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IAEA | Operational Safety Review Team | OSART

REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM

(OSART)

MISSION

TO THE

PENLY

NUCLEAR POWER PLANT

FRANCE

4-21 SEPTEMBER 2023

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/219/2023

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Penly Nuclear Power Plant, France. It includes recommendations for improvements affecting operational safety for consideration by the responsible France 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 France 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 ten 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. 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 Penly Nuclear Power Plant, France from 4 to 21 September 2023.

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 ten areas: Leadership and Management for Safety; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Preparedness & Response; and Accident Management.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader and the team was composed of experts from Canada, China, Germany, Slovakia, Sweden, United Kingdom, United States of America, and one Observer from United Arab Emirates. The collective nuclear power experience of the team was approximately 358 years.

The team identified 14 issues, 4 of them are recommendations, and 10 of them are suggestions. 7 good practices were also identified.

Several areas of good practice were noted:

- The updated plant information project (CONNECT) in the plant and corporate provides real time access to information and effective support to different function groups.
- The plant has installed remote monitoring capability on safety critical seawater piping.
- The plant has developed and installed a system for monitoring sedimentation in the intake cooling water channel.

The most significant issues identified were:

- The plant should improve the sensitivity of their managers and supervisors to recognize, challenge and correct inappropriate behaviours on site and establish an intolerance for rationalizing deviations to maintain personnel safety and high levels of standards.
- The plant should improve implementation of the processes related to plant configuration and status control to ensure plant safety.
- The plant should improve its preparation, control, and implementation of maintenance activities to ensure equipment reliability and personnel safety.

Penly 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 Penly Nuclear Power Plant from 4 to 21 September 2023. The purpose of the mission was to review operating practices in the areas of Leadership and Management for Safety, Training and Qualification, Operations, Maintenance, Technical Support, Operating Experience Feedback, Radiation Protection, Chemistry, Radiation Protection, Chemistry, Emergency Preparedness & Response, Accident Management. In addition, an exchange of technical experience and knowledge took place between the experts and their plant counterparts on how the common goal of excellence in operational safety could be further pursued.

The plant is located about 15 kilometers (km) north of the town of Dieppe, sub-prefecture of Seine Maritime department in the Normandy region of France. Paris is about 160 km to the southeast. The NPP site contains two 1330 MWe reactors. The first unit started its commercial operation in 1990 and the second unit in 1992.

The Penly OSART mission was the 219th in the programme, which began in 1982. The team was composed of experts from Canada, China, Germany, Slovakia, Sweden, United Kingdom, United States of America, and one Observer from United Arab Emirates. The collective nuclear power experience of the team was approximately 358 years.

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

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

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

MAIN CONCLUSIONS

The OSART team concluded that the managers of the Penly NPP are committed to improving the operational safety and reliability of their plant.

The team found areas of good practice, including the following:

- The updated plant information project (CONNECT) in the plant and corporate provides real time access to information and effective support to different function groups.
- The plant has installed remote monitoring capability on safety critical seawater piping.
- The plant has developed and installed a system for monitoring sedimentation in the intake cooling water channel.

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 sensitivity of their managers and supervisors to recognize, challenge and correct inappropriate behaviours on site and establish an intolerance for rationalizing deviations to maintain personnel safety and high levels of standards.
- The plant should improve implementation of the processes related to plant configuration and status control to ensure plant safety.
- The plant should improve its preparation, control, and implementation of maintenance activities to ensure equipment reliability and personnel safety.

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

1. LEADERSHIP AND MANAGEMENT FOR SAFETY

1.1 LEADERSHIP FOR SAFETY

The OSART team conducted a number of field walkdowns and observations of work activities. The team noted that inappropriate behaviours by workers were not always challenged and corrected by managers and supervisors to ensure safety of plant personnel and high level of standards. Such examples were observed in different function areas, such as in industrial safety, radiation protection, maintenance, operation, and technical support. The team made a recommendation in this area.

1.2 MANAGEMENT SYSTEM

EDF and Penly NPP have implemented a new project which will improve efficiency and add quality to evolutions performed out in the field. This new project entitled "CONNECT" utilizes innovative new technologies along with existing plant wiring to allow workers to access important plant and corporate data, documents, and applications real time while working in the field. The team identified this as a Good Practice.

The plant has not implemented "without cause" drug and alcohol testing in its fitness for duty programme. A formal plan to implement a random drug and alcohol testing programme has been prepared at the Penly Nuclear Power Plant. Penly will be the first nuclear plant in the EDF fleet to implement such a programme with full implementation of the programme planned before the end of 2023. The plant is encouraged to complete the implementation of this programme as planned.

1.3. SAFETY CULTURE

The OSART team did not undertake a detailed safety culture assessment at the plant. However, the collective experience of the team was used to capture safety culture attributes, behaviors and practices which help to shape and define the safety culture at the plant. With respect to observed strengths the team identified there was evidence of a supportive and collaborative relationship between departments and with their managers. In addition, a survey of employees revealed that the relationships and trust between managers and their workers has improved over the past three years.

A variety of tools and aids (guides and supporting material) have been developed for new and incumbent managers to develop or further develop their leadership skills (leadership programme).

These tools and aids facilitate increased engagement with staff towards common site and corporate goals. The Safety culture is evaluated.

In contrast, the team noted that some attributes could be strengthened. For example, the team observed several instances where benchmarking of top-performing plants outside of the French and British EDF fleet activities was not being done systematically to facilitate continuous performance improvement. There were examples where individual behaviors did not meet expected standards. For example, the team observed rationalization of deviations from standards in areas, such as in radiation protection, maintenance, operation, and industrial safety. Leadership activities such as the "I am Professional" initiative require additional emphasis to communicate and reinforce the importance of desired behaviors on safe plant operations.

DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY FINDINGS

1.1 LEADERSHIP FOR SAFETY

1.1(1) Issue: Inappropriate behaviours by workers are not always challenged and corrected by managers and supervisors to maintain safety of plant personnel and high level of standards.

The team noted the following:

- The team observed two examples when maintenance workers chose to not implement procedure steps as written. The plan to deviate from the established procedure was not corrected by supervisors during the pre-job brief or during execution. The post-work package review by management did not detect that an entire section of the safety related battery test to record and adjust level was not performed.
- Radiation protection workers handling contaminated laundry were observed walking to the clean side of the laundry and handling clean laundry with potentially contaminated gloves. This was after they had processed potentially contaminated shoes, where additional rubber gloves were required as PPE. The supervisor confirmed this is not in line with expectations but did not challenge the behavior.
- A maintenance supervisor did not update the safety precautions sheets correctly that were attached to the door prior to an internal camera inspection on a valve for the boron water system in Unit 2. Some key personal protective equipment requirements for radiological protection were not checked off on the sheet as expected leading to unclear radiological protection standards for entry to the room.
- Temporary drainage hoses were identified by the team attached to instrument tubing in the Unit 2 turbine building. This is not described in plant procedures as a method to be used and had not been previously identified.
- The following events in 2023 had gaps in adhering to procedures:
  - In June 2023, a safety related turbo generator set was unavailable six times. When a procedure that the operator was using did not deliver the expected results, the operator deviated from the procedure and instructed a field operator multiple times to conduct a step that was not in the approved procedure.
  - In 2023 at the completion of the low flow test for a turbopump, an operator shut the pump down using an unapproved method. This rendered the pump inoperable and incurred an unplanned Group 1 Limiting Condition for Operation. (ESS 23-010)
- The team identified many gaps in industrial safety practices, which were not corrected by peers or managers that were present. The following are some examples:
- A worker was observed standing between a forklift vehicle dumping concrete refuse and a large garbage bin. The worker was at risk of being crushed if the forklift moved forward unexpectedly.
- Two workers were not wearing eye protection during construction work on a road opposite the Purification Station. This standard was posted on the sign at the entrance to the area. This was not challenged by plant personnel walking past the worksite.

- A worker was carrying a chain fall and its attached chains without gloves. The worker was walking with two peers that were wearing gloves. The two workers did not challenge the third worker.

Without challenge and correction of some inappropriate behaviours of workers on site, there will be increased probability of personnel injuries and equipment damage.

Recommendation: The plant should improve the sensitivity of their managers and supervisors to recognize, challenge and correct inappropriate behaviours on site and establish an intolerance for rationalizing deviations to maintain personnel safety and high levels of standards.

IAEA Bases:

SSR-2/2 (Rev.1)

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

GSR Part 2

3.2. Managers at all levels in the organization, taking into account their duties, shall ensure that their leadership includes:
(a) Setting goals for safety that are consistent with the organization's policy for safety, actively seeking information on safety performance within their area of responsibility and demonstrating commitment to improving safety performance;
(b) Development of individual and institutional values and expectations for safety throughout the organization by means of their decisions, statements and actions;

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

GS-G-3.1

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

1.2. MANAGEMENT SYSTEMS

1.2(a) **Good practice**: The CONNECT project and its applications

The CONNECT project upgrades the communication systems in the EDF nuclear plants and allows real time access to information to provide support to Operations and other functional groups working in the plants by facilitating:

- Performance of field operator rounds.
- Management of tagging and Operations line-up procedures.
- Remote requests for technical assistance.
- Management of emergent work via surveillance video or video calls.
- The ability of Operators to access equipment line-up procedures.
- Review of equipment specifications.
- Initiation of work requests when equipment defects are identified.
- Reporting of issues in the “Caméléon” database from the field.
- Display of plant mechanical drawings.

The enhanced capability will improve the efficiency and quality of plant operations and other departments when performing work in the field.

2. TRAINING AND QUALIFICATIONS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

The plant has established a good relationship with a local technical high school to develop the skills of future staff. The plant provided some equipment to help the school with skills training. The school will provide other mock-ups and training facilities to support the plant in training future employees and contractors. The team identified this as a good performance.

The EDF training entity (UFPI) developed corporate Training Performance Indicators (TPIs) for all the plants within the fleet. Penly Nuclear Power Plant also developed 5 TPIs to monitor plant staff competency. However, these indicators do not measure training effectiveness, such as the number of events due to deficiencies in training. The team encourages the plant to develop integrated TPIs to monitor and improve plant training performance.

The team observed that the implementation of the operator training programme is not always carried out in a consistent manner to ensure training effectiveness. For example, 85 percent of plant operators participated in the mandatory simulator refresher training G1.2 in the 2022-2023 training cycle; and Main Control Room operators' performance on the training simulator did not meet expectations. The team made a suggestion in this area.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

2.2 (1) Issue: Implementation of the operator training programme is not always carried out in a consistent manner to ensure training effectiveness and safe and reliable operation.

The team noted the following:

- Training requirements:
  - The EDF corporate organization developed guidelines for the training and qualification of plant personnel to ensure the required competencies. However, the plant did not incorporate all plant specific design, equipment and procedures into these guidelines to ensure the development of plant-specific skills and abilities.
  - The plant developed a system training checklist to support field operator initial training on shift (defined on GT/SC/040 App 3), but it does not contain sufficient information for each system. Only one to three sentences are supplied for each plant system.
- Training implementation and evaluation:
  - 85 percent of plant operators participated in the mandatory simulator refresher training G1.2 in the 2022-2023 training cycle.
  - Prior to beginning a training scenario on the digital simulator at Paluel NPP (used for training while the Penly simulator was being upgraded), the instructor did not inform the trainees of the differences between the digital simulator of Paluel NPP and the plant main control room. This explanation should have included differences in procedures, transient announcements, and cooling tower system operation, all of which could affect the operators' response.
  - The plant evaluates operator task qualification in the field using a very generic task observation sheet instead of a more detailed task performance evaluation. In addition, sample-checks by the training department of the observation sheets completed by functional departments in 2022 identified that only 84 percent met the quality/completeness requirements.
- Shift crew performance during simulator refresher training:
  - A Reactor Operator and a Lead Operator did not use the procedure to calculate and verify the plant dilution calculation involving reactivity change when raising reactor power. The operators did not ask the instructor for a copy of the procedure when it could not be found.
  - A peer check was not conducted when the Turbine Operator input target power and ramp rate for increasing turbine power.
  - The Shift Manager did not communicate to the grid operator that a plant transient with turbine trip had occurred.
  - The Lead Operator did not identify a criterion allowing entry into an Emergency Plan after a transient with radioactive release had occurred. The instructors intervened immediately.
  - The shift crew did not announce a reactor transient after it occurred as per procedure.

