 2019. The second corrective action 'Clarify the division of tasks among Lead Operators and Deputy Shift Manager' was in progress, and in this case, it was expected that experience gained with the implementation of lead operators at the plant will support completing this action on time on 31 December 2019.

The plant implemented the rule that the operator in charge of monitoring the main control room wears a yellow ribbon. This helped to identify the person responsible for the plant monitoring.

The plant procedure on main control room monitoring was improved with clearer expectations.

The plant sub-management system process, operational quality elementary process, was recognised as the most relevant to the deficiencies listed in this issue. This elementary process evaluated all deficiencies related to adherence of procedures, operation communication, main control room monitoring, risk analysis, line-ups and tagging. Significant improvement in operations-related events was achieved in this elementary process over the last two years.

The reinforcement of operator fundamentals in the plant depended on management reinforcement in the field. The number of operational department manager's observations were as follows: 796 in 2017, 752 in 2018 and 647 in September 2019, it is expected to have another 85 at the end of 2019. It was explained by the plant that the quality of observations was improved in general.

The plant had not implemented a corrective action to address the lack of a 'protected equipment' process. It was explained by the plant that the corporate had decided that the current fleet approach was adequate to mitigate the risk and further work on developing additional measures was not necessary.. However, the plant will look into the issue of protected equipment and analyse potential implementation by benchmarking with high performing plants in this area.

Conclusion: Satisfactory progress to date

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

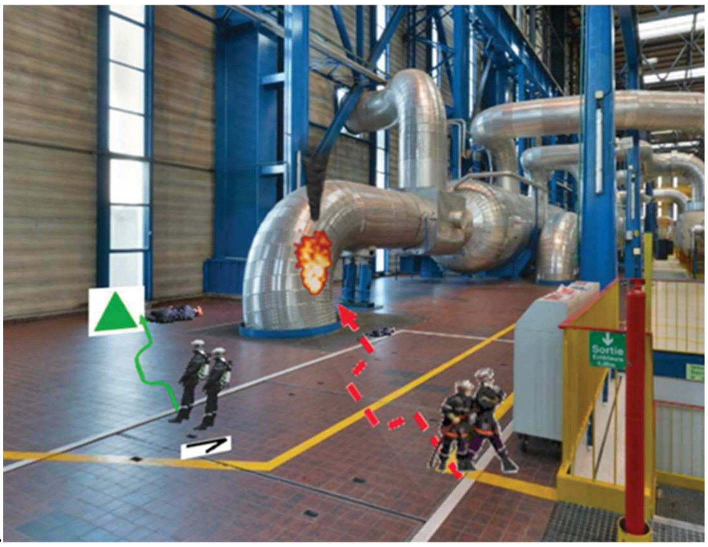
3.6(a) Good practice: SECUREVI emergency response information system

SECUREVI is a software programme for use in an on-site emergency that maps the site in detail, with clickable icons for each building that allow users to display operational information about the building, as well as 360-degree images of the building interior and exterior.

The software – installed on a portable computer on board the on-site emergency command vehicle – also allows graphic information about the real-time tactical situation (details of hazards such as smoke/flames, current risks, response teams/equipment deployed, and planned actions) to be overlaid on interior and exterior building images.

SECUREVI supports emergency teams to respond to a crisis in real time. It can also be used for training purposes, and to collect operating experience after an event (the software records details of an emergency event on a minute-by-minute basis).

Initially developed for the public emergency services, SECUREVI has been designed to meet the operational needs of the plant. Bugey is EDF's pilot site for the implementation of the software.



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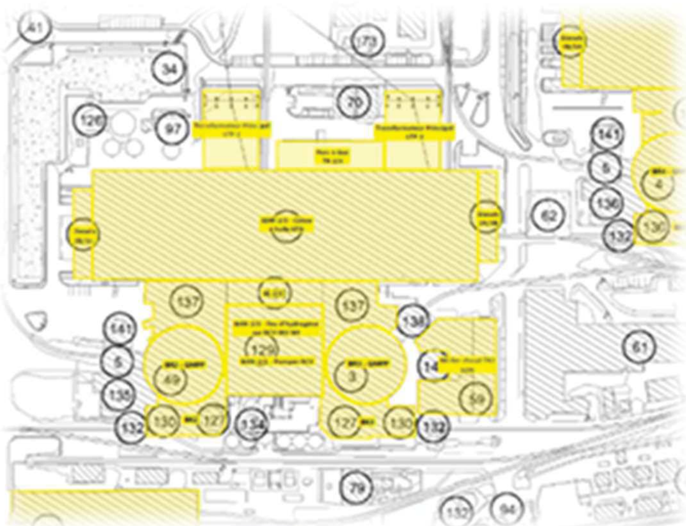

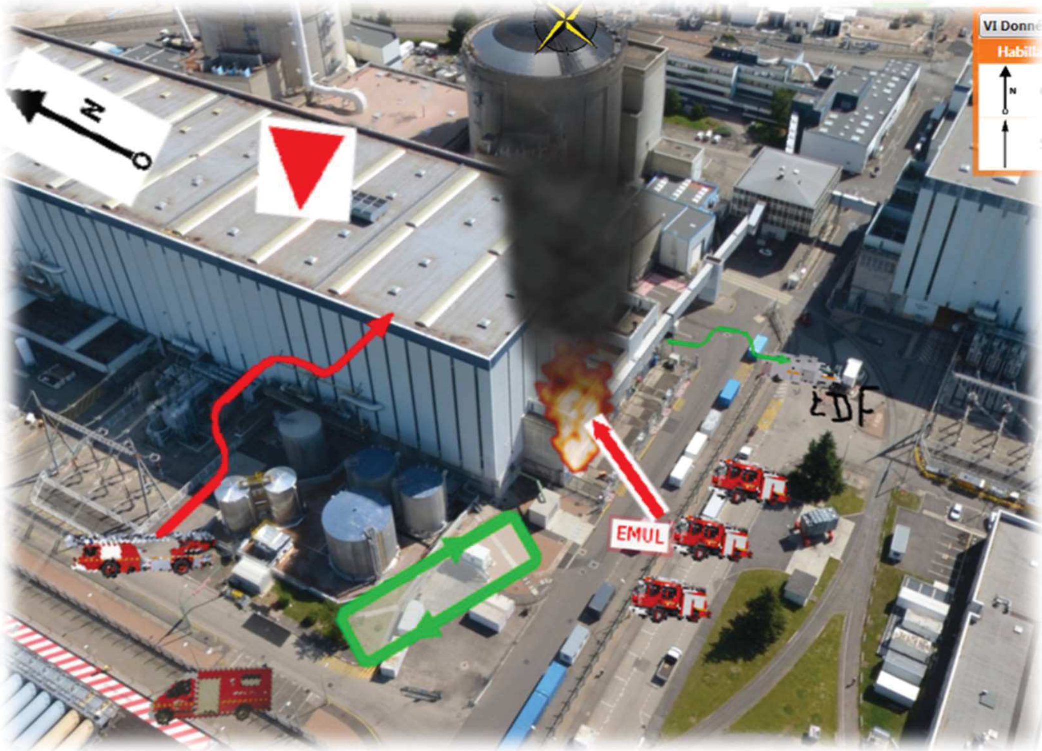
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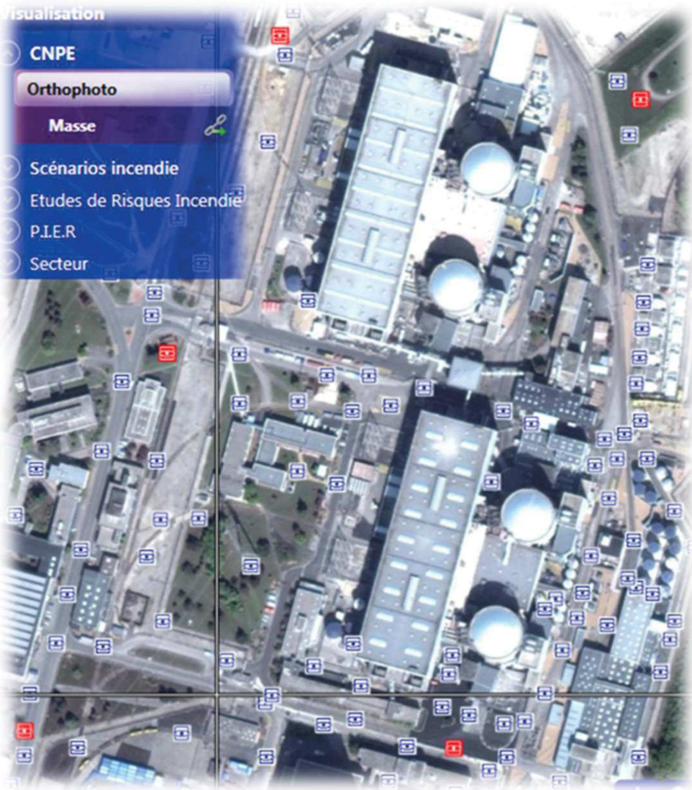
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4. MAINTENANCE

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The plant uses an electronic key cabinet which has been installed in some workshops to ensure proper control of tools, machinery and vehicles. The supervisor can programme the system to control access to each individual piece of equipment. Workers without appropriate qualification cannot access the cabinet to take equipment, machinery or vehicle keys. Keys are also individually controlled and automatically dispensed according to user rights and utilizing the individual's personal pass. This system enhances personal accountability (i.e. use only by an authorized and trained person with a valid work permit; current user and past users can be identified) and contributes to the improvement of industrial safety. The team considered this a good performance.

Mock ups are available in a room of each maintenance department. Sources of training materials are operational experience, equipment knowledge, skills and risk analysis. Training is systematically planned for sensitive activities to improve skills. Training performance is tracked using indicators. Contractors can also use these mock ups. For sensitive activities, they must take part in mock up training according to the risk analysis. The team considered this a good performance.

4.5. CONDUCT OF MAINTENANCE WORK

The preparation and conduct of maintenance work are not always performed in a manner that ensures high quality of work. The team observed weaknesses during work observations and noted some lack of spare parts needed for routine maintenance activities. This caused some delays in work performance. The team made a recommendation in this area.

DETAILED MAINTENANCE FINDINGS

4.5. CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: The plant maintenance work preparation and conduct are not always performed in a manner that ensures high quality of work.

The team noted the following:

- Work preparation:
  - During observation of diagnostic and repair work of the flow-rate sensor of chemical injection system 2SIR034SD, the workers went to collect a reserved spare part but there was no such part in the warehouse. Work conditions were not checked adequately during the preparation phase. It was confirmed by the worker that the preparation of relevant spare parts was not as expected.
  - A water leak from a pipe connection happened during filling 3GTF018VH tank in the turbine hall. At that time, the worker was on a different floor. There was no signage installed indicating the fault. The work preparation and performance during filling the tank was ineffective as the worker was working alone on the task without support.
  - Documentation deficiency was found by a worker during the check of the insulation on a 380V switchboard 2LLI001XZ. The drawing provided in the work package did not correspond to what was found in the field. The worker stopped and went to find the drawing in the office, and this caused a delay in the work implementation.
  - Electrical maintenance work was scheduled to start at 9am but the start was delayed for two hours as the equipment needed was at a different unit. The contractor had not prepared the work and had not moved the equipment within the required time.
  - Working conditions for a preventive maintenance test of the control rods electrical circuit 3RGL001TB were not appropriate. There was a risk of a faulty manipulation because the preparation of the working conditions was not appropriate. The following deficiencies were not registered and not reported by the technicians:
    - There was no light above the I&C cabinet to which a data recorder was connected. The light above the next I&C cabinet was not working;
    - Workers put the data recorder on the floor when they needed to make around 20 wired connections to it and the lighting conditions were inadequate. In addition, the I&C wires were not colour-coded but had small labels fixed to them to identify each connection;
    - The wires were not long or flexible enough to reach the I&C panel. The workers then disconnected all the wires and removed part of the insulating sheath to extend the length of the connections.
  - Lighting was not sufficient in the essential service water pump 2SEC002MO area. Already the day before, the situation was the same for electricians working on the same pump, but they did not report the poor illumination. The next day the workers used portable lamps.
  - A long temporary electrical cable had been extended from a higher floor in the turbine hall in unit 3 in preparation for maintenance work on OSAC002CO because there was no suitable power source at the working level: -7m. Several connections

had been made in mid-air to this temporary cable. Another cable connection was on the floor without protection against damage.

- Work performance:
  - Technicians were using adjustable wrenches which is not consistent with plant expectations:
    - to dismantle a valve in the mechanical workshop (in the same workshop another adjustable wrench was found in a tool box);
    - to disconnect the temperature measurement equipment at the raw water station.
  - The worker did not use the appropriate wrench during electrical works in the connection box of essential water pump 2SEC002MO because it was difficult to rotate. There was a risk of damaging the bolts and nuts.
    - Workers propped the battery room door open before the battery discharge test with an inappropriate item of equipment, the housing for the cable extension.
    - Pipeline coating in two different locations was damaged and scaffolding was touching the pipelines in both locations, causing a risk of corrosion:
      - 5PTR003RF Heat exchanger for the reactor cooling system, area W056;
      - 5SAP009BA Regulation air tank for nuclear auxiliaries.
  - During a preventive maintenance test of 3RGL001TB Control rod system, performance was not appropriate:
      - Errors were made while connecting wires to the recorder and also to the I&C panel.
      - Three-way communication was below expectation and in addition there was noise and insufficient lighting.
  - There were some instances where workers were not using the necessary and appropriate Personal Protective Equipment (PPE):
      - A technician carrying out electrical work on GEX001AP Generator excitation and voltage regulation system was not wearing gloves;
      - A worker did not wear eye protection in the workshop during work. Two other workers carrying out work on the raw water pump were not using eye protection. Another worker using a hammer in the I&C workshop was not wearing eye protection.

Lack of good preparation and proper execution of maintenance work may lead to injuries to workers or damage to the equipment.

Recommendation: The plant should consistently ensure proper preparation and high quality of its maintenance work.

IAEA Basis:

SSR-2/2

8.8. A comprehensive work planning and control system shall be implemented to ensure that work for purposes of maintenance, testing, surveillance and inspection is properly authorized, is carried out safely and is documented in accordance with established procedures.

8.9. An adequate work control system shall be established for the protection and safety of personnel and for the protection of equipment during maintenance, testing, surveillance and inspection. Pertinent information shall be transferred at shift turnovers and at pre-job and post-job briefings on maintenance, testing, surveillance and inspection.

NS-G-2.6

4.29. The operating organization should ensure that an adequate quality assurance programme is effected at all stages in the preparation and implementation of MS&I. Quality assurance has a broad scope in the context of this Safety Guide. It should be applied to ensure that safety principles and criteria have been observed. Quality assurance in MS&I should include the proper identification, evaluation and, eventually, approval of changes in approaches and technology, and uses of qualified materials and parts for replacement, including records and traceability. For further guidance on quality assurance in MS&I see Ref. [2], in particular Safety Guide Q2 on Non-conformance Control and Corrective Actions, Safety Guide Q4 on Inspection and Testing, and Safety Guide Q13 on Quality Assurance in Operation.

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

Plant Response/Action:

A / Analysis of causes

- Cause 1: Work packages are not always in line with expectations, either because risk assessments are inadequate, or because procedures are inappropriate or incomplete.
- Cause 2: Quality defects occur during the execution of certain activities due to poor familiarity with work packages, lack of proficiency in best-practice techniques, poor use of HP tools, and non-compliance with procedures.

B / Strategy adopted to solve the recommendation/suggestion

Actions to improve the quality of maintenance preparation and execution are led by the maintenance/operations quality (MQME) programme. The drivers for improving the quality of maintenance work fall within the scope of the MQME sub-process. The scope of this sub-process is described in the Integrated Management System (IMS). The MQME committee brings together the MQME contacts from each department on a monthly basis to track indicators and steer the actions defined in the plant's annual performance agreement action programme. Use of HP tools and procedure compliance were selected as key Elementary Processes and are managed within the 'Managing safety fundamentals and safety culture' sub-process.

C / Action plan

- Cause 1: Work packages are not always in line with expectations, either because risk assessments are inadequate, or because procedures are inappropriate or incomplete.
  - Action 1: Organise reviews of sensitive activities during modular preparation (in normal operation and outage) to challenge the risks and mitigations for

sensitive activities, including in particular practice drills before activities are carried out.

- Deadline: 31/12/2018
- Action 2: Set up a risk assessment working group to improve the quality of risk assessments, via the creation of a 'risk library' and the use of a corporate tool for production of risk assessments (ADREX).
- Deadline: 30/09/2019
- Action 3: Incorporate operating experience from maintenance activities, in order to update procedures where required. This action is based on the use of the eBrid application to record post-job debriefs, and the use of the corrective action programme to manage follow-up actions.
- Deadline: currently being monitored

- Cause 2: Quality defects occur during the execution of certain activities due to poor familiarity with work packages, lack of proficiency in best-practice techniques, poor use of HP tools, and non-compliance with procedures.
  - Action 4: Reinforce expectations regarding the 'four maintenance and operations quality essentials' determined at corporate level for all sites. In particular, the first of these four essentials is 'Familiarising yourself with the activity and the associated work package, and stating that you are ready to carry out the work'.
  - Create posters for meeting rooms, and cards to be carried with badges.
  - Deadline: 30/04/2019
  - Action 5: Clarify key points for workers when familiarising themselves with work packages.
  - Deadline: 31/12/2018
  - Action 6: Take action to safeguard skills in outages (practices on 'SECOMAT' mock-ups) to ensure proficiency in best-practice techniques in advance of outages.
  - Deadline: 30/03/2019 for outage 3P30, and 30/07 for outage 4R32
  - Action 7: Clarify expectations for 'instinctive' use of HP tools (in 'reflex action' mode)
  - Deadline: Macro-Process 3/Macro-Process 9 Committee meeting on 22/01/19
  - Action 8: Communicate procedure compliance expectations within teams
  - Deadline: 31/10/2019
  - Action 9: Establish agreed objectives for manager-in-the-field (MIF) tours to check and support the correct implementation of maintenance execution fundamentals.
  - Deadline: currently being monitored

D / Progress of action plan as of to date

Action 1: All reviews of sensitive activities have been implemented during modular preparation (in normal operation and outage). Sensitive activities which can be safeguarded by means of practice drills carried out in advance are defined during the reviews. Execution of the practice drills is managed in operational meetings, and via site performance reviews. The execution rate for practice drills in advance of sensitive activities has increased since they were introduced in 2018.

