NSNI/OSART/213/2021
ORIGINAL: English

IAEA | Operational Safety Review Team OSART

REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM

(OSART)

TO THE

BELLEVILLE

NUCLEAR POWER PLANT

FRANCE

15 NOVEMBER – 2 DECEMBER 2021

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/213/2021/

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of the Belleville Nuclear Power Plant, France. It includes recommendations and suggestions for improvements affecting operational safety for consideration by the responsible French authorities and identifies good practices for consideration by other nuclear power plants. Each recommendation, suggestion, and good practice is identified by a unique number to facilitate communication and tracking.

Any use of or reference to this report that may be made by the competent French organizations is solely their responsibility.

FOREWORD by the
Director General

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

An OSART mission, carried out only at the request of the relevant Member State, is directed towards a review of items essential to operational safety. The mission can be tailored to the particular needs of a plant. A full scope review would cover eleven 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, and Human-Technology-Organization Interactions. Depending on individual needs, the OSART review can be directed to a few areas of special interest or cover the full range of review topics.

Essential features of the work of the OSART team members and their plant counterparts are the comparison of a plant's operational practices with the IAEA Safety Standards 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 Belleville Nuclear Power Plant in France, from 15 November to 2 December 2021.

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 eleven areas: Leadership and Management for Safety; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Preparedness and Response; Accident Management; and Human-Technology-Organization Interaction.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader and the team was composed of experts from Belgium, Canada, Czech Republic, Finland, Hungary, Romania, Slovakia, South Africa, United Kingdom, United States of America, and the IAEA staff members. The collective nuclear power experience of the team was approximately 400 years.

The team identified 16 issues, six were recommendations and 10 were suggestions. Five good practices were also identified.

Several areas of good performance were noted:

- The plant used a main control board layover plaque in the control room to increase awareness and high visibility on control rods status.
- The plant implemented the Human Performance Tool refresher training using the virtual ‘escape game’ approach at an on-site training facility.
- The plant developed an approach to identify essential equipment necessary to re-establish core cooling in extremely difficult situations with fluorescent tags.

The most significant issues identified were:

- Managers and supervisors should actively promote excellent performance in all activities important to safety.
- The plant should improve the control and implementation of reactivity manipulations to ensure precise plant control.
- The plant should improve the timeliness of corrective actions development and implementation and improve their quality and effectiveness to prevent recurrence of events.

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

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INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of France, an IAEA Operational Safety Review Team (OSART) of international experts visited the Belleville Nuclear Power Plant from 15 November to 2 December 2021. The purpose of the mission was to review operating practices in the areas of Leadership and Management for Safety; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Preparedness and Response; Accident Management; and Human-Technology-Organization Interaction. 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 Belleville OSART mission was the 213th in the programme, which began in 1982. The team was composed of experts from Belgium, Canada, Czech Republic, Finland, Hungary, Romania, Slovakia, South Africa, United Kingdom, United States of America, and the IAEA staff members. The collective nuclear power experience of the team was approximately 400 years.

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

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

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

MAIN CONCLUSIONS

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

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

- The plant used a main control board layover plaque in the control room to increase awareness and high visibility on control rods status.
- The plant implemented the Human Performance Tool refresher training using the virtual 'escape game' approach at an on-site training facility.
- The plant developed an approach to identify essential equipment necessary to re-establish core cooling in extremely difficult situations with fluorescent tags.

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

- Managers and supervisors should actively promote excellent performance in all activities important to safety.

- The plant should improve the control and implementation of reactivity manipulations to ensure precise plant control.
- The plant should improve the timeliness of corrective action development and implementation and improve their quality and effectiveness to prevent recurrence of events.

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

1. LEADERSHIP AND MANAGEMENT FOR SAFETY

1.1. LEADERSHIP FOR SAFETY

The plant has an organization designed in a matrix structure with 13 departments and nine macro-process areas. Department heads are responsible for the staff in their area and the macro-process owners are responsible for the coordination and oversight of the processes.

The current plant annual performance contract has a focus on four priority performance indicators which are displayed throughout the plant. These are 19 billion kWh of production, 0 Automatic Reactor Trips and Fires, Housekeeping level 2, and 7.8 Industrial Safety overall accident rate per million hours worked. The plant performance measures are tracked in comparison to the other plants in the fleet.

The plant has integrated an unforeseen events database and record of decision template. This ensures that safety risks are identified and considered throughout the response to unforeseen events. The database is open to all plant employees to share information, analyses and decisions made related to the events. The team recognized this as a good performance.

The team noted that plant managers and supervisors sometimes did not promote a commitment to excellent performance in all activities important to safety. Managers and supervisors did not always challenge inappropriate behaviours and plant standards, deliver on commitments, or take opportunities to engage with plant employees. The team made a recommendation in this area.

1.2. MANAGEMENT SYSTEM

The plant has a well-defined management system that includes nine macro-processes that cover plant management and oversight, generation, nuclear safety and quality, risk prevention, environment, human resources, cost control, equipment reliability and long-term operation, and industrial policy and contractor relations. For each macro process there are sub-processes with associated basic processes each with designated owners to manage the process.

The plant uses annual self-assessments, inputs from the fleet and external assessments to define actions for the upcoming annual business planning cycle. In addition, the plant oversight organization performs independent assessments to provide feedback to plant management on the effectiveness of the plant programmes. The plant is currently developing their strategic plan for the 2021-2025 period and expects to have this in place in January 2022.

The plant has introduced a management approach for teams to engage staff and improve performance using a performance management model EVOLEAN. This has been implemented in two teams at the plant and plans are in place to implement this in at least three additional teams in 2022. Teams within the plant that have been using the model have shown improvement in engagement with other plant groups including operations. The team recognized this as a good performance.

1.3. NON-RADIATION-RELATED SAFETY PROGRAMME

The plant has designed and implemented a long-handled device to detect asbestos in preparation for maintenance activities. This has improved industrial safety by eliminating the need for contact with asbestos samples and the need to work at height for hard-to-reach areas. The team recognized this as a good performance.

The plant has implemented a safety poster at the entry to electrical rooms to prompt workers to check that they meet all the Personal Protective Equipment (PPE) requirements to enter the area. The poster includes a visual depiction of a worker with the required equipment so that workers can review their PPE against the visual aid. The team recognized this as a good performance.

Plant activities were not always performed and controlled in a manner that ensured personnel safety. The team noted gaps in behaviours related to industrial safety, unsafe conditions and facilitation of safe work practices. The team made a recommendation in this area.

DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY FINDINGS

1.1. LEADERSHIP FOR SAFETY

1.1(1) Issue: Managers and supervisors do not always promote a commitment to excellent performance in all activities important to safety.

The team noted the following:

Challenging behaviours and standards:

- In the Main Control Room (MCR), in a panel below the firefighting system inhibitor panel there were openings which were used to store documents, a radio and other loose paperwork.
- The MCR dining room had a plant on top of an electrical box with a cardboard box underneath. There were plastic bags stored under electrical cables and cardboard boxes on top of lockers. Against the wall opposite the entrance door were multiple cardboard boxes.
- There was material stored on top of cabinets and on the floor in the Shift Manager's office and a maintenance meeting area. These conditions were not challenged by supervisors or managers in the area.
- The Industrial Safety performance accident rate per one million hours worked in October 2021 was 6.2 compared to 7.8 overall target. The plant indicated that this performance was good compared to the fleet. The plant indicated that it was difficult to compare performance with other world regions based on concerns about the reported data. Work to address this comparison of data is in progress with information expected to be available in December 2021. Using the currently available data,
  - The Industrial Safety lost time accident rate per one million hours worked for the 24-month period to June 2021 for the plant was 2.3 and for the fleet is 3.45. For comparison, the comparable Industrial Safety accident rate for a different world region was 0.16.
  - The Industrial Safety lost time accident rate for contractors per one million hours worked for the 24-month period to June 2021 for the plant was 7.64 and for the fleet was 6.06. For comparison, the comparable Industrial Safety accident rate for a different world region was 0.26.
  - Following a loss of spent fuel pool cooling event due to a coupling failure on one of the spent fuel pool cooling pumps, the plant took actions to repair the failed pump. No maintenance or operations compensatory actions were put in place such as increased monitoring, temporary operating procedures, or reducing the number of starts and stops for the other pumps.
  - The team identified that some issues with examples below were not systematically captured in the Plant Corrective Action database:
    - Foreign Material Exclusion (FME) related issues, such as not using an FME cover on an emergency water connection.
    - Labelling issues on chemistry bottles or other products, such as expired validation dates.
    - Personnel protective equipment not properly used.

  - Radiation Protection issues, such as hot spots on low level waste.
- There were no procedures in place for the management of low-level radioactive waste (LLRW) with no path for disposal.
- The Radioactive Waste Building operation procedure states that 135 drums are allowed in the area for LLRW without a disposal path. More than 200 metal drums were observed in that area of Radioactive Waste Building.
- A manager conducting an ‘Industrial Safety Welcome’ briefing accepted two of seven attendees having masks positioned below their nose even though one of the topics covered was related to Covid-19 protocols.
- A table was found in the Safety Ultimate Diesel (DUS) building but was not secured. This had been previously identified by plant management; however, it was not corrected.
- During a walkdown for fire protection standards, a cardboard box and wood planked trolley were observed in a hot work area. However, the storage area permit sign allowed these items to be present in the hot work area in which grinding work was taking place. This was not challenged by managers or supervisors observing the area.
- There were several examples of storage of equipment without care including unlabelled liquid containers in the essential cooling water rooms. In the turbine building there were wood pallets, debris and metal parts stored in manner that could lead to damage.
- Workers in the electrical maintenance meeting area were seen eating food with masks off while about one meter apart from one another during morning work preparation. This was not challenged by supervisors or managers in the area.

Delivering on Commitments:

- Commitments to the regulator are not consistently completed on time. The plant indicated that one or two late commitments per month was quite a good result.
- The internal target for notification to the regulator for significant events within two business days was not consistently met from January to October 2021. The plant indicated that this had been a weakness noted in the past and actions to accelerate reporting had been unsuccessful at resolving this performance gap.
- A sampling of extensions to corrective actions recently approved in a corrective action review meeting showed that one action had been previously extended 7 times prior to the meeting. Decisions made in the weekly corrective action review meeting for granting extensions to corrective actions were being made without the information of previous extension approvals being available in the meeting package. The decisions were based on risk analysis of impact. A senior manager took action to correct this prior to the next review meeting.
- During a macro-process (MP8) meeting, two performance curves for completion of post modification actions showed performance not meeting the target completion line. Overall action delivery dates were delayed by two months for Unit 1 and one month for Unit 2. This delay had been previously discussed at the director level.

Opportunities to Engage:

- During an ‘Industrial Safety Welcome’ briefing conducted by a manager:
  - key messages were not highlighted and were diluted with a large volume of messages.

  - the duration exceeded stated time and covered a lot of material with risk of losing engagement of the attendees.
  - engagement with the attendees could have been improved by asking questions at the beginning of the session.
  - the briefing environment was noisy and multiple people passed into and through the briefing area, disrupting the session.
  - late arriving attendees caused disruptions.
- Most of the presentation of performance during a weekly macro-process meeting (RHMP) was delivered in a one-way manner by the presenter directed to the plant manager. Typically, there were few (zero to one) questions by peers per presentation.
- Actions in the annual business plan were created for the site, departments and teams in a cascade down manner. This cascade down started from the corporate level to the site level as well. The plant acknowledged that there was little worker up engagement in the development of the current annual plant business plan.
- The actual and potential consequences as presented in investigation reports for several safety significant events generally emphasize positive factors that included violation of technical specification limits through technical reviews that credit reliance on availability of alternate equipment, intervention or after the fact analysis showing minimal actual or potential impact. Internal event communication was normally limited to sharing the investigation report.

Performance Indicators:

- The number of significant safety events involving control of reactivity per unit has remained flat at 0.5 in 2019, 0.5 in 2020 and 0.5 in 2021 up till August.
- The trend of nuclear safety significant events (nuclear safety significant events ratio to workload) is relatively flat over the past 4 years at a value of approximately 0.25.