- Plant events:
  - On 14 June 2020, the plant experienced an event which resulted in the loss of spent fuel pool cooling for 52 minutes due to a lineup error. One root cause identified that the design feature of the train B pool circulation pump cabinet (1PTR024CR) is not discussed in training or identified locally.
  - On 03 June 2021, three percent per hour ramp rate was not complied with during the load increase to 100 percent on Unit 2. One root cause identified was that training on the operation of the turbine control panel was not received by the operator involved in the event.

The knowledge and skills of plant operators may not be adequate to ensure safe and reliable operation without the delivery of a consistent and thorough training programme.

Suggestion: The plant should consider improving the operator training programme implementation to ensure that the training is always delivered consistently to ensure safe and reliable operation.

IAEA Bases:

SSR-2/2 (Rev.1)
4.20. Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel (including, if necessary, external support organizations, including contractors). The content of each programme shall be based on a systematic approach. Training programmes shall promote attitudes that help to ensure that safety issues receive the attention that they warrant.

SSG-75
4.7. Job specific training programmes should also be designed to develop skills and attitudes that contribute to safety.

4.8. For each position that performs safety related activities, the initial training needs and the continuing training needs should be established. These needs will vary depending on the individual position, the level of responsibility and the level of competence, and should be determined by persons with specific competence in plant operation and experience in developing training activities. These training needs should relate to the tasks and activities to be performed and include a clear focus on safety.

4.9. The operating organization should ensure the following with regard to personnel performing safety related activities:
(a) Training needs are continuously analyzed, in accordance with para. 4.18 of SSR-2/2 (Rev. 1) [1], and this analysis gives priority to safety.
(b) A training programme is developed, in accordance with para. 4.19 of SSR-2/2 (Rev. 1) [1].
(c) All necessary resources and facilities for implementing the training programme are provided.
(d) The performance of trainees is assessed at various stages of the training.
(e) The effectiveness of the training is evaluated, in accordance with para. 4.23 of GSR Part 2 [3].
(f) The competence of personnel is periodically checked, and continuing training or retraining is provided on a regular basis, in accordance with para. 4.19 of SSR-2/2 (Rev. 1) [1].

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 and of the feedback given, and further measures should be considered as a result of the evaluation. Assessment should not be regarded as a one-off activity. Reassessment of individuals by instructors and their immediate supervisors should be undertaken at regular intervals.

4.23. Training for all personnel of the operating organization, including plant personnel, should include general induction training (see paras 5.1 and 5.2) as well as specific training to ensure they have a thorough understanding of their particular duties and responsibilities and of their contribution to the safe and efficient operation of the plant.

4.29. Structured continuing training or retraining for control room operators, shift supervisors, responsible managers and technical support personnel should be given on a representative simulator. Simulator training exercises should be performed annually. Such exercises should reflect operating experience with emphasis on those situations that do not occur frequently, for example, startup, shutdown, special transients, accident conditions, including during shutdown mode. Teamwork should be emphasized in dealing with incidents and accidents.

3. OPERATIONS

3.3. OPERATING RULES AND PROCEDURES

The team observed several unauthorized operator aids in the plant electrical buildings as well as the main control room and other locations. The team encourages the station to continue its efforts to reduce the number of unauthorised operator aids.

3.4. CONDUCT OF OPERATIONS

Safety equipment is monitored through regular surveillance tests according to the technical specification. The results from the surveillance test are tracked and trended in order to identify negative trends in performance, and to propose proactive actions if needed. The team identified that during the last 3 years 9 safety related events have occurred that are related to surveillance testing. For instance, there are 5 tests that were overdue according to the requirements. The plant developed an action plan for improving the performance of surveillance testing, however the team identified that several actions are overdue. The team identified a suggestion in this area.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

The team observed a fire drill conducted in a compressor room in Unit 2. The shift crew responded promptly and acted professionally in a realistic manner. Fire drills with different scenarios with different complexities were conducted in the plant periodically to ensure the shift crews maintain their proficiency. The team identifies this as good performance.

3.7. CONTROL OF PLANT CONFIGURATION

The team noted that the processes related to plant configuration and status control are not always properly implemented to manage changes in configuration resulting from tagout, maintenance, and testing to ensure plant safety. For example, events related to configuration control continue to occur and field operators are not fully aware of improvement actions to be taken. The team made a recommendation in this area.

DETAILED OPERATIONS FINDINGS

3.4. CONDUCT OF OPERATIONS

3.4(1) Issue: The management of the surveillance programme does not always ensure that tests are performed in accordance with quality and timeliness.

The team noted the following:

- During the three previous years, nine safety related events had occurred related to surveillance testing at the plant and have been reported to the regulator. Of these events there have been five tests that have been overdue according to the requirements for the surveillance programme.
- An emergency diesel generator (EDG) test on Unit 2 performed in October 2022 was inappropriately evaluated as acceptable. During the next test on the same EDG in November, it was identified that the criteria for repowering time for increase in power was not taken into consideration during the October test. This invalidates the results of the October test.
- During a test of the Unit EDG in October 2022, a technician performing a required inspection incorrectly recorded the pressure.
- In January 2022 during a test of the ventilation system in the main control room, a damper became stuck, and the temperature in main control room exceeded the LCO requirements.
- In November 2021 during surveillance testing of the plant radiation monitoring system, a contractor responsible for performing two tests only performed one, and the second test became overdue.
- In November 2021, a surveillance test of the plant radiation monitoring on Unit 1 was overdue because the work-planning database had made the wrong calculation. The test was done after the outage, and it became overdue. The reason for the miscalculation of times was that the outage was moved one week back from the original schedule.
- There is no specific training for surveillance testing engineers.
- After review of the action plan for improving surveillance testing and adherence to surveillance requirements, the team identified that the action plan consists of nine actions. Of these actions, four are overdue, and two are still open at the time of the OSART mission.
- During surveillance testing on the post-Fukushima diesel generators, the fuel level continued to lower below the acceptable range for 16 consecutive weeks without correction. While categorized a surveillance test, the diesel is not yet in the safety case.

Without having sufficient quality control of the surveillance testing programme, safety-related equipment may unknowingly be unable to perform its design function.

Suggestion: The plant should consider improving the quality of surveillance programme and testing.

IAEA Bases:

SSG-74

9.6. In developing the surveillance programme, the following should be taken into account:

(a) The safety analysis report, the operational limits and conditions, and regulatory requirements;

(b) The results of the commissioning programme, with particular attention paid to baseline data, the as-built state of the plant and the acceptance criteria;

(c) The availability of items important to safety, and the detection of deficiencies and incipient failures that might occur during operation or prior to returning items to service after maintenance, repair or modification.

SSG-76

4.4. The management of the operating organization should ensure the effective involvement of shift personnel to the extent necessary in the authorization and performance of all regular or special activities that affect plant operation. Such activities may be associated with surveillance testing, maintenance work, permanent and temporary modifications and special operating procedures for tests or particular plant changes.

5.22. 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 operating personnel in a timely manner. The shift supervisor should review any observed deviations or malfunctions and verify continued compliance with OLCs. Any deviations discovered in the course of surveillance tests should be evaluated against the success criteria for the surveillance test.

5.23. Departments other than the operations department should be assigned responsibilities by the operating organization to develop and implement individual surveillance test procedures, to specify the appropriate frequency of testing, to complete some of the testing and to identify acceptance criteria. The operations department should retain responsibility for the scheduling and conduct of tests that involve equipment operation, for the review of completed test reports to ensure the test's completeness and for verification that the test results meet the approved acceptance criteria.

3.7. CONTROL OF PLANT CONFIGURATION

3.7(1) Issue: Plant processes related to configuration and status control are not always properly implemented to manage changes in configuration resulting from tagging, maintenance, and testing to ensure plant safety.

The team noted the following:

- On 13 March 2022, during an outage in Unit 2, the shift crew performed switchover of a 125V switchboard equipment resulting in the loss of six secondary switchboards. Loss of the switchboards caused the functional loss of a large amount of equipment required by the technical specifications. This resulted in a loss of a train of spent fuel pool cooling, ventilation, and instrumentation.
- One of the root causes was that the existing documentation was not exhaustive for the required de-energization of the electrical switchboard during outage.
- Each year, over the past few years, there have been several configuration control-related significant events. Two significant events had already occurred by mid-September 2023.
- No peer-check was required according to the corporate reactivity management guideline when expected core temperature change was less than 1°C. Because of this, no peer-check was completed during a rod maneuverability test observed by the team in the main control room.
- On 5 May 2023, an operator made steam driven auxiliary feedwater pump 2ASG031PO unavailable by closing the wrong valve. The related test procedure was not clear.
  - One root cause identified weaknesses in the plant operating procedure, which did not specify the exact equipment to be operated to stop a steam-driven pump.
  - The corrective action resulting from this event only required the procedure for this pump to be checked and did not specify an extent of condition check.
  - This type of operating procedure was updated only when plant modifications took place. No periodic review was required.
- The recently developed improvement plan with six actions to address configuration control weakness was not in line with the Specific, Measurable, Actionable, Relevant, and Time-bound (SMART) action principles. For example, there were no clear criteria for the expected end state of the improvement actions; and the behavioral observation element was not included in this plan to measure progress.
- The operation department was formally planning to review the feedback from the manager-in-field program every six months with focus on operator performance in configuration control. The first review only to be conducted in December 2023 aside from this, the operation department discussed manager-in-the-field program monthly.
- The operation department has established configuration control as one of its top priorities for improvement. However, when asked, one manager in the Operations Department, provided his understanding of the operations focus areas, but did not mention configuration control. Two field operators, when asked, were not able to articulate what the priorities (focus areas) of the Operation Department are and did not mention configuration control.

Without proper implementation of the processes related to plant configuration and status control, the probability of significant events related to configuration control will increase, compromising plant safety.

Recommendation: The plant should improve implementation of the processes related to plant configuration and status control to ensure plant safety.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 10: Control of plant configuration
The operating organization shall establish and implement a system for plant configuration management to ensure consistency between design requirements, physical configuration and plant documentation.

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.

SSG-76
4.25. The issue and updating of procedures, drawings and any other documentation used by the personnel in the operations department (in the main control room or elsewhere in the plant) is required to be controlled (see para. 7.4 of SSR-2/2 (Rev. 1) [1]). Such documentation is also required to be regularly reviewed and updated promptly if updating is necessary, and it should be kept in good condition. The configuration management of the plant should ensure that the operating procedures and other documentation used in the main control room are up to date before the startup of the plant after maintenance outages. Emergency operating procedures should be clearly distinguished from other operating procedures.

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

7.5. The work control process should be used to ensure that operating personnel, in particular the operators in the main control room, are aware of and have approved the work in the plant and are maintaining correct control of the plant configuration (see Requirement 10 of SSR-2/2 (Rev. 1) [1]). The process should further be used to ensure that operating personnel are aware of the expected effects of the work performed, including alarms and changes to the functioning of systems.

