NSNI/OSART/190F/2019

ORIGINAL: English

IAEA
International Atomic Energy Agency

REPORT
OF THE
OPERATIONAL SAFETY REVIEW TEAM
(OSART)
MISSION
TO THE
GOLFECH
NUCLEAR POWER PLANT
FRANCE
10-27 October 2016
AND
FOLLOW UP MISSION
13-17 May 2019

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/190F/2019

PREAMBLE

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

Any use of this report also includes the results of the IAEA's OSART follow-up visit which took place 28 months later. The purpose of the follow-up visit was to determine the status of all proposals for improvement, to comment on the appropriateness of the actions taken and to make judgements on the degree of progress achieved.

f 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 planning and preparedness; accident management; and human, technology and 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 best international practices and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Series documents, including the Safety Standards and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organization for achieving its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power plants.

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

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

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

EXECUTIVE SUMMARY

This report describes the results of the OSART mission conducted for Golfech Nuclear Power Plant in France from 10 to 27 October 2016.

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 and Organization Interactions.

The mission was coordinated by an IAEA Team Leader and Deputy Team Leader and the team was composed of experts from Brazil, Canada, Germany, Slovak Republic, South Africa, Sweden, Ukraine, United Kingdom, United States of America and the IAEA staff members. The collective nuclear power experience of the team was approximately 350 years.

The team identified 13 issues, 4 of them are recommendations, and 9 of them are suggestions. 9 good practices were also identified.

Several areas of good performance were noted:

- The development of a simple but effective system to remove radioactive particles from shoes, using rotating brushes connected to a HEPA filtered vacuum unit.

- The production of short training videos to be used in the training and during the Pre-Job Briefings to instruct staff in the deployment of plant specific mobile emergency equipment.

- The development and implementation of detailed procedure with rigorous control of chemical and radiochemical criteria during the reactor shutdown process to control the radioactive source term and ensure low doses to the maintenance workers.

The most significant issues identified were:

- The plant should ensure that management expectations are achieved and systematically applied in preparation or execution of tasks involving the use of procedures.
- The plant should ensure effective implementation of plant modifications. Temporary modifications should be limited in time and number.
- The plant should improve the system for developing and reviewing the effectiveness of its corrective actions to prevent reoccurrence of events.

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

CONTENT

INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of France, an IAEA Operational Safety Review Team (OSART) of international experts visited Golfech Nuclear Power Plant from 10 to 27 October 2016. 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 and organization interactions. 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 Golfech Nuclear Power Plant is located in the commune of Golfech (Tarn-et-Garonne), on the border of Garonne between Agen (30 km downstream) and Toulouse (90 km upstream) on the Garonne River, from where it gets cooling water. It is approximately 40 km west of Montauban.

The plant has two operating nuclear reactors, both pressurized water reactors of the French P'4 1300 MWe design. The first unit was commissioned in 1991 and the second in 1994. The plant has two cooling towers, only using water to compensate for evaporation; the cooling loop is closed and water is never released back into the river. It is operated by Electricité de France (EdF).

The Golfech OSART mission was the 190th review in the programme, which began in 1982. The team was composed of experts from Brazil, Canada, Germany, Slovak Republic, South Africa, Sweden, Ukraine, United Kingdom, United States of America, together with IAEA staff members and observers from the Netherlands, Slovak Republic and Russian Federation. The collective nuclear power experience of the team was approximately 350 years.

Before visiting the plant, the team studied information provided by the IAEA and the Golfech 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 are based on the plant's performance compared with 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 in which 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 Golfech NPP management fosters a strong culture that seeks the continuous improvement of operational safety and the plant staff is committed to excellent performance in all activities important to safety. The team found good areas of performance, including the following:

- The development of a simple but effective system to remove radioactive particles from shoes, using rotating brushes connected to a HEPA filtered vacuum unit.
- The production of short training videos to be used in the training and during the Pre-Job Briefings to instruct staff in the deployment of plant specific mobile emergency equipment.
- The development and implementation of detailed procedure with rigorous control of chemical and radiochemical criteria during the reactor shutdown process to control the radioactive source term and ensure low doses to the maintenance workers.