Plant Events:

- On 5 January 2021, the reactor coolant pressure exceeded the absolute limit of 45 bar in hot standby mode while operators were attempting to establish the required conditions to conduct an operations surveillance test (LLS003). The root causes included lack of adequate preparation and insufficient contingency management arrangements for the activity.
- In a chemistry laboratory, an unsafe condition was detected related to liquid on the floor from an air conditioning device. This was promptly addressed; however, the temporary measures were not effective at preventing a worker from slipping and falling in the same location. This resulted in a lost time accident.
- Three instances have occurred in 2021 in which radioactive waste has entered the conventional waste stream and was detected at the final check thus preventing the material from exiting the plant. Weaknesses were identified in monitoring equipment availability and behaviours related to radioactive waste handling. Following the first two events, actions taken to prevent further events were ineffective.

Without actively promoting excellent performance, plant and personnel safety could be challenged.

Recommendation: Managers and supervisors should actively promote excellent performance in all activities important to safety.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 5: Safety Policy

The operating organization shall establish and implement operational policies that give safety the highest priority.

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

4.2 The safety policy shall stipulate clearly the leadership role of the highest level of management in safety matters. Senior management shall communicate the provisions of the safety policy throughout the organization. Safety performance standards shall be developed for all operational activities and shall be applied by all site personnel. All personnel in the organization shall be made aware of the safety policy and of their responsibilities for ensuring safety. The safety performance standards and the expectations of the management for safety performance shall be clearly communicated to all personnel, and it shall be ensured that they are understood by all those involved in their implementation.

GSR Part 2

Requirement 2: Demonstration of Leadership for Safety by Managers

Managers shall demonstrate leadership for safety and commitment to safety.

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

(a) Establishing, advocating and adhering to an organizational approach to safety that stipulates that, as an overriding priority, issues relating to protection and safety receive the attention warranted by their significance;

(b) Acknowledging that safety encompasses interactions between people, technology and the organization [2];

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

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

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

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

(b) Development of individual and institutional values and expectations for safety throughout the organization by means of their decisions, statements and actions;

(c) Ensuring that their actions serve to encourage the reporting of safety related problems, to develop questioning and learning attitudes, and to correct acts or conditions that are adverse to safety.

3.3. Managers at all levels in the organization:

(a) Shall encourage and support all individuals in achieving safety goals and performing their tasks safely;

(b) Shall engage all individuals in enhancing safety performance;

(c) Shall communicate clearly the basis for decisions relevant to safety.

Requirement 12: Fostering a Culture for Safety

Individuals in the organization, from senior managers downwards, shall foster a strong safety culture. The management system and leadership for safety shall be such as to foster and sustain a strong safety culture.

5.1. All individuals in the organization shall contribute to fostering and sustaining a strong safety culture.

5.2. Senior managers and all other managers shall advocate and support the following:

(a) A common understanding of safety and of safety culture, including: awareness of radiation risks and hazards relating to work and to the working environment; an understanding of the significance of radiation risks and hazards for safety; and a collective commitment to safety by teams and individuals;

(b) Acceptance by individuals of personal accountability for their attitudes and conduct with regard to safety;

(c) An organizational culture that supports and encourages trust, collaboration, consultation and communication;

(d) The reporting of problems relating to technical, human and organizational factors and reporting of any deficiencies in structures, systems and components to avoid degradation of safety, including the timely acknowledgement of, and reporting back of, actions taken;

(e) Measures to encourage a questioning and learning attitude at all levels in the organization and to discourage complacency with regard to safety;

(f) The means by which the organization seeks to enhance safety and to foster and sustain a strong safety culture, and using a systemic approach (i.e. an approach relating to the system as a whole in which the interactions between technical, human and organizational factors are duly considered);

(g) Safety oriented decision making in all activities;

(h) The exchange of ideas between, and the combination of, safety culture and security culture.

1.3. NON-RADIATION-RELATED SAFETY PROGRAMME

1.3(1) Issue: The plant activities are not always performed and controlled in a manner that ensures personnel safety.

The team noted the following:

Behaviours:

- A worker attached a lifting device to a crane hook while the hook was still in motion just above a filter assembly.
- There was an extension cord running on the ground through a doorway and the metal door was closed on the cord without any protection. There was an electrical outlet bar outside exposed to the rain without any protection. Both issues were located near the plant entrance.
- A spiked shoe cover was placed upside down (three cm spikes sticking up) at the entrance door to the Safety Ultimate Diesel (DUS) Building despite the presence of a designated storage location.
- A drainage catch device in the DUS air compressor room was not in the proper place and was full of oily water resting on a flange above the drain pipe, and was no longer catching dripping water from the pipe resulting in water on the floor.
- During assembly of the new filter elements into a filter cartridge, workers remained in a corner adjacent to drainage pipework that could at times have higher radioactive dose rates. This work was performed in a cramped area with limited mobility for the activity. An adjacent space was available but was not used. This precaution was raised by the Contract Manager during the post-job debriefing.
- Fire hoses that had been previously staged to support work activities on a roof were observed to be no longer stored in a manner that would allow easy deployment during a fire emergency. This was corrected promptly after it was identified by the OSART team.
- An individual was observed coming down a set of stairs inside a building without holding the handrail and not wearing a mask even though masks are required in the building. A manager challenged the individual.
- Two workers were observed moving upstairs with both hands carrying barricades and were not holding handrails in the pump station.
- Two instances where workers were observed in a plant area requiring eye protection and did not have eye protection. This was corrected by coaching from plant managers.

Unsafe conditions:

- On the ground floor in the radioactive waste area there were over 100 blue metal drums. These drums were stacked 5 drums high with no pallet between stacks.
- A work location on the roof of Unit 2 contained bricks, a wheelbarrow, two wooden pallets, and an electrical distribution panel next to a catch containment area. A temporary electrical cable in this area was positioned in a manner that created a trip hazard.
- In the Unit 1 Radiation Controlled Area (RCA) there were two metal gutter covers against the wall in vertical position leaving a 70cm*30cm, 30cm deep hole in the floor.
- At least four emergency exit lights were found out of service in the electrical building.
- All the lights were off in room 1KA0506 that contains steam driven emergency feedwater pump 1ASG031PO. This was determined to be due to a tripped circuit breaker.

- Two circuit breakers (2LUUB51JA and 2LUUC71JA) in an electrical panel were racked out and protruding from the panel with no cover applied to the top opening of the circuit breaker to prevent access to the internals.

Facilitating safe work practices:

- An electrical worker was aware of the need to have no rings or jewellery during electrical work. When questioned regarding wearing metal components such as access badge clips, the worker stated that it was not clearly forbidden by the applicable standards and was acceptable based on risk assessment, provided the metal badge was not dangling down into the panel during the work.
- An operator indicated that it was challenging to know the right system to use to report defects as there are multiple databases depending on the nature of the issue that needs to be addressed.
- The training mock-up area had multiple posters depicting 10 vital safety rules. The posters in the plant depict 11 vital safety rules. The posters in the training building come from the company wide list of the 10 vital safety rules and do not contain the additional safety rule added by the nuclear fleet on radiography.
- In the DUS building, two elevated doors with no exterior access platform were closed. An improvised rope arrangement was in place to control the door position if they needed to be opened.
- There was a long-standing scaffold built at the DUS generator building to allow liquid waste to be pumped out of the building. The connection point for pumping out the waste was too high up to be accessed without the scaffold. The scaffold partially obstructs the stairway. There is a modification outstanding to address this design issue so that the temporary scaffold can be removed.

Performance Trends:

- The plant continues to have lost time accidents with 11 in 2019, 12 in 2020 and 7 in 2021 up to the end of September.
- The plant has an increasing trend in minor accidents with 16 in 2019, 19 in 2020 and 21 in 2021 up to the end of September.
- The ratio of lost time accidents to minor accidents and near-misses is high at 11/37 in 2019, 12/32 in 2020 and 7/27 in 2021 to September.

Plant Events:

- On 13 June 2021, a worker was injured while moving an electrical cable with two other workers. After the activity, the worker felt a pain in his shoulder and went to the hospital. This was a lost time injury.
- On 19 March 2021, a worker injured their ankle while conducting rounds. While ducking underneath pipes they stumbled over some flexible fire hoses laying on the ground. This was a lost time injury.
- On 4 August 2020, a worker injured his hand while using an impact wrench and a hammer. The worker intended to hit the wrench with the hammer and instead hit his hand causing a fracture. This was a lost time injury.
- On 14 June 2020, a worker fell from standing on a plastic chair, injuring their knee while assembling an airlock in front of the In-core Instrumentation room. This was a lost time injury.

Without strict adherence to Industrial Safety standards, personnel safety could be challenged.

Recommendation: The plant activities should be performed and controlled in a manner that ensures personnel safety.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 23 Non-Radiation-Related Safety

The operating organization shall establish and implement a programme to ensure that safety related risks associated with non-radiation-related hazards to personnel involved in activities at the plant are kept as low as reasonably achievable.

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

Requirement 24 Feedback of Operating Experience

The operating organization shall establish an operating experience programme to learn from events at the plant and events in the nuclear industry and other industries worldwide.

5.27 The operating organization shall establish and implement a programme to report, collect, screen, analyse, trend, document and communicate operating experience at the plant in a systematic way. It shall obtain and evaluate available draw and incorporate lessons for its own operations, including its emergency arrangements. It shall also encourage the exchange of experience within national and international systems for the feedback of operating experience. Relevant lessons from other industries shall also be taken into consideration, as necessary.

5.28 Events with safety implications shall be investigated in accordance with their actual or potential significance. Events with significant implications for safety shall be investigated to identify their direct and root causes, including causes relating to equipment design, operation and maintenance, or to human and organizational factors. The results of such analyses shall be included, as appropriate, in relevant training programmes and shall be used in reviewing procedures and instructions. Plant event reports and non-radiation-related accident reports shall identify tasks for which inadequate training may be contributing to equipment damage, excessive unavailability of equipment, the need for unscheduled maintenance work, the need for repetition of work, unsafe practices or lack of adherence to approved procedures.

5.29 Information on operating experience shall be examined by competent persons for any precursors to, or trends in, adverse conditions for safety, so that any necessary corrective actions can be taken before serious conditions arise.

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.

5.31 The operating organization shall be responsible for instilling an attitude among plant personnel that encourages the reporting of all events, including low level events and near misses, potential problems relating to equipment failures, shortcomings in human performance, procedural deficiencies or inconsistencies in documentation that are relevant to safety.

Requirement 28 Material Conditions and Housekeeping

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

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

GSR Part 2

Requirement 12: Fostering a Culture for Safety

Individuals in the organization, from senior managers downwards, shall foster a strong safety culture. The management system and leadership for safety shall be such as to foster and sustain a strong safety culture.

5.1. All individuals in the organization shall contribute to fostering and sustaining a strong safety culture.

2. TRAINING AND QUALIFICATION

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

Human Performance Tool refresher training using the 'escape game' approach at the on-site training facility is providing an improved learning environment for the trainees to use most of the standard set of Human Performance tools, such as, reading and understanding work packages and adherence to procedures. The training facility also drives the teams to take into account operating experience in order to avoid the pitfalls in the game. To successfully complete the escape game, trainees must apply the human performance tools. This helps them understand and value the use of these tools during their activities on the plant. The team recognized this as a good practice.

The plant standards in the implementation of operations training are not always carried out in a systematic way to ensure the consistency of training delivered. For example, training materials are sometimes not formally approved; the simulator is not always a realistic replication of the plant; the staff who fill the field peer coach role do not undergo a formal selection process, training or authorisation. The team made a recommendation in this area.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

2.2(a) Good practice: Human Performance Tool refresher training using the 'escape game' approach at an on-site training facility.

The aim is to reinforce good error reduction techniques using an engaging and dynamic approach, while maintaining good technical links to activities performed on a nuclear power plant.

Trainees must work as a team to solve puzzles, which are distributed across the on-site training facility. The scenario is modified annually to provide a new game for the trainees each year, thus maintaining a strong interest in refresher training.

The exercise forces trainees to use most of the standard set of tools required by Nuclear Power Generation Division from the Corporate, such as, reading and understanding work packages and adherence to procedures. The environment also drives the team to take into account the operating experience in order to avoid the pitfalls in the game in the industrial environment of the on-site training facility.