4. MAINTENANCE

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The maintenance shops and warehouses are maintained effectively. A sufficient amount of tooling and equipment is available for workers to conduct maintenance. The team recognized this as a good performance..

Maintenance has developed innovative tooling to prevent injury while guiding the reactor vessel cover into place. The team recognized this as a good performance.

4.5. CONDUCT OF MAINTENANCE WORK

The team noted that maintenance activities are not always prepared, controlled and implemented in a manner that ensures equipment reliability and personnel safety. For example, during the observations of the maintenance evolutions, the team identified some notable gaps in the conduct of maintenance work practices, particularly in the adherence to procedures important to safety that can also affect equipment reliability. Workers do not always perform procedural steps as written and do not follow the process to revise procedures when they cannot be performed properly. In addition, there were some gaps in adhering to standards for industrial safety. The team identified a recommendation in this area.

4.6. MATERIAL CONDITIONS

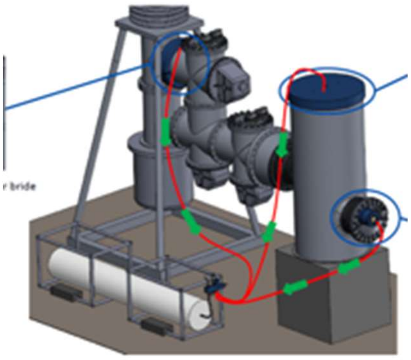
The plant is in good condition for its age and location near the saline environment of the sea. Noteworthy efforts are undertaken to minimize corrosion. Maintenance personnel have improved the ability to detect and correct sulphur hexafluoride (SF_6) gas leaks and this has resulted in a reduction in the release of this greenhouse gas. The team recognized this as a good practice.

DETAILED MAINTENANCE FINDINGS

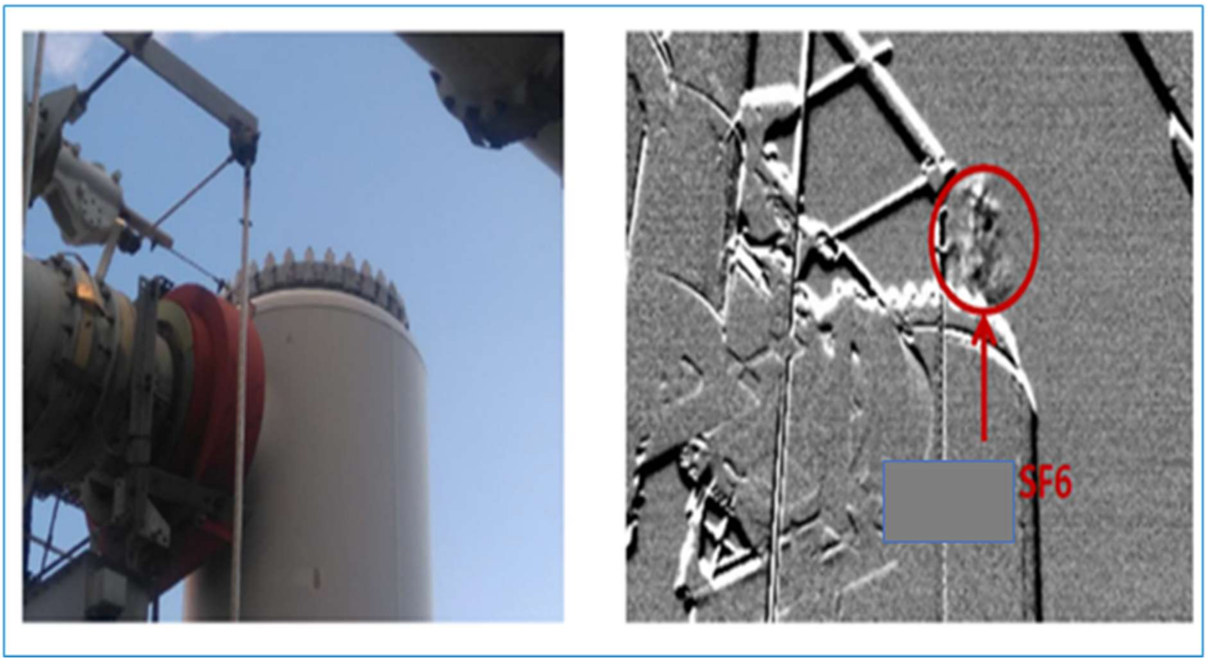
4.2 MAINTENANCE FACILITIES AND EQUIPMENT

4.2(a) Good Practice: SF6 Gas Detection and Recovery

The Penly NPP maintenance department has developed a systematic approach to detect leaks of sulphur hexafluoride (SF6) gas using a thermal imaging camera capable of seeing the gas. In addition, a system was developed to evacuate the gas and store it for reuse while repairing a leak. This has contributed to Penly NPP recycling 209 kg of SF6 gas. SF6 gas has a 23,500 times higher global warming potential than CO2.



SF6 evacuation and reclamation system



The camera is able to see leaking SF6 gas.

4.5. CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: Maintenance activities are not always prepared, controlled and implemented in a manner that ensures equipment reliability and personnel safety.

The team noted the following:

- Work on a fire protection auxiliary transformer deluge valve:
  - Steps from the procedure for replacing the transformer deluge valve were not followed as written, putting undue stress on a flange and making valve installation difficult. The procedure steps require using two threaded rods to separate the flange and then to remove them after the valve is reinstalled. The technicians used a single hydraulic jack on one side of the flange to separate them. This side loaded the flanges and made them misaligned resulting in difficulty inserting the studs as the flanges holes were no longer aligned and plumb.
  - A worker attempted to break the union with a large adjustable wrench and three different wrenches (box wrench, and two pipe wrenches) as backer. The third ~50cm pipe wrench was successful; however, this resulted in some minor rounding of the nut. The procedure did not specify what size or type of wrenches to be used.
  - A stud was left with only one flat of threads protruding on the bottom nut and seven from the top nut.
  - Floor grates at the worksite were not covered to prevent small items and water from falling through to the floor below. Water spilled to the floor below where scaffold workers were moving pallets of scaffolds. The procedure did not include actions to cover the floor grating.
  - A trainee worker carried a toolbox up two flights of stairs without holding the handrail, this behavior was not coached by the lead worker.

- During Safety Related Battery Discharge Test the following items were observed:
  - The workers inappropriately chose to not perform a section of the procedure to check levels and add water to the battery before the discharge. These steps were required to be performed in accordance with procedure usage standards. Workers justified that they would be adding water the next day after the battery was recharged. The procedures require recording and adjusting cell levels before and after discharge.
  - Although the procedure requires that the workers have an acid suit and gloves for the test, they were not used. The workers justified that they only needed the acid suit and gloves when adding water. When removing the level probe and temperature probe, they were handling components that were directly immersed in acid. The worker wore electrical gloves during the evolution.
  - The procedure does not provide detailed steps to remove the level probe and insert the temperature probe or provide caution at this point about handling components with acid. There is no guidance about cleaning components after removal from acid. The procedure required distilled water and cleaning rags; however, they were not used.
  - After the technician removed the temperature probe from the battery internals, it was not wiped down to remove acid. The probe was laid down on the floor and then

passed through the cat door to a trainee without acid gloves. Similarly, the acid level probe that was removed to allow insertion of the temperature probe was laid on the floor. There was a low level of acid residue on the floor. Workers did not bring an acid spill kit to the room. Workers did not wear a rubber apron or have a rag to wipe the probe.

- During Safety Injection Accumulator (SIA) relay testing:
  - Workers placed the simulator box on floor and used a magnet to hold a voltmeter to the cabinet versus working from an elevated cart. Workers were kneeling on the floor or bent over to perform the task of adjusting simulator voltage.
  - A worker overshot the voltage adjustment while lowering it before a second worker could identify when the relay had actuated. It took three times to identify when the point at which the relay actuated – this caused the respective alarm in MCR to annunciate three times versus once, which is an unnecessary distraction to the control room operators.
  - Workers passed a cable from a simulator device through the relay cabinet versus over cabinet – risking bumping components and wires in the cabinet.

Without adequate preparation, control, and implementation of maintenance activities, the work practices can increase the risk of equipment damage and personnel injuries.

Recommendation: The plant should improve its preparation, control, and implementation of maintenance activities to ensure equipment reliability and personnel safety.

IAEA Bases:

SSR-2/2 (Rev.1)
8.3 The operating organization shall develop procedures for all maintenance, testing, surveillance and inspection tasks. These procedures shall be prepared, reviewed, modified when required, validated, approved and distributed in accordance with procedures established under the management system.

8.7 New approaches that could result in significant changes to current strategies for maintenance, testing, surveillance and inspection shall be taken only after careful consideration of the implications for safety and after appropriate authorization, as required.

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.

GS-G-3.1

2.21. All work that is to be done should be planned and authorized before it is commenced. Work should be accomplished under suitably controlled conditions by technically competent individuals using technical standards, instructions, procedures or other appropriate documents.

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

The area of functional engineering assesses and trends the reliability for certain functions including systems and equipment important for safety, for instance containment, reactivity, feed water, heat sink and internal electrical power etc. Data from operation, maintenance and engineering is collected and evaluated. Each year engineering provides a comprehensive function health report that evaluates the function based on analytical and numerical data as well as information from plant walkdowns. This gives a good overview of the safety performance and basis for further development. The team identifies this as a good performance.

For monitoring the biofouling of safety related piping that draws water from the sea the plant has installed remote monitoring equipment. Engineering staff analyze and trend the data collected by this equipment in order to determine the efficiency of chemical treatment, reduce maintenance time, and increase the availability of these critical systems. The team recognizes this as a good practice.

The sedimentation in the intake cooling water channel must not jeopardize the plant's need for intake cooling water. In order to make sure that the plant has sufficient control over the sedimentation the plant has developed a tool for monitoring the sedimentation and to make projection about the future. These projections are used for trending on the conditions and evaluation of when to dredge the intake cooling water channel. The team recognizes this as a good practice.

5.5. USE OF PSA

A Probabilistic Safety Assessment (PSA) is used to assess impacts on hazards and modifications. The PSA-model is developed and maintained by corporate function with support from the plant. The team noted that the plant does not on a regular basis update the PSA after every outage, however the PSA is updated in accordance with the 10-year outage by the corporate organization. The team encourages the plant to consider opportunities to develop its local use of PSA analysis for plant operational activities.

5.7. PLANT MODIFICATION SYSTEM

The plant has procedures in place for the control of temporary modifications, accordingly the plant has started a programme to increase its control of temporary modifications with the objective that over time the number shall be close to zero. However, the team identified that the plant has several temporary arrangements without adequate labelling and tracking at the plant. Further the team identified that the plant does not assess the cumulative impact of temporary arrangements and temporary modifications. The team made a suggestion in this area.

DETAILED TECHNICAL SUPPORT FINDINGS

5.1. ORGANIZATION AND FUNCTIONS

5.1(a): **Good Practice: The** plant has installed remote monitoring capability on safety critical seawater piping.

The new remote monitoring equipment installed on the coolers for the essential service water and component cooling water system is used to monitor the biofouling of safety related piping that draw water from the sea. Information collected by the monitoring equipment is transmitted wirelessly to plant and corporate software platforms and displays the data in real-time. Engineering staff analyze and trend the data in order to determine the efficiency of chemical treatment, reduce maintenance time, and increase the availability of these critical systems.

5.1(b): **Good Practice: The p**lant has developed and installed a system for monitoring sedimentation in the intake cooling water channel.