Action 2: The risk assessment working group met six times in 2018 and has met five times in 2019. The risk library is available for risks associated with FME, lifting, qualification and seismic events, and will be further supplemented in 2019. 90 people were trained in the use of

the corporate tool for production of risk assessments (ADREX) in May and June 2019. Around one hundred people are scheduled to receive training in September 2019.
Action 3: A total of 3400 condition reports have been entered in the eBrid application by 350 people (including contractors) since the application was opened in February 2018. Over 600 condition reports have been the subject of actions in the corrective action programme to improve work packages and update risk assessments or procedure worksheets.
Action 4: Posters on the ‘four maintenance and operations quality essentials’ have been displayed, and badge cards have been distributed to plant personnel and permanent contractors on site.
In 2018-2019, EDF peer reviews on the topic of maintenance and operations quality showed good momentum in this area, and an established organisation. The latest of these reviews highlighted the following:

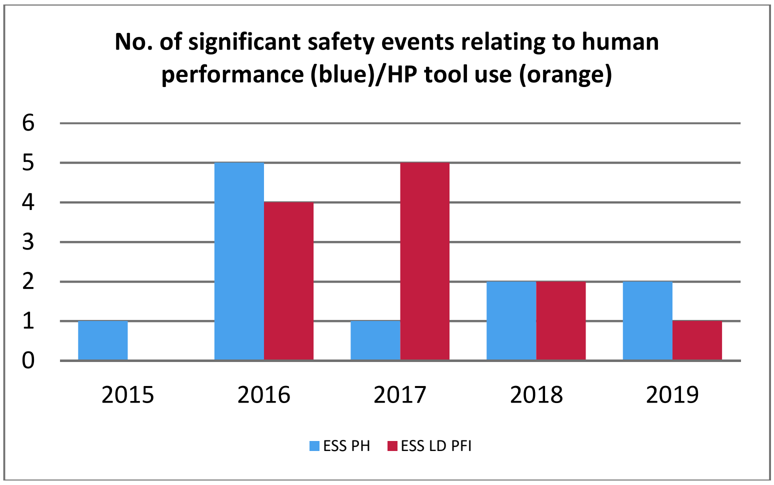
- The responsiveness of the maintenance departments to the suggestions from previous peer reviews
- Improvements in familiarisation with work packages: in the majority of activities observed, workers had familiarised themselves with the package, including practice drills for sensitive activities.
- The organisation and management of practice drills for sensitive activities are real strengths at the plant.

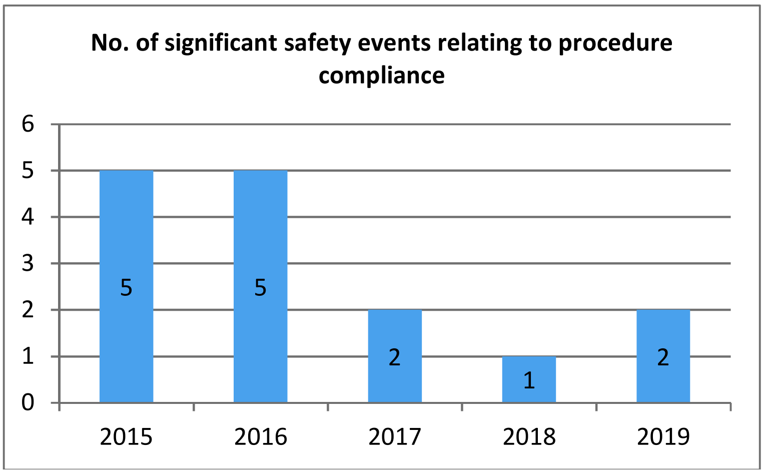
Action 5: The key points for workers when familiarising themselves with work packages have been clarified and identified via posters displayed at locations where workers are likely to carry out work package familiarisation.
Action 6: Around one hundred workers (mainly contractors) took part in a two-day event on the safeguarding of skills in outages (with practices on ‘SECOMAT’ mock-ups) in advance of outage 3P30. One day of training is scheduled for outage 4R32 on 30.07.
Action 7: The expectations for instinctive use of HP tools were defined and shared at the Safety Committee meeting on 22/01/2019. These expectations have been implemented in all of the line departments, and are the subject of feedback at monthly meetings of HP tools champions and at MIF meetings held every two weeks.
Action 8: Principles for procedure use (step-by-step, for reference, for information) were defined at Bugey several years ago, and are consistent with the principles defined at the corporate level. A safety culture workshop is scheduled in 2019 to communicate these principles to teams.
Action 9: Manager-in-the-field (MIF) tours are tracked via the site’s indicator dashboard. At the end of June 2019, the two leading topics for MIF tours were HP tools and procedure adherence, and the target for MIF tours on the topic of HP tools was exceeded (530 tours, compared with 360 expected).
Actions are tracked in the 2019 annual performance agreement programme, with regular status updates in site performance reviews, down to sub-process level.

E / Measuring action effectiveness

- Significant safety events relating to maintenance and operations quality defects, human performance, and HP tool use

Significant safety events due to maintenance and operations quality defects per unit	**2016**	**2017**	**2018**	**June 2019**
	9.5	5.5	3.75	3.25





– **Execution of practice drills for sensitive activities**

2018	Execution rate for practice drills	Plan trace5	Actual trace 5	Plan trace6	Actual trace 6	Plan 4P31	Actual 4P31	Plan 5P30	Actual 5P30	Plan 2P32	Actual 2P32
TOTAL SITE	63%	21	6	16	11	71	38	68	48	54	42
		29%		69%		54%		71%		78%	

2019	Execution rate for practice drills	Plan trace1	Actual trace1	Plan trace2	Actual trace2	Plan trace3	Actual trace3	Plan 3P30	Actual 3P30
TOTAL SITE	88%	26	23	40	27	43	43	54	50
		88%		68%		100%		93%	

IAEA comments:

The plant had reviewed and analysed this issue and concluded that the causes were: inadequate risk assessment and inappropriate and incomplete procedures; lack of familiarity with work package, lack of proficiency in performing works, poor use of human performance tools, and non-compliance with procedures. Nine actions were taken to address the two causes identified.

The plant had enhanced and implemented nine sub-processes to improve work quality, such as identifying critical task, familiarizing with work packages, conducting emergent work properly, better use of operating experience, improving FME implementation, and improving human performance tool use. Representatives from each department in the plant were invited to contribute to the committee on the improvement of work quality.

The plant improved the identification of critical tasks by developing standard risk assessments, periodic meetings were held to identify risks and develop mitigation measures, and the plant also provided various mechanisms to improve the proficiency of workers by using mock-up equipment, using e-learning, and conducting simulated work execution. High-risk activities were also flagged in the operational focus meeting to improve the awareness of critical tasks.

The plant started a campaign to instil the awareness of four prerequisites for activities, namely familiarization with the work package and fully ready for the work, self-conscious use of human performance tools, strictly compliance with FME requirements and no interruption and distraction during line-up and tagging operations. A specific briefing was given to plant and contractor employees on how to properly prepare and become familiarize with work package contents. Maintenance fundamental training was given to plant and contractor staff before outages.

Self-assessments were conducted by the plant to assess the progress on improving quality of work activities and emphasises was put on areas with performance gaps.

The plant witnessed improvements in quality of work activities, the number of events related to quality of work activities reduced to 3.5 per unit in August 2019 from 5.5 per unit in 2017. Days of lost generation due to quality of work activities was reduced to 10.7 days in 2019 from 29.7 days in 2018. The number of quality related issues in maintenance and operation was reduced to 13 in 2019 from 22 in 2017.

However, during a field visit by the OSART follow-up team, it was observed that two electrical technicians did not remove the large number of metal keys chained to their pants when working on a battery bank with naked copper bar connectors. This left a potential for unintended electrical contact and short-circuit. Another electrical technician was asked to hold a plastic ruler that could potentially have had traces of acid on it with his unprotected hand, .

Conclusion: Satisfactory progress to date

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

Function based Health Reports are produced for the protective equipment against main site hazards (e.g. loss of heat sink, flooding). The team considered this as a good performance.

5.2. PERIODIC SAFETY REVIEW

EDF Corporate made a comparison between the Periodic Safety Review (PSR) safety factors recommended by the IAEA and those used for the PSRs prepared for French plants. Safety factors relating to human, technical and organisational factors are typically evaluated in connection with modifications. Other aspects relating to organisation, management system, safety culture, procedures, etc, are typically evaluated on a yearly basis, so EDF considers this as sufficient to meet the purpose of the PSR. The team encouraged the plant to also evaluate the cumulative effects and trends of these aspects on a 10 year cycle in order to ensure that all important safety factors are adequately addressed in their PSRs.

5.5. USE OF PSA

A specific probabilistic safety assessment (PSA) level 1 model for the plant has been developed by EDF Corporate technical support departments, however, the PSA level 1 model is not used at the plant for any application. The team encouraged the plant to improve the awareness of the relevant plant staff about the use of PSA models and results to improve nuclear safety.

5.6. SURVEILLANCE PROGRAMME

The plant surveillance programme (General Operating Rules, Chapter IX) does not include the spent fuel pool integrity/leak tests. Criteria for collective spent fuel pool leaks are stated in litres/hour, which is not appropriate for the dry boron deposit (that cannot be measured in litres) present in the spent fuel pool leak collection system. The team encouraged the plant to apply to safety-related civil structures (such as the containment building and the spent fuel pool) the same approach for surveillance tests as for other safety-related systems and components.

The plant has developed a new predictive e-monitoring tool for early detection of potential equipment deterioration. The tool gathers equipment technological data from the plant IT system and compares the data with expected values. Potential equipment deterioration can be predicted using the equipment data modelling. The e-monitoring tool can automatically detect deviations from the expected data range and send an early alert before reaching the alarm level, when operating staff would become aware. This was identified by the team as a good performance.

5.7. PLANT MODIFICATION SYSTEM

A large number of temporary modifications exists at the plant, some of these are very old and their number is not significantly decreasing. The plant performs impact analysis at the system level but does not assess the cumulative effect of all existing temporary modifications on plant safety. The number of temporary modifications does not meet the fleet objective. The team made a recommendation in this area.

The design documentation for modifications is required to be ready at the latest four months before implementation. However, delays exist in the preparation of modification documentation and many modifications have needed to be postponed. Only 50% of the plant modifications planned for implementation in 2017 were completed at the time of the mission. The team encouraged the plant to focus on the modification preparation phase in order to avoid any delays in the implementation.

DETAILED TECHNICAL SUPPORT FINDINGS

5.7. PLANT MODIFICATION SYSTEM

5.7(1) Issue: The temporary modification programme does not ensure that temporary modifications are limited in time and number.

The team noted the following:

- The following temporary modifications exist on safety related systems:
  - 54 temporary modifications (21 of them safety related) on the in-core monitoring system (RIC), several thermocouples have been inhibited since 2010
  - 9 temporary modifications on the reactor cooling system (RCP), the oldest dates from 2004
- During the period from 2013 to 2017, the number of temporary modifications has not decreased below that of 2010.
- The number of temporary modifications (450) is higher than the fleet objective (250 for a 4 unit site).
- The number of temporary modifications older than 5 years is 21%, 8 years is 16% and 10 years is 7%.
- The plant oldest temporary modifications are:
  - 1 from 2004
  - 6 from 2005
  - 5 from 2006
- The plant performs impact analysis of temporary modifications at the system level, but does not assess the cumulative effect of all existing temporary modifications on plant safety.

Without a robust programme to manage temporary modifications, the cumulative impact of temporary modifications may result in adverse effect on the plant operation.

Recommendation: The plant should improve its temporary modification programme to ensure that temporary modifications are limited in time and number.

IAEA Basis:

SSR-2/2 (Rev. 1)
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.

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

NS-G-2.3

6.3. The number of temporary modifications should be kept to a minimum. A time limit should be specified for their removal or conversion into permanent modifications.

6.5. The plant management should periodically review outstanding temporary modifications to consider whether they are still needed, and to check that operating procedures, instructions and drawings and operator aids conform to the approved configuration. The status of temporary modifications should be periodically reported (typically at monthly intervals) to the plant manager. Those that are found to be needed permanently should be converted in a timely manner according to the established procedure.

6.6. Temporary modifications should be clearly identified at the point of application and at any relevant control position.

Plant Response/Action:

A / Analysis of causes

The plant’s strategy for the removal of temporary plant modifications (MTI) has resulted – in large part due to the removal of these non-safety-challenging modifications being carried over to the fourth ten-year-outages – in the accrual of a large number of ‘long-lived’ MTIs in the plant. This strategy has not proven to be sufficiently proactive in maintaining the number of MTIs at benchmark values. Furthermore, although the plant has strengthened its stewardship of the number of MTIs, there are still temporary modifications without a defined management plan at the current time, or, temporary modifications with a management plan that has been defined but not yet completed (where there has been no appraisal of a long-term modification, in particular). Lastly, the solution of implementing an MTI in the units is not adequately challenged during the appraisal phase for the temporary modification, thereby maintaining significant incoming flows.

- Cause 1: The plant’s multiyear strategy for the removal of MTIs has led to postponing the removal of a number of these, without safety significance, to the fourth ten-year-outages, and has given rise accordingly to long-lasting MTIs in the plant.
- Cause 2: The networking between the Temporary Modification process and the Long-Term Plant Modification process is not sufficiently robust to ensure conclusive resolution of some MTIs and their removal from the plant.
- Cause 3: The solution of implementing an MTI in the units is analysed in the needs assessment conducted during the appraisal phase of the temporary modification but is not adequately challenged, thus sustaining significant incoming flows.

B / Strategy adopted to solve the recommendation/suggestion

In an effort to strengthen its control of the process and bring the number of MTIs back to benchmark values, the plant has driven through a number of actions that bring together all the relevant stakeholders on site. In particular, a training programme (2016-2017) was delivered to all persons likely to take part in the temporary modification process, at both management and operational level, EDF personnel as well as contractor company staff. In all, approximately 500 individuals were trained on the process, including operations personnel.

What is more, stewardship of the process was reinforced thanks to the appointment of one single Operational Lead (lead for directive DI74) for the site, a Strategic Lead, and Temporary Modification Representatives within each site department, notably in the Maintenance Trades, and Operations and Reliability departments, tasked with the implementation of directive DI74 on the front line, among the stakeholders. The Strategic and Operational Leads monitor indicators on a quarterly basis, to pinpoint potential negative drifts, and share any difficulties encountered with the process. The process is also followed closely by the Station Director, since it features among the high-stakes processes: an annual review, chaired by the Station Director, provides a forum for assessing the performance results of the process, identifying its strengths and weaknesses, setting out a multiyear plan for reducing the number of MTIs, and validating suitable action plans.

Quarterly reviews have also been established, undertaken by the Operational Lead and Maintenance Trades Representatives, to jointly examine all the MTIs in place in the units, and challenge efforts made to reduce their numbers.

All of the above actions designed to strengthen the stewardship of the plant's process have resulted in maintaining the number of MTIs present in the units at a high (approximately 475 MTIs across all units) but stable number between 2015 and 2018.

In June 2018, a working group was set up to drastically reduce the number of MTIs installed in the plant: the actions implemented following this review have brought the number of MTIs down to a number that is similar to the figure standing after the third ten-year-outages.

The remaining actions needed to continue reducing the number of MTIs involve, on the one hand, working on the outstanding backlog of modifications in the plant in order to define an appropriate management plan (initiate local modifications for appraisal, with a view to removing corresponding MTIs) and on the other hand, maintaining strong stewardship of the removal of new MTIs in the plant by improving relationships with the plant's multiyear scheduling group. The objective that has been set, for both existing MTIs and future MTIs, is a systematic analysis of the plant's capacity to incorporate their removal in the fourth ten-year-outage programmes, and to provide justifications for any delays beyond this deadline.

C / Action plan

- Cause 1: The plant's multiyear strategy for the removal of MTIs has resulted in carrying the removal of a number of non-safety-challenging MTIs over to the fourth ten-year-outages, and hence maintaining long-standing MTIs in the plant.
  - Action 1: On a yearly basis, present and validate the 5-year MTI removal plan, in the presence of plant senior management and all departments.

  Deadline: 05/02/2019.
  - Action 2: Proceed with the reinforced stewardship of existing MTIs, on a quarterly basis, and establish a follow-up of the number of MTIs in the units as part of the plant's performance review.

  Deadline: 31/12/2019.
- Cause 2: The networking between the Temporary Modification process and the Long-term Plant Modification process is not sufficiently robust to ensure conclusive resolution of some MTIs and their removal from the plant.
  - Action 3: Conduct a 2nd level analysis of the MTIs installed in the plant, and conduct appraisals of the local modifications identified as essential for reducing the number of MTIs.

  Deadline: 30/06/2019.
  - Action 4: Strengthen links between the Temporary Modification process and the Long-term Plant Modification process, to simplify the system for managing MTIs as local modifications wherever necessary.

Deadline: 30/06/2019.

– Cause 3: The solution of implementing an MTI in the units is analysed in the needs assessment conducted during the appraisal phase of the temporary modification but is not adequately challenged, thus sustaining significant incoming flows.

The training given to all stakeholders involved in the process (500 individuals trained between 2016 and 2017) provided an opportunity to reiterate the different phases to be complied with prior to implementing a temporary modification in the plant, and to remind those involved in the needs assessment that the first step in reviewing an MTI as a solution is to challenge this option (is there an alternative solution? What else could be done?). Furthermore, the reinforced stewardship of the MTI backlog, notably via quarterly reviews, has raised stakeholder awareness of the presence of MTIs in the plant, and highlighted the need to limit their number: this has helped improve the quality of the essential challenges raised before considering any new MTI in the plant, at all validation levels of the organisation.

D / Progress of action plan as of to date

Action 1: This action is underway. The programme was presented and validated for the first time in a Safety Committee meeting on 5 February 2019.

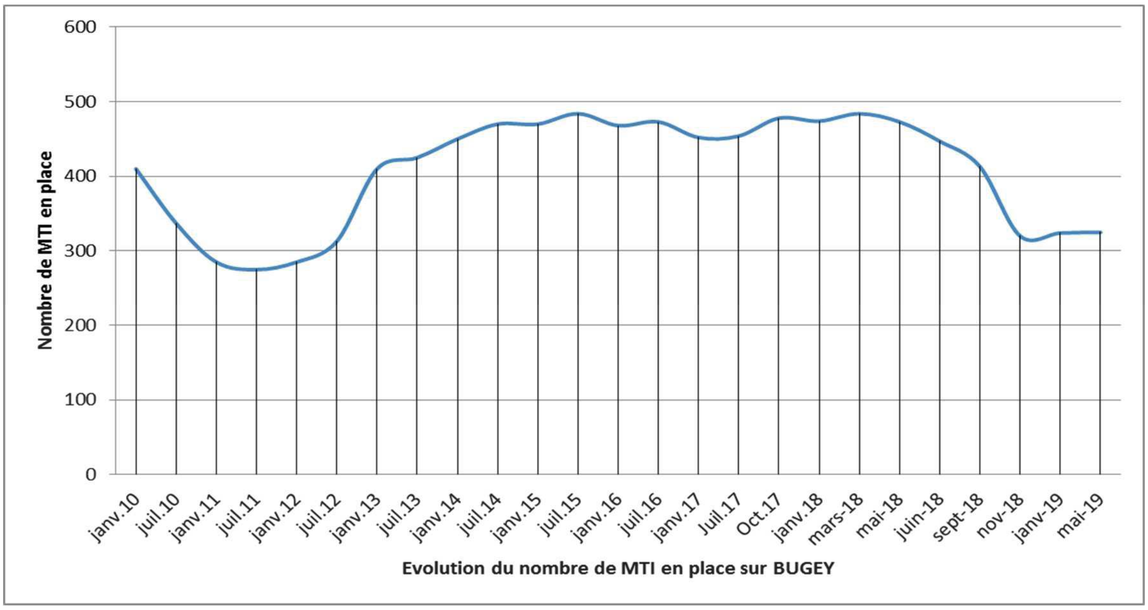
Action 2: This action is underway. The quarterly management system has been in place since the end of 2016. Monitoring of the number of MTIs in the plant as part of the plant's performance review remains to be implemented.

Action 3: A 2nd level analysis of existing MTIs installed in the units was carried out during the MTI review of 21 February 2019. The task now is to follow up and examine all identified casefiles.