To successfully complete the escape game, trainees must apply the human performance tools. This helps them understand and value the use of these tools during their activities on the plant.

The feedback from trainees is excellent and they are enthusiastic about and entirely satisfied with this training approach.

This approach can be deployed at all plants with an on-site training facility by adapting the scenario.

(Note: This photograph was taken before the Covid pandemic).

2.2(1) Issue: The plant standards in the implementation of operations training are not always carried out in a systematic way to ensure the consistency of training delivered to conduct safe and reliable operations.

- The team noted the following: There is no process to assess the suitability of a staff member to be field peer coaches and on-the-job observers, this is a judgement call made by the shift team lead according to their experience and attitude.
- Formal training is available for staff who carry out the role of field peer coaches and on-the-job observers, but this is not always given to staff. The operations team indicated that it is only given if it is felt that they will carry out a lot of field peer coaching or on-the-job observations. Currently only one person in the operations department has undertaken this training.
- There is no formal selection process or training for staff who undertake field coaching and observation of staff to confirm their suitability for authorization.
- In interviews with deputy shift manager, lead operator, senior tagging officer, field operators, and online and outage operations teams:
  - All stated they had not received formal training regarding field peer coaches and trainers and on-the-job observers or assessment on granting authorization, instead they used their skills and experience.
  - All stated that the proposal for authorization of Tagging Officers trainees comes from Senior Tagging officer observing the trainee working in the field on multiple occasions. No formal training in on-the-job observations had been given to these team members at this time.
  - It was stated that the Field Operators proposal for the authorization process is completed by walk down with peer coach and trainee. This is in line with their guidance note for authorization of field operators. No formal training in on-the-job observations and training is given to the team members carrying out this role at this time.
  - It was confirmed that in line with Plant Processes, the Reactor Operator proposal for authorization process is completed by a walk down with peer coach. This is in line with their guidance note for authorization of field operators. No formal training in on-the-job observations is given to the team members carrying out this role at this time.
- There was no requirement in the management guidance to carryout formal post-training assessment when assessing skills or issuing and renewing reactor operator and field technicians' authorization. The only requirement in the standard training plan is field observations.
- During an interview with the operations documentation modification controller, it was stated that team training for smaller modifications may be given to shift team and if staff miss this, they have to get information from their team members. There was no formal make-up training available to ensure all team members get the same baseline knowledge in the field on plant modifications.

Simulator difference control:

- In cold shut down mode, from the point when the pressurizer manhole access starts to open, there are some parameters that are no longer representative in the simulator. For example, the simulator code does not cover:
  - emptying steam generators during cold shutdown.

  - steam generator tube failure causing dilution of the Reactor Cooling System (RCS) during cold shut down.
- Practical training is not possible in these situations with the simulator.
- There are several differences between the simulator and NPPs that generate complications during operator training.
  - On the simulator, there is no control panel for the containment sweeping ventilation system used during outage.
  - On the simulator, the threshold for tripping the circulating water pumps is different from that on the NPPs. The plant has a specific alarm response sheet in the simulator for trainees.
  - The Safety Ultimate Diesel (DUS) and the alarms are not included in the simulator.
  - Chart recorders are all digital for the simulator, but paper recorders are used in the NPPs.
- While observing one operator training on the simulator, the instructors did not discuss simulator deviations from the NPPs. Midway through the scenario, the deputy shift manager called the shift manager (a simulator instructor was acting as shift manager). The instructor informed the deputy shift manager that there was a difference from the NPPs, and that he had to look at indicators other than those that the procedure stated.

Operation training evaluation:

- Training materials can be modified by the trainer without any evaluation or analysis. The plant stated that the presenter is permitted to change the corporate material supplied within certain defined boundaries.
- For Severe Accident classroom training for Main Control Room (MCR) personnel, no formal evaluation of the trainees is conducted and so there is no confirmation that they understand the training topic.
- No mandatory refresher training on learning techniques is required for simulator instructors.
- In the summary report (annual report September 2020 to September 2021) on simulator training, it was stated that only 60% of trainees worked correctly with the procedures for a reactor control rod scenario.

Without a systematic and consistent training for operation employees, their knowledge of the training topic and associated skills may not be adequate to ensure safe and reliable operation.

Recommendation: The plant should improve operations training implementation to ensure the training is always delivered consistently to conduct safe and reliable operation.

IAEA Bases:

SSR 2-2 (Rev.1)

Requirement 7: Qualification and training of personnel

The operating organization shall ensure that all activities that may affect safety are performed by suitably qualified and competent persons.

4.16. The operating organization shall clearly define the requirements for qualification and competence to ensure that personnel performing safety related functions are capable of safely performing their duties. Certain operating positions may require formal authorization or a licence.

4.17. Suitably qualified personnel shall be selected and shall be given the necessary training and instruction to enable them to perform their duties correctly for different operational states of the plant and in accident conditions, in accordance with the appropriate procedures.

4.18. The management of the operating organization shall be responsible for the qualification and the competence of plant staff. Managers shall participate in determining the needs for training and in ensuring that operating experience is taken into account in the training. Managers and supervisors shall ensure that production needs do not unduly interfere with the conduct of the training programme.

4.19. A suitable training programme shall be established and maintained for the training of personnel before their assignment to safety related duties. The training programme shall include provision for periodic confirmation of the competence of personnel and for refresher training on a regular basis. The refresher training shall also include retraining provision for personnel who have had extended absences from their authorized duties. The training shall emphasize the importance of safety in all aspects of plant operation and shall promote safety culture.

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.

4.21. The training programmes shall be assessed and improved by means of periodic review. In addition, a system shall be put in place for the timely modification and updating of the training facilities, computer models, simulators and materials to ensure that they adequately reflect current plant conditions and operating policy, and that any differences are justified.

4.22. Operating experience at the plant, as well as relevant experience at other plants, shall be appropriately incorporated into the training programme. It shall be ensured that training is conducted on the root cause(s) of the events and on the determination and implementation of corrective actions to make their recurrence less likely.

4.23. All training positions shall be held by adequately qualified and experienced persons, who provide the requisite technical knowledge and skills and have credibility with the trainees. Instructors shall be technically competent in their assigned areas of responsibility, shall have the necessary instructional skills, and shall also be familiar with routines and work practices at the workplace. Qualification requirements shall be established for the training instructors.

NS-G-2.4

6.19. A training programme should ensure that personnel at all levels of operation of nuclear power plants have the requisite competence. It should identify the activities in which safety is involved, should provide for acquisition of the knowledge and practical experience needed for these activities and should foster a responsible attitude towards all safety matters.

NS-G-2-8.

5.7. Personnel specified by the operating organization should be made familiar with the features of safety analysis as part of their training programme. Training and assessment of plant operators should ensure their familiarity with the symptoms of beyond design basis accidents and with the procedures for accident management. Simulators should represent the way in which an accident would evolve. If the available simulator facilities are inadequate, computer based training, classroom training and plant walkthroughs should be used to explain the consequences of an accident involving a seriously degraded reactor core.

5.19. Operators should be trained in routines for normal operation of the plant and in the response of the plant to changes that could cause accidents if not counteracted. The training programme should improve the diagnostic skills of the trainees. Operating procedures for normal operation and for anticipated operational occurrences and, as far as practicable, severe accident conditions should be included in the programme and should be practiced at the simulator, so that the trainees recognize the negative consequences of errors or of violations of procedures.

3. OPERATIONS

3.1. OPERATIONS ORGANIZATION AND FUNCTIONS

The plant has implemented monthly self-assessments using high-level and low-level events to assess the management of Operator Fundamentals. The team recognized this as good performance.

3.4. CONDUCT OF OPERATIONS

Reactivity manipulations are not always controlled and implemented at the plant in a manner that ensures precise plant control. For example, during the visit the team observed gaps from a number of reactivity manipulations in the control room. The team made a recommendation in this area.

Operator behaviours for some Main Control Room (MCR) activities do not always ensure high level of professionalism. For example, the team observed that in some cases, behaviours demonstrated by the operating crew did not meet management expectations. Behaviours observed included gaps in maintaining overall plant monitoring, inconsistent use of some human performance tools, and operators sitting on control panels. The team made a suggestion in this area.

3.5. WORK CONTROL

The plant's expectations for on-line work management is not robust enough to maximize equipment availability, effectively manage resources, and provide a stable work schedule. For example, work is regularly impacted for a variety of reasons but there is no process being used to identify and track the main reasons for work being delayed or cancelled. Learning reports are not regularly submitted to investigate the reasons. The team made a suggestion in this area.

3.7 CONTROL OF PLANT CONFIGURATION

Operations management developed a tool to alert operators when control rods are in manual position to prevent the rods from being controlled in manual mode due to operator error or omission. The team identified this as a good practice.

DETAILED OPERATIONS FINDINGS

3.4. CONDUCT OF OPERATIONS

3.4(a) Good Practice: Use of a Main Control Board layover plaque to provide an alert to the operator, when control rods are in manual position.

To prevent the rods from being controlled in manual mode owing to an operator error or omission, a double-sided plaque has been created, which fits onto to rod control switches.

This plaque can only be positioned on the panel if the rods are in automatic mode. Its presence therefore confirms that rod position is controlled in automatic mode.

When an activity requires the rods to be switched over to manual mode, this plaque is positioned on the vertical panel in the control room using magnets. Its red color and its position on the vertical panel alerts all operations staff in the control room that the control rods are in manual mode, thereby facilitating plant status control. This plaque was developed with inputs from past events from the plant.

On the left, control rod switches in automatic position with plaque (green side) in place.

On the right, flip side of plate (red side), positioned on the vertical panel using magnets and visible for all the crew when the rods are controlled in manual mode.

3.4 CONDUCT OF OPERATIONS

3.4(1) Issue: Reactivity manipulations are not always controlled and implemented at the plant in a manner that ensures precise plant control.

The team noted the following:

- During the performance of the Unit 1 Hydrotest Pump Turbine Generator Set (LLS) Surveillance Test:
  - The operator took precautionary action to raise volume control tank (RCV) pressure in anticipation of the test. However, switch manipulations were made without observable correct component verification or Stop-Think-Act-Review.
  - No control bands were established prior to the start of the test to take into account the potential to take suction on the refuelling water storage tank (RWST/PTR tank). Countermeasures outlined in the procedure were appropriately briefed and, in this case, the RWST level did not change.
- During a dilution of the reactor coolant system (RCS) to control RCS Temperature by the Main Control Room (MCR) operators, no procedure was used, or peer checks performed for the reactivity manipulation. However, it was informed that this meets plant expectations, if self-check is performed, when changes to RCS temperature are less than 1 degree C.
- On 10 March 2019, the RCS high-temperature limit was exceeded when operators did not recognize rod control had been taken to manual during a period of load following, and subsequent Xenon decay resulted in rising RCS temperature.
- On 23 March 2021, during cycle stretch-out mode on Unit 2, operators performed surveillance test RPN003 instead of surveillance test RPN008. This could have resulted in not identifying the need to reset the power channels. If the power range channels were not reset, the 'Automatic Reactor Trip upon high flux' protection function, set at 109%, could have been delayed. This was not classified as a reactivity management impact by the site but as a surveillance test issue.

Performing reactivity manipulations without rigour in human performance and supervisory oversight has the potential to result in unintended power transients and challenges to operating parameters.

Recommendation: The plant should improve the control and implementation of reactivity manipulations to ensure precise plant control.

IAEA Bases:

SSR-2/2 (Rev. 1)

7.20. The operating organization shall be responsible for establishing a safe reactivity management program under a strong management system for quality. Decisions on, and the planning, evaluation, conduct and control of, all operations or modifications involving the fuel that are liable to affect reactivity control shall be undertaken by using approved procedures and respecting predefined operational limits for the core.

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

NS-G-2.14

5.21. The operations management should be involved in the planning, evaluation and conduct of all operations affecting the fuel while the fuel is under its supervision (i.e. not only during operation of the reactor). The level of involvement of the operations management should correspond to the degree of responsibility that the operations department has for the safe operation of the plant and to the degree of responsibility assigned to shift personnel under the supervision of the shift supervisor. Further recommendations on operations relating to reactivity are provided in Ref. [10].