The weather and water current conditions outside the plant can lead to a higher risk for sand sedimentation in the intake cooling water channel. The sedimentation has historically jeopardized requirements for intake cooling water. The new system allows the plant to have margin to avoid torrential flow in the channel. This prevents cavitation of intake water pumps.

To make sure that the plant has control over sedimentation buildup, the plant, together with corporate functions, developed software to monitor the sedimentation and to make projections about the future. These projections are used for trending on the conditions and evaluation of when to dredge the intake cooling water channel.

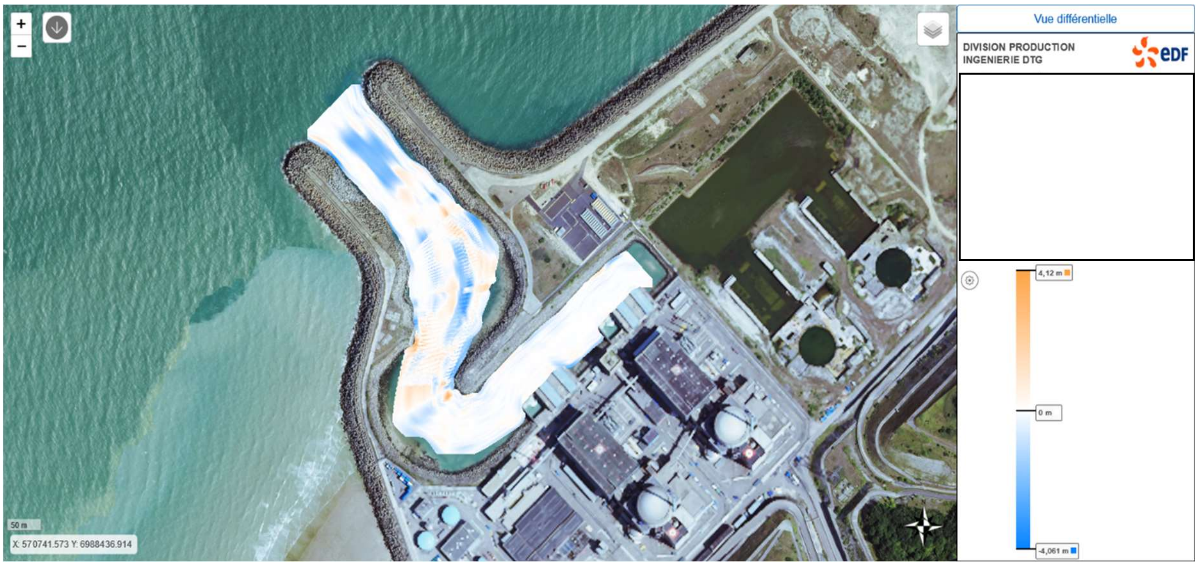


Figure 1 Intake channel bathymetry analysis

5.7. PLANT MODIFICATION SYSTEM

5.7(1) Issue: The management and cumulative assessment of temporary arrangements, and temporary modifications, does not always support efficient control and resolution of these deviations to minimize cumulative risk.

The team noted the following:

- There are several arrangements at the plant that are not identified as a plant deviation or as a temporary modification with the requisite tracking and labelling. Individual evaluation of safety impact is not performed on many of these deviations. There are 20 temporary modifications installed on the plant that are more than 10 years old. In addition, a cumulative assessment is not performed at the unit or plant level for the level of current temporary modifications.

- Examples of plant deviations that are not recorded nor adequately labelled:

  - At the Unit 1 emergency diesel generator LHQ, the programmable logic control cubicle 1BX and 2BX both had their rear cubicle doors removed. The panels were removed due to overheating and impact to electronic component reliability. There were no labels describing why this is allowed.
  - At the Unit 2 turbine area, a hose was inappropriately attached to instrument tubing for the low-pressure feedwater system differential pressure gauge without labelling.
  - The unit one diesel generator (LHQ) programmable logic controller (PLC) panel for both 1BX and 2BX had temporary modifications in place. There was no date identified for the temporary modification.
  - In the Unit 1 turbine basement, there is a temporary pipe connecting to 1-HP-152-YP without identification.
  - Near the Unit 1 reactor water storage tank, there were three plastic hoses collecting roof leaks that are drained to the rad waste sump. No temporary modification tag was in place.
  - In the auxiliary building at NA-07-37, a temporary pump was connected to a sump with hose and collection tank that was not identified as a deficiency or a temporary modification.
  - At the Unit 2 pumpstation, a hose that led drain water from pump 2SEC204PO was not labelled.

- At the plant there are 63 temporary modifications. 35 of these temporary modifications were on safety related equipment. Of these 35, 3 have a regulatory impact that requires additional compensatory actions.

Without having efficient handling for the control of temporary arrangements, including a cumulative safety assessment, the understanding and recording of plant configuration can decrease over time and may affect safety margins.

Suggestion: The plant should consider strengthening its process for control of temporary modifications, arrangements, and cumulative assessments of deviations on the plant level to minimize cumulative risk.

IAEA Bases:

SSR-2/2 (Rev.1)

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

SSG-71

6.4. Paragraph 4.41 of SSR-2/2 (Rev. 1) [1] states that "Temporary modifications shall be limited in time and number to minimize the cumulative safety significance." To achieve this, any opportunity should be taken to remove temporary modifications as soon as possible, in particular during outages, or convert them into permanent modifications. Justification should be provided if a temporary modification persists longer than its agreed duration and a new time limit should be specified.

6.5. Documents such as drawings and procedures relating to a temporary modification should be clearly marked to show the presence of the modification until the modification is removed or changed to a permanent modification

6. OPERATING EXPERIENCE FEEDBACK

6.5. INVESTIGATION

The team observed that almost all of the Root Causes Analyses (RCA) lacked the documentation of a qualitative review of previous similar events which have occurred at Penly, EDF, and externally outside of EDF. A review of the EDF Root Cause Analysis guideline identified a lack of guidance on how to identify similar internal and external similar events, and how to evaluate them for relevance to the event under investigation. This could prevent the Root Cause Analysis team from identifying effective corrective actions to prevent recurrence, because the investigation team and reviewers will not be aware of previous actions taken to address similar issues within the stations, fleet or externally. The team identified a suggestion in this area.

6.7. CORRECTIVE ACTIONS

When an event occurs at Penly NPP which is classified as significant, a root cause analysis investigation is performed to identify the root causes and corrective actions to prevent recurrence. Compensatory actions are taken by the plant to mitigate the impact of the causes until corrective actions to prevent recurrence can be completed. At Penly NPP, all causes identified during an investigation are classified as root causes, and all corrective actions are weighted equally. Some of the corrective actions will address contributing causes of events, however, only one or two of the corrective actions will prevent recurrence of the event or issue. Throughout the management and closure of the corrective actions, there is no specific focus on the most impactful corrective actions. The lack of focus on the corrective actions to prevent recurrence can delay the correction of the main root causes, and therefore can increase the time at risk to the plant of recurrence of the similar event. The team identified a suggestion in this area.

DETAILED OPERATING EXPERIENCE FINDINGS

6.5. INVESTIGATION AND ANALYSIS

6.5(1) Issue: The Operating Experience (OE) programme does not always thoroughly document and evaluate previous internal and external OE when performing root cause analysis which can result in future similar events.

The team noted the following:

- The corporate root cause analysis guideline does not require documentation or evaluation of previous internal or external OE and it does not require evaluation of why the previous event corrective actions did not prevent the subsequent event from occurring.
- Root cause report ESS 22-011 (entry into Group 1 and Group 2 LCOs, caused by the loss of secondary switchboards) evaluated a safety significant event in which there was a loss of electrical sources that resulted in 2 group 1 and 11 group 2 LCOs. The root cause analysis did not identify or evaluate any previous events or OPEX within the investigation report.
- Significant event report ESS 21-024, "Overall leakage rate of the reactor coolant system greater than 2300 l/h," documents a similar event which occurred at another fleet plant; however, the root cause analysis did not evaluate why corrective actions taken from the other plant's investigation did not prevent the current event from occurring at Penly.
- Event report ESS 23-001, "Defects in the characterization of criterion A of operations surveillance test EPC 1LHP104" (LHP Diesel), identifies a similar event within the investigation, but does not evaluate the relevance to the current event.
- Significant event report ESS 23-013, "Late detection of the unavailability of turbo-pump 1ASG031PO in normal shutdown state on steam generators", identified no previous similar events or external operating experience within the root cause analysis.

Failure to evaluate previous internal and external operating experience can result in the implementation of the same ineffective actions that caused a similar event to recur.

Suggestion: The plant should consider requiring the thorough evaluation and documentation of internal and external operating experience to prevent similar events when performing root cause analyses.

IAEA Bases:

SSG-50

2.36 External operating experience (from other nuclear installations and interested parties, such as vendors, suppliers, designers and research institutions) should also be identified and screened for applicability to the installation and significance for safety. Such operating experience should not be dismissed solely, for example, on the basis of differences in design or equipment; all relevant aspects should be considered. Screening for applicability should include consideration of aspects such as the following:

(a) Whether immediate actions are necessary in response to significant external operating experience;

(b) Whether there are generic implications that may apply to the installation;

(c) Whether there is similar equipment at the installation;

(d) The possibility of the occurrence of a similar event at the installation;

(e) Whether reported corrective actions are applicable to the installation.

(f) Whether similar environmental conditions exist;

(g) Whether similar management expectations, personnel behaviors, practices or processes (i.e. organizational factors) have been observed in the organization.

2.38 When external operating experience is determined to be significant but not applicable to the installation, the basis for this decision should be documented.

2.48 Relevant internal and external operating experience should be reviewed in an investigation to identify any other similar events and to learn from industry experience. If a previous similar event is found to have occurred at the installation, then the corrective actions taken should be reviewed to identify why the event recurred and to identify more effective corrective or preventive actions.

6.6. CORRECTIVE ACTIONS

6.6(1) Issue: Corrective actions to prevent recurrence from safety significant event (ESS) analyses do not receive sufficient focus which could result in a delay in preventing recurrence of similar events.

The team noted the following:

- The Corporate Root Cause Analysis guideline does not specifically state that the effectiveness review should be completed after all corrective actions have been completed.
- There are 133 open Level 1 corrective actions all equally weighted as the time of the OSART mission.
- Six open level 1 ESS corrective actions are more than one year old.
- Effectiveness review from Root Cause Analysis ESS 21-025, “No efficiency test of the very high efficiency filter of the ventilation circuit following its replacement”, was annotated as complete before all corrective actions were performed and there was a similar event that occurred in 2023.
- Of the 295 corrective actions created from Level 1 events, a corrective action from a significant event investigation had been extended more than once.
- Root Cause Investigation ESS 23-002, “Shortfalls in management of filter replacement activity 2DVK101FI and 2DVK110FI carried out after entry into LCO DVK”, identified nine root causes and nine corresponding corrective actions, all causes were designated as root causes.
- Root Cause Report ESS 21-028, “Failure to apply Group 2 LCO under the Operating Technical Specifications”, in which a configuration control (status control) event resulted in a group 2 unplanned LCO, did not identify any previous events, any OPEX, and did not include an effectiveness review.

Without sufficient focus on the Corrective Action(s) to Prevent Recurrence, the risk of event repetition may be increased.

Suggestion: The station should consider adding more focus to the corrective actions to prevent recurrence.

IAEA Bases:

SSR-2/2 (Rev. 1)

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

SSG-50

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

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

(b) A cause analysis identifying technical, human and organizational factors and other contributing factors (why it happened);

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

(d) An evaluation of the immediate or compensatory actions taken;

(e) Corrective actions identified to prevent recurrence;

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

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

(h) An evaluation of the extent to which similar specific root or underlying causes could affect the safety of other structures, systems and components.

