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# REPORT

**OF THE**

# OPERATIONAL SAFETY REVIEW TEAM

# (OSART)

# MISSION

**TO**

# BUGEY

# NUCLEAR POWER PLANT

# FRANCE

# 2 – 19 October 2017

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/197/2017

## 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.

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 good areas of 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.

# 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.

# 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 program (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.

# 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.

## 3.4 CONDUCT OF OPERATIONS

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

## 3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

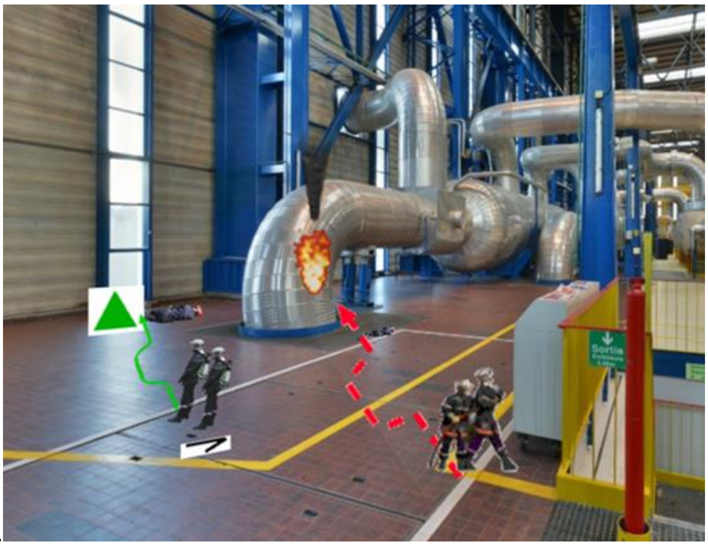
**3.6(a) Good practice:** SECUREVI emergency response information system

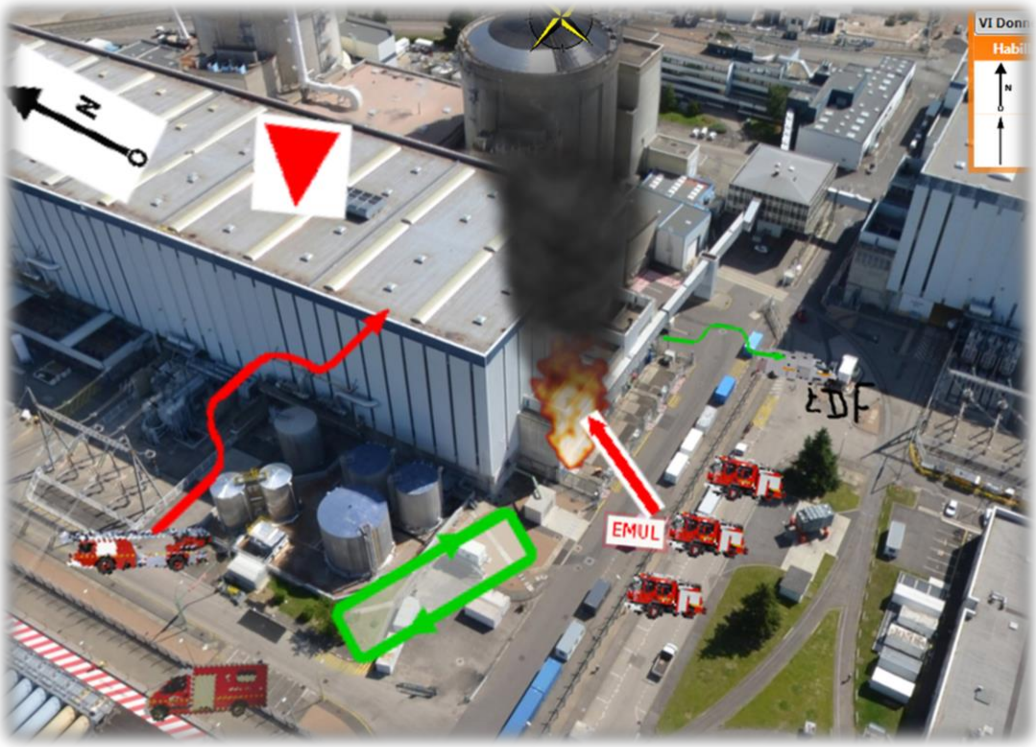
SECUREVI is a software programme for use in an on-site emergency that maps the site in detail, with clickable icons for each building that allow users to display operational information about the building, as well as 360-degree images of the building interior and exterior.