5.22. Decisions on operations that may result in manipulations of reactivity should be such that the reactor is maintained within established core operational limits. Operation within operational limits for the core provides the basis for safety in anticipated transient operational states. The importance of maintaining margins to core operational limits should be highlighted as part of the management's expectations for operating within established limits.

5.23. Reactivity manipulations should be made in a deliberate, carefully controlled manner, and should include appropriate time intervals between reactivity changes, during which the reactor is monitored to verify that the desired response has been obtained. Planned reactivity changes should only be performed in accordance with written operating instructions and the explicit permission of the shift supervisor. The supervisor should monitor the reactivity and the plant evolution and the reactor operator should be free from other duties and free from distractions while planned reactivity changes are carried out.

5.24. Any planned major changes to the reactor power or to any other operations relating to reactivity should be initiated only after a pre-job briefing on the expected effects of the change. Prior to any major change being made, any conflicts in procedures should be resolved and possible distractions from work or contingency action should be discussed.

5.25. Self-assessment and error prevention techniques, such as the stop, think, act, review (remembered as the mnemonic STAR) methodology and peer checking, should be used during reactivity manipulations. Effective and appropriate control should be established over other activities that could affect reactivity or the removal of residual heat and which are performed by other plant personnel such as chemistry technicians or instrumentation and control technicians.

3.4(2) Issue: Operator behaviours for some Main Control Room (MCR) activities do not always ensure high level of professionalism.

The team noted the following:

- In the Unit 2 MCR, when an issue was reported on the Spent Fuel Pool Cooling system, all four operators in the MCR grouped around the Spent Fuel Pool Cooling system display. There was no one standing back maintaining an overview of plant conditions.
- During the performance of the Unit 1 Hydrotest Pump Turbine Generator Set (LLS) Surveillance Test:
  - At the Pre-Job Briefing, the crew aligned to performing peer checks due to the critical nature of the test. However, peer checks were not consistently performed. The lead operator did not provide coaching.
  - The operator started the turbine generator then signed off a few steps in a row; however, procedure use and adherence require step-by-step performance of surveillance testing. The operator took this action due to the belief that his actions were time critical.
  - At times, both board operators and the lead operator grouped in close proximity to the main control board leaving no operators in a position to maintain overall plant status. Following the test, coaching was provided by the operations manager.
- On several occasions, operators sat down on the horizontal section of the main control board. In one case, an operator sat on the main control board for the duration of the handover brief. No coaching was provided by the lead operator or peers.
- In the MCR there is demarcation representing the ‘at the controls’ area of the control panels. In many cases, field operators walked casually through the area without regard for the demarcation, in many areas the demarcation is wearing or missing. In discussion with management, field operators are authorized to enter this area, as long as no contact is made with any switches, without authorization.
- During the Shift Handover meeting report out by the Tagging Supervisor, a number of conversations started resulting in a lack of engagement in the information being shared by the Tagging Supervisor. The lead operator did not provide coaching, peers also did not provide coaching.
- During an observation of the Unit 2 MCR, the Risk Assessment engineer entered the control room, when staff were dealing with a Spent Fuel Pool cooling issue to deliver training. The at the controls operator role was transferred during this training for the opposite Reactor Operator to undertake.
- While observing operator training on the simulator, during the scenario the crew responded to a large reactor coolant system leak. No announcements were made from the control room to alert personnel to changing plant conditions. However, the plant informed that this meets the plant expectation. While observing operator training on the simulator, 50 minutes into the scenario the leak increased from 30 tons/hour to 120 tons/hour, the primary operator did not perform a crew update when RCS leakage had increased, despite the noted change in mitigating strategy.

Without the implementation of high operational standards and management expectations for MCR activities, shift personnel may be conditioned to perform at a lower standard of monitoring, precise control, and conservative bias behaviors.

Suggestion: The plant should consider improving expectations and practices for the conduct of operations in the MCR to ensure high level of professionalism.

IAEA Bases:

SSR-2/2 (Rev.1)

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

NS-G-2.14

3.5. The main responsibilities of the control room operators are to operate the plant and the plant systems in accordance with the design intent and operating procedures and to maintain the reactor and other plant systems within the established operational limits and conditions.

4.8. The panels in the control room should be closely monitored. Operators should be required to check important parameters periodically (e.g. hourly), irrespective of whether these parameters are also recorded electronically. An analysis of trends should be carried out if the parameters demonstrate drifting. Supervisors should ensure that other duties (e.g. log keeping) that might distract the operators from the monitoring of panels are limited to short periods of time.

4.17. Shift briefings should be conducted in such a way as to ensure that the expectations and objectives of the shift supervisor are effectively communicated to, and understood by, all the staff under supervision. The level and number of shift briefings may vary depending on the composition of the shift crews. Briefings for control room staff should be conducted in the control room and should include the communication of information between relevant individual members of the two shift crews, and also between the two shift crews as a whole.

4.29. The management's expectations with regard to performance in the control room should be established and operators should be trained to meet these expectations. These expectations should be made clear, and managers should ensure that all operators understand them. Managers should continuously monitor the performance of operators in fulfilling the management's expectations.

3.5. WORK CONTROL

3.5(1) Issue: The plant's expectations for on-line work management is not robust enough to maximize equipment availability, effectively manage resources, and provide a stable work schedule.

The team noted the following:

- Work Management set a target of 85% completion and is currently achieving 77%. The current process for work week review is not consistently and clearly identifying the issues impacting schedule completions. During interviews with operators, they indicated that changes to the work week plan on the day of execution was one of their top concerns. Late changes have resulted in plant equipment being taken out of service and made unavailable to the operators, with no work performed prior to restoration.
- Unavailability of spare parts causes maintenance delays on equipment, some of which has nuclear safety relevance. The Operations Department clearly sets priorities and expresses a sense of urgency to complete the maintenance. However, these priorities are not fully communicated to the Corporate Spare Parts Management Department.
- As an example, the maintenance work on Process Air Compressor 1SAP101CO had to be postponed for a longer period.
- The 2 DEL train 'A' control room HVAC unit was recently changed out under a corporate-led modification project. As there are no spare parts available for temperature module 2DEL101MT, the plant was forced to apply for a STE Group 2 event derogation on the unavailability limit period.
- Due to late availability of the spare parts required, Maintenance applied for a derogation on the Preventive Maintenance Plan of gaseous waste compressor 2TEG061CO and delayed completion with one week.
- The sampling pump 2SIT111PO failed on 28 March 2021, but was rerouted through the 2SIT116PO pump for sampling of the different condenser sections. The 2SIT111PO pump was unable to perform its function and a demand for replacement of the pump was sent to Maintenance. The redundant 2SIT116PO pump also blocked completely at a later date. The demand for replacement of both pumps was sent out to Maintenance on 20 July 2021. Maintenance requested the replacement pumps on the 23 July 2021, and by mid-August 2021 the delivery date for the spares was confirmed as 30th October 2021. This date has been further delayed by the Corporate until 31 January 2022.
- During interviews with the Online and Outage Operations teams it was stated that Work Authorization is performed by the Shift Manager at the time of execution. Authorization is provided based on experience, there is no formal procedure in place. However, it is referenced from Technical Specifications. This can impact work with delays or cancellations. No formal process is in place to control or track these events. The operations team follow two rules set at corporate level, Two Group 1 Technical Specifications entries or five group 2 Technical Specifications entries requires the impacted unit to be shut down. Operations limits the entries below these levels. No PSA or PRS assessment is done on site as it is done at a corporate level.
- The stock level and type of critical spares stored locally or at corporate fleet level are decided by the corporate organization.
- There is no requirement to have the critical spares for a modification procured before the modification is transferred to the plant for operation and the Original Equipment Manufacturer (OEM) warranty period has expired. The Station Black-Out Emergency

Power System was commissioned in a fleet-wide modification process and transferred to the site for operation in mid-2020. Limited parts are available to date in the fleet. Operating experience has shown that the diesel OEM who is contractually bound to deliver the parts during the warranty period works with particularly long response delay.

When Work Management accepts delays in work completion this can reduce equipment availability.

Suggestion: The plant should consider improving its on-line Work Management processes to maximize equipment availability, effectively manage resources and provide a stable work schedule.

IAEA Bases:

SSR-2/2 (Rev.1)

Requirement 31;

8.10. The work control system shall ensure that plant equipment is released from service for maintenance, testing, surveillance or inspection only with the authorization of designated operations department staff and in compliance with the operational limits and conditions. The work control system shall also ensure that permission to return equipment to service following maintenance, testing, surveillance and inspection is given by the operating personnel. Such permission shall be given only after the completion of a documented check that the new plant configuration is within the established operational limits and conditions and, where appropriate, after functional tests have been performed.

NS-G-2.6

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

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

5.18. Management of the work should be recognized as a cross-functional process, not exclusive to any one work group but integrating the important activities of all work groups. Consequently, for the work control process to be fully effective, all needs and concerns in relation to operations, maintenance, technical support, radiation protection, procurement and stores, contractors and other matters should be considered and should be accommodated wherever appropriate, consistent with the long term operating strategy for the plant.

5.19. The effectiveness of the work control process should be monitored by appropriate

Indicators (such as repeated work orders, individual and collective radiation doses, the backlog of pending work orders, interference with operations) and by assessing whether corrective action is taken whenever required.

8.24. The operating organization should arrange to purchase appropriate quantities of spare items and components for systems important to safety at the same time as purchasing those to be installed at the plant. These spares should, as a minimum, meet the same technical standards and quality assurance requirements as the equivalent installed plant items, but with additional provisions for ensuring adequate protection during long term storage.

8.25. The initial quantities of spare items and components to be purchased should be approved by the plant management after consulting with the vendor and taking account of relevant maintenance experience available to the operating organization.

NS-G-2.14

7.4. The work control process should ensure adequate interfaces between all work groups. Operations personnel should assist the maintenance department in the planning and execution of work on plant systems and components to ensure that the reliability and availability of equipment are optimized. By doing this, operations personnel will be better able to assess the risk when equipment is inoperable and the period of unavailability of important items of equipment due to maintenance will be reduced.

4. MAINTENANCE

4.5. CONDUCT OF MAINTENANCE WORK

The team observed that plant maintenance activities were not always controlled and implemented in a manner that ensures equipment and personnel safety. For example, the team observed in some cases works were not properly implemented, lifting and rigging operations were not performed in a safe manner, and materials were not stored according to the plant requirements. The team made a suggestion in this area.

4.7. WORK CONTROL

The team observed the implementation of a plant procedure with the detailed checklist on all relevant information in relation to the job to be performed and a formal declaration during the pre-job briefing that they are ready to perform the job, which contributes to the in-depth preparation of the technician performing the job and therefore the quality of the maintenance work. The team recognizes this as a good performance.

The team observed an extensive backlog in the schedule for repairing reported and logged leaks on the plant's equipment. The team encourages the plant to address this backlog and effectively reduce the number of active reported leaks.

DETAILED MAINTENANCE FINDINGS

4.5 CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: The plant maintenance activities are not always controlled and implemented in a manner that ensures equipment and personnel safety.

The team noted the following:

Maintenance Work Practices

- When lifting a container onto a trailer outside the pump station:
  - It was observed that the lift driver moved the container passing above the ventilation duct of the pump station without using the safe route, and one of the supporting staff was observed putting his hand in between the suspended container and the surface of the trailer to remove some objects.
  - It was observed that the container when suspended above the trailer was not attached with a guide rope to prevent accidental bumping into surrounding structures.
- During the observation of a filter replacement work in Unit 1:
  - The bolt tightening pattern was prompted by the technical checker to the performer. The performer was not referring to a procedure or drawing for the bolt pattern. This was discussed in the post job debriefing.
  - A previously removed filter that was still draining in the filter container prevented the use of the container for draining the newly removed filter. A plastic drum was used instead, and plastic wrap placed on top once completed.
  - Tools for a filter replacement were stored on top of an adjacent filter housing by contractors performing the work even though they had brought a small table to the work location for that purpose.
- A contract monitor doing surveillance of a contractor performed job was at times helping the workers with handling tooling and equipment.
- During contractor work on hot water circulation pump 9SES011PO in the Unit 2 Turbine Hall, the work area was fenced off together with the close-by redundant pump in hot condition fenced in along with the cold pump to work on, despite the fence being marked as a hot hazard area.
- The pink Work Site Local Identification is inconsistently used:
  - In some cases, they had expired but were still at the worksite
  - In some cases, there was work ongoing without the on-site documentation present:
    - There was maintenance work ongoing in Unit 2 on the electrical building Chilled Water Unit 2DEL101CO without the work order being displayed.
  - In one case, an empty pink envelope hung at the worksite.
- In the train A Raw Water Pump Cellar, a technician performing the greasing of the bearings on Raw Water Pump 2SEC002PO climbed up the vertical pump foundation to get to the greasing nipple.
- In the Unit 1 Turbine Hall next to the main generator, a slab was found open, the label on the fencing showing that the authorization for this had expired.