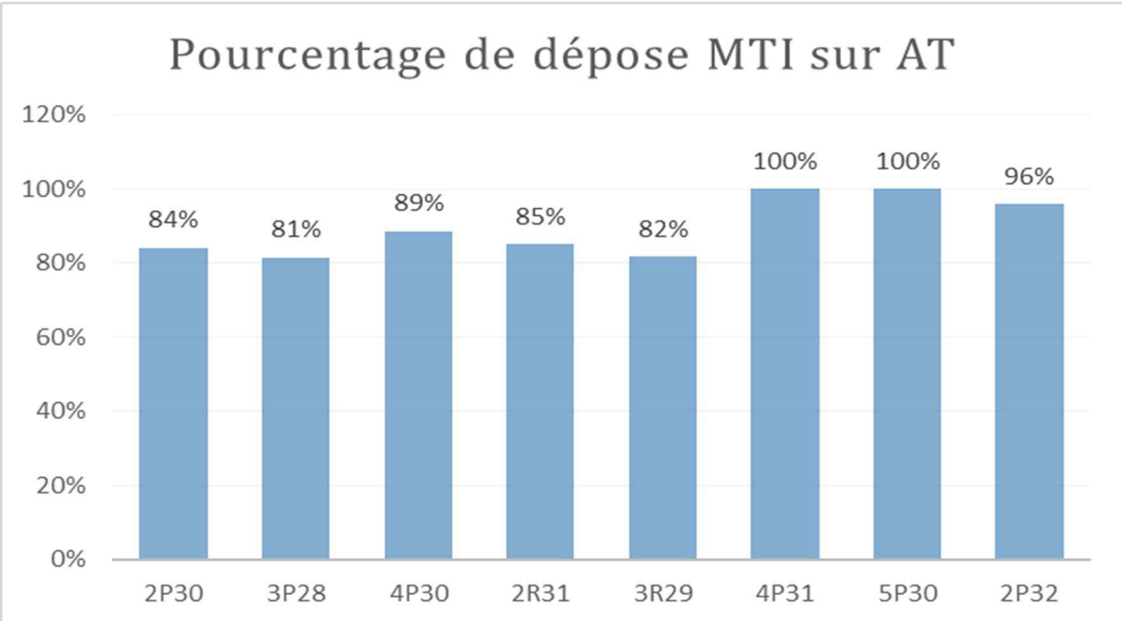
Action 4: This action is underway.

E / Measuring action effectiveness

All in all, the aforementioned actions aim to reduce the number of MTIs and limit the length of time they are installed in the plant. Monitoring the total number of existing MTIs and the lifespan of MTIs is therefore the most appropriate measure of the effectiveness of actions taken. The graph below (trend in the number of MTIs in place at Bugey since 2010) shows that numbers stabilised between 2014 and 2018 subsequent to a significant increase from 2012 to 2014, followed by a sharp tailing-off early 2018, before returning to a figure that is similar to the figure standing after the third ten-year-outages:



The following graph shows the performance results for the removal of MTIs during recent outages (percentage of completed removals versus planned removals):



IAEA comments:

The strategic pilot manager and operational project manager in Bugey NPP were given responsibility to resolve this issue. The main cause of the issue was a decision to postpone the removal of TMs, in particular on SSCs not important to safety, until the fourth ten year outage scheduled in 2020 (VD4). The second cause was that the process of changing TMs into permanent modifications was not adequately challenged by the site management. The third cause was that the level of inflow of new TMs was very high (around 150 per year). The root cause for this was that the analyses supporting new TMs were not challenging enough.

The corrective actions were to appoint a strategic pilot manager and operational project manager in order to reinforce the management of TMs. Since 2016, the operational project manager has led a working group to review the status of TMs quarterly. The strategic pilot manager, the maintenance engineers and operation representatives participated in this working group. However, local Engineering Department representatives responsible for permanent modifications were not members of the group and are only informed of the results. TMs without a removal project were analysed as well as TMs with delayed removal projects. The aim was to remove TMs for SSCs important to safety in the next outage and for SSCs not important to safety during VD4. The action plan for the removal of TMs was presented annually to management with strengths and weaknesses and updated action plans.

A one-time working group was set up in February 2019 to initiate the process of converting existing long-term TMs into permanent modifications This working group had the same composition as the previously mentioned working group with the engineers responsible for permanent modifications also invited.

To reduce the inflow of new TMs, additional training was provided. It included raising awareness of the need to challenge new TMs development and performing analyses concerning the need for new TMs. Training was performed from 2016 to 2017. About 500 persons were trained in 27 sessions for engineers and technicians and 6 sessions for managers.

The total number of TMs was around 450 in the period between 2014 and June 2018. Outages in 2018 and the one-time working group in June 2018 led to a reduction of 100 TMs by the end of 2018. Currently, the total number of TMs was around 330 whereas the EDF objective for the site with 4 units is 120 TMs.

30 TMs (14 on SSCs important to safety) have been in place since before 2010, of which 27 were planned to be removed following VD4, one after VD4 and the other two, installed on SSCs not important to safety, had no defined removal date.

148 TMs were originated in the period 2011 to 2017 (51 of them on SSCs important to safety). These 51 TMs have associated actions and 26 will be removed during the next outage, 18 require modifications at local level, and 7 require fleet-wide modifications.

The trend of the inflow of new TMs opened every year does not show significant improvement yet (147 in 2017, 122 in 2018, 53 from January to the beginning of April 2019).

Conclusion: Satisfactory progress to date.

6. OPERATING EXPERIENCE FEEDBACK

6.5. INVESTIGATION AND ANALYSIS

In a number of root cause analyses, some important elements were missing or not documented in the final Root Cause investigation report. These elements include the evaluation of internal and external operating experience, evaluation of previous similar events, evaluation of the extent of cause and extent of condition. Furthermore, these investigations did not include actions to perform a formal effectiveness review of the corrective actions to prevent recurrence. The team made a suggestion in this area.

6.7 TRENDING AND REVIEW OF OPERATING EXPERIENCE

The overall corrective action programme consists of four databases for corrective actions, three databases used for trending, five databases for capture of non-reportable issues and events, and two meetings for the approval of events. There are different coding schemes utilized for each database, and no trending tools available that can extract data from all of the various databases simultaneously. Formal root cause analysis is not performed when adverse trends are identified. This makes effective trending of corrective action programme data cumbersome, time consuming and less effective. The team encouraged the plant to improve the effectiveness of trending of operating experience.

DETAILED OPERATING EXPERIENCE FEEDBACK FINDINGS

6.5. INVESTIGATION AND ANALYSIS

6.5(1) Issue: Root cause analysis reports performed for significant events do not always include important elements and formal effectiveness reviews of important corrective actions are not performed

The team noted the following:

- ‘Extent of cause’ and ‘extent of condition’ are not documented in many root cause or apparent cause evaluations. Examples include:
  - Failure of containment sweeping ventilation valve 3 EBA 017 VA to close
  - Group 1 LCO caused by premature racking out of CVCS pump 4 RCV 001
  - Nuclear auxiliary building ventilation 9DVNa flow rate lower than tech spec requirements for 24 seconds during an Operations maneuver
- Although closure reviews are performed for each completed corrective action, formal effectiveness reviews of corrective actions are not performed for each event. Examples include:
  - Racking in circuit breakers for Reactor Coolant Pumps 2 RCP 001 PO & 2 RCP 003 PO during maintenance outage mode
  - Pressure excursion of U2 Reactor Coolant System during maintenance outage mode
  - Unplanned unavailability of the LHG Diesel generator on Unit 4 during installation of tagging
  - Unquantified primary leak rate greater than 230 litres per hour during unit 4 hot shutdown
- Root Cause investigations do not always document the evaluation of previous similar events or external operating experience during root cause analysis and investigations. Examples include:
  - Safety injection and automatic reactor scram after closure of main steam valve 2VVP003VV
  - Automatic reactor SCRAM after trip of reactor protection breaker module 3 RPR 501 UP
  - Improper installation of valve handle on valve 2 LHG 015 VA resulting in erroneous installation of safety lockout on the LHG emergency diesel generator, similar event SAL D5380 RESS202313.
- No formal root cause qualification is indicated in the training records (CIF) of most managers and directors that are approving the investigations.
- Although equipment failure root cause investigations are documented in plant corrective action programme database SYGMA, effectiveness reviews of root cause investigations are not always performed. Examples include:
  - 00013463 – Total dynamic head criteria for the auxiliary feedwater pump not met during performance of ASG 037 surveillance test.
  - 00013141 – Availability of the pump in question due to the total dynamic head criteria for the auxiliary feedwater pump not being met during performance of ASG 037 surveillance test.

Failure to effectively conduct root cause investigations may result in a recurrence of previous similar events.

Suggestion: The plant should consider improving the performance of root cause investigations to prevent the recurrence of significant events.

IAEA Bases:

SSR-2/2

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

GSR Part 2

4.26. All individuals in the organization shall be trained in the relevant requirements of the management system. Such training shall be conducted to ensure that individuals are knowledgeable of the relevance and the importance of their activities and of how their activities contribute to ensuring safety in the achievement of the organization's goals.

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…whether a similar occurrence has taken place earlier at the same installation or at an installation of a similar type.

4.7. Event analysis should be conducted on a timescale consistent with the safety significance of the event. The main phases of event analysis can be summarized as follows:

- Establishment of the complete event sequence (what happened);
- Determination of the deviations (how it happened);
- Cause analysis:
  - Direct cause (why it happened);
  - Root cause (why it was possible);
- Assessment of the safety significance (what could have happened);
- Identification of corrective actions.

5.3 Recommendations on corrective actions should be proposed on the basis of the feedback of either internal or external information and should be identified prior to or as a result of a thorough analysis of an event.

Appendix IV Section IV.4. The plan for corrective action should include a provision for verification of the effectiveness of the actions.

Plant Response/Action:

A / Analysis of causes

When the site of BUGEY rolled out the In-Depth Event Analysis method in July 2015, the conditions were not the best possible (lack of resources on the Human Factor Consultant level, which are essential for the support they provide and the challenges they make to Significant Event analyses). The site found it difficult to carry out In-Depth Analyses of Significant Events correctly because of the lack of guidance from the Human Factor Consultants. From 2016 onwards, the site focused on improvement: firstly, by correcting the initial mistakes in the way the In-Depth Analysis method was used; then by probing deeper for the root causes and developing more relevant corrective actions. BUGEY NPP has been in the momentum of continuous improvement since 2016. In 2018, the corporate level Nuclear Safety Committee/Nuclear Safety Management (GPSN/MSN) considered that BUGEY NPP analyses are of high quality, and now BUGEY is in the first quartile of the fleet for the depth of root cause analysis and the relevance of the corrective actions. The site of Bugey can now concentrate on OPEX analysis, on the extent of condition and on corrective action effectiveness reviews.

– Cause 1: The points to be analysed from the OPEX, extent of condition and effectiveness reviews are not yet included in our analyses.
– Cause 2: The corporate model and the site-level model for Significant Event Reports do not clearly state that the analysis of any OPEX (similar Significant Events at fleet and site level, and review of any precursor event) must be included in the Significant Event Report.
– Cause 3: The In-Depth Analysis corporate guide and the site-level model for Significant Event Reports do not insist on the need to reflect on the extent of condition.

B / Strategy adopted to solve the suggestion

The Operational Coordinator (PO) for the In-Depth Analysis of Significant Events elementary process has discussed the shortfalls mentioned above (OPEX review, the extent of condition analysis and the need to set up corrective action effectiveness reviews) with the Nuclear Safety correspondents from all the Departments during the Nuclear Safety Committee meetings on 16/11/2017 and 27/06/2018.

The Operational Coordinator of the In-Depth Analysis of Significant Events elementary process has also presented these shortfalls and the associated corrective actions in the Weekly Coordination Meeting (RPH):

– RPH on 17/09/2018 for reviewing OPEX and analysing the extent of condition.
– RPH on 12/11/2018 to set up corrective action effectiveness reviews for Safety Significant Event Reports and Environmental Significant Event Reports.

The methodology chosen for corrective action effectiveness reviews following Significant Event Reports originates from benchmarking on other French sites, on the Canadian NPP, BRUCE and from the IAEA (discussion with the reviewer during the OSART in October 2017). The proposed methodology was validated by the Nuclear Safety Committee on 16/10/2018 and was rolled out for Safety Significant Event Reports and Environmental Significant Reports for events declared after 01/11/2018. OPEX will be generated after about 1 year of use and presented at the annual In-Depth Analysis Review in 2019.

The annual In-Depth Analysis Review, presented to Nuclear Safety correspondents from the Departments at the Nuclear Safety Commission on 23/01/2019, highlighted the areas for improvement for 2019 which mostly corresponded to the shortfalls identified by the OSART: OPEX review, extent of condition and corrective action effectiveness reviews. We have nevertheless seen some progress on OPEX review and extent of condition since Summer 2018.

C / Action plan

– Cause 1: The points to be analysed from the OPEX, extent of condition and effectiveness reviews are not yet included in our analyses
  – Action 1: Roll out the corrective action effectiveness reviews for Safety Significant Event Reports and Environmental Significant Event Reports of events declared after 01/11/2018.

  Deadline: for events declared after 01/11/2018

- Action 2: After about one operational year, collate OPEX from rolling out the effectiveness review tool for actions resulting from Safety Significant Reports and Environmental Significant Reports, to consider if any adjustments are necessary and if the scope is covered. Include this OPEX in the 2019 annual review for the In-Depth Analysis process and present it to the Nuclear Safety Commission at the end of 2019.

Deadline: 31/12/2019

- Cause 2: The Significant Event Report models do not clearly state that the analysis of any OPEX must be included in the Significant Event Report
  - Action 3: Consolidate both the OPEX review (similar events and precursor events) and the extent of condition analysis.

Deadline: 30/09/2019

- Action 4: Change the site-level model for Significant Event Reports so that it clearly states that an OPEX review is required: add paragraph 3.5.3 'OPEX Review' – Similar events on the site or in the fleet and precursor events.

Deadline: 31/07/2018

- Cause 3: The In-Depth Analysis corporate guide and the site-level model for Significant Event Reports do not insist on the need to consider the extent of condition.
  - Action 5: Change the site model for Significant Event Reports to make it clear that the extent of condition must be considered: *'This paragraph is never left blank',* with a description of the type of questions to ask: 'identify if the dysfunction is limited to the event being analysed or if it can be found elsewhere: other teams, departments, sites, equipment, procedures, etc'.

Deadline: 31/07/2018

D / Progress of action plan as of to date

Action 1: The corrective action effectiveness review has been rolled out for Safety Significant Event Reports and Environmental Significant Event reports of events declared after 01/11/2018

Action 2: OPEX from rolling out action effectiveness reviews following Safety Significant Event Reports and Environmental Significant Event Reports will be collated for the 2019 annual review of the In-Depth Analysis process and presented to the Nuclear Safety Commission at the end of 2019.

Action 3: The action for consolidating OPEX and analysis of the extent of condition is ongoing.

Action 4: The site model for Significant Safety Reports has been changed. It now clearly states that an OPEX Review is required, with the addition of paragraph 3.5.3 'OPEX Review' – Similar event on the site or in the fleet and precursor events.

Action 5: The site model for Significant Event Reports has been changed to make it clear that the extent of condition must be considered.

E / Measuring action effectiveness

Overall, the quality of our analyses is considered to be very good, based on the feedback given by the Corporate Nuclear Safety Commission, positioning us as the first site in the fleet ranking on this specific subject.

As for the Regulator, they never send remarks on the quality of our significant event reports.

Since 2018, the Corporate Nuclear Safety Commission (GPSN/MSN) assesses the quality of analysis for the OPEX Review. This assessment helps the site to judge how much progress has been made. With this in mind, the site has noticed that OPEX Reviews have improved since the paragraph dedicated to OPEX Review (§ 3.5.3) was included in the Significant Event Report model. The corporate also assesses the relevance of the review in relation to the extent of condition.

For the rolling out of the corrective action effectiveness review, the OPEX from the 1st operational year will allow us to determine how effective it has been and to evaluate the strengths and weaknesses. The effectiveness review of the tool which aims to prevent repeat events or recurrence of similar causes will only become operational at a later date and will be evaluated by: no repeat events or no similar causes.

IAEA comments:

The plant analysed the root cause of the issue and identified that there were insufficient corporate and plant requirements related to important elements of event analysis.

The plant did not clearly distinguish between ‘extent of cause’ and ‘extent of condition’ based on the corporate approach. Instead of this term it used the term ‘extent of problem’ in the event investigation. ‘Extent of problem’ was analysed for all significant events and for some interesting events. In July 2018, the plant changed the template for significant event evaluation to ensure the ‘extent of problem’ is always considered.

The plant adopted methodology for corrective actions effectiveness reviews from benchmarking at other French sites, from Bruce Power in Canada and from IAEA. The plant created an organization for the corrective action effectiveness evaluation; however, not all corrective actions adopted for significant events were subject to effectiveness evaluation. The plant chose the most important corrective actions of each significant event to evaluate them for effectiveness. They were selected by the group analysing the event using their own judgment. The plant decided to start evaluating corrective action effectiveness for the events declared after 1 November 2018. To evaluate the corrective action effectiveness, it was necessary to check if similar events had taken place at the plant. Monitoring of possible similar events occurrence takes about one year. Because of this no formal effectiveness review of corrective actions had been finalized at the time of the follow up mission.

Since July 2018, the plant started consistently to evaluate previous ‘similar events’ during significant events investigation. The plant evaluates ‘similar events’ based on similar type of equipment, similar root causes and similar consequences. However, the time period for the similar event occurrence was not defined. External operating experience was consistently used for significant events investigation and the corporate event database CAMELEON was used as a source of external operating experience.

Conclusion: Satisfactory progress to date

7. RADIATION PROTECTION

7.3. RADIATION WORK CONTROL

Currently, the plant has a legacy contamination issue and has a plan to address it. At the time of the mission, 4% of the rooms in the Radiologically Controlled Area (RCA) have a contamination level between 0.4Bq/cm2 and 4Bq/cm2. 15% of the rooms in the RCA have a contamination level more than 4Bq/cm2. The team encouraged the plant to implement the current action plan in a timely manner to improve this condition.

During plant walk downs performance shortfalls were identified in housekeeping and cleanliness in some areas inside the RCA. These performance shortfalls, if not addressed, will continue to contribute to contamination control issues. The team encouraged the plant to address these performance shortfalls and improve in this area.

7.4. CONTROL OF OCCUPATIONAL EXPOSURE

A computer system equipped with badge recognition is used to control the movement of radioactive sources present on the site. The team considered this system as a good practice.

7.6. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

A lot of containers are used for the storage of potentially radioactive material outside the RCA. Some of the containers, although not currently in use, have overdue certification dates. The team encouraged the plant to improve in this area.

DETAILED RADIATION PROTECTION FINDINGS

7.4 CONTROL OF OCCUPATIONAL EXPOSURE

7.4 (a) Good practice: Effective management of radioactive source movements with a dedicated computer system without the involvement of dedicated radiation Protection personnel.

A computer system equipped with badge recognition is used to control radioactive sources present on the site. This system controls access to the building, to the source store room, and to the security safe that contains the sources. This system allows radioactive sources to be obtained without RP having to monitor the movement of the source.

Benefits:

- Only authorized workers can obtain the source that they need;
- Duration of access to the sources can also be limited in time;
- Computer monitoring of source withdrawals makes it possible to track and record any source movement, while limiting potential loss/theft;
- Autonomous worker, no need for an RP technician to open the safe which allows RP technicians to focus on their core activities.