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

- The plant should ensure that management expectations are achieved and systematically applied in preparation or execution of tasks involving the use of procedures.
- The plant should ensure effective implementation of plant modifications. Temporary modifications should be limited in time and number.
- The plant should improve the system for developing and reviewing the effectiveness of its corrective actions to prevent reoccurrence of events.

Golfech 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.

GOLFECH NPP FOLLOW-UP SELF-ASSESSMENT

The 2016 OSART recommendations and suggestions have been incorporated into the annual programmes of the Integrated Management System - along with the areas for improvement delivered by the WANO Peer Review, the recommendations and concerns raised by the 2018 corporate Operational Excellence Assessment (EGE), the station's internal analyses of high- and low-level events, and the results of in-house audits and presence-in-the-field.

Regarding the main topics highlighted during the OSART mission, the station is implementing **long-term actions** that have **begun to deliver satisfactory results.**

Progress is being made with the development of **effectiveness reviews of actions** and analyses of the effectiveness of actions, subsequent to events.

With respect to **temporary modifications**, the station has established a backlog-reduction plan to cut back the number of longstanding temporary plant modifications (10% reduction in longstanding temporary modifications). **On the subject of long-term modifications**, the station has revised its organisation by structuring the process around the use of new IT tool SDIN EAM (Nuclear Information System work management software), which allows precise management of the process. In 2018, there was clear progress in the modification preparation phase, while further progress was still needed in the execution phase. Priority 3 of the station's 2019 Annual Performance Contract sets out the need to adapt organisations to ensure successful incorporation of modifications, in particular with regard to the upcoming industrial programme (Fleet Upgrade Programme), which will involve a significant number of modifications.

On the subject of **reinforcement of requirements and application of requirements in the field**, several management initiatives have been set in motion: definition of overriding requirements (fundamentals), provision of support to managers through training actions, stewardship of the management line (seminars on management handling of deficiencies, on feedback, on mindset and role). Since 2017, every station team draws up an improvement plan to promote requirements and fundamentals. Lastly, a working group has been created to consider and put forward practical and realistic actions to improve procedure adherence.

Since 2016, the station has driven major changes and developments that have required follow-up, and have not yet been fully completed:
Organisations within the trades have changed with the creation of new trade disciplines, the information system has changed and involved restructuring methods of operation. In parallel, a high turnover of staff required considerable effort to rebuild the baseline skills-sets of new arrivals.

The 2017 industrial and technical programme was marked by the station's first two outages using SDIN (new Nuclear Information System) and by the transition of a Power Operations Group project to SDN at the end of 2016. The station has lost its agility, and its ability to optimise and consolidate, which had been its strong points in past years. Compensating for, adapting to real-time needs has mobilised individuals, which could have led to off-normal situations, and given rise to more frequent significant deficiencies.

Organisations and skills have been put to the test, in a context where many individuals find themselves with limited experience in their trade, or in a trade that is changing with the deployment of the Guide to Maintenance Trades in Operating Plants (MMPE). In 2017, underlying weaknesses were not always addressed, or compensated for, as they had been in the past.

2018 saw only one maintenance outage (2P1818).

The 2018 programme aimed to achieve the stewardship of operational performance via the Integrated Management System, fuelled by presence in the field, and to establish heads-up management, from the station senior management team down to basic work teams. The September 2018 corporate Operational Excellence Assessment (EGE) highlighted the clarity of targets and programmes, but flagged up weaknesses in the stewardship of basic actions.
Work has begun on the Integrated Governance System to enable control of compliance with the Decree Governing Nuclear Facilities (Arrêté INB), and will continue in 2019.

Management of change has been deployed in several areas (information systems, trade projects, information and communication systems, team projects, visual management). The station was not able to deliver the necessary support for all demands in a manner that measured up to expectations and needs.