Foreign Material Exclusion

- Two long handle tools were not fully secured in their storage location on the side of Unit 2 Spent Fuel Pool.
- During contractor work on Hot Water Circulation Pump 9SES011PO in the Unit 2 Turbine Hall, a soft textile Foreign Material Exclusion flange cover was used as a collecting box containing bolts and nuts. Some loose nuts and rings and a clip were found on the pump foundation.
- On four locations, loose screws, nuts and bolts were found under equipment.
- In the Unit 2 fuel building, a sign used to identify access to a radiological area was found broken near the spent fuel pool Foreign Material Exclusion area.
- In the mechanical workshop, there were large amounts of pigeon droppings on the floor at different locations where maintenance activities are conducted.
- New filter cartridges were stored on top of other equipment without protecting them from debris.
- Special tooling and hoses for outages were stored in the hot workshop without Foreign Material Exclusion covers on the openings.
- No Foreign Material Exclusion cover was applied on an emergency water connection to the Unit 1 Emergency Water Injection System.

Management of stored materials

- The lay down area for insulation material dismantled from Auxiliary Feed Water Pump 1ASG042TC steam admission valve was not fenced or marked.
- On the Unit 2 turbine hall ground floor, two 200L drums holding Fyrquel Phosphate Ester Oil were stored without a temporary storage label.
- In room 1NA0405, two 200 l plastic barrels were stored, one of them had no cover and no label.
- The barricade around the storage area of a contractor worksite outside the BAS building was broken and contained an informal liquid collection container under a mobile diesel powered compressor.

Without adequate controls on maintenance activities, there may be an increase in the risk of equipment damage and personnel injuries.

Suggestion: The plant should consider improving its control of maintenance activities to ensure equipment and personnel safety.

IAEA basis:

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.

7.10 Administrative controls shall be established to ensure that operational premises and equipment are maintained, well lit and accessible, and that temporary storage is controlled and limited.

7.11 An exclusion programme for foreign objects shall be implemented and monitored, and suitable arrangements shall be made for locking, tagging or otherwise securing isolation points for systems or components to ensure safety.

NS-G-2.6

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

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

The plant operational practices in terms of checks carried out on items used during operation and maintenance activities do not always guarantee the prevention of a potential risk of interaction with seismically qualified equipment. The team noted that the plant did not always manage activities near seismically qualified equipment in accordance with plant expectations. For example, unsecured monitoring equipment and scaffolds were observed near seismically qualified equipment. The team made a suggestion in this area.

DETAILED TECHNICAL SUPPORT FINDINGS

5.1. ORGANIZATION AND FUNCTIONS

5.1(1) Issue: The plant operational practices in terms of checks carried out on items used during operation and maintenance activities do not always guarantee the prevention of a potential impact on seismically qualified equipment.

During the review the team noted:

- In electrical room 1LC0914, near the Main Control Room (MCR), a recorder was placed on the floor near seismic qualified electrical panel 1KRG301AR, without being secured. It had been there for nearly one month. The plant took prompt action to address the situation.
- In the unit 1 Safety Ultimate Diesel (DUS) building, in 1HDU1302LO room, four scaffolds were close to the diesel generator and could damage it in the event of a seismic event. In addition, these scaffolds had been there for over one month without being used.
- In electrical room 1LC0914, near the MCR, a damaged cable tray was found near seismic qualified electrical panels.
- In electrical room 1LC0914, a metal cover was not totally attached and could damage the 1LBF001RD panel if a seismic event occurred. Currently, it is not considered to constitute a seismic hazard because there are still several fixings in place, but if left to degrade further, it could become a hazard. The plant took prompt action to address the situation.
- In the Unit 1 and 2 DUS buildings, an oil pump cart close to safety-related equipment was not secured. Follow up with operators revealed that the painters had removed this oil pump cart from the secure location to paint the frame.

Without effective practices to check items used for operation and maintenance activities in the vicinity of seismically qualified equipment, the operability and reliability of these equipment could be potentially compromised in case of seismic events.

Suggestion: The plant should consider improving the effectiveness of checks carried out on equipment used for operation and maintenance activities in order to prevent their potential impact on seismically qualified equipment.

IAEA Bases:

GSR Part 2

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

SSR-2/2 (Rev.1)

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

NS-G-2.13

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

6. OPERATING EXPERIENCE FEEDBACK

6.6. TRENDING AND REVIEW

Low level events in the plant are not always trended in a comprehensive manner to ensure adverse trends are identified early. For example, the various departments maintain different Excel sheets with issues identified at department level and trending is performed without systematically compiling them at plant level. The team made a suggestion in this area.

6.7. CORRECTIVE ACTIONS

The plant has a clearly defined process for performing root cause analyses and for establishing and tracking corrective actions related to safety-significant events. However, the team observed that there is a high backlog of corrective actions, with overdue target dates and a high number of actions being rescheduled. Furthermore, the time between the occurrence of an event and the decision to perform an analysis sometimes exceeded the plant's own expectations. Examples of recurrent events and some quality-related issues in cause analyses show that, in some cases, corrective actions to prevent recurrence are incomplete or ineffective. The team made a recommendation in this area.

DETAILED OPERATING EXPERIENCE FEEDBACK FINDINGS

6.6. TRENDING AND REVIEW

6.6(1) Issue: Low level events in the plant are not always trended in a comprehensive manner to ensure adverse trends are identified early.

- The various departments maintain different Excel sheets with issues identified at the department level and trending is performed (example showed by the electrical maintenance department) without systematically compiling these at the plant level.
- During discussions with Industrial Safety specialists, it was identified that low level industrial safety trends from behavioural observations are difficult to establish since they are captured in multiple databases. The trends are only determined through verbal discussions of manager observations and from annual reviews.
- During an interview with a Corrective Action Program (PAC) coordinator, it was stated that it is generally accepted that near misses are not reported in PAC, only consequential events.
- During an interview with outage management, it was confirmed that only delays for critical path activities greater than 12 hours are included in the PAC. Lower-level issues are not analysed for causes or trending.
- The existing application allows the contractors to issue a corrective action report, however, a new application (CAMELEON), will be implemented that will not allow the contractors to issue this type of report, they will have gone through their plant supervisor.

Without performing an integrated data analysis on low-level events, there could be missed opportunities for the early identification and correction of adverse trends before they develop into events with more significant safety implications.

Suggestion: The plant should consider improving its trending in a more comprehensive manner to ensure adverse trends are identified early**.**

IAEA Bases

SSR-2/2 (Rev.1)

5.29. Information on operating experience shall be examined by competent persons for any precursors to, or trends in, adverse conditions for safety, so that any necessary corrective actions can be taken before serious conditions arise.

NS-G-2-4

6.64. The operating experience at the plant should be evaluated in a systematic way, primarily to make certain that no safety relevant event goes undetected. Low level events and near misses should be reported and reviewed thoroughly as potential precursors to degraded safety performance.

6.66. Operating experience should be carefully examined by designated competent persons to detect any precursor signs of possible tendencies adverse to safety, so that corrective action can be taken before serious conditions arise. Trending should identify recurring similar events and continued problems based on the causes and initiators of previous events. Event trend reviews and conclusive interpretations should be provided periodically to the plant manager and to the management of the operating organization.

NS-G-2-11

6.3. The purpose of an event trending process should be to determine the frequency of occurrence of certain conditions that have been gathered from reports on minor and major problems and event investigations.

6.5. Trending should be used to analyze the performance of various work groups, to identify those factors that result in either less than desired or better than expected performance.

7.2. Managers of nuclear installations should clearly define their expectations regarding the systematic reporting, screening and use of internal and external operating experience.

I–8. The aim of a programme for the feedback of operational experience is to ensure that the following objectives are achieved: (1) the collection of information is sufficiently comprehensive that no relevant data are lost (this necessitates broad reporting criteria and low detection thresholds).

6.7 CORRECTIVE ACTIONS

6.7(1) Issue: Corrective actions are not always developed or implemented in a timely manner and sometimes are of an inadequate quality to prevent the recurrence of events.

- Backlogs for corrective actions are presented and discussed during the weekly Corrective Actions Review Board (CARB), together with any extension requests. Over 30 actions were reported overdue in the CARB, with about 10 overdues by more than one month, some were overdue by more than one year (reported as such in several consecutive CARBs). In addition to the overdue actions, five to 10 actions are presented for rescheduling in every weekly CARB, with some being rescheduled several times.
- Examples of recurrent events showing incomplete or ineffective corrective actions to prevent recurrence:
  - Event on 15 March 2021, Scaffolding affecting the fire sprinklers for a pump – root cause analysis was requested by management and actions that could have prevented recurrence were confirmed as implemented in the CARB meeting on 5 August 2021. During the OSART team observations on 16 November 2021, a similar problem was detected.
  - Recurrent radiological safety event on 14 September 2020 (Operational dosimeter alarm of a contractor worker during radiological testing). The same individual had generated the same type of event on 8 August 2020; the rapid analysis from similar event on 8 August 2020 was not effective in preventing the occurrence of a safety significant event. Also, there were previous similar events at the plant, with the same company (10 July 2019 and 27 July 2019). There was no analysis to ascertain why the previous actions were not effective. Actions from the report only required an action plan for the contractor. There was no analysis on the root causes related to barriers and organizational aspects related to the supervision of this radiological work.
  - Over the successive years 2019, 2020, and 2021, there had been a recurrent environmental impact event of cumulative refrigerant fluid release in excess of 100kg (31 December 2019, 31 December 2020, and 28 August 2021). The analysis was limited to the technical contributors for the release (leaks from components) and actions only focussed on leak repair. There was no analysis in the reports on the recurrence of reaching the reportable value every year and there was no action to set up an overall approach to prevent this recurrence. The individual contributors to these events, even if the internal 'alert' limit of 20kg is reached, are treated as level 2 or 3 events, and even if a simplified analysis is requested, actions are limited to repairs.
- Quality issues on cause analyses, leading to ineffective corrective actions:
  - Safety significant event from 12 May 2021 (Shutdown of Unit 2 in accordance with the Action Statement for group 1 LCO SPA 6) – the root cause analysis concludes that the way the technical specification is written will lead to a significant reportable event in any similar situation. The action taken was only to inform the corporate entities of the issue, no actions were established to prevent recurrence by avoiding a similar situation.
  - Root cause analysis reports include section 4.2 that is used for Operating Experience (OE) analysis; on several of these reports (Safety significant events from 30 May 2020, 11 August 2020, and 30 September 2020) it is written 'Not Applicable' in this section.

  - Safety significant event from 23 March 2021 (Surveillance test RPN003 performed instead of surveillance test RPN008 in cycle stretch-out mode, Unit 2) – section 4.2, OE analysis describes events that had occurred in other plants. There was no analysis on how OE from similar events could have prevented the event at the plant, in order to establish if opportunities exist to improve use of OE. One new action was implemented for a root cause, to revise documentation. Later, this action was closed because it was identified that another action from another plant was created on 18 August 2020 (a similar event from the other plant existed from July 2020).
  - Examples of delays in screening approval for corrective actions:
  - Screening approval has a limit of one week for deviations and one month for improvements. Some cases exceed this limit, several cases by two to 10 months. The cases are from the meeting on 17 November 2021 (screening committee at PAC coordinators level), if they are not validated in this committee, they are not referred to the management committee that decides the screening approval. The backlog for PAC that are not screened includes 36 that are overdue by more than one month, and nine that are overdue by more than three months.
  - The screening meeting on 18 November 2021 (management decision level) had a case from June 2021 for which a decision was taken for the first time, five months after initiation. There was no challenge from management on this delay.
- Safety significant event from 11 August 2020 - Automatic start-up without connection of diesel generator 1LHQ upon criteria 1GEV001JA open and C8 (turbine trip) was initially assessed as category 2 and an action had been raised to perform an apparent cause analysis with a target date for completion on 15 October 2020. This action was reported overdue in every CARB up to December 2020. During the safety committee meeting in December, the event was upgraded to category 1 - safety significant by Nuclear Safety Director and a root cause analysis was initiated more than five months after the event.