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 station. Bugey is EDF's pilot site for the implementation of the software.

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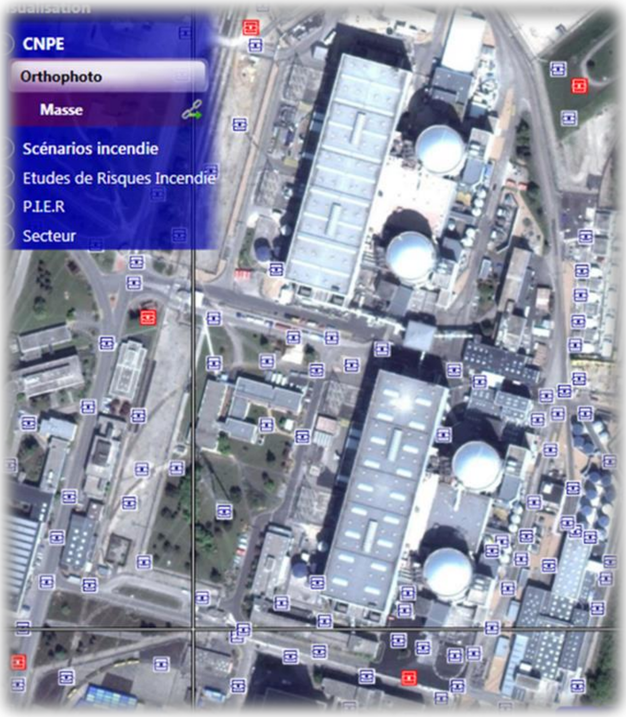
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# 4. MAINTENANCE

## 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

# 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 can not 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.

# 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 reocurrence. 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.

# 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.”

**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.

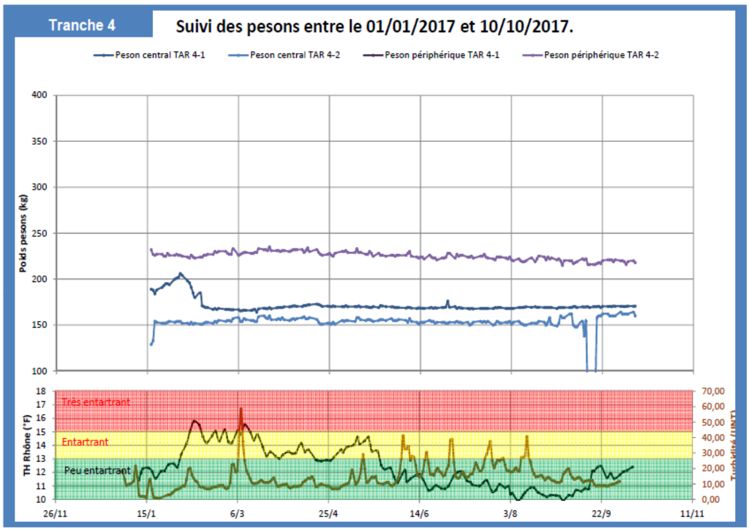
**8.2(a) Good practice**: Circulating water system treatment for scale and sludge removal using an environmentally friendly product

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 unfavorable 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 center 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).

## 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 center 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 center 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.

# 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.

## 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.

# 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 behavioral 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 analyze 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.

<u>3D immersion technology and virtual reality:</u>

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.

<u>Camera goggles:</u>

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 wifi. 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 withthe 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 don’t 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) ….

SSG-48

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.

## 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 yearupdate 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.

SSG-48

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.