7. RADIATION PROTECTION

7.2. RADIATION PROTECTION POLICY

The plant has implemented a documented process to enable Radiological Protection (RP) engineers to provide authoritative advice on matters relating to RP to the plant management team. This is to ensure traceability of decisions and to track any reasons for the refusal of such advice. This ensures that the authority of the RP department is controlled. The team identified this as a good performance.

7.3. RADIATION WORK CONTROL

The team noted instances where workers did not demonstrate the application of RP standards in the field. The team also noted instances where the interaction between RP supervisors and workers in the field did not identify where a shortfall in standards had occurred. The team made a suggestion in this area.

7.4. CONTROL OF OCCUPATIONAL EXPOSURE

The team identified that the principle of ‘as low as reasonably achievable’ (ALARA) was not consistently being applied by the plant with the same rigour across all practices. The team noted there is a focus on the control of Collective Radiation Exposure (CRE) for work of higher radiological risk at the plant, although the contribution to CRE for lower-risk work is typically a significant proportion of total annual CRE. The team also noted there is no check or verification by RP personnel, supervisors and management contractors for such work and that the RP EDF training does not include specific information on dose optimization for work planners. The team made a recommendation in this area.

7.5. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING AND FACILITIES.

The plant has connected Small-Articles Monitors to the Local Area Network (LAN) to enable timely identification of issues relating to contaminated personal items leaving the RCA. This allows RP engineers to view alarms from their office, allowing prompt understanding of events through increased visibility of instrument data. This also assists timely rectification of issues relating to contamination control, as well as trending of data for analysis of specific problems for work-sites or work teams. The team identified this as a good performance.

DETAILED RADIATION PROTECTION FINDINGS

7.3 RADIATION WORK CONTROL

7.3(1) Issue: Workers do not always demonstrate the application of radiological protection standards in the field.

The team noted the following:

- Following transport of the waste filter 1 RCV 052 FI from the Radiological Controlled Area (RCA) to the Radioactive Waste Building (BTE) using the ‘red area’ process (i.e. expected dose-rate >100 mSv/hr), Radiation Protection (RP) workers did not check the transport container for contamination immediately after it left the RCA. Instead, the vehicle moved the container over 100 metres to another location along the road prior to the expected checks, which could lead to a road contamination event. The plant experienced three low-level occurrences of road contamination in 2021.

- An RCA worker exiting the contaminated boundary in the waste treatment area (NB 0804) moved the contamination probe with potentially contaminated gloves to see the screen prior to monitoring his hands. He did not check the probe for contamination after touching it, which demonstrates a lack of application of contamination control standards.

- In the Unit 2 RCA, a temporary orange area (i.e. expected dose-rate between 2 mSv/h and 100 mSv/hr) was positioned around a waste-filter cask in the waste treatment area (NB 0804). The positioning of the orange area was not optimized and was in close proximity to a waste processing area where workers were exposed to an ambient dose-rate of 20 µSv/hr. The cask was on a wheeled trolley, so the orange area could have been repositioned. None of the waste treatment workers or RP personnel challenged the positioning of the orange area.

- Contractors responsible for dose-rate mapping in the RCA were using an outdated process for designating hot-spots and high dose-rate areas (orange and red areas). In the Unit 1 RCA waste treatment area (NB 0804), a red dot indicated the presence of a red area but this was not consistent with the expected mapping process using separate signage. In the same room for the Unit 2 RCA, there was no orange dot to indicate the presence of an orange area as this was shown on a separate sign. During an interview, this inconsistency was acknowledged by the RP contract supervisor but had not been challenged in the field, thus leading to unclear RP standards.

- In the waste treatment area of Unit 2 RCA, guidance on putting on and removing respirators was posted on the door of the enclosure and dated back to 2009. There was no reference to the current procedure listed. The RP department stated that guidance was still relevant but this was not confirmed by the document management system.

- During observations in the Active Laundry, the standards for contaminated and clean laundry were unclear. Workers were observed scanning shoes for contamination and placing them into a container for contaminated shoes if an alarm was raised. However, the sign on the wall showed the container was for ‘clean gloves’ not contaminated shoes.

Without consistent application of radiological protection standards in the field, the plant may experience an increased number of events related to radiological safety.

Suggestion: The plant should consider reinforcing the application of radiological protection standards in the field to improve radiological safety.

IAEA Bases:

SSR-2/2 (Rev.1)

5.13 All plant personnel shall understand and acknowledge their individual responsibility for putting into practice the measures for controlling exposures that are specified in the radiation protection programme.

GSR Part 3

3.83 Workers:
a) Shall follow any applicable rules and procedures for protection and safety as specified by the employer, registrant or licensee;
b) Shall use properly the monitoring equipment and personal protective equipment provided;

3.94. Employers, registrants and licensees, in consultation with workers, or through their representatives where appropriate:
d) Shall ensure that any work in which workers are or could be subject to occupational exposure is adequately supervised and shall take all reasonable steps to ensure that the rules, procedures, and measures for protection and safety are observed;

7.4 CONTROL OF OCCUPATIONAL EXPOSURE

7.4 (1) Issue: Radiological protection practices do not always adequately ensure that radiation risks to workers are optimized (ALARA).

The team noted the following:

- During removal of the waste filter 1 RCV 052 FI from the Unit 1 RCA under the 'red area' process, workers completed documentation and carried out discussions in close proximity to the high dose-rate package, instead of using the shielding of the building fabric to perform these activities in order to minimise dose.

- The RP department does not trend and analyse planned dose versus actual dose for Radiological Work Permit (RWP) Levels 0 and 1. It was stated this is because RWP Levels 2 and 3 have a larger impact on Collective Radiation Exposure (CRE). So far in 2023, the contribution to the total CRE for both units for the different RWP levels was 5%, 30%, 65% and 0% for RWP Levels 0, 1, 2 and 3 respectively. Results for RWP Level 0 and 1 so far for 2023 contributes 35% to total CRE. There is no check or verification by the RP department in planning of these RWPs as this is done by personnel outside the RP department.

- The planning of Level 0 and 1 RWPs is not done by RP personnel and may be carried out by people with RP1 training (lower level) but not RP2 training (higher level). RP1 training does not include specific slides on dose optimization. Level 0 and 1 RWPs cover tasks with a dose-rate of up to 2 mSv/hr and collective dose of 10 mSv, so dose optimization opportunities may be missed.

- RP training for management of skin decontamination for hot particles does not include advice if contamination is present near eyes, ears or hair. There is also no advice on actions if a wound is present. The process relies on workers contacting designated on-call staff, with no requirement for trained decontamination personnel to be on site. This could lead to mis-management of skin decontamination and increases the risk of internal exposure.

- Hand-held radiation instruments can be issued to personnel in the Tool Shop opposite the turnstiles at the entrance to the plant. These instruments are not checked with a radioactive source to confirm they function correctly, which is not in line with industry standard. This is due to corporate advice that sources should not be used in peripheral plant areas. This check is performed for the same instruments issued in the RCA (Unit 1 and 2). This could result in inaccuracies in workplace monitoring of radiation and increase worker dose.

- The plant does not systematically specify 'point-of-work' airborne contamination sampling requirements for work in enclosures. Airborne contamination is instead monitored outside the enclosure. In the event of failure of respiratory equipment, there is no means to assess internal exposure, other than a whole-body count, which does not provide a full assessment of dose from non-gamma radionuclides.

- Where airborne contamination is expected, the plant only requires the assessment of airflows to measure the depressurisation at the entrance to an enclosure. The plant follows a standard which does not take into account the volume of the enclosure, nor the number of air changes expected for the plant to understand if an excursion of contamination may occur from the area.

Without adequate radiological controls in place to restrict exposure, radiological risks to workers are not always managed as low as reasonably achievable (ALARA).

Recommendation: The plant should implement radiological control practices to ensure that radiation risks to workers are as low as reasonably achievable (ALARA).

IAEA Bases:

SSR-2/2 (Rev.1)

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

GSR Part 3

3.23. Registrants and licensees shall ensure that protection and safety is optimized.

GSG-7
9.10. The purpose of the primary ventilation system in a facility is to provide fresh air to workplaces to remove airborne contaminants generated by the operations. Careful attention should be given to the design of the ventilation network, including the calculation and verification of rates and velocities of air flow, to ensure that it is adequate for controlling airborne contamination. In many facilities, the control of airborne contamination is achieved by:
b) Providing an adequate or prescribed number of air changes in the workplace

9.48 Personal contamination includes the contamination of personal clothing, skin, hair, eyes, mucous membranes and wounds. In this context, personal clothing includes work clothing provided by the employer, but does not include protective clothing provided solely for the purposes of contamination control.

10.4 The occupational physician in charge of the programme for workers' health surveillance should have the following responsibilities:

d) To advise, as appropriate, on the arrangements for hygiene at work and the removal of contamination from wounds, in consultation with the radiation protection officer, as appropriate.

8. CHEMISTRY

8.1. ORGANISATION AND FUNCTIONS

The Chemistry organization has a well-developed training programme to ensure that new members of staff acquire the necessary skills. In addition to the core training, a tutoring process is in place and the person’s progress is recorded in an individual training file. Throughout the training, progress is validated via written and oral assessments until final qualification delivered by the manager. A yearly appraisal interview highlights any needs for further training in line with the laboratory requirements and the person’s career development. The team recognized this as a good performance.

8.2. CHEMISTRY PROGRAMME

Tritium released through evaporation from the pools has an impact in terms of radiation protection and gaseous releases into the environment. Tritium is produced in the Reactor Cooling System (RCS) throughout the cycle and transferred to the pools during outages. Upon daily requests by Chemistry, operators perform regular feed-and-bleed operations for the specific purpose of tritium management. By progressively releasing tritium as liquid primary effluents over a cycle, the plant reduces the activity of tritium in the RCS prior to an outage therefore, lowering the activity in the In-Refueling Water Storage Tank (IRWST) and Spent Fuel Pool (SFP). The team considered this as a good practice.

Lithium is used in correlation with boron for primary pH control and is a safety related parameter. The ion exchangers used for primary purification must be lithium saturated in order not to modify the pH. In some cases, demineralizers can be lithium-depleted and withdraw lithium from the primary circuit causing pH drops every time they are put in operation. To prevent this, Chemistry has developed a system which continuously compensates lithium retention as long as necessary. This system is designed as a mobile device so that it can be used on both units. The team considered this as a good performance.

8.3. MANAGEMENT OF CHEMISTRY DATA

In the Cr51 and Cs134 activity data for unit 2 spent fuel pool since 01 January 2021, many values are recorded in the data collection application “Merlin” as “0”. This practice is tolerated for some systems in compliance with a corporate guide about data input conditions into “Merlin”, as long as total gamma is trended. However, a “0” activity makes no radiological sense, and it would be expected to see a result expressed as a value lower than the analytical quantification limit. The team encouraged the plant to adjust the data input to international standard.

The plant laboratory takes part in interlaboratory tests at least every year. The previous years, satisfactory results for chemical analyses from the unit lab ranged between 80% and 90%. For the current year, 54% of the results for the same kind of analyses were satisfactory. The root cause analysis revealed that optimum conditions for performing the interlaboratory tests were not met at the time. This was due to a recent change of premises affecting the equipment and a prolonged period of inactivity with both units in shutdown. The team encouraged the plant to ensure that interlaboratory tests are carried out in adequate conditions.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

The team observed that the practices in labelling, storage management and use of chemicals and other substances do not always meet the plant expectations in order to ensure the safety of personnel, systems and equipment. For example, the team noted the following: Missing or incomplete labels on samples and chemicals, products with overdue expiry dates not identified for disposal, drip trays missing in a few areas, and inconsistent display of local safety data sheets. The team made a suggestion in this area.

DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY PROGRAMME

8.2.(a) Good practice: Specific tritium management to minimise tritium activity in the pools, i.e. In-Refueling Water Storage Tank (IRWST) and Spent Fuel Pool (SFP).

This good practice limits tritium in gas releases with a beneficial impact on radiation protection and the environment.

Tritium (^3H) is a radionuclide produced in the reactor. It is a pure-beta emitter with low energy for external radiation. Therefore, the radiotoxicity of this element is relevant to internal exposure situations.

Over a cycle, tritium spreads and accumulates in the different systems connected to the Reactor Coolant System (RCS). During shutdowns, the opening of the reactor vessel causes tritium to spread to the Reactor Building Pool. The tritium activity in the IRWST and in the SFP will therefore increase from cycle to cycle if the tritium activity in the reactor cooling circuit is not reduced beforehand.

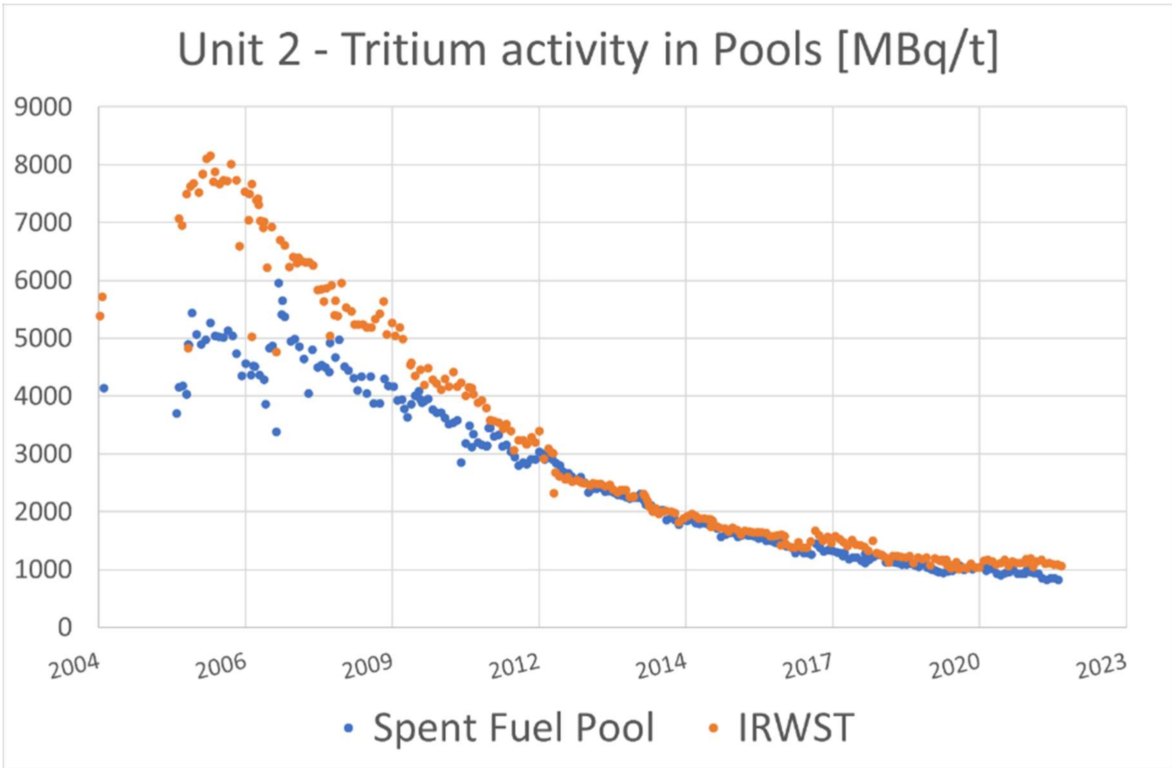
Currently, there are no treatment processes for tritium enriched water and, due to its long radioactive half-life (12.3 yrs), interim storage for decay prior to environmental releases is not feasible.

Accordingly, the good practice applied by the plant is to progressively release as much produced tritium as possible in liquid effluents over a cycle:

- Yearly objectives are to achieve a 100% release of the yearly tritium source term into the liquid effluents.

- During the cycle, chemists define and apply the overall strategy by regularly requesting RCS feed and bleed operations, for the specific purpose of eliminating tritium.
  The distillates which are produced from the treatment of primary effluents are not recycled.

- Tritium activity is also monitored in boron tanks prior to shutdowns: the tank with the lowest tritium activity will be used in priority during shutdown boration.
  Since the implementation of this strategy, the tritium activity in the pools has decreased by a factor of 4 to 6.



Decrease in tritium concentration in the IRWST and in the SFP over the years 2004 to 2022

8.6(1) Issue: The practices in labelling, storage, management and use of chemicals and other substances do not always meet the plant expectations in order to ensure the safety of personnel, systems and equipment.

The team noted the following:

– Two chemicals were found in the laboratory chemicals warehouse for which the printed expiration date had been manually crossed out and a new one added by hand. The Chemistry team manager explained that a default expiry date is allocated when a chemical product is received from a supplier and entered into the chemicals management application. The actual date was updated by hand when receiving the supplier certificate, but the label was not re-printed.

– In the Hot Lab some incorrect and incomplete labels on samples were found; the labelling was inconsistent and not in accordance with the laboratory rules; occasionally the expiry date was exceeded or was missing on some solution bottles; the person responsible for preparing the samples or standards was not always identified; and samples waiting for disposal were not labelled as such:

  - Among the samples in a temperature-regulated bath, a sample for pH measurement from the waste treatment system was not identified as such and did not have a sampling date.
  - A bottle of silver nitrate, used for chloride titration measurements, had expired on 3 August 2023, the previous month.
  - According to the information on the label, the test date on a Mettler scale had expired on 24 June 2023, but this was a typing error (the correct expiry date was 24 June 2024) which no one had noticed.
  - One bottle was labelled “ANS” (which is 1-amino-2-naphthol-4-sulfonic acid). The hazardous substance labelling was partially covered with transparent adhesive tape to protect the glass bottle from breaking. The original labelling was no longer visible due to the way the label had been pasted. The question of what “ANS” means could only be answered after reading the analysis procedure.
  - The solutions prepared for ion chromatography were labelled “Elution Solution” and the specific chemical content was not mentioned. The chemical content for the Elution Solution is only described in the analysis procedure.

– In the “SIR” (Chemical Reagents Injection System) reagent injection room, the solutions for injection are produced for the feedwater plant with hydrazine, ethanolamine, trisodium phosphate and ammonia. There is only a safety data sheet for hydrazine displayed on the wall. The safety data sheets for ethanolamine, ammonia and trisodium phosphate are not displayed. The chemistry technician showed that the sheets were present in the work package. However, all safety data sheets were displayed in the demineralization station at all different chemical tanks (ammonia, acid, etc.).

- In the temporary laboratory store, product locations are numbered on the shelves. These locations are also mentioned on the bar code labels printed from the store management software and present on every container. A few containers showed a discrepancy between the label and the shelf number. The team manager explained that 250 container labels were not updated when the laboratory was moved 9 months previously and that the technicians rely on the store management software to find the correct locations.

- An ICP-MS (Inductively Coupled Plasma Mass Spectrometry) standard solution for 25 elements was found in the laboratory chemicals warehouse. When asked which 25 elements this solution contains, no quick answer could be given as the necessary document was not available locally. It was pointed out that the information could be found in the supplier database.

- The mechanical department performs oil analyses for water in oil under a dedicated hood in the workshop. Inside the analysis kit, two containers of reagent capsules used for the analyses were expired, one in 2020 and the other in 2022. In addition, the content of the blue reagent used for the measurement inside the graduated column was not identified. Neither was the mother solution placed on top of a nearby cabinet. When asked, the maintenance engineer could not supply the information.

- In the workshop, there were three containers with a total of approximately 50 litres of oil mixed with water on one side of the washing machine and 6 containers of 20 litres each of alkaline washing solution on the other side. There was no bunding for any of these containers.

Without adequate labelling, storage, management and use of chemicals and other substances the risk of personal injury or adverse effect on plant equipment could increase.

Suggestion: The plant should consider improving the practices for labelling, storage, management and use of chemicals and other substances.

IAEA Bases:

SSG 13

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).

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

9.14. Material safety data sheets for all approved chemicals and substances should be made available and easily accessible. These data sheets should include, as a minimum, possible dangers to the health of staff, preventive measures for handling the materials and medical recommendations in case of accidental use.

SSR 2/2

7.17. The use of chemicals in the plant, including chemicals brought in by contractors, shall be kept under close control.

9. EMERGENCY PREPAREDNESS AND RESPONSE

9.2. EMERGENCY RESPONSE

The onsite emergency plan “Station Emergency Response Plan – Penly NPP” provides criteria for the type of activation of the sub-plans. However, in this document, there is no direct reference to the identification of the severity of the event according to IAEA guidelines (alert, on-site emergency, off-site emergency). The team encourages the plant to improve the classification process to include event severity.

The plant has made good logistical arrangements and a well established process for the decontamination within the Emergency Control Centre, which can be handled by the first people arriving at the Emergency Control Centre. This decontamination process is autonomous, without the need for radiation experts support. The team considers this as a good performance.

The team observed that the procedures for the emergency response activation and notification process are not always sufficiently detailed to ensure the plant response in a timely and effective manner. For example, there are no specific details in the emergency response procedure covering the arrangements for an alternative Emergency Control Centre outside the plant. There is no requirement to check the acknowledged message register before the command posts in the Emergency Control Centre are activated to see if any functions have not acknowledged receipt of the message; and there is no formalized procedure to provide Emergency Response team members using the environmental monitoring trucks with operational dosimeter with alarms. The team made a suggestion in this area.

The team observed that the plant arrangements for protective actions in case of an emergency are not always sufficiently thorough to enhance personal safety and adequate response capacity. For example, the bunker used as the Emergency Control Centre is not sufficiently protected against radiation release, because there is no pressure airlock system with two doors at the entrance to the bunker, and there is no pre-defined form for “volunteers” which includes dose limits, description of the potential health risks, and confirmation with a signature. The team made a suggestion in this area.

9.3. EMERGENCY PREPAREDNESS

The plant has established a comprehensive multi-year training, drill and exercise programme for Emergency Response Organisation team members. Regular training in communication is conducted for dedicated functions in the Emergency Response Organisation for communication with the public through the media with, for example, simulation of press conferences and the answering of questions from the public. There are visibility vests, to identify who is performing the key functions in the Emergency Control Centre (BDS). However, the team noted that some of the emergency exercise criteria are not measurable, there is no requirement to do a final evaluation of the criteria summary completed by every observer and no general criteria to evaluate the success of an exercise. The team encourages the plant to improve the exercise evaluation process.

The plant has created a very detailed procedure “Managing on-site emergency equipment” with 32 types of equipment easily identified through pictures, map-locations, and characteristics. The plant developed a pocket guide from this procedure to simplify the identification and deployment of plant emergency equipment. The pocket guide contains details and photographs of the different types of plant emergency equipment and essential information, such as the identification code, the function of the equipment, the procedure references for deployment, the owner department, the storage areas, and installation points, as well as the time and resources needed for deployment. The pocket guide provides practical support for Emergency Response Organization teams when they are in the field in emergency situations. The team considers this as a good performance.