Without timely implementation of appropriate corrective actions, there is a high potential for the recurrence of safety significant events.

Recommendation: The plant should improve the timeliness of corrective actions development and implementation and improve their quality and effectiveness to prevent recurrence of events.

IAEA Bases

SSR-2/2 (Rev.1)

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

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.

GS-G-3.1

6.75. Senior management should monitor the status of corrective actions frequently and should consider:

- Whether the time delay is reasonable for corrective actions that are still open (not completed);
- Whether the necessary resources are available to complete open corrective actions;
- Whether managers are being held accountable for completing corrective actions.

NS-G-2-11

3.6. The screening of internal events should be carried out promptly to assign priorities in the process for the feedback of experience from events and in the follow-up actions.

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

5.7. A tracking process should be implemented to ensure that all approved corrective actions are completed in a timely manner and that those actions with long lead times to completion remain valid at the time of their implementation in the light of later experience or more recent developments. A periodic evaluation should be carried out to constantly review the need for items in the pending corrective actions list and separately to check the effectiveness of actions implemented.

7. RADIATION PROTECTION

7.3. RADIATION WORK CONTROL

The plant has utilized a double barrel key control programme for access to High Radiation Areas. The unique part of this process is that it ensures leadership engagement by requiring plant senior management to be present at the team briefing and to also be holder to one of the two required keys for access. There have been no reported High Radiation Access Events in the last five years. The team recognized this as a good practice.

The plant has installed a computer terminal at the plant entrance for all workers to check their qualification status. This gives workers the capacity to ensure that their data is valid and up to date upon their first entry to the site and before arriving at the Radiologically Controlled Area (RCA) to perform work. This is particularly useful during outage periods where the number of workers at the plant is greatly increased. The team recognized this as a good performance.

7.4. CONTROL OF OCCUPATIONAL EXPOSURE

The team observed that contamination control practices are not always implemented in a manner to ensure the spread of contamination is prevented. For example, worksites are not always properly prepared and controlled and workers do not always properly adhere to radiation work practices. The team made a suggestion in this area.

7.6. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The team observed that some plant Low Level Radioactive Waste (LLRW) activities are not appropriately managed and implemented. For example, some LLRW bags were stored in the chemistry hot laboratory hallway for over two weeks and the trefoil labeling of LLRW containers in the enclosed outside LLRW storage area was missing or degraded from weather exposure. The team encourages the plant to improve in this area.

DETAILED RADIATION PROTECTION FINDINGS

7.3 RADIATION WORK CONTROL

7.3(a) Good Practice: Radiation Protection had a double barrel key control programme for High Radiation Zone access in which Senior Management person and a Radiation Protection (RP) officer are the only key holders. Both people must attend to open the lock.

Access to the High Radiation Zones is granted by meeting the following criteria:

– A justified and planned activity
– An approved High Radiation Zone access form
– An approved specific Radiological Work Permit (RWP)
– A specific Risk Analysis
– A briefing of the workers in the presence of plant senior management (one key holder) and a Radiation Protection officer (second key holder).

These well-defined access criteria include senior management engagement for both access and briefing. The senior management engagement in granting access to red area contribute to the heightened awareness on this topic. There have been no reported High Radiation Access Events in the last five years. This practice can be applied to any plant.

7.4 CONTROL OF OCCUPATIONAL EXPOSURE

7.4(1) Issue: The practice of Contamination Control is not always implemented to prevent the spread of contamination.

The team noted the following:

- When the Large Equipment Room at the containment hatch is used for large items to be removed from the RCA this provides conditions for spread of contamination as some items are too large to be fully checked and wrapped. There were two road contamination events at the plant in 2021.
- The Large Equipment Room at the containment hatch had many half-filled open pink radiological waste bags and bird excrement on the floor. The inside of the Fuel Handling Building was dirty with trash in various spots and piles of dirt on the floor.
- The Equipment and Material Transfer Area in the Decontamination Facility did not have a barrier installed, frisker available, or a personal protective equipment (PPE) posting. The step off pad signage was installed backwards.
- A worker in the chemistry lab in the RCA was seen without the required white gloves, rubber gloves and eye protection. The worker self-corrected without coaching.
- A decontamination worker was observed working in cotton gloves, not the rubber gloves required to be used when working in the area. When questioned, the worker said he was writing so didn't need to wear rubber gloves and then continued to handle bags full of contaminated items.
- Required rubber gloves and paper coveralls were not provided and stocked at the entrance to the LAM room at the Arrival and Departure Vehicle Check building.
- Lab coats were used instead of the required paper coveralls at the LAM room at the Arrival and Departure Vehicle Check building. The lab coats were stored on a coat rack in the LAM room.
- Observed four Not Contaminated and Contaminated (NP/NC) interface areas without the correct PPE posting.
- In the changing room of the Fuel Handling Building, the required PPE was not available.
- The ladies change rooms did not provide a clear direction for entering and exiting the RCA.

Without consistent application of radioactive contamination control practices, spread of radioactive contamination outside the RCA could occur.

Suggestion: The plant should consider enhancing its practices of contamination control to ensure the risk of the spread of contamination is minimized.

IAEA Bases:

GSR Part 3

Requirement 21

3.77(a) Employers, registrants and licensees: Shall involve workers, through their representatives where appropriate, in optimization of protection and safety;

Requirement 22

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;

GSG-7

2.18 In planned exposure situations, employers, registrants and licensees (hereinafter referred to simply as the 'management') are responsible for ensuring that protection and safety is optimized, that applicable dose limits are complied with, and that appropriate radiation protection programmers are established and implemented.

3.11 From a practical viewpoint, the requirements for optimization call for an approach that:

(a) Considers all possible actions involving the source(s) and the way workers operate with or near the source(s).

(b) Implies a 'management by objective' process with the following sequence: planning, setting objectives, monitoring, measuring performance, evaluating and analyzing performance to define corrective actions, and setting new objectives.

(c) Can be adapted to take into account any significant change in the state of techniques, the resources available for the purposes of protection or the prevailing societal context.

(d) Encourages accountability, such that all parties adopt a responsible attitude to the process of eliminating unnecessary exposures.

3.16. The optimization of protection and safety should be considered at the design stage of equipment and installations, when some degree of flexibility is still available.

8. CHEMISTRY

8.1. ORGANIZATION AND FUNCTIONS

The plant chemistry section is a part of the Environment-Chemistry and Testing department. The chemistry department has its own goals and objectives to improve the quality of the activities for chemistry parameters. The team observed an effective interface with other sections and departments through the Operational Chemistry Monitoring Unit. The performance of operational chemistry is monitored by the weekly Unit meeting and the results are distributed to the managers. As a result, they initiated early interventions in the chemistry process. The team recognized this is a good performance.

8.5. LABORATORIES AND MEASUREMENTS

All necessary procedures and equipment are available in the laboratories to perform the analyses. The equipment which has an impact on chemical measurements is not always maintained and returned to service in a timely manner. For example, a pump of the feed water conductivity meter has been out of order since March 2021. The team encourages the plant to ensure that the maintenance of equipment which has an impact on chemical measurements is performed in a timely manner.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

The plant work practices for handling, labelling and use of chemical substances are not always applied properly to prevent adverse effects on laboratory safety, equipment reliability and the environment, and to maintain the quality of chemistry measurement. For example, in several cases, chemical products used in the plant were observed not properly labelled and stored. The team made a suggestion in this area.

DETAILED CHEMISTRY FINDINGS

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

8.6(1) Issue: The plant work practices for handling, labelling and use of chemical substances are not always applied properly to prevent adverse effects on laboratory safety, equipment reliability and the environment, and to maintain the quality of chemistry measurement.

During the review the team noted:

- In the Unit 2 laboratory of the auxiliary building, a yellow metal cupboard which contained 4x5L canisters with 55% concentration hydrazine was found in the total gamma analysis room. This cabinet carried no inventory list, no dangerous product symbol, and no storage area information.
- In the Puisaye laboratory, a storage cabinet intended for acids and bases (alkaline) contained nitric acid (one litre, 65%) in the section for bases. This was stored with ethanol, glycerol and hydrogen peroxide. The inventory list was out of date: it showed only nitric acid but not the other stored products.
- In the Unit 2 turbine hall, an oil leak from an upper level (2SVA999IC, auxiliary steam distribution system) was being collected in a plastic canister which was not properly labelled. There was no information about the type of oil and no label on the canister which had a handwritten note.
- Near the fenced conventional island liquid waste collection system and the nuclear island liquid radwaste monitoring and discharge system, there were two near-empty plastic containers (one m^3) each with no retention tray. The temporary storage was not marked as such. One container was for Coolelf gel and the other was 15W-40 for diesel engine oil.
- In the Unit 2 laboratory of the auxiliary building, near the Mettler Toledo for boron analysis, Manitol powder (chemical product) was stored in an open canister. The label on the canister showed that this container was opened in 2015 and the contents had expired in 2019.
- In the Puisaye cold laboratory, empty plastic canisters, labelled with radioactive stickers, were stored, awaiting transfer to the RCA. These canisters contained no product information and were not stored in a separate area.
- In the Environment and Control laboratory (LEC) outside the plant premises, the signs on the chemical cabinet doors were not coherent with the contents inside: where the sign indicated bases, there were products such a Nitromethane, Collodion and Ethanol which were not bases. This cabinet also had no inventory list.
- In the Puisaye cold laboratory, one storage cabinet for chemicals was not properly labelled; no safety instructions or inventory were listed on the front of this cabinet. Inside, different products were stored but they were not chemicals.

Without the proper application of work practices for handling, labelling and use of chemical substances, there is an increased risk that the use of chemical substances could adversely affect laboratory safety, equipment reliability, the environment and the quality of chemistry measurement.

Suggestion: The plant should consider enhancing its work practices for handling, labelling and use of chemical substances to minimize adverse effects on laboratory safety, equipment reliability and the environment and to maintain the quality of chemistry measurement.

IAEA Bases:

SSR-2/2 (Rev. 1)

7.17. The use of chemicals in the plant, including chemicals brought in by contractors, shall be kept under close control. The appropriate control measures shall be put in place to ensure that the use of chemical substances and reagents does not adversely affect equipment or lead to its degradation

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

a) The classification of the chemical;

b) Its hazards;

c) The precautions to be observed.

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

SSG-13

9.1. A policy should be established to prevent the use of chemicals or other substances that could introduce potentially harmful impurities into plant areas or circuits, thereby affecting to coolant, auxiliary and safety systems, or other external surfaces. The responsibility for coordinating the control of chemicals and other substances on-site should also be clearly established in accordance with the requirements established in Ref. (7).

9.2. The operating organization should be responsible for the use of proper chemicals and for their correct quality.

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.

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

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

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

9.16. In the storage of chemicals, account should be taken of the reduced shelf life opened containers. Unsealed and partly emptied containers should be stored in such a manner that the remaining product is kept in satisfactory condition.

NS-G-2.6.

8.32. The operating organization should ensure that storage facilities offer adequate space and provide for the secure retention of stocks in suitable environmental conditions, in order to prevent deterioration. Access and the installed handling equipment should be adequate for the types and sizes of items to be stored.

9. EMERGENCY PREPAREDNESS AND RESPONSE

9.2. EMERGENCY RESPONSE

In the plant emergency planning flowchart (LOIC), there are criteria for emergency plan activation, but there is no direct classification system with emergency action levels to evaluate the severity of initial events. In the internal emergency plan, there are no deadlines for event severity classification. The team encourages the plant to improve these procedures.