The Baseline Standards for Operations Roles (NCC) and Guide to Maintenance Trades in Operating Plants (MMPE) were rolled out in 2015, the Nuclear Information System (SDIN) was set up in 2017, and the transition to SharePoint is underway in one station, structured around an optimal information system leveraged around Sygma and Lotus since the start. The replacement of station 'pioneers' is nearly complete (close to 2/3 of current Golfech employees in 2018 were not on site in 2010).

Strategic guidelines based on workers (strategic guideline OS1) and on the preparation and standardisation of industrial programmes prior to the third ten-year-outages (OS2) have been confirmed, and the station Annual Performance Contract's actions to deploy the Maintenance and Operations Quality Control initiative (MQME) will be undertaken in a consistent and steadfast manner.

However, the management of profound change in the trades, in IT tools and in organisations, requires greater focus to remedy certain setbacks that had not all been anticipated.

Arrangements to monitor the positioning of new trade disciplines - linked to the Baseline Standards for Operations Roles (NCC) and Guide to Maintenance Trades in Operating Plants (MMPE) - will be strengthened through enhanced support (training actions, trade-role coordination groups, and coaching). The deployment of new information system tools and operational processes will be monitored at operational-staff level, where individuals sometimes have difficulty adapting to the new setups.

The effectiveness of management presence in the field, too often seen as limited to verifying implementation of the four requirements for Maintenance and Operations Quality Control (MQME), was reviewed, with managers working together on the topic, and will lead to coaching of managers and feedback on the correct mindset and standpoint to adopt.

In a drive to recapture the technical depth of knowledge that is the station's trademark, the management of skills – through trade subject-matter leads and through growing support from the training centre UFPI – continues to develop with the deployment of SAT and Training Committees. This is a long-term action that remains a station priority, firmly embedded in the team projects.

The Multiyear Scheduling Group, currently lagging, is structuring itself around greater resources and enhanced management reinforcement, with a view to delivering, as from end 2019 – using OE from the third ten-year-outages of other 1300MW series stations – the industrial programmes that are now finalised and secured with our in-house partners (engineering divisions, Operational Technical Unit UTO, Logistics and Maintenance Unit ULM) and external partners (preferred contractors for the Fleet Upgrade Programme).

Although some performance results in 2018 continued to stand as reference points in certain areas (environment, reliability of operating units, plant condition, chemistry), safety results experienced a dip, which required strong action.

For the current year, 2019, the station has set itself the overriding priority of regaining first-class safety performance results, by eradicating technical specification violations and noncompliant plant status, through ongoing actions and safeguarding plans, and by implementing new practical measures. Management reinforcement will be improved, while the stewardship of these subject areas will focus more on the basic work teams.

To illustrate, work activities that entail the risk of a technical specification violation are explicitly challenged and discussed during every Operations crew briefing (as are activities that comprise a risk of an automatic reactor trip); and during refuelling outages, at the start of shift, one Operator will be assigned to completing a full plant status parameter review, without interruption, before being assigned to any other task.

The four priorities of the 2019 programme are as follows:

[P1] <u>**As from 2019, regain solid safety performance results**</u>

- **Eradicate plant status noncompliance by**
  - Guaranteeing that line-up and system configuration operations are never interrupted;
  - Providing worker OE for all line-up and system configuration activities;
  - Clarifying and implementing independent checks for line-up and system configuration activities, in connection with risk assessments.
- **Eradicate technical specification violations by**
  - Discussing the risk of technical specification violations at every shift briefing;
  - Presenting teams with information on technical specification violation 'error-traps' and 5-year OE, during outage days;
  - Identifying the risks of technical specification violations in work schedules (as is done for automatic reactor trip risks).
- **Control and monitor criticality operations by**
  - Including one criticality operation in the refresher training for shift Operations staff;
  - Drafting and communicating a 'Criticality fundamental' brief;
  - Including criticality operations in the Resident Inspection Group's (FIS) 2019 audit programme.