Access to the source building

Identification of the authorized user

Keys box

Access to the authorized keys (source room and source locker)

Access to the authorized source

8. CHEMISTRY

8.2. CHEMISTRY PROGRAMME

The handling and use of hazardous substances is not consistently performed in a way that prevents adverse effects on industrial safety or the condition of equipment.

The plant chemistry quality control programme is not always followed to ensure that all procedural requirements and controls are adequately applied. For example: the plant performs online sodium measurements, the analyser produces analytical and verification data which are documented, however the plant personnel were not aware that there were some software deficiencies and some of the data on control cards of the online sodium analyser were out of limit. The team made a suggestion in this area.

The chemistry department operates an anti-scaling system to reduce deposits in the cooling tower. An environmentally friendly product for scale and sludge removal is added to the circulating water system. The team recognized this as a good practice.

DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY PROGRAMME

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

The team noted the following:

- At the hydrazine and morpholine dosing stations (F22, -7m unit3 at 3 SIR 004 BA), two unlabelled containers were found with flushing water of hydrazine and morpholine solutions. The only warning label was an unfixed piece of paper on top of the containers.
- In the radiochemistry laboratory of unit 2 and 3 a hazardous material cabinet was found not connected to the ventilation system. Chemicals within it were not stored in accordance with the rules for the combination of hazardous substances which were shown in a pictogram at the door of the cabinet.
- In the office of the demineralisation-water production plant two bottles of mercury nitrate, which is extremely dangerous, were stored in an unlocked cabinet which was only labelled ‘corrosive’ and ‘health hazard’.
- In the laboratory for effluent and secondary side analyses:
  - Some of the information on a label on a sampling bottle from the steam generator blow down system unit 5 was not readable.
  - A plastic bottle with an unknown fluid inside was unlabelled.
  - The printed date on the label of reserve samples of effluents was corrected manually and not signed by the worker.
  - A dosage instruction for phosphate was edited without signing.
  - Almost all liquid dispensers were not stored in a collecting basin.
- A battery of gas bottles (acetylene, carbon dioxide and argon) was stored in a cabinet next to the wall of unit 2/3. Although a safety chart for acetylene was attached to the cabinet doors, there was no signage for carbon dioxide or argon.
- In the general warehouse where grease and lubricants are stored, smaller amounts are refilled in smaller canisters. However, not all of the necessary hazard information was put on the new canisters.
- The floor of the warehouse for grease and lubricants is made as a containment basin. However, the single shelves inside the building do not have any extra barriers to keep leaks contained.
- In the boiler workshop building 42, two unlabelled oil cans were found. In the personal cabinet for the workers three bottles with chemicals were found and they were not supposed to be there.
- Two hazardous materials cabinets are not regularly inspected, the last inspection was in 2013. In the valves workshop building 38, a hazardous materials cabinet is not regularly inspected, the last inspection was in 2008. In this cabinet 3 insufficient manually labelled canisters were found.
- The injection and mixing stations in the water treatment building are shielded by plastic sliding doors. However, there were no danger symbols or labels on the outside of the doors.

Without consistent implementation of the policy for handling chemicals, there is an increased risk that the use of chemical substance and reagents could adversely affect plant equipment or personal industrial safety.

Suggestion: The plant should consider improving the application of its policy for handling chemicals to ensure that the use of chemical hazardous substances and reagents does not have an adverse effect on plant equipment or industrial safety.

IAEA Basis:

SSG-13

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

8.13. ‘Chemistry staff and other staff who deal with chemicals should be trained in the following specific areas:

(a) The handling of hazardous and flammable chemicals;

(b) The labelling of chemicals stored and used inside and outside the laboratory;

(c) Material safety data sheets;

(d) The use and maintenance of personal protective equipment;

(e) The specific use and storage of poisonous chemicals.

9.9. ‘Chemicals and substances should be labelled according to the area in which they are permitted to be used, so that they can be clearly identified. The label should indicate the shelf life of the material.’

9.10. ‘When a chemical is transferred from a stock container to a smaller container, the latter should be labelled with the name of the chemical, the date of transfer and pictograms to indicate the risk and application area. The contents of the smaller container should not be transferred back into the stock container. Residues of chemicals and substances should be disposed of in accordance with plant procedures. The quality of chemicals in open stock containers should be checked periodically.’

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

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

Safety in the use of chemicals at work – ILO; 4.2.5: 'Each container or layer of packaging should be marked. The particulars should always be visible on the container or package during each stage of the supply and use of the chemicals.'

Safety in the use of chemicals at work – ILO; 4.3.2: 'The purpose of the label is to give essential information on:

a) The classification of the chemical;

b) Its hazards;

c) The precautions to be observed.

The information should refer to both acute and chronic exposure hazards.'

Plant Response/Action:

A / Analysis of causes

- Cause 1: There are areas for improvement in organisation and oversight, and the use of chemical products is not incorporated in the NPP's Integrated Management System (IMS).
- Cause 2: There is a lack of awareness of the challenges and risks in the field, requiring a culture change to ensure that NPP staff understand and adopt appropriate behaviours in relation to the use of hazardous substances.

B / Strategy adopted to solve the recommendation/suggestion

In order to ensure effective oversight, it has been necessary to include the management of hazardous substances into the NPP's IMS through the establishment of an Elementary Process, and to update the database of hazardous substances.

In order to raise awareness of hazardous substances among NPP staff, the decision was taken to produce a comprehensive status update (inventory of hazardous chemical products stored by each department, assessment of the risks associated with their use, definition of occupational exposure limits, etc.). In addition, training on chemical hazards was set up to meet the needs of workers.

C / Action plan

- Cause 1: There are areas for improvement in organisation and oversight, and the use of chemical products is not incorporated in the NPP's IMS:
  - Action 1: Incorporate the management of hazardous substances into the NPP's Integrated Management System by creating an Elementary Process under Sub-Process 'Improving health and safety at work'.

  Deadline: 31/12/2018.
  - Action 2: Describe the Elementary Process in a memorandum.

  Deadline: 31/12/2018.
  - Action 3: Update the database of hazardous products used on site, and produce a site-specific Safe Use Instruction Sheet for each hazardous substance.

Deadline: 30/09/2019.

- Action 4: Conduct an assessment of the risks associated with the hazardous products.

Deadline: 31/12/2019.

- Action 5: Using the conclusions of the risk assessment for hazardous substances, establish and drive forward an action plan.

Deadline: 31/12/2019.

- Cause 2: There is a lack of awareness of the challenges and risks in the field, requiring a culture change to ensure that NPP staff understand and adopt appropriate behaviours in relation to the use of hazardous substances.
  - Action 6: Raise awareness of the risks among the persons encountered during the risk assessment of dangerous substances.

  Deadline: 31/12/2019.
  - Action 7: Define the training needs of workers, and develop a suitable training course.

  Deadline: 31/12/2018.
  - Action 8: Trial the training course, finetune it, and roll it out.

  Deadline: 31/12/2018.
  - Action 9: Designate one Hazardous Products Representative in each department. The representatives have a bridging role in departments. Each representative is the Hazardous Substances Champion of his department.

  Deadline: 30/06/2018.

D / Progress of action plan as of to date

Action 1: The action is closed out. The Elementary Process 'Control of chemical hazards' has been established under Sub-Process 'Improving health and safety at work'.

Action 2: The action is closed out. The Elementary Process 'Control of chemical hazards' has been detailed in sub-process memorandum D5110/NPS/15030.

Action 3: The field inventories carried out in 2018 and 2019, in the RCA and outside the RCA, highlighted the use of around 200 products without a site application sheet (FLU). The action plan defined and implemented by the Industrial Safety and Radiation Protection Department (SSR) has resulted in all these deviations being addressed. As at the end of August 2019, the OLIMP database contained 600 chemicals (whereas it contained fewer than 350 as at the end of 2018).

Action 4: Chemical risk assessment is based on supply of the safety datasheets and site application sheets for all the products on site. As soon as a chemical is integrated in the OLIMP database, it is discharged into SEIRICH (EDF chemical risk assessment tool) at the same time, for chemical risk assessment and the SSR coordinates the programme for measuring the occupational exposure limit values. At the mid-year point, more than half of the products with occupational exposure limit values had been measured without any breach of the regulatory thresholds occurring. The target of 100% of occupational exposure limit values as at 31/12/2019 is feasible.

Action 5: As was done for the 2017 assessment of chemical risks, the action plan will be produced on completion of the field inventories, and subsequent to the update of the OLIMP database and SEIRICH software.

Action 6: In the course of the inventory checks by the Industrial Safety and Radiation Protection department, the workers encountered were given awareness training on the requirements for using chemical products (being in possession of and understanding the Safe Use Instruction Sheet, wearing PPE, etc.).

Action 7: The action is closed out. The training needs in relation to chemical substances and asbestos were presented to the Health and Safety Committee on 19 June 2018. A pilot training

course entitled ‘APHCPRCH10: training on the safe handling of chemical substances at the NPP’ was delivered in December 2018.
Action 8: The action is closed out. Subsequent to the trial training session in December 2018, course APHCPRCH10 was scheduled for delivery in two further sessions in 2019 (24 September, 3 December). This course will be offered to all sites.
Action 9: The action is closed out. A ‘COCHIMI’ – Chemical Risks Representative – has been designated in each relevant department.
E / Measuring action effectiveness
The actions that have been undertaken are beginning to produce results.
During the 2018 operational excellence evaluation (ECE) by the Nuclear Inspectorate, the management of hazardous substances was evaluated. The inspectors noted a marked improvement in the management of key storage facilities for hazardous products, and the implementation of a robust organisation underpinned by an action plan whose action owners and deadlines are defined and indicators are tracked. The creation of a training course for the management of dangerous substances was also a positive finding.
In addition, the 2019 ISO 14001 Audit delivered very positive feedback, again highlighting progress made in this area.
The basic process indicator is the percentage of OLIMP compliance: 68% as at the month of August 2019. Further to the field walkabout campaign and compiling of site application sheets (see action 3 above), the site doctors will sign off on new sheets so that they can then be validated by the SSR. After this validation the OLIMP indicator will change over to 100%.

IAEA comments:
Improvements were observed in the management of the handling and storage of chemicals. The plant undertook field surveys which identified that there were 600 different chemicals used on the site. This information was then included in the site chemical database (OLIMP). Of these 600 chemicals, 400 (67%) had approved site-specific chemical application sheets. For the remaining 200, 138 were waiting medical approval and 62 (10% of total) were waiting for feedback from the user departments before approval.

One of the site strategic actions for 2019 was to approve all the site-specific chemical application sheets before the end of December 2019. Consequently, progress was monitored on a monthly basis and all site-specific chemical application sheets were expected to be at the approved status by the target date.

The plant also planned to raise the awareness of the chemical handling and storage hazards, by providing additional training. A new training course was developed and was scheduled to be conducted in October and December 2019.

In addition, a network of hazardous substance champions had been established within each department and presentations on chemical handling and storage requirements were regularly discussed at industrial safety committees. Plant personnel were encouraged to come up with suggestions to improve chemical storage, a recent example being the installation of three compartmentalised chemical storage cabinets for use by contractors in the Boiler Workshop.

Since the OSART mission, the plant had two external audits on the management of hazardous substances, and both recognised the significant improvement in the management of chemicals with no additional actions or recommendations identified. A plant walkdown found all chemicals observed were stored in accordance with the station expectations. In 2017 the plant had two chemical handling and storage minor accidents and eight minor events. In 2018 it recorded three minor chemical handling and storage events and the same number so far in 2019.

Conclusion: Issue resolved

8.2(2) Issue: The plant chemistry quality control programme is not always followed to ensure that all procedural requirements and controls are adequately understood and applied by plant staff.

The team noted the following:

- The plant performs online sodium measurements, the analyser produces analytical and verification data which are documented. However, plant personnel were not aware that some of the data on control cards of the online sodium analyser were recorded outside specified limits due to some software deficiencies:
  - ‘2REN 542MG NA GV2’ Nov. and Dec. 2016; four limit values exceeded
  - ‘2REN 543MG NA GV3’ Jun. 2017; one limit value exceeded.
  - ‘3REN 542MG NA GV2’ Dec. 2016, Jan. 2017 and Aug. 2017 three limit values exceeded.
  - ‘2REN 541MG NA GV1’ Dec. 2016, Jan. 2017 five limit values exceeded.
- The plant injects morpholine to adjust the pH of the secondary side water. The amount of morpholine is adjusted by chemistry department. The ideal concentration in the circuit is about 5mg/kg to 6mg/kg, and the limit value is at 8mg/kg. Trending diagrams presented at the time of the mission from 2014 to 2017 of the secondary side shows the concentration of morpholine was above the limit of 8mg/kg several times on unit 2, 3 and 4 during full power operation. There was a justification, prepared by EDF Corporate, allowing such anomalies, however this justification was not formalised and documented at the plant level and the staff in the field was not aware of this justification.
- To protect the secondary side against corrosion the plant has to set the pH in this system between 9,5 to 9,6. The absolute maximum limit is 9,8. Trending diagrams presented at the time of the mission show that the pH of GV-System unit 2 was above the limit of 9,8 in January 2014, March 2014 and February 2017.

Without a reliable chemistry quality control potential adverse trends in plant chemistry conditions may not be identified and corrected in a timely manner to avoid equipment damage.

Suggestion: The plant should consider improving organizational factors that impact human behaviour to ensure chemistry quality control programme requirements are always correctly recorded, understood and applied by the staff.

IAEA Basis:

SSG-13

2.10. Managers and supervisors should routinely observe chemistry activities to ensure adherence to plant policies and procedures. Tests after maintenance and modifications should be conducted systematically and thoroughly to ensure that the equipment and systems are ready to return to service. Chemistry performance indicators should be trended, and preventive and/or corrective measures should be undertaken where necessary.

2.23. A report on water chemistry and radiochemistry parameters should be formulated and shared with other areas in the operating organization and with appropriate external organizations on a regular basis. The report should include water chemistry analysis for safety systems and safety related systems, results of activity measurements, parameter trends, analysis of deviations and corrective actions, as well as their possible consequences, and overviews of quality audits of laboratory performance.

3.4. In the chemistry programme, it should be ensured that:

There is a timely response to correct any deviations from normal operational status, such as small deficiencies, adverse trends or fast transients of chemistry parameters.

6.14. On-line chemistry monitoring and data acquisition systems should be used that accurately measure and record data and provide alarms for key chemistry parameters. The measurement ranges of analytical instruments should extend beyond the operating ranges and safety limits of the plant.

7.1. The results of analytical and quality control measurements should be recorded properly (e.g. laboratory logs, registered data sheets, databases containing periodic on-line measurements). The results should be supplemented with complementary information necessary for their interpretation, assessment and communication.

7.5. The primary responsibility for review of chemistry data should be assigned to the chemistry staff. The chemistry staff should compare the current data with those previously obtained and should investigate situations where the results obtained are outside the expected range of the system operating conditions, should identify recent additions of chemicals and operational changes and should consider the results of laboratory quality control tests.

7.6. Data should be compared with operational limits and the evaluation and trending of data should be carried out to assess the efficiency of chemistry control, to identify inconsistencies in analytical data and adverse trends in chemistry conditions and to help in optimizing chemistry in the plant systems. Particular attention should be given to data that deviate from operational limits.

7.8. Trends should be reviewed soon after data have been recorded, in order to identify problems that may need corrective action before a parameter exceeds its specified limit. Trending should also be used to evaluate transients of short duration caused by plant operational changes and slower long term changes occurring under stable plant conditions. Evaluation of slow changes may facilitate the prediction of when a change could become a significant safety problem.

Plant Response/Action:

A / Analysis of causes

- Cause 1: Changing reference standards that require personnel to develop skills and gain experience.
- Cause 2: Chemistry parameter monitoring and measuring equipment metrology are not as expected.

B / Strategy adopted to solve the recommendation/suggestion

In order to address this recommendation, the plant took the decision to focus first on upskilling staff in the monitoring of chemistry parameters.

In addition, it was also necessary to set up chemistry parameter trend analysis, and to work on implementing the metrology directive (DI61). Regarding metrology, the plant is now a participant of the corporate working group for measurement methods.

C / Action plan

- Cause 1: Changing reference standards that require personnel to develop skills and gain experience:
  - Action 1: Closely oversee the training given to each new arrival.

  Deadline: closed out.
- Cause 2: Chemistry parameter monitoring and measuring equipment metrology are not as expected.
  - Action 2: Set up quarterly trend analysis of technical specification parameters.

  Deadline: closed out.
  - Action 3: Refocus the Chemistry Engineer on his mandate, as it is described in the Baseline Standards for Operational Chemistry Roles.

  Deadline: closed out.
  - Action 4: Create the position of Lead Planner Responsible for Metrology.

  Deadline: closed out.
  - Action 5: Apply Directive 61 to process chemistry.

  Deadline: 31/12/2019
  - Action 6: Participate in corporate working groups tasked with deploying Directive 61 and measurement methods.

  Deadline: On going

D / Progress of action plan as of to date

Action 1: The action is closed out. The training given to new arrivals is now closely overseen.
Action 2: The action is closed out. Technical specification parameters are now subject to quarterly trend analysis.
Action 3: The action is closed out. The Chemistry Engineer's mandate was revised, allowing him to refocus on his remit.
Action 4: The action is closed out. A Lead Planner has been put in charge of metrology.
Action 5 and 6: These actions are ongoing.

E / Measuring action effectiveness

The 2018 Evaluation of Operational Excellence (ECE) by EDF's Nuclear Inspectorate reviewed chemistry parameter monitoring and measuring equipment metrology. The review concluded that the plant had made significant improvements in these areas subsequent to the implementation of the action plan presented above.
In addition, the 2018 external Peer Review did not give rise to any areas for improvement in the area of chemistry.
The feedback from these two evaluations underpin the progress made by the plant between 2016 and 2018 in the chemistry area.

IAEA comments:

The plant improved its chemistry quality programme through the implementation of the fleet chemical metrology directive (DI61). This required the plant to review and improve the accuracy and consistency of measurement for all seventeen installed chemical analysis measurement equipment. Fifteen chemical analysis equipment reviews had been completed at the time of the follow up mission and for the remaining two, one instrument was 33% complete and the metrology improvements for the other instrument were expected to be completed by

December 2019. In addition, the team noted an improvement in the awareness and corresponding actions to be taken when measurements limits on control cards for the on-line analysers were exceeded.

For example, for the on-line sodium measurements: 2REN 542MG NA GV2, 2REN 543MG NA GV3, and 2REN 541MG NA GV1 in 2019 there were no instances when the control card measurement data recorded values outside of the specified limits. For on-line measurement 3REN 542MG NA GV2, there was one instance when the control point limit was exceeded, and this was identified, and corrective actions were taken.

For morpholine injection, for 2019 on unit 2 there were no instances when the pH limit on the secondary side water was exceeded with the unit at power. For unit 3, for the same period, there were two instances (for unit 4, one instance) when the secondary side water limit was exceeded but these instances were identified, and corrective actions were taken to bring the pH back into acceptable limits.

For the period January to July 2019, the GV-system on unit 2 did not exceed the limits for pH. Currently, these parameters were trended to enable early detection of any deviations from permissible chemistry limits.

Furthermore, the plant showed improvements in the quality of its metrology measurements by a reduction in the deviations in measurements from interlaboratory measurement comparisons. For example, in 2017 the plant had six deviations in measurement values and in 2018 only two.