The plant arrangements for protective and response actions for emergencies are not always sufficiently developed and verified to ensure an effective and timely response. For example, there was no procedure or display for what the first emergency responders who enter the Emergency Control Center (BDS) should do. Regarding the habitability of the Emergency Control Center (BDS), there were no prescribed criteria and no checking processes relating to air quality, including radiation limits and these points were not checked during exercises. There is no alternative template for the form for calculating dose and estimating the authorized time the emergency teams may spend in the field. The team made a suggestion in this area.

9.3. EMERGENCY PREPAREDNESS

A one-week exercise, conducted in June 2021, tested coordination and cooperation between the plant, Nuclear Rapid Action Force (FARN) teams and the Corporate support organization (GIE-INTRA). Various operational activities were implemented by partner entities. This type of large-scale exercise, based on practical simulation, creates exchanges between the different departments and external entities that would work together in the event of a real emergency situation. The entities contribute constructively to effective cooperation between the plant and external emergency services, including medical teams. The plant exercise in 2021 could be used as a reference exercise for a variety of activities and cooperation between different organizations and the plant operator. The team considers this as a good performance.

In 2021 the plant developed a new alert system (GUEPARD) for on-call personnel at home and for planning purpose. It is a decentralized system that allows the emergency manager to remotely activate an alert sent to emergency personnel and emergency support personnel's homes. The team considers this as a good performance.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

9.2. EMERGENCY RESPONSE

9.2(1) Issue: The plant arrangements for protective and response actions for emergencies is not always sufficiently developed and verified to ensure an effective and timely response.

The team noted the following:

- There was no procedure or display for what to do for first emergency responders who enter the Emergency Control Centre (BDS) via the decontamination room in the event of an emergency with possible radiation consequences.
- Regarding the habitability of the Emergency Control Center (BDS):
  - there were no prescribed radiation limits which should be used as an indicator to leave the bunker in case of a worsening radiation situation.
  - there was no tracking sheet to ensure that this radiation data (regarding habitability) is checked during exercises.
  - there were no prescribed criteria and no checking processes relating to air quality and filter change during an emergency.
  - the ventilation system cooling system was heavily corroded.
- There was no defined rest area with beds in the Emergency Control Center (BDS), only two camp beds stored in the kitchen.
- In the Emergency Control Center (BDS) decontamination room:
  - there was no tray for contaminated waste.
  - there was one inventory for two storage cupboards, with no details about which items are in which cupboard.
  - items were not properly stored in one cupboard.
  - seven towels were missing (out of 50).
- In the Technical Support Center (LTC) room in Unit 1, there was only one neutron dosimeter (two in inventory list), and 15 gamma dosimeters (only 13 in inventory list).
- The emergency muster points should have FFP3 respirators to protect the people gathering there, but these respirators were moved away at the beginning of the Covid-19 crisis. They are temporarily stored in the plant management room and can be taken only by the Station Director and the Emergency Directors (PCD1) in an emergency. However:
  - this temporary change had no written record or instructions.
  - in the temporary-storage place for the FFP3 respirators from the muster points:
    - there was no inventory of the numbers of FFP3 respirators.
    - some of the shelves storing respirators also stored other non-emergency material.
    - the respirators were not stored in an efficient way.
- There is a process for calculating the length of time emergency teams can stay in the field based on the expected dose rate. The calculation is recorded in the PREVAIR, an application used in normal operation to issue radiological work permits. However, if the application is not available, there is no alternative template form which could be used as

evidence of the calculation and of the authorized time the emergency teams may spend in the field.

- In the Logistics Emergency Response Center (PCM) room:
  - there was a plant layout on the wall that does not show the new muster point No.7,
  - on the nearby wall table, muster point No.7 was also not on the list.
- The location of muster point No.7 was not signed either internally or externally.
- In the mobile truck used for environmental monitoring in case of emergency, there was:
  - no visible inventory of required protective equipment.
  - no iodine tablets.
  - various items stored in individual lockers in an untidy manner.
- Muster point No.7 was not fitted with an automatic badging system as other muster points.
- There is an exercise on evacuation from the muster points every three years, but it does not systematically involve real-time bus evacuation, only evacuation (on foot) to the defined gates was exercised.
- During the muster point assembly exercises, there was no evidence that iodine administration was simulated.
- The volunteers' forms with the estimated radiation risk are available for the intervention emergency group, but there was no evidence that these had been used during exercises.
- The emergency procedures do not prescribe how to manage contaminated waste collected from the Emergency Control Center (BDS).
- In the Health Physics Emergency Response Center (PCC) room, there is a corporate support document for the calculation and prognosis of radiation consequences including distance-based (0.5, 1, 2, 5, 10, 20 km) protective measures (evacuation, iodine administration and sheltering) which is used by members of this center. However, messages based on this methodology (the PCC2.1 form) do not refer to the 0.5 km distance (i.e. the plant). If relevant information is required, it is added by hand to the form as a separate note.
- Out of business hours, the shift manager (PCL1) can decide alone to order iodine intake for people present on site if the radiation situation deteriorates only in one instance when the situation affects the emergency teams' mobilization to the power plant. However, the shift manager (PCL1) has no support documentation in order to take this decision. In all other cases, emergency director (PCD1) approval is mandatory.

Without providing sufficient arrangement for protective and response actions, the effective implementation of the emergency response actions may be compromised.

Suggestion: The plant should consider improving the arrangement for protective and response actions to achieve the effective and timely implementation of the emergency response.

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

10.1. ORGANIZATION AND FUNCTIONS

The scope and timeliness of the Severe Accident Management training, exercises and drills are not comprehensive to maintain an adequate level of knowledge, experience and proficiency of the Emergency Directors involved in the application of the severe accident management guidelines at the plant. For example, three of the six of the Emergency Directors (PCD-1) have not performed a formal Severe Accident Management tabletop exercise. The team made a suggestion in this area.

10.2 OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT (SAM) PROGRAMME

The plant accident management program is not comprehensive enough to ensure that all modes and states of operation and all fuel locations are considered in its scope. For example, there is no guidance for severe accidents occurring in the Spent Fuel Pool. The team made a suggestion in this area.

10.5. PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

On the loss of all AC and DC power, lighting is very limited, impeding local actions to maintain core cooling, such manually supplying Auxiliary Feedwater to Steam Generators and manually controlling the steam release to the atmosphere. On these critical components necessary to maintain core cooling, the plant has installed fluorescent tags to aid the field operators to quickly identify the correct equipment. The team recognized this as a good practice.

The plant has installed a backup system that, in the event of a loss of all AC and DC power, can depressurize the primary circuit to avoid the vessel failing at high pressures. This is critical to preserving the last fission product barrier, the Containment building. The backup system consists of a light battery pack stored near the Main Control Room (MCR) which connects into an installed electrical cabinet. Sufficient charge is available to open (and maintain open) all of the primary circuit pressurizer relief valves. The system is easy to use which is essential in the challenging conditions experienced during loss of all AC and DC power. The team recognized this as a good practice.

The plant has implemented many additional safety features to prevent a severe accident. Examples include:

- The upgrading of the Ultimate Safety Generators (GUS), from one single gas turbine (of 4 MW) to four independent diesels (each of 1.2 MW) that can be synchronized. This improved the reliability and maintainability of this AC power supply.
- The upgrading Nuclear Rapid Action Force (FARN) to include the mitigation of the Loss of the Ultimate Heat Sink with new materials and training.
- Installing a ground water extraction pump (SEG) for the re-supply of water to tanks used in accident mitigation (such as the Auxiliary Feedwater and Refueling Water Storage Tanks) and make-up to the Spent Fuel Pools. As the pump is underground, it is protected from many external hazards.

The team recognized this as a good performance.

DETAILED ACCIDENT MANAGEMENT FINDINGS

10.1 ORGANISATION AND FUNCTION

10.1 (1) Issue: The scope and timeliness of the plant Severe Accident Management training, exercises and drills are not comprehensive to maintain an adequate level of knowledge, experience and proficiency of the Emergency Director (PCD1) in the application of the Severe Accident Management guidelines at the plant.

The team noted the following:

- The Emergency Preparedness (EP) drills involving the use of severe accident management guidance by the Technical Support Centre (ELC) and the Emergency Response Centre (BDS) occur every 2 years. Given 5 teams, personnel may only get to perform a Severe Accident Management (GIAG) drill once every ten years. A similar situation exists for multi-unit accidents (PUI-SACA) drills.
- The plant Emergency Director (PCD1) can be appointed with no Severe Accident Management training for a period of up to 6 months.
- The plant Emergency Director (PCD1) is not required to do re-qualification training in Severe Accident Management.
- Three of the 6 of the Emergency Directors (PCD1) have not performed a formal Severe Accident Management tabletop exercise.
- Four of the 6 Emergency Directors (PCD1) have not performed an EP Drill that involved core melt.

Without adequate training, exercises and drills, the severe accident management guidelines may not be applied in an effective manner in case of emergencies.

Suggestion: The plant should consider extending the scope and improving the scheduling of the training, exercises and drills to ensure an adequate level of knowledge, experience and proficiency of the Emergency Director (PCD1) in the application of the Severe Accident Management guidelines at the plant.

IAEA Bases:

SSR-2/2 (Rev.1)

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

NS-G-2.8

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

SSG-54

2.98 Personnel responsible for performing accident management measures should be trained to acquire the required knowledge, skills and proficiency to execute their tasks. A comprehensive training programme for accident management should be prepared that includes the interfaces with emergency preparedness and response. Training should include a combination of techniques, such as classroom training, drills, tabletop exercises and the use of simulation tools.

2.103 Training, including periodic exercises and drills, should be sufficiently realistic and challenging to prepare personnel responsible for accident management duties to cope with and respond to situations that may occur during an event [21]. Drills should extend over a time period long enough to realistically represent the plant response and should allow for the transmission of information during shift changes to be tested. Special exercises and drills should be developed to practice shift changeovers between operations staff and technical support centre staff and information transfer between different teams. Training should cover accidents occurring simultaneously at more than one unit, accidents occurring in different reactor operating states and accidents in the spent fuel pool. Training should consider unconventional line-ups of the plant equipment, the use of non-permanent equipment (e.g. diesel power generators, pumps) and repair of the equipment.

2.105 Training for new staff, as well as refresher training for existing staff, should be developed for all groups of staff involved in accident management. The frequency of refresher training should be established on the basis of the difficulty and the importance of accident management tasks. A maximum interval for refresher training should be defined, but depending on the outcome of exercises and drills held at the plant, a shorter interval may be selected. Changes in the guidance or in the use of the guidance should be reflected in the training programme. Such changes should be communicated to interested parties.

2.106 Criteria for evaluating the effectiveness of an exercise or a drill should be established. Such criteria should characterize the ability of the team participating in the exercise or drill to understand and follow the evolution of the plant status, to reach well founded decisions for various events (including unanticipated events), to initiate appropriate actions and to meet the objectives of the exercise or drill.

2.017 Results from exercises and drills should be systematically evaluated to provide feedback for the improvement of the training programme and, if applicable, the procedures and guidelines, as well as the organizational aspects of accident management.

3.114 Training, including periodic exercises and drills, should be sufficiently realistic and challenging to prepare personnel responsible for severe accident management duties to cope with and respond to situations that may occur during an event. Drills should extend over a time period long enough to realistically represent the plan response and should allow for the transmission of information during shift changes to be tested. Special exercises and drills should be developed to practice shift changeovers between operations staff and technical support centre staff and information transfer between different teams. Training should cover severe accidents occurring simultaneously at more than one unit and severe accidents occurring in different reactor operating states. Training should consider unconventional line-ups of the plant equipment, the use of non-permanent equipment (e.g. diesel power generators, pumps) and repair of the equipment.

3.115 Exercises and drills should be based on scenarios that require the application of a substantial portion of the overall severe accident management programme in concert with emergency response and should simulate realistic conditions characteristic of those that would be encountered in an emergency. Large scale exercises providing an opportunity to observe and evaluate all aspects of severe accident management should be undertaken.

3.117 Some of the scenarios used for exercises and drills should assume an extensively damaged state of the core that eventually results in failure of the reactor pressure vessel and the containment. Consideration should be given to conducting exercises that enhance the awareness of main control room staff, technical support centre staff and engineering staff of the need for and possible consequences of defeating or resetting control and logic systems.