[P2] <u>**Develop and broaden the Maintenance and Operations Quality Control initiative (MQME) for delivery of a successful 2019 campaign**</u>

- **Within each project (Outage Group, Power Operation Group, Multiyear Scheduling Group)**, from the start of modular preparations, oversee the follow-up of completion of work activities classed as NQ1/2 (quality deficiency risk classifications): practice sessions, understanding and ownership, supervision;
  - **Ensure systematic understanding and ownership of work packages** by:
  - Defining the time and place for reviewing each work package;

    - Setting aside time for reviewing preventive work activities classed as NQ1/2, at least one week prior to work execution;
- Communicating to workers the expectations for understanding and ownership of each task, based on the existing fundamental.
- **Update risk assessments** and record these in the ADREX database (OE indicating the need for an improvement to a risk assessment);
- **Ensure successful requalification** by complying with the process set out in the Nuclear Information System (SDIN).

[P3] Position long term planning at the heart of decisions on plant refit/3rd ten-year outages, in full compliance with reference outage durations

- Manage and coordinate long-term planning with strong station leadership support, based on a structured and organised contribution by the relevant craft departments.
- As early as 2019, prepare and organise modified processes and organisations (project teams and craft departments) in order to incorporate and plan modifications and corporate/regulatory requirements.
- Ensure and freeze modification schemes jointly with corporate engineering and UTO corporate Division
- Decide on plant refit/3rd ten-year outage activities in line with reference durations and programmes.
- Stabilise reliable AP1 / 5 programmes and ensure a 10-year ahead overview.

[P4] Manage changes close to the field and provide related coaching

- Coach on new job positions (at operations and maintenance - NCC and MMPE) based on training and support for proper control of the tools and applications.
- Enhanced management of IMS programmes based on clarification of action owner roles and on processing gaps and deviations
- Coordinate and manage team projects with a focus on fundamentals and technical skills and know-how, with the support of departmental craft representatives and HU champions
- Pick cross-functional minor challenges and commit to correct them.
- Coach managers, supervisors and leaders during their time in the field.

GOLFECH NPP OSART TEAM FOLLOW-UP MAIN CONCLUSIONS

An IAEA Operational Safety Review Follow-up Team visited Golfech NPP from 13-17 May 2019. There is clear evidence that Golfech NPP management has gained benefit from the OSART process. The plant has analysed in a systematic way the OSART recommendations and suggestions and developed corrective action plan to address them all.

The willingness and motivation of plant management to use benchmarking with other nuclear power plants, consider new ideas and look for improvement was evident and is a clear indicator of their strong commitment to safety. During the follow-up mission the plant staff demonstrated openness and transparency. Sustainable positive results were obtained in many areas reviewed during the follow-up mission. 1 issue was fully resolved, 11 issues were found to have achieved satisfactory progress and 1 issue has been found as insufficient progress to date.

The plant has resolved an issue regarding monitoring and control of the quantity and content of macro and micro fouling organisms when plant safety related service water system components are open for cleaning.

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

The plant has improved the management of actions developed because of Integrated Management System (IMS) performance reviews. The actions are categorized based on the risk assessment and tracked to completion through a dedicated system. Several indicators is used to review the status of actions, work preparation and execution. Improved tracking of management in the field supports more effective resolution of issues in the field. A new system was introduced in 2018 to improve tracking of actions. However, some of the processes still show a high backlog of actions, e.g. temporary modifications. Implementation of the action plans to improve monitoring and tracking of actions and their backlog will continue in 2019.

The station review of the differences between the simulator and the control room operations concluded that these would not affect the quality of the training provided to the operators if additional measures were put in place. Consequently, any differences are highlighted before simulation exercises commence and experienced operators are used to coach newly qualified operators when working in the control room following simulation exercises. There have been no events which identified, as a causal factor, differences between simulator training and actual control room operations. However, while modifications are in progress to remove some of the hardware differences, these modifications will not be implemented until 2022 and not all differences will be removed.

The plant has made noticeable efforts to improve human-performance tool use. Management expectations were reinforced to ensure high quality of conducted activities. Additional training was delivered to plant workers. Specific working groups were established. Nevertheless, the plant had significant events caused by human errors last year, and progress is not clear in this area. The implementation of action plans has not yet been completed.