**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.

# DEFINITIONS

DEFINITIONS – OSART MISSION

## Recommendation

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

## Suggestion

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

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

## Good practice

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

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

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

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

# LIST OF IAEA REFERENCES (BASIS)

*Safety Standards*


- **SF-1**; Fundamental Safety Principles (Safety Fundamentals)
- **SSR-2/2 Rev.1**; Safety of Nuclear Power Plants: Commissioning and Operation (Specific Safety Requirements)
- **GSR Part 2;** Leadership and Management for Safety (General Safety Requirements)
- **GSR Part 3;** Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
- **GSR Part 7;** Preparedness and Response for a Nuclear or Radiological Emergency (General Safety Requirements)
- **SSR-2/1 Rev.1**; Safety of Nuclear Power Plants: Design (Specific Safety Requirements)
- **NS-G-1.1**; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)
- **NS-G-2.1**; Fire Safety in the Operation of Nuclear Power Plans (Safety Guide)
- **NS-G-2.2**; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)
- **NS-G-2.3**; Modifications to Nuclear Power Plants (Safety Guide)
- **NS-G-2.4**; The Operating Organization for Nuclear Power Plants (Safety Guide)
- **NS-G-2.5**; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)
- **NS-G-2.6**; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)
- **NS-G-2.7**; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.8**; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)
- **NS-G-2.9**; Commissioning for Nuclear Power Plants (Safety Guide)
- **NS-G-2.11**; A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide)
- **NS-G-2.12**; Ageing Management for Nuclear Power Plants (Safety Guide)
- **NS-G-2.13**; Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide)

- **NS-G-2.14**; Conduct of Operations at Nuclear Power Plants (Safety Guide)
- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power Plants (Safety Guide)
- **SSG-13**; Chemistry Programme for Water Cooled Nuclear Power Plants (Specific Safety Guide)
- **SSG-25**; Periodic Safety Review for Nuclear Power Plants (Specific Safety Guide)
- **GSR Part 1**; Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements)
- **GSR Part 4**; Safety Assessment for Facilities and Activities (General Safety Requirements)
- **GS-G-4.1**; Format and Content of the Safety Analysis report for Nuclear Power Plants (Safety Guide)
- **SSG-2**; Deterministic Safety Analysis for Nuclear Power Plants (Specific Safety Guide)
- **SSG-3**; Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide)
- **SSG-4**; Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide)
- **GSR Part 5**; Predisposal Management of Radioactive Waste (General Safety Requirements)
- **GS-G-2.1**; Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
- **GSG-2**; Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency (General Safety Guide)
- **GS-G-3.1**; Application of the Management System for Facilities and Activities (Safety Guide)
- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
- **RS-G-1.1**; Occupational Radiation Protection (Safety Guide)
- **RS-G-1.2**; Assessment of Occupational Exposure Due to Intakes of Radio-nuclides (Safety Guide)
- **RS-G-1.3**; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)
- **RS-G-1.8**; Environmental and Source Monitoring for Purposes of Radiation Protection (Safety Guide)
- **SSR-5;** Disposal of Radioactive Waste (Specific Safety Requirements)

- **GSG-1** Classification of Radioactive Waste (General Safety Guide)
- **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
- **WS-G-2.5**; Predisposal Management of Low and Intermediate Level Radioactive Waste (Safety Guide)

▪ ***INSAG, Safety Report Series***

**INSAG-4;** Safety Culture

**INSAG-10**; Defence in Depth in Nuclear Safety

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

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

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

**INSAG-15**; Key Practical Issues In Strengthening Safety Culture

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

**INSAG-17**; Independence in Regulatory Decision Making

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

**INSAG-19**; Maintaining the Design Integrity of Nuclear Installations throughout their Operating Life

**INSAG-20**; Stakeholder Involvement in Nuclear Issues

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

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

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

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

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

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

▪ ***Other IAEA Publications***

- **IAEA Safety Glossary** Terminology used in nuclear safety and radiation protection 2007 Edition

- **Services series No.12**; OSART Guidelines, 2015
- **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
- **EPR-NPP PPA 2013**; Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor

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

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

# TEAM COMPOSITION OF THE OSART MISSION

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