Conclusion: Issue resolved

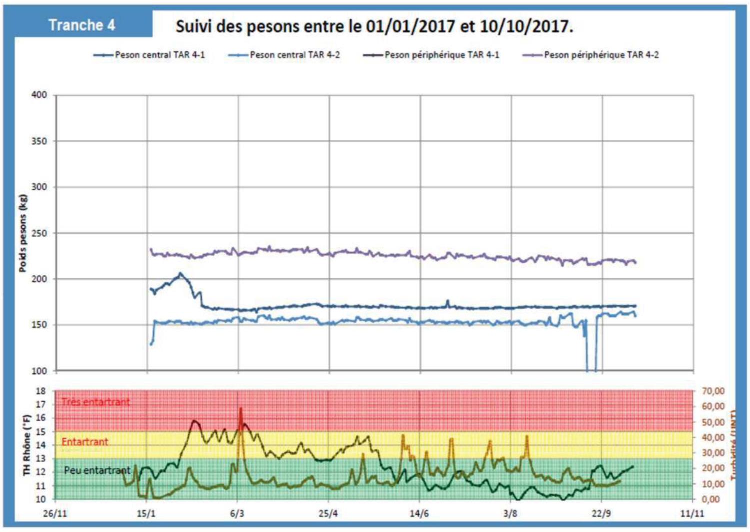
8.2(a) Good practice: Circulating water system treatment for scale and sludge removal using an environmentally friendly product

At the plant, an injection facility injects on an ongoing basis an organic scale removal product (ATO) into the circulating water system. The idea is to prevent scale and sludge deposits in the condenser and circulating water systems. The product used is organic, harmless for the environment and contains neither phosphate nor nitrogen.

ATO injection pumps

The advantage of this process is to protect cooling water baffles against excessive weight, resulting in a significant decrease in maintenance needs (cleaning and flushing) and in number of replacements, thus avoiding possible unit shutdowns for corrective maintenance.

Load cell curve indicating absence of weight gain since ATO injection.



ATO is a heavy acrylic polymer which has an effect on scale with a dispersing factor against suspending matter coming from the river and present in the circulating system.

A process totally devoid of environmental impact.

9. EMERGENCY PREPAREDNESS AND RESPONSE

9.1. ORGANIZATION AND FUNCTIONS

The plant has frequent contact and an pro-active relationship with its offsite counterparts in preparation for an emergency as part of its emergency planning programme. The plant has periodic coordination meetings with the prefect, local authorities and organizations. Furthermore, these external organizations participate in all plant exercises. The team considered this a good performance.

9.2. EMERGENCY RESPONSE

The plant's arrangements for the safe evacuation of workers in the event of a radiological emergency are not always adequate and have not been tested effectively. The team made a recommendation in this area.

The plant sends a monthly newsletter to everyone living within the precautionary action planning zone, providing information on the steps to take in the event that the off-site emergency plan is activated. The team considered this a good performance.

The plant has acquired redundant and diverse communication systems for its internal communications and for communications with the off-site authorities. Several backup systems are available for each communication mode. This improves the likelihood that at least one of the communication systems will be functional in an emergency situation. The team considered these arrangements a good performance.

9.3. EMERGENCY PREPAREDNESS

The plant is planning to build a new emergency response centre (expected to be available by 2021). However, the current emergency response centre of the plant is located in a building with insufficient long-term protective measures. The team identified weaknesses in the emergency control centre decontamination and contamination control processes. The team made a suggestion in this area.

The plant training programme and annual schedule for the conduct of drills and exercises are described in the on-site emergency plan. The plant prepares and conducts 6 drills and exercises each year, with the participation of all members of the plant emergency response organization and external organizations. However, the plant does not provide training on the recovery plan to return the plant to normal operation in a long-term scenario, multi-unit exercises or prolonged emergency exercises with turnover of emergency workers. The team encouraged the plant to complete their training programme.

The plant provides video training for security personnel on actions to be taken during emergencies. The team considered this a good performance.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

9.2. EMERGENCY RESPONSE

9.2(1) Issue: The plant's preparedness for the safe site evacuation in the event of a radiological emergency is not always adequate and has not been tested effectively.

The team noted the following:

- The plant has 11 muster points for the assembly of up to 4000 workers, and has calculated the number of workers to be assembled at each muster point. In the event of evacuation following a radiological accident, plant personnel are evacuated by bus only to an off-site muster point (Blyes) located 6 km from the plant. The evacuation buses will operate as a shuttle service between the off-site muster point and the gatehouse at the plant site. However, the plant has not analysed how many buses would be required for the evacuation of plant personnel and how long such an evacuation might take.
- The plant has an agreement with a bus company for the evacuation of plant personnel. Under this agreement, 3 buses are required to be at the site within 60 minutes for the evacuation of up to 4000 workers. However, the effectiveness of these arrangements has not been tested in representative exercises.
- The evacuation buses are not equipped with radiological personal protective equipment (PPE) and electronic dosimeters for the bus drivers are not provided.
- Evacuation training received by plant personnel only covers assembly at the on-site muster points. Emergency evacuation exercises were conducted on 11 December 2012 and 19 May 2015. During the 2012 exercise, only 10-15 people were evacuated. During the 2015 exercise, only 20-30 people were evacuated. This represents less than 5% of plant personnel.
- The plant on-site muster points are not equipped with dosimeters and personal protective equipment (PPE).
- The plant has a pre-determined off-site muster point for the evacuation of plant personnel but does not have an alternative pre-determined off-site muster point for unfavourable radiological conditions.
- The plant provides iodine pills, however the plant does not provide radiological PPE (protective clothes, masks, filters) for plant personnel. During the visit to the EDF post-Fukushima rapid response emergency centre which is located at the plant site, it was noted that there were 2100 masks on the kit cabinet inventory. However, these are not intended for use by plant personnel during evacuation.

Without a robust, comprehensive and adequately tested evacuation process, the safety of plant personnel may be compromised in case of a radiological emergency.

Recommendation: The plant should improve its preparedness to ensure effective and safe site evacuation in the event of a radiological emergency.

IAEA Basis:

GSR Part 7

5.4. For a site where several facilities in categories I and II are collocated, adequate arrangements shall be made to manage the emergency response at all the facilities if each of them is under emergency conditions simultaneously. This shall include arrangements to manage the deployment of and the protection of personnel responding on and off the site (see Requirement 11).

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

(a) Prompt exercise of authority and discharge of responsibility for making decisions to initiate protective actions and other response actions upon notification of an emergency (see para. 5.12); (b) Warning the permanent population, transient population groups and special population groups or those responsible for them and warning special facilities; (c) Taking urgent protective actions and other response actions such as evacuation, restrictions on the food chain and on water supply, prevention of inadvertent ingestion, restrictions on the consumption of food, milk and drinking water and on the use of commodities, decontamination of evacuees, control of access and traffic restrictions; (d) Protection of emergency workers and helpers in an emergency.

5.52. The operating organization and response organizations shall ensure that arrangements are in place for the protection of emergency workers and protection of helpers in an emergency for the range of anticipated hazardous conditions in which they might have to perform response functions. These arrangements, as a minimum, shall include:

(a) Training those emergency workers designated as such in advance;

(b) Providing emergency workers not designated in advance and helpers in an emergency immediately before the conduct of their specified duties with instructions on how to perform the duties under emergency conditions (‘just in time’ training);

(c) Managing, controlling and recording the doses received;

(d) Provision of appropriate specialized protective equipment and monitoring equipment;

(e) Provision of iodine thyroid blocking, as appropriate, if exposure due to radioactive iodine is possible;

(f) Obtaining informed consent to perform specified duties, when appropriate;

(g) Medical examination, longer term medical actions and psychological counselling, as appropriate.

6.24. Emergency response facilities or locations to support an emergency response under the full range of postulated hazardous conditions shall be designated and shall be assigned the following functions, as appropriate:

(a) Receiving notifications and initiating the response; (b) Coordination and direction of on-site response actions; (c) Providing technical and operational support to those personnel performing tasks at a facility and those personnel responding off the site; (d) Direction of off-site response actions and coordination with on-site response actions; (e) Coordination of national response actions; (f) Coordination of communication with the public; (g) Coordination of monitoring, sampling and analysis; (h) Managing those people who have been evacuated (including reception, registration, monitoring and decontamination, as well as provision for meeting their personal needs, including for housing, food and sanitation); (i) Managing the storage of necessary resources; (j) Providing individuals who have undergone exposure or contamination with appropriate medical attention including medical treatment.

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 9 of GSR-part VII 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, fisherman).

Plant Response/Action:

A / / Analysis of causes

- Cause 1: The site evacuation procedures do not fully guarantee a rapid and efficient evacuation of all the personnel
- Cause 2: Evacuation of the site is not tested with realistic numbers of personnel.

B/ Strategy adopted to solve the recommendation or the suggestion

EDF has revised its strategy for evacuating personnel from the site by reformulating how the personnel are managed in the three situations of radiological release (delayed release, short immediate release and long immediate release). We have factored in the new Public Authorities strategy for evacuating the population, which can be found in the NPP Off-Site Emergency Plan that was drawn up by the Ain Prefecture.

Consequently, once the alert has been given and the site personnel are mustered in the assembly areas, site evacuation is no longer based on moving from the site to the fall-back facility but is in response to the radiological conditions of the event:

- If the radiological release is delayed, auto-evacuation is possible. In collaboration with the Public Authorities, the personnel leave the site and the different assembly areas in staggered groups. Car-sharing is encouraged and coaches can be mobilised to make up any shortfalls in transportation.
- If the radiological release is immediate, protection of the personnel falls in line with the Directives adopted by the Public Authorities for the population. The first step is to muster the personnel in the assembly areas to avoid exposure to any release, taking wind direction into account. Then, a radiological inventory of the site is carried out to delineate the least exposed routes towards one of the site exits and to set up radiological checks and decontamination, if possible. The personnel can be equipped with white over-suits to protect them from contamination. Several scenarios have been envisaged in terms of release duration and the direction of the wind, the different site exits and means of transport that are not contaminated, and the measures taken by the Public Authorities to move and shelter the population, which includes the setting up of

Reception and Assembly Centres. All the actions that are decided for protection of the personnel are communicated to the Public Authorities.

C / Action plan

- Cause 1: The site evacuation procedures do not fully guarantee a rapid and efficient evacuation of all the personnel
  - Action 1: Develop the strategy for evacuating the personnel on the NPPs by factoring in the Public Authorities strategy for evacuating the population.

  Deadline: 31/12/2018
  - Action 2: Roll out the organisational structure developed in action 1:
    - Action 2.1: Update or create the documents and procedures for the evacuation of personnel from the NPP.

    Deadline: 30/10/2019
    - Action 2.2: Train the people implicated in the changes.

    Deadline: 30/10/2019
    - Action 2.3: Roll out any equipment needed for the new requirements

    Deadline: 30/10/2019
- Cause 2: Evacuation of the site is not tested with realistic numbers of personnel.
  - Action 3: Carry out a site evacuation exercise with a significant number of evacuated people

  Deadline: 15/09/2019
  - Action 4: Schedule regular evacuation exercises with the same framework as Action 3.

  Deadline: Immediately

D / Progress of action plan as of to date

The modifications resulting from the changes made by the Public Authorities to population evacuation measures have been assessed by our corporate engineering unit (UNIE). These modifications were presented to the National Regulator and are currently being rolled out on the NPP, and will become operational once approval has been given by the Divisional Regulator in Lyon.

In anticipation, the NPP is preparing to roll out all the modifications scheduled for documents, organisations and equipment. The site has identified the roll out actions and has launched those that can be implemented before receiving approval from the Regulator. The current state of progress is as follows:

Action 1: The action is closed out.

Action 2 and sub-actions: These actions are awaiting approval from the Regulator.

Action 3: The site evacuation exercise is scheduled for 11/09/2019.

Action 4: The action is closed out.

E / Measuring action effectiveness

The effectiveness of the implemented measures will be tested when the evacuation exercise is carried out with the new procedures. This is scheduled for 11/09/2019.

IAEA comments:

The plant analysed this recommendation and determined that the site evacuation procedures do not fully guarantee an effective and safe evacuation of all site personnel in the event of a radiological emergency. The plant took into consideration the recommendation on evacuation exercises, which were performed with a limited number of personnel.

Together with the Corporate, the plant developed a new strategy and procedures for the evacuation of plant personnel factoring the new Public Authority Strategy (PPI) for evacuating the population. The new procedures entailed:

- Three different radiological situations (late release, short immediate release and long immediate release)
- NPP responsibility for mustering the personnel in the assembly areas, mapping possible site contamination (to select a path with less risk of contamination) and performing radiological checks of the personnel at the exit of the plant.
- The public authorities responsibility for setting up Reception and Assembly Centres (CARE), which are prepared for decontamination procedures and transport of personnel. There were 4 different locations for the reception and assembly centres that could be activated depending on the radiological conditions.

The procedures were going through formal approval process by relevant authorities. .

The plant also analysed the need for equipment and procedures for delivering equipment to the relevant personnel. The dosimeters would be carried by the radioprotection support officer in charge of evacuating the groups from the muster points to the exit gates. Other equipment, such as masks, were already available on the site, however at the time of the follow up mission the procedures for their distribution were still to be developed.

A site evacuation exercise was carried out in 2019 in which 400 people participated for the validation of the new procedures. Evacuation exercises with the same scope were planned to be carried out once every 3 years with site personnel, and once every 5 years with the local authorities involved.

Conclusion: Issue resolved

9.3. EMERGENCY PREPAREDNESS

9.3(1) Issue: The existing emergency response facilities of the plant are not always adequately equipped and clearly organized to fully protect the emergency response personnel in the event of a radiological emergency.

The plant is planning to build a new emergency response centre (expected to be available by 2021), however the team noted the following:

- The plant Emergency Response Centre (ERC) is not a hermetically sealed building, and is not equipped with pressurized air bottles and oxygen bottles.
- There is no effective procedure for staff decontamination for ERC access. The plant decontamination centre is located outside of the ERC at the medical department. In the event that an emergency worker who needs to enter the ERC is contaminated, this worker is required to go to the medical department for decontamination. The medical department does not have a filtered ventilation system and in the event of radioactive release, this centre will become contaminated.
- The ERC does not have the skin decontamination supplies in the shower area.
- The clean protective clothes are stored in the radiation controlled area of the ERC.
- Contaminated clothes are disposed of in the decontamination area (shower area). Incoming contaminated emergency workers and outgoing clean emergency personnel pass through the same room.
- The ERC does not have an internal automatic dose rate monitor. In the event of failure of the ventilation system or saturation of the filters, the dose rate in the ERC is not measured in real time.
- The plant supplies electronic dosimeters for 73% of the ERC emergency workers. The plant does not have a written procedure for the distribution of electronic dosimeters in the event of an emergency. According to the ERC inventory list, 47 electronic dosimeters are available, but only 44 of these were found during the last check review conducted on 11.09.2017.
- There is no dosimeter reader with an automatic reset function in the ERC.
- The thermal luminescent dosimeters (TLDs) located in the ERC and required for ERC emergency workers were three months past their expiry date. The plant prepares a monthly review on the availability of the emergency equipment in the ERC. The most recent protocol, dated 11.09.2017, indicates that these TLDs are operational.
- The plant does not keep an inventory check list in the ERC to indicate the emergency equipment that must be available.
- The main control rooms 2, 3, 4 and 5 do not have radiological PPE, electronic dosimeters for the operators, and radiation monitors for the dose rate inside the room.

Without robust emergency response facilities, the protection of emergency response workers may not be ensured in the event of radiological emergencies.

Suggestion: The plant should consider improving the condition of the existing plant emergency response facilities and providing adequate protective equipment to ensure that emergency response personnel are adequately protected in the event of a radiological emergency.

IAEA Basis:

SSR-2/2

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

GSR Part 7

5.55. The operating organization and response organizations shall ensure that no emergency worker is subject to an exposure in an emergency that could give rise to an effective dose in excess of 50 mSv other than:

(1) For the purposes of saving human life or preventing serious injury;

(2) When taking actions to prevent severe deterministic effects or actions to prevent the development of catastrophic conditions that could significantly affect people and the environment;

(3) When taking actions to avert a large collective dose.

5.57. The operating organization and response organizations shall ensure that emergency workers who undertake emergency response actions in which doses received might exceed an effective dose of 50 mSv do so voluntarily; that they have been clearly and comprehensively informed in advance of associated health risks as well as of available protective measures; and that they are, to the extent possible, trained in the actions that they might be required to take. Emergency workers not designated as such in advance shall not be the first emergency workers chosen for taking actions that could result in their doses exceeding the guidance values of dose for lifesaving actions, as given in Appendix I. Helpers in an emergency shall not be allowed to take actions that could result in their receiving doses in excess of an effective dose of 50 mSv.

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

6.22. Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation (such as documentation of procedures, checklists, manuals, telephone numbers and email addresses) shall be provided for performing the functions specified in Section 5. These items and facilities shall be selected or designed to be operational under the conditions (such as radiological conditions, working conditions and environmental conditions) that could be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (e.g. compatible with the communication frequencies used by other response organizations), as appropriate. These support items shall be located or provided in a manner that allows their effective use under the emergency conditions postulated.

6.23. For facilities in categories I and II, as contingency measures, alternative supplies for taking on-site mitigatory actions, such as an alternative supply of water and an alternative electrical power supply, including any necessary equipment, shall be ensured. This equipment shall be located and maintained so that it can be functional and readily accessible when needed (see also Safety of Nuclear Power Plants: Design (SSR-2/1) [18]).

6.24. Emergency response facilities or locations to support an emergency response under the full range of postulated hazardous conditions shall be designated and shall be assigned the following functions, as appropriate:

(a) Receiving notifications and initiating the response; (b) Coordination and direction of on-site response actions; (c) Providing technical and operational support to those personnel performing tasks at a facility and those personnel responding off the site; (d) Direction of off-site response actions and coordination with on-site response actions; (e) Coordination of national response actions; (f) Coordination of communication with the public; (g) Coordination of monitoring, sampling and analysis; (h) Managing those people who have been evacuated (including reception, registration, monitoring and decontamination, as well as provision for meeting their personal needs, including for housing, food and sanitation); (i) Managing the storage of necessary resources; (j) Providing individuals who have undergone exposure or contamination with appropriate medical attention including medical treatment.

Plant Response/Action:

A / Analysis of causes

- Cause: The Emergency Control Centre (BDS) was not designed for managing a long-term emergency in significantly deteriorated radiological conditions.

B / Strategy adopted to solve the recommendation/suggestion

As a result of the Operating Experience from the accident at Fukushima, EDF decided to equip all of the NPPs with a more robust emergency control centre, called On-Site Emergency Centres (CCL). The CCL will provide much better living conditions compared to the BDS. The CCL will be:

- Designed for continuous use over 12 months, 24 hours a day, with a total autonomy of 3 days (independent electrical supply, drinking water, food rations, sewerage system, waste storage)
- Robust against the core group of hazards, with the secondary effects from the reviewed extreme conditions also being taken into account.
- Supplied by a backup generator as well as a wall connection to connect a FARN (Nuclear Rapid Response Task Force) generator to provide the building with a continuous independent electrical supply.
- Equipped with iodine filtration and containment overpressure to protect the occupiers from any radiological hazard; as well as a 4-hour static containment to manage any chemical hazards.
- Equipped with a dedicated area for decontamination of personnel coming from outside the building.

The current Emergency Control Centre (BDS) has some of these features, but to a lesser extent: resistance to external hazards, containment overpressure and iodine filtration, decontamination area and emergency electrical supply from dedicated generators. However, pending the commissioning of the CCL building, protection measures have been made available for the emergency response teams, such as respiratory masks, electronic dosimeters and over-suits. Lastly, the NPP can receive support from FARN resources within 24 hours of the alert being given.