A tool has been developed for the Emergency Response Organization to record and keep pace with the required messages and audioconferences during emergency situations or exercises. It is used to schedule audio conferences, consultation points and message circulation for the Emergency Director (PCD1), as prescribed in the On-site Emergency Plan references. The team considers this as a good performance.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

9.2. EMERGENCY RESPONSE

9.2.(1) Issue: The procedures for the emergency response activation and notification process are not always sufficiently detailed to ensure the plant response in a timely and effective manner.

The team noted the following:

- There are no specific details in the emergency response procedure covering the arrangements for an alternative Emergency Control Centre outside the plant, including logistics requirements for this alternative Centre, or for alerting Emergency response team members with the requirement to come directly from home to that alternative centre, and for evacuating Emergency Control Centre members from the NPP to the alternative emergency centre under emergency conditions. Also, this has not been exercised.

- In the event of an emergency, the key Emergency Response Organization functions on duty are notified via the notification system and acknowledge the message received. However, there is no requirement to check the acknowledged message register before the command posts in the Emergency Control Centre are activated to see if any functions have not acknowledged receipt of the message.

- There is no formalized procedure to provide Emergency Response team members using the environmental monitoring trucks with operational dosimeter with alarms.

- After the notification of the emergency event, Emergency Response Organization key members are expected to be in their emergency work places within an hour regardless of whether the initiation is conducted during working hours or after work hours. Moreover, the Emergency Director (PCD1) on duty has not performed an exercise to check that all on-duty Emergency Response Organization team members can reach the Emergency Control Centre within one hour, because his role was to trigger the alert from the plant.

- Only one Emergency Response Organization position (PCD4) can make changes to the Emergency Response Organization key members roster application, which is automatically connected to the notification system.

- There is no procedure that details how to communicate the new address of the alternative Emergency Control Centre to the Emergency Response Organization key members on duty through the notification system.

- There is no requirement in the Plant Shift Manager's (PCL1) emergency response action sheet to check for evidence of people present on the site out of working hours before the on-call Emergency Response team members arrive at the plant.

- The Plant Shift Manager's (PCL1) action sheet does not contain a specific table for the turnover process, which includes operation shift crew functions, the address of external meeting point, and type of protective kits.

- No fire expert is involved in the Emergency Response Organization key members roster to provide support to the Emergency Response Organization team and the external fire brigades.

- There is no agreement with offsite authorities on how to identify plant Emergency Response Organization members arriving from outside the power plant via roads blocked by police officers in the event of an emergency situation.

- There are no printed forms that are required by the procedure "Additional instructions for the Logistics Command Post (PCM) action sheets" available in the muster points to physically account for the personnel present in an emergency situation, in the event that the electronic badge system is unavailable. This procedure has not been exercised.

Without detailed procedures for the activation and notification process, emergency response actions might not be implemented in a timely and effective manner.

Suggestion: The plant should consider improving procedures for the activation and notification process to ensure emergency response in a more timely and effective manner.

IAEA Bases:

GSR Part 7

5.12. For facilities in categories I and II and for areas in category V, the notification point shall be able to initiate immediate communication with the authority that has been assigned the responsibility to decide on and to initiate precautionary urgent protective actions and urgent protective actions off the site (see also para. 5.7).

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

5.17. For facilities and activities in categories I, II and III, and for category IV, arrangements shall be made: (1) to promptly recognize and classify a nuclear or radiological emergency; (2) upon classification, to promptly declare the emergency class and to initiate a coordinated and preplanned on-site response; (3) to notify the appropriate notification point (see para. 5.11) and to provide sufficient information for an effective off-site response; and (4) upon notification, to initiate a coordinated and preplanned off-site response, as appropriate, in accordance with the protection strategy. These arrangements shall include suitable, reliable and diverse means of warning persons on the site, of notifying the notification point (see paras 5.41–5.43, 6.22 and 6.34) and of communication between response organizations.

5.23. The operating organization of a facility or activity in category I, II, III or IV shall promptly decide on and take actions on the site that are necessary to mitigate the consequences of a nuclear or radiological emergency involving a facility or an activity under its responsibility.

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

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5.2. Emergency arrangements shall cover the capability of maintaining protection and safety in the event of an accident; mitigating the consequences of accidents if they do occur; protection of site personnel and the public; protection of the environment; coordinating response organizations, as appropriate; and communicating with the public in a timely manner [1, 6]. Emergency arrangements shall include arrangements for: the prompt declaration of an emergency; timely notification and alerting of response personnel; assessment of the progress of the emergency, its consequences and any measures that need to be taken on the site; and the necessary provision of information to the authorities. Appropriate arrangements shall be established from the time that nuclear fuel is first brought to the site, and the emergency plan and all emergency arrangements shall be completed before the commencement of fuel loading.

9.2.(2) Issue: The plant arrangements for protective actions in case of an emergency are not always sufficiently thorough to enhance personal safety and adequate response capacity.

The team noted the following:

- The bunker used as the Emergency Control Centre is not sufficiently protected against radiation release when people enter through the single door. There is no pressure airlock system with two doors at the entrance to the bunker.
- There is no pre-defined form for "volunteers" which includes dose limits, description of the potential health risks, and confirmation with signature.
- The document "Preparation and Management of Emergency Response team handovers" does not include the steps on how to obtain the address of external meeting points and the type of protective kits required for Emergency Response Organization team members coming from outside the plant under emergency conditions.
- The Emergency Control Room does not have emergency ventilation to ensure habitability in case of radiation release.
- Four muster points (1, 2, 5, and 6) out of seven are not directly equipped with respirators, although overalls are available there.
- Out of working hours, the Plant Shift Manager can implement administration of iodine tablets only after agreement from on duty Emergency Director (PCD1). This PCD1 makes the decision with support from one Radiation Protection function in the Resources Command Post (PCM5), the doctor and Corporate Emergency Response Organization Director.
- The action sheet of dedicated Emergency Response Organization member (PCM3.1) does not contain any reference on how to obtain information concerning protective kits which are needed for Emergency Response Organization members coming from outside the plant under emergency conditions.
- The criteria for Emergency Control Centre habitability do not include requirements to measure oxygen levels.
- There is no requirement to check the efficiency of the ventilation filters in the Emergency Control Centre during emergency situations.

- In the specific procedure "Preparation and Management of Emergency Response Team handover", related to the process of shift turnover during the emergency, only the time constraints are mentioned. There is no evaluation of other aspects such as radiation consequences.

- No exercise has been performed to search for missing people during an emergency situation.

- The plant has not performed an exercise to test the use of buses, coming from outside the plant and provided by a contracted company, to evacuate plant personnel.

Without the effective arrangement of protective actions, the personal safety and adequate response capacity might be compromised in the event of emergency.

Suggestion: The plant should consider improving the plant arrangements for protective actions in case of emergency in order to enhance personal safety and adequate response capacity.

IAEA Bases:

GSR Part 7

Requirement 9: Taking urgent protective actions and other response actions.

The government shall ensure that arrangements are in place to assess emergency conditions and to take urgent protective actions and other response actions effectively in a nuclear or radiological emergency.

5.37. Arrangements shall be made for actions to save human life or to prevent serious injury to be taken without any delay on the grounds of the possible presence of radioactive material (see paras 5.39 and 5.64). These arrangements shall include providing first responders in an emergency at an unforeseen location with information on the precautions to take in giving first aid or in transporting an individual with possible contamination.

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

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

(b) For all persons on the site to take appropriate actions immediately upon

notification of an emergency;

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

persons unaccounted for;

(d) To provide immediate first aid;

(e) To take urgent protective actions.

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

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

(b) A sufficient number of suitable escape routes;

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

Requirement 11: Protecting emergency workers and helpers in an emergency.

The government shall ensure that arrangements are in place to protect emergency workers and to protect helpers in a nuclear or radiological 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.

5.53. The operating organization and response organizations shall ensure that all practicable means are used to minimize exposures of emergency workers and helpers in an emergency in the response to a nuclear or radiological emergency (see para. I.2 of Appendix I), and to optimize their protection.

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.

5.61. Information on the doses received in the response to a nuclear or radiological emergency and information on any consequent health risks shall be communicated, as soon as practicable, to emergency workers and to helpers in an emergency.

10. ACCIDENT MANAGEMENT

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

An accident mitigation strategy has been developed for the re-injection of highly contaminated water from the Nuclear Auxiliary Building back into the Containment Building. This is to reduce off-site contamination. The system has been designed, installed and has procedures for its implementation. The team recognized this as a good practice.

The plant accident management programme does not consider spent fuel pool and multi-unit severe accidents. There is no training and no EP drills on spent fuel pool and multi-unit severe accidents. The team made a suggestion in this area.

10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

Accident mitigation strategies implemented in the plant have been timed in exercises and these times are included in the guidelines for their implementation. The team recognized this as a good practice.

There are several improvements that the plant can implement with respect to the storage and use of the Local Crisis Equipment (MLC). The team observed that some MLC equipment were not strapped in place to better protect them from seismic activity. The team also observed that some MLC equipment did not have floor markings where the equipment would be located in the event of their use. The team encourages the plant to implement these improvements.

DETAILED ACCIDENT MANAGEMENT FINDINGS

10.2 OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

10.2(a) Good Practice: An accident mitigation strategy has been developed for the re-injection of highly contaminated water from the Nuclear Auxiliary Building back into the Containment Building to reduce off-site contamination. The system has been designed, installed and has procedures for its implementation.

The aim of this strategy is to limit the contamination of the Nuclear Auxiliary Building which both improves the accessibility of the building and reduces off-site leakage from the building. This is done by re-injecting the contaminated effluents back into the Containment Building.

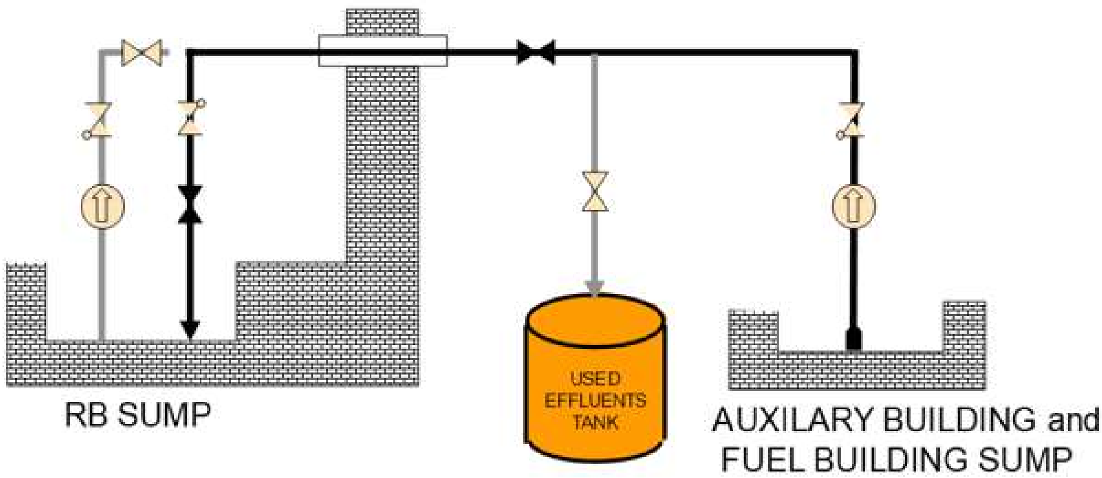
The Containment Spray and Safety Injection pumps are located outside of the Containment Building. Thus, during the Containment Spray or Safety Injection recirculation phase of an accident, contaminated water passes through the Nuclear Auxiliary Building.

The Containment Spray and Safety Injection systems are not designed to operate in a severe accident with very hot primary fluid, heavily loaded with debris and heavily contaminated. Under the effect of this loading, it is likely that leaks will occur at the pump packings or joints sensitive to irradiation.