10.2 OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

10.2 (1) Issue: The plant Severe Accident Management programme is not comprehensive enough to ensure that all modes and states of operation and all fuel locations are considered in its scope.

The team noted the following:

- There is no guidance for severe accidents occurring in the Spent Fuel Pool.
- The severe accident management (GIAG) supporting analyses do not scope a severe accident on more than one unit or severe accidents in the Spent Fuel Pool.
- There is no training provided for multi-unit severe accidents to the Technical Support Centre (ELC) or the Emergency Response Centre (BDS) personnel.
- There is no training provided for severe accidents occurring in the Spent Fuel Pool for the Technical Support Centre (ELC) or the Emergency Response Centre (BDS) personnel.
- There has been no Emergency Preparedness (EP) drill where a severe accident was simulated to occur on both units.
- There has been no EP drill where a severe accident was simulated to occur in a Spent Fuel Pool.

Without a comprehensive 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 severe accident management program to address multi-unit severe accidents and severe accidents involving spent fuel locations.

IAEA Bases:

SSR-2/2 (Rev. 1)

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

SSG-54

2.11 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 PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

10.5(a) Good Practice: Identification of essential equipment with fluorescent tags

On the loss of all AC and DC power, lighting is very limited which impedes local actions to re-establish core cooling, such as manually supplying Auxiliary Feedwater to the Steam Generators and manually controlling steam dump to atmosphere. On critical components necessary to re-establish core cooling in this difficult situation, the plant has installed fluorescent tags to aid the field operators quickly identify the correct equipment. This improves the reliability of these local actions and aids the prompt recovery of core cooling.

Benefits:

- Time saved by identifying equipment more readily,
- Reduced stress when applying emergency documents, and
- Reduced exposure to ionizing radiation.

Fluorescent tag

Fluorescent tag on steam dump valve

10.5(b) Good Practice: Protection against high pressure vessel failure

The plant has installed a backup system that, in the event of a loss of all AC and DC power, can be used to depressurize the primary circuit to avoid the vessel failing at high pressures. This is critical to preserving the last fission product barrier (Containment). If the primary circuit vessel fails at high pressure then High Pressure Melt Ejection (HPME) occurs leading to Direct Containment Heating (DCH) with the potential of a simultaneous hydrogen burn. The resultant pressure spike can challenge the final fission product barrier.

The backup system consists of a light battery pack stored by the Main Control Room (MCR) which connects into an installed electrical cabinet. Sufficient charge is available to open and maintain open all of the primary circuit pressurizer relief valves. The system is easy to use which is essential in the challenging conditions experienced by loss of all AC and DC power.

Benefits:

- An easy and effective means of depressurizing the primary circuit on loss of all AC and DC power,
- Ensuring the injection of water from accumulators attached to the primary circuit, delaying the progression of the accident, and
- The preservation of the final fission product barrier (Containment) on loss of all AC and DC power.

Portable Battery Pack

Installed Electrical Cabinet for opening of the pressurizer relief valves.

11. HUMAN-TECHNOLOGY-ORGANIZATION INTERACTION

11.1. INTERFACES AND RELATIONSHIPS

The team identified that the contractor workers performance is not always properly challenged and followed up to ensure they meet the plant expectations for safety. There were several contractor performance shortfalls observed, including behavioural, human performance tool use, and in the plant approach used to improve contractor performance. The team made a recommendation in this area.

11.5 SAFETY CULTURE

The overall experience of the team was utilized to capture safety culture attributes, behaviours and practices which help to shape and define the safety culture at the plant. With respect to observed strengths, the team noted that the strongest characteristic was that the importance of safety is reflected in the business plan and that the high priority given to safety is shown in documentation, communications and decision making. The team also noted that an open working relationship existed between the plant and regulatory body regarding the sharing of information and working together to improve performance. However, the team noted that some attributes could be strengthened to improve the overall safety culture and safety performance at the plant. The team observed deviations from established standards and expectations in the areas of operations, maintenance, industrial safety, and contractor performance monitoring. This indicated that shortfalls exist in the safety culture characteristic areas of leadership for safety and accountability for safety.

The plant carries out an assessment of nuclear safety management every two years, this approach is complemented by the nuclear safety culture climate survey on the alternate year. The nuclear safety management assessment survey looks primarily for improvement opportunities at all levels of leadership, focusing on senior management, departmental managers and first line managers. It delivers a clear picture of the leadership performance opportunities in this priority area. The team considers this as a good performance.

DETAILED HUMAN-TECHNOLOGY-ORGANIZATION INTERACTION FINDINGS

11. INTERFACES AND RELATIONSHIPS

11.1(1) Issue: Contractor workers performance is not always properly challenged and followed up to ensure they meet the plant expectations for safety.

The team noted the following:

Professionalism of contractors that affects safety performance

- Several contractors were challenged by their leader for not wearing surgical masks and also safety goggles, this was despite the fact the radiation work permit contained contamination hazards and the team had undergone a pre-job brief that stated these risks. The workers were coached further by their leader and some still did not respond positively. The team leader then justified their actions by stating four different excuses that were not accepted by the manager observing.
- During the plant observation it was noted that a significant plant leak of demineralized water had occurred on a task that contractors were working on. The area had been left flooded, with no control being managed by barriers, signs or a person to prevent entry to the unsafe area. After a number of telephone calls, it was established by a senior manager that the contractors had called the plant maintenance team to report the issue and then left the building in this unsafe condition.
- During outage work activities in 2019 and 2020, a contractor performed measurements on several primary coolant system piping support devices. In some cases, the measurements were not properly conducted, nor checked against the required limits. Weaknesses were identified in technical knowledge, document preparation, conduct of measurements, and checks of the measurements compared to the limits.
- On 19 August 2021, a motor was disconnected from a rolling shutter door during a contractor maintenance activity, resulting in the shutter door dropping, damaging scaffolding and injuring a worker. The worker suffered injuries to their forearm and shoulder and was taken to the hospital. The investigation revealed that several safety rules had been violated. This was a lost time injury.

Drive for timely and appropriate improvement actions

- After leader in the field tours, managers write reports, which include suggestions to improve work and frequently these include contractor work that does not achieve site standards. Apart from significant events, there is no formal or systematic approach to report these findings to contractor senior management.
- The results of the human performance tools weak signals analysis for the plant were presented to the senior management in June 2021. The gaps were the performance of the site and contractor personnel. The only action delivered to date was for each manager to brief their teams and take into account the weak signals analysis paper when managing their team's objectives.
- Three contractor companies carry out joint observations with plant managers and they write up reports, and some include items that require actions to resolve. The plant management does not have access and does not regularly request copies of contractor's leader in the field reports, making it difficult to understand how the contractor management have decided to close out any issues and therefore if this process is effective in meeting the plant's objectives.

Human performance tool use

- As part of work related to a filter replacement, a Pre-Job Briefing (PJB) was conducted after the assembly of replacement filter cartridge had been completed. The PJB discussion included operating experience relevant to filter cartridge assembly. This was not recognized by the Contract Manager or the Contract Monitor present at the job site and was not discussed in the post-job de-brief until prompted by an observing manager.
- Thirty two event reports related to human performance between September 2020 and August 2021 were analyzed by the consultant for human factors, and about 50% were linked to contractors. This analysis of events suggested that contractors may not always be consistently applying human performance tools and techniques to mitigate risks associated with their activities.
- A contractor whose job is to brief teams being set to work on high-risk task stated, “we get full attendance at the PJB on these high-risk tasks because I demand it, but rarely do we get full attendance at the post-job debriefing”.
- A post-job debriefing was interrupted by a contract manager with questions to the team leader near the beginning of the discussion and as a result the workers were less engaged in the discussion of performance.
- A contractor’s PJB, which was for a high-risk job (cleaning ‘Hepa’ filters using a high-pressure acid wash, then flushing the system) took place in an environment outside next to some cooling fans, making it difficult to hear.
- During the observation of a contractor’s PJB, which was for a high risk job (cleaning ‘Hepa’ filters using a high pressure acid wash, then flushing the system), the briefer engaged in a two way conversation with the team leader for approximately 80% of the PJB. They discussed the risks, the mitigation and briefly discussed the human performance tools they could use. The contractor staff involved in the task had very little input to the conversation, in fact, one staff said nothing throughout the entire 10 minute brief.

Without consistently challenging and following on contractor performance gaps, the potential of events related to personnel injuries and equipment safety could increase.

Recommendation: The plant should improve their challenge of contractors, respond more effectively to analysis, timeliness and quality of improvement actions associated with gaps identified.

IAEA Bases:

SSR-2/2 (Rev. 1)

3.1. The prime responsibility for safety shall be assigned to the operating organization of the nuclear power plant. This prime responsibility shall cover all the activities relating to the operation directly and indirectly. It includes the responsibility for supervising the activities of all other related groups, such as designers, suppliers, manufacturers and constructors, employers and contractors, as well as the responsibility for operation of nuclear power plant(s) by the operating organization itself.

NS-G-2.4;

4.5. Contractor personnel may be used to perform tasks that are of a specialized or temporary nature for which it is not feasible to hire or maintain a full-time plant employee. When contractor personnel are used, their duties and authorities should be clearly defined. Contractor personnel should be trained and qualified for the task to be performed and held to the same performance standards as plant personnel performing similar tasks.

NS-G-2.6;

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

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

Good Practice

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

- is novel;
- has a proven benefit;
- is replicable (it can be used at other plants); and
- does not contradict an issue.

Normally, good practices are brought to the attention of the team on the initiative of the plant.

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-2.1 Fire Safety in the Operation of Nuclear Power Plans

NS-G-2.13 Evaluation of Seismic Safety for Existing Nuclear Installations

GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities

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
NS-G-2.2	Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants
NS-G-2.3	Modifications to Nuclear Power plants
NS-G-2.4	The Operating Organization for Nuclear Power Plants
NS-G-2.5	Core Management and Fuel Handling for Nuclear Power Plants
NS-G-2.6	Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants
NS-G-2.8	Recruitment, Qualification and Training of Personnel for Nuclear Power Plants
NS-G-2.14	Conduct of Operations at Nuclear Power Plants

TEAM COMPOSITION OF THE OSART MISSION

IAEA

JIANG, Fuming Years of nuclear experience: 24
Team Leader

MARTYNENKO, Yury Years of nuclear experience: 37
Deputy Team Leader

REVIEWERS

MOECK, Andy Years of nuclear experience: 31
Company: Omega Energy Leadership Solutions Inc., Canada
Review area: Leadership and Management for Safety

SOLJA, Taija Years of nuclear experience: 14
Company: Fortum Power and Heat Oy, Finland
Review Area: Training and Qualification

PAGLIA, Thomas Years of nuclear experience: 34
Company: Duke Energy, United States of America
Review Area: Operations 1

MONAGHAN, Mark Years of nuclear experience: 20
Company: EDF NNB, Hinkley Point C, United Kingdom
Review Area: Operations 2

BRACKE, Paul Years of nuclear experience: 34
Company: Engie Electrabel, Doel NPP, Belgium
Review Area: Maintenance

HEJDUS, Josef Years of nuclear experience: 29
Company: CEZ Group, Temelin NPP, Czech Republic
Review Area: Technical Support

TEODOR, Vasile Years of nuclear experience: 28
Company: SNN S.A. CNE Cernavoda, Romania
Review Area: Operating Experience Feedback

GREGORY, Cristy Years of nuclear experience: 20
Company: IAEA
Review Area: Radiation Protection

ELTER, Eniko Years of nuclear experience: 27
Company: MVM Paks NPP Ltd., Hungary
Review Area: Chemistry

MANČÍKOVÁ, Mariana Years of nuclear experience: 36
Company: Slovenske Elekrarne, Mochovce NPP, Slovakia
Review Area: Emergency Preparedness and Response

PERRYMAN, Lindley	Years of nuclear experience: 32
Company:	Nawah, Barakah Nuclear Power Plant, United Kingdom
Review Area:	Accident Management

GEORGE, Andrew	Years of nuclear experience: 39
Company:	Sellafield Ltd. United Kingdom
Review Area:	Human-Technology-Organization Interaction