C / Action plan

Cause: The current Emergency Control Centre (ECC) was not designed for managing a long-term emergency in significantly deteriorated radiological conditions.

– Action 1: Provide white over-suits for the emergency response team, along with the respiratory masks that are already available.

Deadline: 31/12/2018

– Action 2: Provide white over-suits for the employees who are not part of the emergency response team.

Deadline: 31/12/2019

– Action 3: Construction of the CCL

Deadline: 31/12/2024

D / Progress of action plan as of to date

Action 1: The action is closed out. The stock of respiratory masks is sufficient to equip all of the personnel mobilised for emergency response.

Action 2: The site is planning to increase the stock of over-suits before the end of 2019 to equip all of the employees in case of evacuation under radiological conditions.

Action 3: The CCL project is coordinated at EDF corporate level (Major Refit Project) as all of the EDF NPPs are going to be equipped. The construction of the CCL at Bugey NPP is scheduled to start in the second quarter of 2021, with the delivery date in the first half of 2023. The location of the building on the site is already reserved and rerouting operations have also started to free up the space needed for the construction work.

E / Measuring action effectiveness

There are no effectiveness measurements possible. By its design, the CCL responds to the requirement of protecting the personnel in the case of a long-term emergency response in severely deteriorated radiological conditions.

IAEA comments:

The plant recognized that the existing emergency response facilities were not fully adequate to protect the emergency response personnel in the event of a radiological emergency, and therefore a plan was developed to build a new On-Site Emergency Centre (CCL) based on a Corporate resolution.

The Corporate provided a basic design that will be tailored to fit specifics of the plant, for example choosing the construction materials, building of a separate warehouse, enough space for the technical support centre of the 4 units (65 people), noise reduction panels.

The location of the new CCL had been decided and the ground prepared. Construction will start in the second half of 2021 and the CCL is expected to be functional by 2023.

Between 2017 and 2019, efforts were directed to improve the conditions in the current Emergency response centre (BDS) as far as possible considering the limitations of the existing facilities, by means of:

- Modifying the decontamination procedure to include the use of the medical centre, a nurse was included in the staff at the BDS, and a doctor was arranged for on call duty. It was understood by the plant that this was not an ideal solution, since personnel had to walk to the medical centre which was outside the BDS, go through the decontamination process and go back to the BDS. However, there were only two showers available at the BDS and decontamination of the personnel could not be done in an effective way in the facility.
- Updating the procedure for the Emergency Logistic Manager (PCM 5.2) with a plan for distributing the electronic dosimeters
- Equipping the BDS with a dedicated mobile dose rate monitor to be used for the staff inside the building, as well as the one entering the building.

– Taking forward an inventory check list of the equipment that should be available at the BDS, which was kept at the logistic centre (SCLD). The team confirmed that at the time of the follow-up mission the equipment listed in the inventory was available at the BDS.

Conclusion: Satisfactory progress to date

10. ACCIDENT MANAGEMENT

10.1 ORGANIZATION AND FUNCTIONS: TRAINING AND DRILLS

No drills executed at the plant included the use of the severe accident management guidelines (GIAG), hence evaluation of their effectiveness and personnel proficiency are not performed by the plant. Moreover, the lack of table-top exercises and inconsistent attendance on the severe accident refresher courses point out to the need for improvement on the scope of exercises/training for SAMGs users and the local emergency response team. The team made a recommendation in this area.

Certain strategies from the emergency response guidelines (GAEC), for example the containment chapter, interface with the severe accident management guidelines (GIAG). Since the GAEC documentation is not available at the plant, as it is only available at the corporate technical support centre, the team encouraged the plant to complement the severe accident management training with the GAEC strategies relevant to the GIAG in such a way that SAMGs users are familiar with concerned parts of GAEG.

10.2 OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

At present, the severe accident management guidelines (GIAG), version 3B, are limited to the plant state with the primary system closed. It does not specifically address multi-unit events, an open primary system, as well spent fuel pool accidents. However, a new version is available at the corporate level, and its implementation is planned. The team made a suggestion in this area.

The national support centre heavily supports the local technical support centre with highly qualified personnel and state-of-the-art analysis capability. Once entering the severe accident management guidelines (GIAG) immediate actions are performed without the need for corporate support. However, the current scope of the severe accident management guidelines (GIAG) at the plant does not provide sufficient guidance for the local support centre to independently assess essential parameters, such as. hydrogen concentration in the containment, to apply the guidelines in the very unlikely event that external support is unavailable. The team encouraged the plant to evaluate the practical coping ability of the local support team in this regard.

10.3 ANALYTICAL SUPPORT FOR SEVERE ACCIDENT MANAGEMENT

The plant benefits from the support of the corporate research division SEPTEN for the development and analytical analysis of severe accident management strategies. All the relevant severe accident phenomena considered and analysed by SEPTEN are done not only by using the system code MAAP but also by performing analysis with codes developed for specific phenomena like steam explosion (MC3D), melt-core-concrete interaction (TOLBIAC), hydrogen distribution (SATURNE –CFD) and core degradation (LEONAR – PROCOR). Potential negative effects are assessed by risk assessment based on system code analysis and sensitivity analysis. PSA level 2 analysis, which includes human factors, is used to assess the safety level, risk of radiological releases, identify main contributing events, check effectiveness, and assess the plant modifications as well as in the performance of safety review. The team recognised this as a good performance.

DETAILED ACCIDENT MANAGEMENT FINDINGS

10.1. ORGANIZATION AND FUNCTIONS: TRAINING AND DRILLS

10.1(1) Issue: The scope of the training and drills is not sufficient to maintain an adequate level of experience, knowledge and proficiency of the personnel responsible for the implementation of the severe accident management guidelines at the plant.

The team noted the following:

– No drills for the emergency response personnel were performed in which the current Severe Accident management guidelines (GIAG version 3B) were employed.
– The training related to severe accident management consists of a 4-hour lecture which includes: an overview on severe accidents, associated risks, safety systems related to severe accidents and an overview of all available severe accident guidelines. No table-top exercises have been conducted to familiarize the relevant personnel on use of the severe accident management guidelines (GIAG).
– The local technical support team (ELC) has the function to advise the emergency director (PCD-1) on what strategies to take in a severe accident. Refresher training on severe accidents is recommended every 3 years. However, the team noted that only 2 out of 4 ELC took the refresher course and none of these were done within the recommended 3 year periodicity, and 1 of the 4 did not receive any training on the current severe accident guidelines.
– In the mitigative domain, the emergency director (PCD-1) has the decision making responsibility. The team noted that 2 out of 4 PCD-1 underwent GIAG training before 2009, before the Fukushima accident and before the implementation of the severe accident management guidelines, and no refresher course was found on their training records.

Without adequate training and drills the severe accident management guidelines (GIAG) might not be applied in an efficient manner.

Recommendation: The plant should extend the scope of exercises/drills and training programme and ensure an adequate level of experience, knowledge and proficiency of all the personnel responsible for the implementation of the severe accident management guidelines at the plant.

IAEA Basis:

SSR2/2

5.8E. The accident management programme shall include training necessary for implementation of the programme.

NS-G-2.8

4.32. A training programme for emergencies should be established to train and evaluate plant staff and staff from external emergency response organizations in confronting accident conditions, coping with them and maintaining and improving the effectiveness of the response. Emergency preparedness exercises should be designed to ensure that plant staff and staff from other participating organizations possess the essential knowledge, skills and attitudes required for the accomplishment of non-routine tasks under stressful emergency conditions.

NS-G-2.15

2.29. The overall form of the guidance and the selected amount of detail should be tested in drills and exercises. Based on the outcome of such drills, it should be judged whether the form is appropriate and whether additional detail or less detail should be included in the guidance.

3.104 The training should be commensurate with the tasks and responsibilities of the functions; hence, in-depth training should be provided for the key functions in the severe accident management programme, that is, the technical support centre evaluators, decision makers and implementers.

3.108. Initial training as well as refresher training should be developed. Refresher training should take place at regular intervals that are compatible with the plant's overall training programme. A maximum interval for refresher training should be defined; depending on the outcome of exercises and drills held at the plant, a shorter interval may be selected.

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 / Analysis of causes

- Cause: Severe accident management guidelines are not put to the test regularly enough during emergency response exercises with simulator use.

B / Strategy adopted to solve the recommendation/suggestion

The plant has established periodic scheduling of exercises containing severe accident scenarios, alongside enhanced training for personnel responsible for implementing severe accident management guidelines (SAMG).

C / Action plan

- Cause: Severe accident management guidelines are not put to the test regularly enough during emergency response exercises with simulator use.
    - Action 1: Conduct an exercise involving implementation of severe accident management guidelines during an emergency response exercise with simulator use.

  Deadline: 31/12/2018.
    - Action 2: Program an exercise involving implementation of severe accident management guidelines into the exercise schedule.

  Deadline: immediate.
    - Action 3: Provide refresher training to personnel responsible for implementing severe accident management guidelines.

  Deadline: 31/12/2019.

D / Progress of action plan as of to date

Action 1: The action is closed out. Severe accident management guidelines were deployed during an emergency response exercise that took place on 21/11/2018. During this exercise, the SAMG were implemented as expected and provided full control of the situation in light of the chosen scenario. In addition, this exercise confronted the emergency response organisation with a multi-unit event, compounded by site isolation.
Action 2: The action is closed out. An exercise of this kind has been included in the multiyear schedule of exercises.
Action 3: The new severe accident management guidelines will be in force at the beginning of 2020, linked to the equipment modifications deployed in the course of ten-year-outages. Persons responsible for their implementation will receive training and a refresher on these guidelines before modified equipment is put into service. The new SAMG are in the process of being amended by corporate engineering departments. The corresponding training material is being produced.

E / Measuring action effectiveness
A first assessment of the effectiveness of these actions was made with the exercise that was carried out on 21/11/2018, which confirmed that the severe accident management guidelines were implemented as expected.

IAEA comments:

The plant recognized the need for exercises/drills involving the emergency personnel and the use of the severe accident management guidelines (GIAG).

In December 2018, the plant conducted an emergency response exercise considering accident conditions in unit 2 at full power and unit 3 during shutdown process. The scenario was devised so that unit 2 would enter severe accident conditions whereas unit 3 would reach a controlled state before entering severe accident conditions. The crisis team for both units was deployed and fully staffed. The simulator was used to reproduce the operator actions, and a predefined scenario was used upon entry conditions for severe accidents. During the exercise, the current GIAG (version 3B) was used as well as one of the strategies of the emergency response guidelines (GAEC).

Emergency response exercises including the use of GIAG were now scheduled to be performed once every 3 years.

In 2018, training on severe accident management based on the current GIAG (version 3B) was given to the new emergency directors (PCD-1), and 4 out of 6 PCD-1 had undergone training between 2016 and 2018.

The plant received the new severe accident management guideline; however, the corresponding training material was still being developed by the Corporate. Nonetheless, between November 2019 and June 2020, refresher courses with the new GIAG have been scheduled for all relevant plant staff.

Conclusion: Satisfactory progress to date

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

10.2(1) Issue: The current scope of the severe accident management guidelines does not address severe accidents with an open primary system, multi-unit events or accidents involving spent fuel pools.

The team noted the following:

- At present, the severe accident management guidelines (GIAG), version 3B, are limited to the plant state with the primary system closed and do not specifically address multi-unit events.
- The plant has a comprehensive procedure to manage the loss of spent fuel cooling, but a strategy to address severe accidents in the spent fuel pools has not been developed.
- Each two units share the same filtered venting system which is dimensioned for only one unit. In the case of both units simultaneously undergoing a severe accident, there is not a specific procedure, strategy or clear prioritization on how to proceed.

Without comprehensive severe accident management guidelines, the plant may not be able to cope with severe accident involving an open primary system, a multi-unit event, or severe accidents involving the spent fuel pools.

Suggestion: The plant should consider broadening the scope of the severe accident management guidelines to include severe accidents with an open primary system, multi-unit events and accidents involving spent fuel pools.

IAEA Basis:

SSR-2/2

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

NS-G-2.15

2.16. Severe accidents may also occur when the plant is in the shutdown state. In the severe accident management guidance, consideration should be given to any specific challenges posed by shutdown plant configurations and large scale maintenance, such as an open containment equipment hatch. The potential damage of spent fuel both in the reactor vessel and in the spent fuel pool or in storage should also be considered in the accident management guidance. As large scale maintenance is frequently carried out during planned shutdown states, the first concern of accident management guidance should be the safety of the workforce.

2.17. Severe accident management should cover all modes of plant operation and also appropriately selected external events, such as fires, floods, seismic events and extreme weather conditions (e.g. high winds, extremely high or low temperatures, droughts) that could damage large parts of the plant. In the severe accident management guidance, consideration should be given to specific challenges posed by external events, such as loss of the power supply, loss of the control room or switchgear room and reduced access to systems and components.

Plant Response/Action:

A / Analysis of causes

- Cause: The severe accident management guidelines do not take into account some conditions.

B / Strategy adopted to solve the recommendation/suggestion

The severe accident operational documentation consists of documents enabling Operations teams and corporate and site emergency responders to guarantee that the severe accident management priorities are met, in other words, to control containment and minimise releases to the lowest levels possible.

The operational documentation currently on site (Several Accident Management Guide - SAMG) is the version referenced V3B dated 2005 and updated in 2009. There are therefore discrepancies between the existing operational documentation on site and the latest developments in research and understanding of severe accident management.

Therefore, an update to the operational documentation for severe accident management (SAMG) was scheduled to factor in all the events considered in the updated periodic safety study undertaken for the fourth ten-year-outages of the plant's units. This update covers modifications carried out for the purpose of extending the operating lifetime of the units beyond 40 years, as well as lessons learned from the Fukushima accident:

- Incorporation of WENRA reference levels,
- The Nuclear Safety Authority's request to make a judgement regarding the safety objectives of third-generation reactors, to identify possible improvements to operating reactors,
- Management of hazards using so-called 'hardened core' measures designed to counter natural off-site hazards, the severity of which exceeds levels addressed in the safety standards for the units.
- Introduction of the concept of limiting lasting effects on the environment.

Among other things, the scenarios covered in the update include making provisions for severe accident management in all shutdown states with primary system open, and for risks associated with the fuel in the spent fuel pool.

C / Action plan

- Cause: The severe accident management guidelines do not take into account some conditions.
  - Action : Update the BUGEY CP0 SAMG.
    Deadline: 31/03/2020.

D / Progress of action plan as of to date

The compilation and update of the SAMG are driven by several EDF engineering departments: the Technical Directorate (DT), The Fleet Engineering, Dismantling and Environment Division (DIPDE), and the Operational Engineering Unit (UNIE).

Action : In October 2019, the plant will conduct a dry-run validation of the SAMG with a view to implementing them at the beginning of 2020, in line with the first unit undergoing its fourth ten-year-outage (unit 2).

E / Measuring action effectiveness
The effectiveness of actions will be assessed through the OPEX from training actions and severe accident exercises.
In addition, analyses performed during periodic safety studies will re-examine the scope of events and accident conditions to be considered in severe accident management procedures.

IAEA comments:

The current severe accident management guidelines (SAMG), GIAG version 3B, only address severe accidents for a single unit with a closed primary system.

The plant received the new version of GIAG, version 6A, developed by the Corporate. The plant will conduct the validation of the new guidelines in October 2019, and the new GIAG will be implemented at the plant at the beginning of 2020.

GIAG version 6A addressed accidents with a closed and partially open primary system.

The procedures for shutdown conditions, i.e. open primary system, will be covered by version 6B that was planned to be implemented at the plant's 10-year outage.

There were no plans to date for the plant to develop the severe accident management guidelines to address multi-unit events. Nor had the plant developed a procedure to support the decision-making process on the use of the filtered venting system in the event that both units sharing the same systems would simultaneously undergoing a severe accident. However, in the event of a severe accident involving more than one unit, the plant would rely on the Corporate emergency response teams (ECTN and PCDN) to provide expertise to support the plant.

The plant had specific procedures to monitor and handle spent fuel pool accidents in the preventive domain. Although the development of SAMGs for severe accidents involving the spent fuel pools is not envisioned, the plant could rely on the onsite rapid nuclear response force (FARN).

The plant followed the Corporate directives and had developed a comprehensive plan for the implementation of the updated GIAG (version 6) and corresponding training programme. In response to the OSART findings, the plant and the corporate organization plan to analyse the existing operational differences and limitations related to SAMGs as part of the crisis organization and implement a relevant initiative within a reasonable timeframe.

Conclusion: Satisfactory progress to date

11. HUMAN, TECHNOLOGY AND ORGANIZATION INTERACTIONS

11.1 INTERFACES AND RELATIONSHIPS

Although the plant reviews performance against macro-processes, there is no cross-functional overall review of human performance for the site to identify common behavioural challenges or organizational weaknesses. The team noted a number of areas where there appears to be unaddressed organizational factors that may lead to a decline in standards (e.g. shift turnover expectations, control of chemistry parameters). The team encouraged the plant to monitor and analyse human performance in an integrated manner to support the plant’s continuous improvement activities.

11.2 HUMAN FACTORS MANAGEMENT

The team recognized the current focus on error reduction tools and on the observation and coaching programme. However, the current set of human performance tools are targeted at workers performing hands-on activities. The team encouraged the plant to extend the deployment of error prevention tools to technical staff.

As part of the plant’s endeavours to reinforce the importance of human performance tools, the plant training department is using innovative digital technologies for initial and refresher training. This approach provides easier and more effective feedback from the instructor to trainees on the use of human performance tools. The team considered this as a good practice.

11.3 SAFETY CULTURE

The plant conducted a safety culture self-assessment in 2015 and an independent safety culture assessment in 2017. However, contractors who perform work on the site did not participate in surveys, interviews or focus groups. The team encouraged the plant to widen the target audience for future safety culture assessments to ensure that all personnel working on site participate in the process (self-assessment and independent assessment).

DETAILED HUMAN, TECHNOLOGY AND ORGANIZATION INTERACTIONS FINDINGS

11.2 HUMAN FACTORS MANAGEMENT

11.2 (a) Good Practice: The plant's training department has used digital technologies in an innovative way to reinforce the use of human performance (HU) tools.

The plant has utilized digital technologies to improve the quality of its human performance training. The 3D immersion technology and camera goggles are used to complement initial and refresher training. These technologies have also enabled greater feedback from the instructor to trainees on the use of error prevention tools.

3D immersion technology and virtual reality:

The use of 3D immersion technology allows trainees to apply HU tools in a totally modelled environment, fully immersed, without exposing them to any kind of risks. The 'virtual consequence' of not using these tools properly is experienced by the trainee and reinforces the importance of using HU tools when performing tasks in the field.

The current set of scenarios are designed to reinforce the use of self-check, peer check, situational awareness, and 3-way communication. This will be further developed in 2018, applying it to the plant's industrial premises (water-filled systems, relays, electrical panels, etc), thereby directly connecting 3D training to the plant environment. It can also be tailored to the various plant departments.

The modelling costs are similar to those of a real mockup and this virtual tool can be used throughout a fleet, which would limit the additional deployment costs to those of the computer and headset purchase.

Camera goggles:

The plant training department has developed video googles for use during training of HU champions. The videos are used to replicate the activity as experienced by the trainee, showing what he/she has actually seen, said and heard. The goggles can be operated by the instructor using wi-fi. The videos are subsequently viewed during post training critique.