Thus, leaks may occur and contaminated water build-up in the sumps of the Nuclear Auxiliary Building. These effluents are collected and can be re-injected into the Containment Building.

Upon detection of a threshold exceedance on the radiation sensors associated with the Nuclear Auxiliary Building, Operations re-inject the effluents from the entire nuclear island back into the Containment Building either in the accident phase and/or in the post-accident phase.

The documented procedure is simple to apply and can be performed entirely from the Main Control Room, preventing unnecessary exposure to fission products.



Benefits

1. Re-injecting highly contaminated water behind the 3rd Fission Product Barrier where it belongs.
2. Improving accessibility to the Nuclear Auxiliary Building, parts of which may need to be entered to perform recovering actions.
3. Reducing off-site contamination since the Nuclear Auxiliary Building is not designed to retain significant severe accident by-products.

10.2 (1) Issue: The plant accident management programme does not consider Spent Fuel Pool severe accidents and multi-unit severe accidents.

The team noted the following:

- There is no specific training provided for multi-unit severe accidents to Technical Support Centre (ELC) personnel or the Emergency Director (PCD1).
- There is no specific training provided for severe accidents occurring in a Spent Fuel Pool to either Technical Support Centre (ELC) personnel or the Emergency Director (PCD1). However, there is detailed training on preventing a severe accident in a Spent Fuel Pool.
- Whilst there has been an Emergency Planning drill where the accident impacted both units, there has been no drill where a severe accident was simulated to simultaneously occur on both Units and none are currently planned.
- While there has been an Emergency Planning drill where loss of Spent Fuel Pool cooling occurred, there has been no drill where a severe accident was simulated to occur in a Spent Fuel Pool and none are planned.
- Spent Fuel Pool accident management is based on preventive measures. A detailed accident prevention procedure and equipment are in place to decrease the probability of spent fuel being uncovered in the pool. However, there is no guidance available for plant personnel on the mitigation of severe accidents occurring in a Spent Fuel Pool.
- While there are procedures for Fuel Handing accidents in the Refuelling Cavity, fuel assembly melt within the Refuelling Cavity is not within the current scope of the Severe Accident Management guidance provided to the plant.
- If there is a multi-unit severe accident, the Technical Support Centre (ELC) will request additional support in accordance with the relevant procedure since there are insufficient resources on stand-by.
- There is only one radiation monitor for the Containment Filtered Ventilation System which makes monitoring releases from both ventilation systems challenging in the event of a multi-unit severe accident.

Without a detailed severe accident management programme, the plant may not be able to effectively manage a severe accident involving both units or a severe accident involving fuel in a Spent Fuel Pool.

Suggestion: The plant should consider expanding the scope of the accident management program to consider Spent Fuel Pool severe accidents and multi-unit severe accidents.

IAEA Bases:

SSR-2/2 (Rev. 1)

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

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2.11 The accident management programme should address all modes and states of operation and all fuel locations, including the spent fuel pool, and should take into account possible combinations of events that could lead to an accident. The accident management programme should also consider external hazards more severe than those considered for the design, derived from the site hazard evaluation, that could result in significant damage to the infrastructure on the site or off the site which would hinder actions needed to prevent imminent significant degradation of the fuel rods or to mitigate significant fuel rod degradation.

2.37 Accident management guidance should be considered for any specific challenges posed by shutdown plant configurations and large scale maintenance. The potential for damage to fuel in the reactor core and in the spent fuel pool, and in on-site dry storage if applicable, should also be considered in the accident management guidance. As large scale maintenance is frequently carried out during planned shutdown states, the protection of workers should be a high priority of accident management.

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

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

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

3.105 All significant sources of radioactive material in the plant, including the reactor core and spent fuel pools, and the occurrence of accidents in all relevant normal operating and shutdown states (including open reactor or open containment barriers) should be addressed.

10.5(a) Good Practice: The accident mitigation strategies implemented on the plant have been timed in exercises and these times are included in the guidelines for their implementation. This facilitates resource allocation and strategy prioritization.

The aim is to assist the overall implementation of accident management strategies by including the likely implementation times on all strategies implemented on the plant.

These strategies could either be implemented by Field Operators such as the manual opening of the Steam Generator atmospheric dump valves or it could be the deployment and installation of portable equipment by maintenance technicians.

The Field Operator procedures for actions on the plant have a documented expected time to complete the procedure. An example is that it is indicated that it takes one Field Operator 15 minutes to refine the alignment of the space between the double Containment Building walls to the Containment Filtered Vent System.

The guidance for the Maintenance Technicians for deploying and installing portable equipment also have documented expected time for completion. An example is that it is indicated that it will take 4 hours for two Maintenance Technicians to align the demineralized water system to provide make-up to the Spent Fuel Pool.

Benefits

1. Decreased stress in the Technical Support Centre by knowing when to expect implementation of an accident mitigation strategy.
2. Decreased stress of Field Operators and Maintenance Technicians by knowing they have a reasonable amount of time to accomplish a given task.
3. Aid the choice and prioritization of accident management strategies by appreciating which are likely to be faster.
4. Aid the management of limited resources in each discipline when numerous strategies on the plant may be required.

SUMMARY OF RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

AREAS	RECOMMENDATIONS, SUGGESTIONS & GOOD PRACTICE
LMS	**Recommendation:** The plant should improve the sensitivity of their managers and supervisors to recognize, challenge and correct inappropriate behaviours on site and establish an intolerance for rationalizing deviations to maintain personnel safety and high levels of standards. **1.2(a) Good practice:** The CONNECT project and its applications
TQ	**Suggestion**: The plant should consider improving the operator training programme implementation to ensure that the training is always delivered consistently to ensure safe and reliable operation
OPS	**Suggestion:** The plant should consider improving the quality of surveillance programme and testing. **Recommendation**: The plant should improve implementation of the processes related to plant configuration and status control to ensure plant safety.
MA	**Recommendation:** The plant should improve its preparation, control, and implementation of maintenance activities to ensure equipment reliability and personnel safety. **4.2(a) Good Practice**: SF6 Gas Detection and Recovery.
TS	**Suggestion:** The plant should consider strengthening its process for control of temporary modifications, arrangements, and cumulative assessments of deviations on plant level to minimize cumulative risk. **5.1(a)**: **Good Practice: The** plant has installed remote monitoring capability on safety critical seawater piping. **5.1(b)**: **Good Practice: The** plant has developed and installed a system for monitoring sedimentation in the intake cooling water channel.
OEF	**Suggestion:** The plant should consider requiring the thorough evaluation and documentation of internal and external operating experience to prevent similar events when performing root cause analyses. **Suggestion:** The station should consider adding more focus to the corrective actions to prevent recurrence.

RP	**Recommendation:** The plant should implement radiological control practices to ensure that radiation risks to workers are as low as reasonably achievable (ALARA). **Suggestion:** The plant should consider reinforcing the application of radiological protection standards in the field to improve radiological safety.
CH	**Suggestion:** The plant should consider improving the practices for labelling, storage, management and use of chemicals and other substances. **8.2.(a) Good practice:** Specific tritium management to minimise tritium activity in the pools, i.e. In-Refueling Water Storage Tank (IRWST) and Spent Fuel Pool (SFP).
EPR	**Suggestion:** The plant should consider improving procedures for the activation and notification process to ensure emergency response in a more timely and effective manner. **Suggestion:** The plant should consider improving the plant arrangements for protective actions in case of emergency in order to enhance personal safety and adequate response capacity.
AM	**Suggestion:** The plant should consider expanding the scope of the accident management program to consider Spent Fuel Pool severe accidents and multi-unit severe accidents. **10.2(a) Good Practice:** An accident mitigation strategy has been developed for the re-injection of highly contaminated water from the Nuclear Auxiliary Building back into the Containment Building to reduce off-site contamination. The system has been designed, installed and has procedures for its implementation. **10.5(a) Good Practice:** The accident mitigation strategies implemented on the plant have been timed in exercises and these times are included in the guidelines for their implementation. This facilitates resource allocation and strategy prioritization

DEFINITIONS

Recommendation

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

Suggestion

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

Good practice

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

Good performance

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 nuclear installation. However, it might not be necessary to recommend its adoption by other nuclear installations, because of financial considerations, differences in design or other reasons.

Self-identified issue

A self-identified issue is documented by the OSART team in recognition of actions taken to address inadequate conformance with the IAEA safety standards identified in the self-assessment made by the host organization prior to the mission and reported to the OSART team by means of the Advance Information Package. Credit is given for the fact that actions have been taken, including root cause determination, which leads to a high level of confidence that the issue will be resolved within a reasonable time frame. These actions should include all the necessary provisions such as, for example, budget commitments, staffing, document preparation, increased or modified training, or equipment purchases, as necessary.

Encouragement

If an item does not have sufficient safety significance to meet the criteria of a ‘recommendation’ or ‘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 host organization to…)

REFERENCES

Safety Fundamentals (SF)

SF-1	Fundamental Safety Principles (Safety Fundamentals)

General Safety Requirements (GSR)

GSR Part 1	Governmental, Legal and Regulatory Framework for Safety
GSR Part 2	Leadership and Management for Safety
GSR Part 3	Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
GSR Part 4 Rev.1	Safety Assessment for Facilities and Activities
GSR Part 5	Predisposal Management of Radioactive Waste
GSR Part 6	Decommissioning of Facilities
GSR Part 7	Preparedness and Response for a Nuclear or Radiological Emergency

Specific Safety Requirements (SSR)

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

General Safety Guides (GSG)

GSG-2	Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency
GSG-7	Occupational Radiation Protection
GSG-11	Arrangements for the Termination of a Nuclear Radiological Emergency

Safety Guides (SG)

NS-G-2.13	Evaluation of Seismic Safety for Existing Nuclear Installations
GS-G-2.1	Arrangement for Preparedness for a Nuclear or Radiological Emergency
GS-G-3.1	Application of the Management System for Facilities and Activities
GS-G-3.5	The Management System for Nuclear Installations
RS-G-1.8	Environmental and Source Monitoring for Purposes of Radiation Protection

Specific Safety Guides (SSG)

SSG-2 Rev.1	Deterministic Safety Analysis for Nuclear Power Plants
SSG-3	Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants
SSG-4	Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants
SSG-13	Chemistry Programme for Water Cooled Nuclear Power Plants

SSG-25 Periodic Safety Review for Nuclear Power Plants

SSG-28 Commissioning for Nuclear Power Plants

SSG-38 Construction for Nuclear Installations

SSG-39 Design of Instrumentation and Control Systems for Nuclear Power Plants

SSG-40 Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors

SSG-47 Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities

SSG-48 Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants

SSG-50 Operating Experience Feedback for Nuclear Installations

SSG-54 Accident Management Programmes for Nuclear Power Plants

SSG-61 Format and Content of the Safety Analysis report for Nuclear Power Plants

SSG-70 Operational Limits and Conditions and Operating Procedures for Nuclear Plants

SSG-71 Modifications to Nuclear Power Plants

SSG-72 The Operating Organization for Nuclear Power Plants

SSG-73 Core Management and Fuel Handling for Nuclear Power Plants

SSG-74 Maintenance, Testing, Surveillance and Inspection in Nuclear Power Plants

SSG-75 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

SSG-76 Conduct of Operations at Nuclear Power Plants

SSG-77 Protection against Internal and External Hazards in the Operation of Nuclear Power Plants

International Labour Office publications on industrial safety

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

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

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

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Review area: Training and Qualification

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Review area: Operations 1

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Review area: Maintenance

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Review area: Technical Support

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Company: EQRPI INC
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Company: Consultant
Review area: Chemistry

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Review area: Emergency Preparedness & Response

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Review area: Accident Management

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