In fire prevention, a set of actions has been developed and partially implemented. Clear objectives were introduced, and related performance indicators are monitored. The plant management team reinforced its expectations about fire safety. Some of these were revised and improved. However, the team noted that the plant still has weaknesses in fire prevention. Some actions are still in progress. Some performance indicators are not used, or show stable trends, which does not make progress evident.

The station made noticeable improvements in the conduct of maintenance. FME practices have been strengthened and risk assessments and work preparation improvements were observed. However, the station actions to improve the quality of maintenance work and post maintenance testing practices require more time to become embedded within the organization as the station continues to have safety significant events where inadequate maintenance or incorrect post maintenance testing were causal factors.

In permanent and temporary modifications, the plant has implemented a set of corrective actions. A significant number of long-term temporary modifications has been closed and actions to be completed have been identified for modifications which have not been closed. Nevertheless, the number of long-term temporary modifications is still high, and some facts identified by the team during the mission still exist. The number of overdue permanent modifications and related actions does not demonstrate visible reduction despite significant improvement efforts.

In developing and reviewing corrective actions to prevent reoccurrence of events, a new process for corrective action effectiveness reviews was established in 2017. Deficiencies identified during the implementation phase were used to initiate an improvement plan for 2019. However, several recent significant events were evaluated by the plant as ‘repeated’. A new initiative has been launched to improve performance of the corrective action programme. The areas for improvement include developing more effective actions. The issue needs continuous attention to ensure consistent use of the effectiveness reviews across the plant and enhance the quality of corrective actions.

In response to the issue in radiation protection the plant has implemented some programs aiming to improve adherence to management expectations in the field and demonstrated some progress. However, a lack of meaningful metrics and trending indicators specially created to measure the program’s effectiveness prevents the plant from verifying and, if necessary, correcting the program’s progress. The team considered that the issue has made satisfactory progress to date.

The plant has completed or addressed actions to cope with harsh weather conditions, installed a radiation monitor in the control room to prompt operators to manually respond to possible ventilation intake conditions, and addressed comments to the corporate organization. These actions still require a response from corporate, the radiation monitors create a workaround since they are not automatic, and the local actions are not yet complete.

The plant conducted a two-day exercise and is planning a joint exercise with the Rapid Response Nuclear Taskforce. In addition, the plant trained the deployment of site emergency mitigation equipment in degraded conditions. The quality of information regarding radiation levels provided to the emergency responders still needs some improvement, and the plant has addressed these topics for the coming exercises.

The plant group responsible for accident management arrangements has made an evaluation of the plant’s SAMGs and has recognized that there are several limitations in the scope of SAMG application. In some cases, some information and data as well as capabilities of the plant facilities and structures appeared to be outdated and limited.

As a part of the corrective action plan, the plant’s SAMGs have been reviewed and superseded by new SAMGs (version 6) that cover conditions with the primary system open. Associated with that, plant personnel training has been timely delivered prior to implementation of these guidelines. However, although a scenario involving a severe accident with the primary system open has been considered, this has never been exercised either at Golfech NPP or at corporate level.

EDF is still implementing substantial arrangements to avoid severe accidents and to ensure that emergency response teams can respond adequately (SAMG). EDF’s corporate emergency response entity, which supports the station, has substantial means of analysis and response.

In response to the OSART finding, the station and the corporate organization will start looking into any organizational and operational improvements which could be considered regarding the response to severe accidents as part of the emergency preparedness programme, and will also implement arrangements so that these can be addressed within a reasonable timeframe.

The following provides an overview of the issue that has reached insufficient progress to date towards resolution and where further work is necessary.

In response to the OSART team's recommendation to ensure adherence to management expectations and procedures, the plant has developed comprehensive action plans. Underlying causes of the issue included shortfalls in personnel fundamentals due to high turnover and major organizational changes in recent years, and weaknesses in personnel behaviour and safety culture. The actions are focused on building a proactive safety culture, improving personnel fundamentals and adherence to management expectations. However, most of the actions have been implemented recently or are in the process of implementation. Since the 2016 OSART mission, plant safety performance related to the issue has declined and the plant has experienced an increased number of events, such as technical specification violations or loss of configuration control. The effectiveness of the action plan has yet to be demonstrated by improved plant safety performance.