12. LONG TERM OPERATION

12.1 ORGANIZATION AND FUNCTIONS

The current plant operational license will expire in 2020 for units 2 and 4, in 2021 for unit 5 and in 2023 for unit 3. By extending the license beyond this timeframe, the plant will enter a period of Long Term Operation (LTO). Extended outage will be performed after 40 years of operation, with an objective to implement a broad range of modifications and safety upgrades to support safe LTO for the next 10 years. The Grand Carenage project was introduced to manage all necessary activities until completion of the extended outages for all four units in 2023.

The policy for LTO of the plant is not clearly established and is not communicated to the operating organization staff. There are inconsistencies with some long term activities being evaluated for 50 years and others for 60 years. There is no top-level corporate or plant document, which would define the aim to operate the plant beyond 50 years. The Unit DAPE (Unit Ageing Analysis Report) is being updated in anticipation of 50 years of operation. Also, Environmentally Qualified components are being requalified for 50 years of operation. The plant modification/ safety upgrades plan is targeting 60 years. The team encouraged the operating organization to develop and communicate a clear policy for the LTO of the units.

12.2 SCOPING AND SCREENING, AND PLANT PROGRAMMES RELEVANT TO LTO

Scope setting of structures, systems and components (SSCs) for LTO evaluations is not complete and the compilation of results does not enable scope completeness verification. There are gaps in the scope setting methodology. The results of scoping are currently spread across many different documents and stand-alone databases. The operating organization should consider completing the scope setting of SSCs for LTO and improving the compilation of results to enable scope completeness verification. The team made a suggestion in this area.

12.3 REVIEW OF AGEING MANAGEMENT AND AGEING MANAGEMENT PROGRAMMES, AND REVALIDATION OF TIME LIMITED AGEING ANALYSES

The operating organization has implemented a reactive process to manage technological obsolescence. The operating organization should consider improving the identification of technological obsolescence issues using a proactive approach. The team made a suggestion in this area.

The identification and revalidation of time limited ageing analyses (TLAAs) for LTO has gaps and is not completed yet. The operating organization has developed a methodology for identification of TLAAs but the process of identification of TLAAs has gaps. Revalidation of TLAAs for LTO is at a very early stage. The operating organization should consider completing identification and revalidation of TLAAs for LTO. The team made a suggestion in this area.

The operating organization has implemented a systematic approach to ageing management using a complex system of FAVs (Ageing Analysis Sheets) and component DAPEs (Ageing Analysis Reports) developed at corporate level, and unit DAPEs developed at plant level. Nevertheless, several gaps were identified in these documents fulfilling the function of AMPs (ageing management programmes) in the operating organization. Environmentally-assisted fatigue is currently not addressed at the plant. The flow-accelerated corrosion programme has some gaps (for example the consistency of components in the programme database BRT-CICERO is not systematically verified with the plant components in SYGMA database, programme actions are manually transferred from BRT-CICERO to SYGMA). Ageing management programme of cables is not fully implemented yet. The team encouraged the plant to improve ageing management programmes to properly manage potential ageing effects.

For equipment qualification for operation in normal and accident conditions, EDF applies the assumption that the plant is comparable with the reference plant: Tricastin. However, Bugey is a CP0 series plant, while Tricastin is a CPY series plant. Lists of safety-related components, buildings and civil structures are developed separately for Bugey and for Tricastin. Specific ambient condition monitoring and monitoring of hot-spots for qualified equipment has not yet been performed at Bugey. At this time, the approach used by EDF for equipment qualification preservation is based on different methods, which do not take into account directly the real ambient conditions at the plant. The team encouraged the plant to assess adequately that ambient conditions for qualified components at the plant are consistent with EQ assumptions.

Benchmarking of EDF's ageing management process against IAEA Safety Standards and other guidance (e.g. Safety Report No. 82 IGALL) has been performed, with the objective to improve the ageing management process in EDF. The list of EDF Ageing Analysis Sheets (FAV) has been compared to the IAEA IGALL Ageing Management Review tables, to review if all potential ageing effects are properly considered in the EDF ageing management process. All EDF FAV authors (more than 1000 FAVs currently exist in EDF) have been identifying which analyses meet the criteria of the IGALL TLAAs. All IGALL AMPs have been reviewed, with the objective to identify gaps in EDF ageing management activities. EDF has identified, for each IGALL AMP, the relevant EDF documents that demonstrate compliance with the 9 attributes of effective AMPs. The team recognized this as a good performance.

The CAPCOV research and development process aims to capitalize, update and disseminate scientific knowledge available from EDF research and development on material ageing. The list of 61 material ageing effects and degradation mechanisms encountered in PWR operating conditions is updated regularly. The CAPCOV database includes general modelling and kinetic models of ageing effects. This allows the estimation of the sensitivity of a material to a degradation mechanism, and prediction of the long term trend of ageing effects on exposed materials. Reports are regularly updated (every 5 years as a minimum) in regard to the evolution of scientific knowledge, internal and external operating experience feedback. A multi-criteria search enables searching for ageing effects likely to occur for a material grade under specific operating conditions. This database is a powerful diagnostic tool which enables the identification of potential ageing effects for specific operating conditions, for specific symptoms or for a specific material grade. The team recognized this as a good performance.

DETAILED LONG TERM OPERATION FINDINGS

12.2. SCOPING AND SCREENING, AND PLANT PROGRAMMES RELEVANT TO LTO

12.2(1) Issue: Scope setting of structures, systems and components (SSCs) for LTO evaluations is not complete and the compilation of results does not enable scope completeness verification.

The team noted the following:

- By using the criterion 'Non-safety SSCs, whose failure due to an ageing mechanism could represent a hazard for safety SSCs' for the scoping of non-safety SSCs for LTO, non-safety SSCs whose failure due to other reasons could represent a hazard for safety SSCs are neglected.
- The current guidelines for SSC scoping do not yet cover all relevant hazards which need to be considered. There is not yet a specific guidance on how to perform scoping of non-safety SSCs due to potential internal flooding of safety SSCs at the plant.
- The results of scoping are currently spread across different documents such as EIPs (safety related) list, EIPr (ultimate release containments – usually civil works like core retention) and EIPi (negative impact for population like noise, smell, releases) lists and multiple unit DAPE (Ageing Analysis Report) documents.
- There is no unique list or database of SSCs which differentiates between SSCs in the scope and out-of-the scope SSCs for LTO.
- SYGMA database contains the plant equipment master list of plant SSCs but there is no identification of in-scope and out-of-scope SSCs.
- All databases/lists and documents with SSCs for ageing management and LTO are kept separately from the SYGMA database equipment master list.
- Review of consistency of scoping databases/lists against changes in the SYGMA database is performed only once in 10 years prior to VD (ten-yearly outage) and after VD.
- For non-safety SSCs, which can cause internal flooding of safety SSCs, only non-safety auxiliary piping is in the process of analysis. Other components, which can cause internal flooding such as valves, pumps, tanks, are currently not yet identified from this perspective and their FAVs (Ageing Analysis Sheets) are not created yet.
- There is currently no specific guidance how to perform scoping of non-safety SSCs due to potential internal flooding of safety SSCs (for example walk-downs).
- For all non-safety SSCs with a potential impact on safety SSCs in case of earthquake, walk-downs and visual inspections were performed by sampling during VD3 to confirm that these components are resistant in case of seismic event. Not all rooms and all components were reviewed.

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

Suggestion: The operating organization should consider completing the scope setting of SSCs for LTO and improving the results processing to enable scope completeness verification.

IAEA Basis:

SSR 2/2

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

(a) …

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

(c) Categorization of structures, systems and components with regard to degradation and ageing processes;

(d) ….

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5.9 A data collection and record keeping system should be in place as a necessary base for the support of ageing management.

5.15 A list or database of all SSCs at the nuclear power plant (such as a master list of SSCs) should be made available before the scope setting process is commenced.
5.16 The following SSCs should be included in the scope of ageing management:

- ….
- Other SSCs whose failure may prevent SSCs important to safety from fulfilling their intended functions. Examples of such potential failures are:
  - Missile impact from rotating machines;
  - Failures of lifting equipment;
  - Flooding;
  - High energy line break;
  - Leakage of liquids (e.g. from piping or other pressure boundary components).
- Other SSCs that are credited in the safety analyses (deterministic and probabilistic) as performing the function of coping with certain types of events, consistent with national regulatory requirements, such as:
  - SSCs needed to cope with internal events, e.g. internal fire and internal flooding;
  - SSCs needed to cope with external hazards, e.g. extreme weather conditions, earthquake, tsunami, external flooding, tornado and external fire;
  - SSCs needed to cope with specific regulated events, e.g. pressurized thermal shock, anticipated transient without scram and station blackout;
  - SSCs needed to cope with design extension conditions or to mitigate the consequences of severe accidents.

5.18 If an SSC within the scope is directly connected to an SSC out of the scope, clear definitions of the boundaries between them should be established.

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

5.20 Since the subsequent process is carried out at the level of a structure or component (or its subcomponent), all structures or components and their subcomponents within the scope for ageing management should be identified. If the components or structures within a group have similar functions and similar materials and are in a similar environment, that group may be defined as a structure or component ‘commodity group’.

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

5.70 The assumptions, activities, evaluations, assessments and results of the evaluation of the plant programme for ageing management should be documented in accordance with national regulatory requirements as well as in accordance with IAEA safety standards. The documentation should be developed and retained in an auditable and retrievable form.

7.33 All information and conclusions with regard to the scope of an ageing management review for long term operation should be documented, including:

- An identification and listing of SSCs subject to an ageing management review and their intended functions;
- A description and justification of the methods used to determine the structures or components that are subject to an ageing management review;
- The information sources used to accomplish the above, and any description necessary to clarify their use.

Plant Response/Action:

A / Analysis of causes

- Cause 1: The main cause giving rise to this suggestion can be found in the divergence between EDF’s ageing management policy and the IAEA reference standards. The two approaches differ, particularly in relation to establishing the scope of equipment to be considered as potential aggressors to ‘EIPS’ (equipment important for safety reasons in the control of radiological accidents) subsequent to ageing phenomena. The inclusion of failures of non safety SSCs - failures other than those linked to ageing and that may impact safety SSCs - should be analysed in the process.
- Cause 2: Aggressions are not fully taken into consideration in the process (scoping and screening), particularly in relation to non safety SSCs that are potential aggressors to safety SSCs in the event of internal flooding or earthquake.

B / Strategy adopted to solve the recommendation/suggestion

The chosen strategy was to review how the topic of non-classified equipment aggression of classified equipment was taken into account, and to do so in the course of implementing the safety standards for fourth ten-year-outage status, in line with the EDF’s undertakings to the Nuclear Safety Authority. This strategy forms part of the action plan for the corporate process led by the Operational Engineering Unit (UNIE) and the Technical Directorate (DT).

C / Action plan

- Causes 1 and 2:
  - Action 1: Establish a list of SSCs classified as safety significant for the reference standards for fourth ten-year-outage status: D455617247117C (action completed by DIPDE in April 2019).
    Owner: Fleet Engineering, Dismantling and Environment department (DIPDE) – Deadline: April 2019.
  - Action 2: Conduct a completeness review to ensure that the contents of the new list of SSCs classified as safety significant for fourth ten-year-outage status are fully covered by the ageing management process, particularly if an Ageing Analysis Sheet (FAV) applies to the safety significant equipment.

Owner: DT – Deadline: 31/12/2019.

- Action 3: Update memorandum D305914005559A, which sets out how aggressions are taken into consideration in the ageing management process, by incorporating the safety standards applicable to fourth ten-year-outage status.
  Owner: DT – Deadline: 31/10/2019.
- Action 4: Draw a list of SSCs for consideration in probabilistic safety assessments (internal events and aggressions).
  Owner: DIPDE – Deadline: 31/10/2019.
- Action 5: Implement the new standards for fourth ten-year-outage status in the 2020 Compendium of Ageing Analysis Sheets.
  Owner: DT – Deadline: 31/07/2020.
- Action 6: Take account of the new Compendium of Ageing Analysis Sheets in the 'DAPE' documents (clearance for continued unit operation) produced from 2020 onwards, via the DAPE for units with fourth ten-year-outages from 2022/2023 onwards (including Bugey unit 3), or from 2020 via the Site Ageing Management Plan for those units that have already completed their DAPE (Bugey 2/4/5).
  Owner: SMF – Deadline: 31/12/2020.

D / Progress of action plan as of to date

Action 1: The action is closed out. The list of SSCs classified as safety significant for the reference standards for fourth ten-year-outage status (D455617247117C) was drawn up by DIPDE in April 2019.

Actions 2 to 6: These actions are ongoing.

E / Measuring action effectiveness

Thanks to its Ageing Management Representative within the corporate network, Bugey NPP is kept abreast of the process status of all corporate-led actions.

The effectiveness of the actions will be measured on completion of the DAPE clearance for continued operation of unit 3, and through the annual Site Ageing Management Plans produced from 2020 onwards.

IAEA comments:

The Technical Directorate (DT) in the Corporate organization was appointed as responsible organizational unit to resolve this issue. The cause analysis showed that the relevant process to identify SSCs for LTO evaluation was missing at fleet-level and thus it did not provide identification of in-scope and out-of-scope SSCs at the plant level.

EDF decided to publish two technical notes at fleet-level and two technical notes for Bugey NPP to provide guidance to develop the list of SSCs for LTO evaluation.

The high-level technical note D455617300105, 'Nuclear Safety Standards for Bugey VD4 – Nuclear Safety Requirements for Important to Safety Equipment', version A was issued on 6 February 2019. This document provided a list of SSCs important to safety for Bugey NPP unit 2 at VD4 status. It identified requested attributes of in-scope SSCs. Section 4 provided a list of types of SCs with no functional ID which were important to safety e.g. pipes, supports, electrical SCs, I&C SCs. Section 5 provided criteria for scope setting of important to safety SSCs. Section 5.3 provided criteria for SSC to cope with severe accidents. Section 5.4 provided criteria for SSC to cope with certain types of events e.g. flooding, fire, explosion, high energy line break (HELB). The Appendix contained a list of SSCs important to safety.

D305914015559, 'Identification and Selection of SSCs not important to safety which could prevent SSCs important from safety fulfilling their functions due to ageing', version B was issued on 27 September 2019. Methodology of the scope setting of SSCs not important to safety was updated to be in line with IAEA Safety Standards. Section 7 contained a list of external and internal events. For each event, an analysis was performed to evaluate the effects of ageing on SSCs not important to safety. Results of the process could be an update of the scope of SSCs and an update or creation of a new FAV.

D305919035554, 'List of SSCs considered in Ageing Management for LTO (VD4) due to PSA' (DT document), version A issued on 27 September 2019 provided a list of SSCs not important to safety with high contribution to postulated core damage frequency.

D5110NT18266, 'Analysis of SSCs important to conventional risks protection and SSCs important for inconveniencies (environment impact and health) in Bugey approach to ageing management', Rev.1 issued on 27 September 2019 provided guidance for Bugey NPP to check if identified SSCs are properly monitored and maintained to manage ageing.

An update of the scope setting for Bugey NPP using revised procedures was initiated in 2019 and is planned to be completed in 2020. An update of SSCs not important to safety and PSA relevant will be done in 2020.

At the end of 2017, Bugey NPP migrated from the SYGMA database to the SDIN database (Asset Suite type) which allowed identification of in-scope and out-of-scope SSCs. The database was partially populated with SSCs data, though SSCs not important to safety were not in the database yet. In-scope SSCs were planned to be completely populated by the end of VD4. The link of SSCs in the SDIN database with relevant FAVs did not exist but was under consideration in the future. The SDIN database contained fields important for ageing management of in-scope SSCs but the majority of the data was missing e.g. installation date, manufacturer, model, maintenance and modifications history (available in the SDIN database only from 2017).

Conclusion: Satisfactory progress to date.

12.3. REVIEW OF AGEING MANAGEMENT AND AGEING MANAGEMENT PROGRAMMES, AND REVALIDATION OF TIME LIMITED AGEING ANALYSES

12.3(1) Issue: The operating organization has not implemented a proactive approach to the identification of technological obsolescence issues within its obsolescence programme.

The team noted the following:

- The operating organization has implemented a reactive process to manage technological obsolescence. The process is initiated when the obsolescence issue is identified at the plant level (typically unavailability of spare parts) or at corporate level (supplier will not provide spare parts). An obsolescence 'package' is opened when the obsolescence issue is detected. Obsolescence issues are prioritized depending on safety relevance, on the stock level and on the organization's capability to repair the equipment.
- Existing procedures do not require proactive identification of obsolete components at the plant and corporate levels.
- No methodology for the proactive identification of potential obsolete items has been provided for any of the obsolescence procedures presented, such as systematic monitoring of suppliers, systematic monitoring of spare parts availability.
- Some deficiencies/discrepancies exist in control documentation that prevent complete management of technological obsolescence:
  - National elementary process D4008.10.11.10/0557, Rev.1 'Addressing obsolescence of spare parts' from April 2011 is still being used (beyond the five year update period);
  - The document referred to in the plant elementary process to address identification of obsolete items on corporate level D4507091979, Rev.2, 'Operating Mode for Anticipating and Addressing Obsolescence' was cancelled on 21 April 2017. It was replaced by D450717009216, Rev.0 but it is not updated in the elementary process;
  - Document D450717009216, Rev.0 from March 2017 which is one level below the obsolescence elementary process has the title 'Obsolescence Elementary Process' which creates confusion;
  - Procedure D04008.10.11.09/0464, Rev.0 'Storage Management Policy' from 2009 is still being used (beyond the five year update period).

Without implementing a proactive approach to technological obsolescence, the operating organization cannot ensure of obsolescence issues will be addressed in a timely manner.

Suggestion: The operating organization should consider improving the use of proactive approach for the identification of technological obsolescence issues.

IAEA Basis:

SSR 2/2

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

4.50. The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components. The ageing management programme shall be coordinated with, and be consistent with, other relevant programmes, including the programme for periodic safety review. A systematic approach shall be taken to provide for the development, implementation and continuous improvement of ageing management programmes.

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6.1. Technological obsolescence of the SSCs in the plant should be managed through a dedicated plant programme with foresight and anticipation and should be resolved before any associated decrease in reliability and availability occur.

6.5. The technological obsolescence programme should be consistent with the nine attributes set out in Table 2, as applicable.

6.6. The technological obsolescence programme should include three basic steps illustrated in Fig. 6:

1. The operating organization should identify the installed SSCs important to safety that are technologically obsolete or will become obsolete in the upcoming years;
2. The identified equipment should be prioritized on the basis of the safety and criticality significance of the obsolete equipment (i.e. its impact on the plant safety);
3. The operating organization should develop and implement effective replacement solutions in a timely manner. Solutions to manage technological obsolescence are illustrated in Fig. 7 and are described in the IGALL technological obsolescence programme.

6.7. For the identification of obsolete equipment and parts, the following activities should be performed:

– Collection of data on structures and components, usually from plant asset management systems (equipment databases with information on manufacturers and parts);
– Determination whether the manufacturer still supports (provides) replacement equipment and spare parts.

6.10. The operating organization should exchange information and should participate in collaboration within the nuclear industry and should make use of industry tools to identify and resolve common occurrences of technological obsolescence.

6.11. The operating organization should periodically assess the effectiveness of the technological obsolescence programme and should continuously seek to improve performance and efficiency. Self-assessments should be performed concerning the obsolescence programme, its implementation and its effectiveness and any lessons learned should be acted on.

Plant Response/Action:

A / Analysis of causes

Background information: derived from a NPP/Technical Directorate (DT)/Operational Technical Unit (UTO) meeting held on 20/03/2019.

– Cause 1: The process for identifying obsolescence issues is deemed to be insufficiently proactive in comparison with the procurement process.
– Cause 2: A number of documents have not been updated within their revision deadlines.

B / Strategy adopted to solve the recommendation/suggestion

The Operational Technical Unit (UTO) has redefined the obsolescence management process.

C / Action plan

- Action 1: Upgrade the Integrated Management System's Elementary Process 'Management of obsolescence' to a Sub-Process entitled 'Ensure the monitoring and management of obsolescence', underpinned by the establishment of two Elementary Processes – 'Ensure monitoring' and 'Management of obsolescence'.
  Owner: UTO – Deadline: 31/12/2019.
- Action 2: Replace joint decision 'Manage the obsolescence of spare parts' with an organisational memorandum 'Ensure monitoring and guarantee the management of obsolescence issues', which specifies the role and expectations for each contributing body.
  Owner: Fleet Engineering, Dismantling and Environment Department (DIPDE) – Deadline: 30/09/2019.
- Action 3: Redefine responsibilities for addressing obsolescence casefiles during corporate meetings (Equipment Management Board for 2018).
  Owner: UTO – Deadline: 31/12/2018.
- Action 4: Implement monitoring for the valves and electricity sectors, in conjunction with the industrial policy. Within this framework, monitoring of supplier/equipment pairings will be set up.
  Owner: UTO – Deadline: 31/12/2019.
- Action 5: Deploy a new computer-based tool to improve the management of obsolescence (transition to electronic versions of obsolescence casefiles, reinforced stewardship of actions).
  Owner: UTO – Deadline: 30/06/2019.

D / Progress of action plan as of to date

Action 1: The two Elementary Processes – 'Ensure monitoring' and 'Management of obsolescence' – have been created. A memorandum governing Sub-Process 'Ensure the monitoring and management of obsolescence' has been drafted.
Action 2: The action is closed out. The organisational memorandum 'Ensure monitoring and guarantee the management of obsolescence issues', which will supersede the joint decision, is pending sign-off.
Action 3: The action is closed out. The decision was taken to adopt a new approach: UTO is the only EDF body responsible for the procurement chains for obsolete parts. From now on, NPPs will only be called upon to assist with technical matters (documentation, plant, etc.) but will no longer take action.
Action 4: The action is closed out. In 2019, monitoring was established for the valves and electricity sectors, in conjunction with the industrial policy. This included setting up a mechanism for monitoring supplier/equipment pairings that present significant challenges for the electricity sector. The valves constituent will be addressed by the end of 2019.
Action 5: The action is closed out. A new computer-based tool was created using Sharepoint, to manage obsolescence issues (electronic versions of obsolescence casefiles, reinforced stewardship of actions).

E / Measuring action effectiveness

The overhaul of the process for managing obsolescence at corporate level - with a clarification of the roles of corporate bodies and NPPs, the introduction of a technical monitoring system in conjunction with EDF's industrial policy - strengthens EDF's operational capacity to guard against the risks associated with equipment obsolescence. The technical monitoring system in place also allows EDF to be at the ready and proactive in working with industrial partners to address obsolescence issues and consolidate the long-term operation of equipment.

IAEA comments:

The Nuclear Production Division (DPN) in the Corporate organization was appointed as the responsible organization unit to resolve the issue. Operational Technical Unit (UTO) and Central Engineering (CI) also contributed to the solution. At the beginning of 2018, DPN, UTO and CI agreed on an action plan. The main actions, implemented for the whole EDF fleet, were: to update the organizational structure for obsolescence management, to implement proactive monitoring of obsolescence, to develop and maintain a fleet-wide obsolescence status overview and to develop a user-friendly tool for managing proactive obsolescence. The original time schedule for implementation of these main actions was from January 2018 to June 2019, which had not been met.

DPN management decided to produce a new organisational memorandum D450719017645 'Ensure monitoring and guarantee the management of obsolescence issues' at the beginning of 2018. Currently, the document was still at draft status in the final step of validation process by DPN management. It specifies the role and responsibilities of each contributing organization unit. The CI was responsible for obsolescence monitoring (e.g. information about obsolete items which comes to light during implementation of modifications and procurement), equipment qualification, qualification of equivalent equipment and materials and preparation of modification and design upgrades. The UTO was responsible for monitoring spare parts availability and suppliers' production plans etc. The operational engineering Unit - RD UNIE which was part of DPN, was responsible for strategies for obsolescence management, deadlines, budget allocation and risk assessment connected with obsolescence. The Grand Carenage (GK) project provides DPN with information on obsolescence (both monitoring and solutions). The Elementary Processes unit (PE) was responsible for ensuring obsolescence management at national level and to maintain a fleet-wide overview of obsolescence status.

A new organisational memorandum D450719016459 'UTO/DPRL Obsolescence Sub-process' was developed at the level of a sub-process (one level higher than original elementary process) and was approved in July 2019. It replaced the original elementary process for obsolescence which was linked only to spare parts. The objective of this subprocess is monitoring and management of obsolescence. It comprises two elementary processes – 'Ensure monitoring' (proactive monitoring) and 'Management of obsolescence' (implementation of solutions).

'Methodology of Technical Monitoring', D450719023665, issued on 24 September 2019, was a guidance document providing definition of availability of spare parts, roles of contributors, input data important for obsolescence and important for monitoring, criteria for scope setting, and examples of monitoring activities (an initial list to be later expanded based on results of real evaluation of in-scope items). It provided the methodology for scope setting. In-scope SSCs, spare parts and materials were managed in the database (Obsolescence Portal). It was planned that all information necessary for technological obsolescence of in-scope items would be collected, analysed and stored in a format of summary sheets as defined in D450719023665. Currently, a pilot for all electrical boards was being prepared with the deadline of December 2019. Afterwards the obsolescence committee (COPIL) would decide if the items need to be only monitored or if there is a need for an obsolescence solution (scheduled pilot of electrical boards in January 2020). A strategy will be proposed for items which need monitoring as described in D450719023665. An obsolescence case would be opened for items which needed an obsolescence solution. A Technical Committee was established to decide on suitable obsolescence solutions (new supplier, substitutes, modification etc.) If an effective preventive action was defined, the item will be moved to the group of monitored items (e.g. supplier changes production plan).

As per D450719023665, monitoring activities would comprise systematic regular activities for all in-scope items e.g. review of contracts, monitoring of suppliers concerning availability of spare parts, and monitoring of supplier skills and competences. Necessary activities would be determined by the Technical Committee. Annex 2 provided a template for Summary Sheet of in-scope items which contained agreed prescribed monitoring activities.

Obsolescence Portal, the new computer-based tool to improve the management of obsolescence was launched in July 2019 for all EDF units. It contained monitoring, solutions and feedback modules:

– Monitoring module – the list of monitored items for a pilot for electrical boards had not been uploaded yet but is planned for January 2020. In addition, summary sheets of in-scope items with prescribed monitoring activities had not been uploaded. Several reports with obsolescence status declarations had been uploaded as an example but categories would be redefined with an implementation of pilot results.
– Solutions module - national register in excel format, linked with word files containing past solutions had been uploaded. A task with a deadline in 2022 had been initiated to transfer solutions into the Obsolescence Portal format.
– Feedback Module: it was planned that the operating experience module would be linked to obsolescence to formalize operating experience feedback with an impact on obsolescence.

Conclusion: Satisfactory progress to date.

12.3(2) Issue: The identification and revalidation of time limited ageing analyses (TLAAs) for LTO has gaps and is not complete.

The team noted the following:

- Based on a methodology for identification of TLAAs developed by EDF engineering department SEPTEN, FAV (ageing analysis sheet) authors (585 relevant FAVs) provided information to SEPTEN on what they consider to be TLAAs. SEPTEN has initiated an evaluation of the results and is creating an overview of TLAAs and their links to FAVs but this work is not finalized and verified yet.
- There is no procedure or process for TLAAs revalidation yet.
- The time frame for TLAA revalidation and periodicity of TLAA revalidation is not decided yet.
- For the review of identified TLAAs for mechanical components, the reactor pressure vessel (RPV) was selected. Embrittlement, fatigue, stress corrosion cracking (SCC) and primary water stress corrosion cracking (PWSCC) analyses were identified by FAV authors and verified by SEPTEN as TLAAs. Analysis for SCC and PWSCC were incorrectly identified as TLAAs as they contain no time limited assumptions.
- For the review of identified TLAAs for electrical components, four electric motor valve actuators were selected. Document ENSEMD070378, Rev. B, 'Strategy for life extension', 2011 was identified as a TLAA. This document is not a TLAA but a summary document which leads to actions to extend the life time (TLAA can be one of the options).
- The plant provides real aged samples for equipment qualification (EQ) requalification tests but the specific histories of ambient conditions of the selected samples are not always known and the conservatism of the selected approach might not always be demonstrated.
- Requalification of part of the qualified equipment for LTO is still pending.

Without identification and revalidation of TLAAs for LTO, the operating organization cannot demonstrate that all ageing effects of SSCs important to safety are properly managed for LTO.

Suggestion: The operating organization should consider adequately completing identification and revalidation of TLAAs for LTO.

IAEA Basis:

SSR 2/2

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

(a) …

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

(e) ….

SSG-48

2.22. Time limited ageing analyses (also termed safety analyses that use time limited assumptions) should demonstrate that the analysed ageing effects will not adversely affect the ability of the structure or component to perform its intended function throughout an assumed period of operation, as described in Section 5.

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

4.13. The design basis documentation, including design basis requirements and supporting design basis information, should be owned by or accessible to the operating organization to support appropriate configuration management and modification management and to allow identification of the time limited ageing analyses for the plant.

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

1. Time limited ageing analyses associated with these structures or components should be evaluated to determine the continued validity of the analyses for the intended period of operation. Results of the evaluation of time limited ageing analyses should be taken into account in the ageing management review;
2. …

5.68. If the time limited ageing analyses cannot be found acceptable using criterion (i), (ii), or (iii), then corrective actions should be implemented. Depending on the specific analysis, corrective actions could include:

– Refinement of the analysis to remove excess conservatism;
– Implementation of further actions in operations, maintenance or the ageing management programme;
– Modification, repair or replacement of the structure or component.

5.69. Results of the evaluation of time limited ageing analyses should be used as an input for ageing management review.

7.28. Time limited ageing analyses should be reviewed to determine the continued acceptability of the analysed structure or component for the planned period of long term operation, in accordance with para. 5.67. The time dependent parameter should be determined from a re-evaluation or analysis of the operating history of the plant (including its projection to the end of the planned period of long term operation) to define a value of the parameter that applies to or bounds the expected value of the parameter at the end of the planned period of long term operation. The value of the time dependent parameter applicable to the period of long term operation should be used to re-evaluate the time limited ageing analyses as described in para. 5.67.

Plant Response/Action:

A / Analysis of causes

– Cause 1: There are differences in the documentation structure of the AIEA standards based in particular on TLAA (Time Limited Ageing Analyses / cf. SSR 2/2, SSG 48), and EDF's ageing management process – comprising ageing mechanisms detailed in the Ageing Analysis Sheets (FAV) applicable within a specific scope; and 'DAPE' documents (clearance for continued operation) for components. The Technical Directorate had undertaken an analysis focused on identifying the study reports that could be regarded as TLAA.

– Cause 2: The TLAA should be revalidated during the Periodic Safety Review conducted for the fourth ten-year-outage.
– Cause 3: EDF has identified a number of documents as TLAA when in fact they were not. This is the case, for example, for the 'DAPE' documents (clearance for continued operation) for components.

B / Strategy adopted to solve the recommendation/suggestion

The process of identifying those documents that could be regarded as TLAA will be finalised (causes 1 and 3). The revalidation of TLAA (cause 2) will not be performed following the update to the Regulatory Reference Documents (DRR). The objective of the comparison of reference standards was to demonstrate that EDF's ageing management standards meet the requirements of the IAEA, despite different documentation structures.

C / Action plan

– Causes 1 and 3:
    - Action: Identify the TLAA and demonstrate equivalence between the EDF ageing management process and the IAEA standards.
      Owner: Technical Directorate – Deadline: 31/12/2020.

D / Progress of action plan as of to date

Action : The list of recognised TLAA is being checked (removal of ageing mechanisms that do not fall under a TLAA and removal of documents that are not considered to be TLAA).

E / Measuring action effectiveness

Thanks to its Ageing Management Representative within the corporate network, Bugey NPP is kept abreast of the process status of all corporate-led actions. The effectiveness of the actions will be measured on completion of the 'DAPE' clearance for continued operation of unit 3, and through the annual Site Ageing Management Plans.

IAEA comments:

The Technical Directorate (DT) in the Corporate organization was appointed as the responsible organizational unit to resolve this issue. The result of the cause analysis was that people in charge of ageing analyses sheets (FAVs) did not have the required knowledge to identify TLAAs. The other cause was that there was no unique document which was clearly stamped as a TLAA.

In February 2018, EDF decided to perform training for 40 to 50 DT equipment experts responsible for writing FAVs on identification of TLAAs. No action to update EDF processes and procedures connected with identification and revalidation of TLAAs was identified.

Training of equipment experts responsible for writing FAVs was launched in 2019. It was planned that the training for DT electric components, Engineering Support, Dismantling and Environmental Services Division (DIPDE) and Power Generation Engineering Design Centre (CNEPE) experts will be completed in 2020. The subject-matter of the training was the identification of TLAAs (6 criteria), familiarization with IGALL TLAAs, examples of correctly and incorrectly identified TLAAs. Revalidation was not part of the training.

Equipment experts responsible for writing FAVs were to review and update identification of TLAAs in FAVs by December 2020. Once TLAAs were fully identified, equipment experts would check if revalidation of all TLAAs was being properly addressed by existing processes. This activity had been already initiated for mechanical components and it was planned to be completed in 2020. Electrical TLAAs review were planned to be performed in 2020. Existing processes to revalidate TLAAs were equipment qualification and Reference Regulatory File (DRR) updating process, etc.

Analyses of qualified equipment for Bugey NPP unit 2 VD4 in January 2020 was completed. Replacement of equipment which was not requalified for LTO will be completed by the end VD4 (40% already replaced) e.g. level indicators, semiconductors, bearings of diesel engines, and overvoltage protection.

TLAA identified in FAVs were already partially reviewed and correct TLAAs were identified. Only one mistake for reviewed FAVs was found, otherwise TLAA are properly identified.

Conclusion: Satisfactory progress to date.

SUMMARY OF STATUS OF RECOMMENDATIONS AND SUGGESTIONS OF THE OSART FOLLOW-UP MISSION TO BUGEY NPP

	RESOLVED	SATISFACTORY PROGRESS	INSUFFICIENT PROGRESS	TOTAL
Leadership and Management for Safety				
S1.1(1)		X		
Training and Qualification				
R2.2.1		X		
Operations				
S3.3(1)			X	
R3.4(1)		X		
Maintenance				
R4.5(1)		X		
Technical Support				
R5.7(1)		X		
Operating Experience Feedback				
S6.5(1)		X		
Chemistry				
S8.2(1)	X			
S8.2(2)	X			
Emergency Preparedness & Response				
R9.2(1)	X			
S9.3(1)		X		
Severe Accident Management				
R10.1(1)		X		
S10.2(1)		X		
Long Term Operation				
S12.2(1)		X		
S12.3(1)		X		
S12.3(2)		X		
TOTAL R	1	5	0	6
TOTAL S	2	7	1	10
TOTAL	19%	75%	6%	

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

Good practice

A good practice is an outstanding and proven programme, activity or equipment in use that contributes directly or indirectly to operational safety and sustained good performance. A good practice is markedly superior to that observed elsewhere, not just the fulfilment of current requirements or expectations. It should be superior enough and have broad enough application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence. A good practice is novel; has a proven benefit; is replicable (it can be used at other plants); and does not contradict an issue. Normally, good practices are brought to the attention of the team on the initiative of the plant.

DEFINITIONS - FOLLOW-UP MISSION

Issue resolved - Recommendation

All necessary actions have been taken to deal with the root causes of the issue rather than to just eliminate the examples identified by the team. Management review has been carried out to ensure that actions taken have eliminated the issue. Actions have also been taken to check that it does not recur. Alternatively, the issue is no longer valid due to, for example, changes in the plant organization.

Satisfactory progress to date - Recommendation

Actions have been taken, including root cause determination, which lead to a high level of confidence that the issue will be resolved in a reasonable time frame. These actions might include budget commitments, staffing, document preparation, increased or modified training, equipment purchase etc. This category implies that the recommendation could not reasonably have been resolved prior to the follow up visit, either due to its complexity or the need for long term actions to resolve it. This category also includes recommendations which have been resolved using temporary or informal methods, or when their resolution has only recently taken place and its effectiveness has not been fully assessed.

Insufficient progress to date - Recommendation

Actions taken or planned do not lead to the conclusion that the issue will be resolved in a reasonable time frame. This category includes recommendations on which no action has been taken, unless this recommendation has been withdrawn.

Withdrawn - Recommendation

The recommendation is not appropriate due, for example, to poor or incorrect definition of the original finding or its having minimal impact on safety.

Issue resolved - Suggestion

Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been fully implemented or the plant has rejected the suggestion for reasons acceptable to the follow-up team.

Satisfactory progress to date - Suggestion

Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been developed but not yet fully implemented.

Insufficient progress to date - Suggestion

Consideration of the suggestion has not been sufficiently thorough. Additional consideration of the suggestion or the strengthening of improvement plans is necessary, as described in the IAEA comment.

Withdrawn - Suggestion
The suggestion is not appropriate due, for example, to poor or incorrect definition of the original suggestion or its having minimal impact on safety.

LIST OF IAEA REFERENCES (BASIS)

SF-1	Fundamental Safety Principles (Safety Fundamentals)
GSR-1	Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements)
GSR-2	Preparedness and Response for a Nuclear or Radiological Emergency (Safety Requirements)
GSR Part 2	Leadership and Management for Safety
GSR-3	The Management System for Facilities and Activities (Safety Requirements)
GSR Part 3	Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Interim Edition
GSR-4	Safety Assessment for Facilities and Activities (General Safety Requirements 2009)
GSR-5	Predisposal Management of Radioactive Waste (General Safety Requirements)
GSR Part 7	Preparedness and Response for Nuclear or Radiological Emergencies
GSG-1	Classification of Radioactive Waste (Safety Guide 2009)
GSG-2	Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency
GSG-2.1	Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
GSG-3.1	Application of the Management System for Facilities and Activities (Safety Guide)
GSG-3.5	The Management System for Nuclear Installations (Safety Guide)
GSG-4.1	Format and Content of the Safety Analysis report for Nuclear Power Plants (Safety Guide 2004)
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)
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

SSR-5 Disposal of Radioactive Waste (Specific Safety Requirements)

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)

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)

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

RS-G-1.1 Occupational Radiation Protection (Safety Guide)

RS-G-1.2 Assessment of Occupational Exposure Due to Intakes of Radionuclides (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)

WS-G-2.5: Predisposal Management of Low and Intermediate Level Radioactive Waste (Safety Guide)

WS-G-6.1 Storage of Radioactive Waste (Safety Guide)

Safety Report Series No.2 Optimization of Radiation Protection in the Control of Occupational Exposure

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

Services Series No.12 OSART Guidelines

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

EPR-ENATOM-2002 Emergency Notification and Assistance Technical Operations Manual

EPR-METHOD-2003 Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)

EPR-EXERCISE-2005 Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, (Updating IAEA-TECDOC-953)

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)

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