1.2. INTEGRATED MANAGEMENT SYSTEM

The plant organizational structure is defined and documented in a comprehensive integrated management system. There are eight defined main management processes (macro-processes), including a nuclear safety process, industrial safety process, and environmental process. There is a yearly review of each macro-process and associated sub-process action plans where their effectiveness is reviewed and new programmes and actions are defined. Yearly performance agreements (contracts) are signed between the Corporate organisation and the plant manager, as well as between the plant manager and the department managers with objectives, programmes and actions. Plant management are clear on their primary responsibility for safety and communicate this during their management activities.

The plant integrated management system, the continuous improvement programmes and a standardised information system have associated performance indicators which are used to track the progress of plant programmes and activities. Each year, each department develops a department action plan. This document contains an analysis of the results from the previous year, and the department actions linked to the plant-wide priorities. This document lists the actions, the owner of each action and the corresponding indicators or deliverables. These are then included in the annual performance contract for agreement with the plant manager. All action plans are tracked in a unified system as part of macro-process one, the plant direction process.

However, despite tracking of the various plans and actions, the team identified a number of backlogs where the holistic management of priorities was of concern. The team made a suggestion in this area.

The plant management has a number of ways to identify standards and expectations to ensure all personnel understand the behaviours and standards expected while carrying out their tasks. A guide to the working fundamentals 'Fondamentaux Metiers' clearly identifies the plant manager's expectations, human performance tools and priorities for different sections. An equivalent document called 'operations fundamentals at your finger tips' with five fundamentals has been developed specifically for operators. The plant leadership frequently refer to the guidance and associated developed tools. However, the team identified that there was evidence to show that these have not been fully embedded into front line tasks and activities, and the team made a recommendation concerning preparation and execution of tasks involving the use of procedures.

The plant process for industrial safety includes accident reporting, monitoring and trending, as well as reporting and trending of risk observations and near misses. Programmes and actions are defined based upon the risk analyses results, responsibilities are assigned, and any resulting actions tracked. Although the plant shows a favourable, decreasing trend in industrial accidents, the team also observed a number of events linked to procedures associated with risk assessment. This concern was addressed also by the above mentioned recommendation.

The management has installed and uses 'Visual Management Boards' in all departments, together with short daily meetings to communicate safety related issues and align the organization's priorities in a consistent manner. Once a week a longer team meeting is held and wider messages and discussions are held. The 'Visual Management Boards' facilitate the leader-led discussions with staff on company values, standards and expectations, and increase staff awareness of their contributions to overall safety performance. In observations the process included participation from the team members presenting and leading discussions. This also integrated the discussions for the forthcoming days and weeks work schedules and forward planning activities. The team considers this as a good performance.

The plant's external communication arrangements with interested parties include the agreement that a local committee in the community are able to take their own samples of river water to confirm the plant's analysis. This has been established since May 2011. The committee also meets to discuss social, organisational, and human topics. The team considers this as a good performance.

The selection of contractors is in accordance with the Corporate process that preauthorises companies. Supervision and control of contractors on plant includes both contactor management and EDF supervision. All corrective actions assigned to contractors are integrated through the site processes, and contractors also have the opportunity to suggest improvements to working conditions and practices. The plant management works to develop a partnership in working with the contractor companies. The team noted that there are recent events involving contractors with respect to their activities on plant that indicate that further effort in contractor awareness of safe working practices is required. The plant is aware of this aspect and is working to improve their existing communication and control processes. The team encourages the plant to further develop their relationships with contractors to improve their application of risk assessment and adherence to local plant procedures.

DETAILED LEADERSHIP AND MANAGEMENT FOR SAFETY

1.2. INTEGRATED MANAGEMENT SYSTEM

1.2(1) Issue: The plant has many processes and systems that show a backlog of issues and the holistic prioritisation and planning process for managing the overall plant priorities is not fully effective.

Many performance indicators (2286) are used to track actions and conditions on plant and these are used in intensive monitoring of plant performance, management performance and personnel performance. Many also have individual prioritisation criteria to enable the plant to carry out improvement actions in accordance to the importance of the issue identified.

However, there are multiple of data trends that appear to have safety implications, which do not have a clear integrated strategy for prioritisation and/or resolution in a timely manner.

The team identified the following:

- The reactivity management improvement plan was put in place in April 2015. There are 10 actions and 4 have not been completed by their due dates (end 2015). They are at 75% completion status. The annual review recognised the late actions and agreed to extend the deadline to end 2017.
- The plant indicators for system health ERI (6.2) show that there are 10 systems which have been coded yellow (equipment degradation condition) for greater than 18 months. These include Liquid Waste Treatment system (TEU), Reactor in-core instrumentation (RIC), Nuclear island vents and drains system (RPE both units) and Control Room Ventilation system (DVN) which are all safety related.
- Temporary modifications' records show that there are 76 modifications older than 1 year, and 20 that are outstanding for more than 10 years.
- There are no site performance indicators or metrics to track the priority of obsolescence, performance against due dates, or follow up actions for the late actions, for example: obsolescence of the DO000113-11 Honeywell transmitter is 'priority 1 obsolescence' and being progressed by Corporate. However, it has been an open issue since 2011 and is still not resolved.
- Outstanding work requests to be implemented on the Reactor Safety Systems (IPS):
  - There are 6 outstanding work requests from 2012 (which could be completed during unit operation).
  - There are 96 outstanding work requests in 2016 (which could be completed during unit outage).
  - A primary circuit thermocouple change has been outstanding since 2006
- Work packages: There are 310 open work packages in total, and 5% of work packages on safety systems and components are older than 3 years. Also, there are no time goals for completion with respect to Critical Component classified packages (C1 'risk of scram', C5 'risk trip safety system').
- There are greater than 400 operating procedures that exceed their periodic review date. Some of the procedures have not been reviewed since 2002.
- The continuous performance improvement sub-process effectiveness review (SDA data base), was conducted in 2015. The corrective actions are classified into 4 levels from 0 to 3. In 2015, 12 level 0 (most significant actions), were not completed by the required date. 338 action level 1 were also not completed on time, exceeding department targets.

Gaps in analysing priorities for implementation of various plant action plans may have safety impacts.

Suggestion: The plant should consider improving its oversight and management of backlog trends in order to ensure appropriate prioritization and integration of improvement actions, and future planning.

IAEA Basis:

GSR part 2

4.3. Goals, strategies, plans and objectives for the organization shall be developed in such a manner that safety is not compromised by other priorities.

GSR part 2

6.1. The effectiveness of the management system shall be monitored and measured to confirm the ability of the organization to achieve the results intended and to identify opportunities for improvement of the management system.

6.2. All processes shall be regularly evaluated for their effectiveness and for their ability to ensure safety.

SSR 2/2 rev 1**:**

4.33. An adequate audit and review system shall be established by the operating organization to ensure that the safety policy of the operating organization is being implemented effectively and that lessons are being learned from its own experience and from the experience of others to improve safety performance.

4.34. Self-assessment by the operating organization shall be an integral part of the monitoring and review system. The operating organization shall perform systematic self-assessments to identify achievements and to address any degradation in safety performance. Where practicable, suitable objective performance indicators shall be developed and used to enable senior managers to detect and to react to shortcomings and deterioration in the management of safety.

NS-G-2.14

5.20. To monitor safety performance in an effective and objective way, wherever possible and meaningful, the relevant measurable safety performance indicators should be used. These indicators should enable senior Corporate managers to discern and react to shortcomings and early deterioration in the performance of safety management within the train of other business performance indicators.

Plant Response/Action:

The integrated management system (IMS) cycle provides the chronological framework for management of the plant via commissions, committees, management reviews, and the plant strategic review. Every year, in the plant strategic review, the actions for the next year are prioritised on the basis of the plant risk assessment and the inter-project schedule. This feeds into an annual performance agreement with Nuclear Generation Division (DPN) management which groups the priority 1 actions for the year.

To ensure that operational management of the plant is maintained on a secure footing, management oversight is implemented in respect of sponsors, department heads and individuals responsible for actions.

This translates into:

– **More clearly focused performance agreements**

To strengthen management of the plant, and ensure that actions are carried out, the individuals responsible for cross-functional actions are explicitly stated in each department performance agreement. The actions are assigned to the individuals under their own performance agreements at annual appraisals. The team performance agreements, implemented at the plant for the past two cycles, will be challenged every three months in 2019 with regard to the progress of actions. Mid-year reviews are conducted in the presence of a member of plant management.

– **Stronger field presence and internal oversight at the plant**

A programme of internal oversight and field presence by plant management has been implemented in order to measure the effectiveness of actions taken in respect of management of actions in the departments. Visual management for the plant management team is currently being finalised, with the introduction of the inter-project schedule, tracking of field presence by plant management on a weekly basis, and the creation of 'head-up' indicators.

– **Creation of SMART macro-process action programmes challenged by the plant director,** with the implementation of effectiveness measurements.

A management seminar was held in 2018 on the fundamentals of IMS bodies, mutual expectations among the four IMS actors (macro-process leads, sub-process leads, managers and contributors), and, in conclusion, the individual commitment of managers. The plant strategic review in December 2018 provided macro-process leads and department heads with a satisfactory, clear understanding of the challenges and objectives for the coming year. These arrangements were supplemented in 2019 with a training programme on the key challenges of the IMS within the scope of the macro-process 1 programme, in order to re-establish a clear understanding of the plant management system, and train new sub-process leads, macro-process leads, department heads and cross-functional action leads in the challenges and expectations of our management system.

– **Performance review repositioned as an arbitration body**

The monthly performance review has been revised in order to support work in respect of our key challenges. It is the plant's prioritisation and/or arbitration and/or re-orientation body. It is structured around key results indicators, the status of programmes, actions that contribute to the plant's performance agreement priorities, monitoring of field presence, team projects, a focus on the maintenance and operations quality (MQME) initiative, and an update on innovation, simplification and copying.

– **Restoring meaning and effectiveness to the CAP**

This action was launched in 2018, and is continuing in 2019. The use of a new application (caméléon) provided an opportunity to review our organisation, and the way we collect and analyse findings. Three benchmarking exercises were carried out in the first quarter of 2019. A dedicated AMC commission on this topic was held, and improvement proposals for the CAP will be presented to the macro-process 1 committee on May 20th. The number of delayed corrective actions in the portfolio has already seen a drastic reduction, and currently stands at around 60.

– **Introduction of an inter-project schedule**

This tool was created by the site, and is now used as a system for prioritising and assessing workload and resources. It is discussed on a monthly basis at the POPP, and is a vital input for scheduling the various cross-functional work streams at plant level. Based on examination of the schedule at the mid-year plant strategic review, plant management my decided to reschedule, defer or cancel actions in the programme to ensure that priority targets are met.

IAEA comments:

The plant has improved the management of actions that are developed because of IMS performance reviews. The actions are categorized based on the risk assessment and tracked to completion through a dedicated system. Status of the actions is presented and discussed at regular management review meetings. As observed by the OSART team, the current backlog of actions is kept at a minimal level, with clear justifications for overdue actions. The performance review process has been improved to better support resolution of challenges using a graded approach.

Several indicators are used to review the status of actions, and work preparation and execution, e.g. health reports of individual macro processes, tracking of management in the field, or status of work orders.

Regarding the tracking of corrective actions in the corrective action programme, a new system was introduced in 2018. As observed, the number of corrective actions backlog has significantly improved.

The management has installed and uses 'Visual Management Boards' in all departments, together with short daily meetings to communicate safety related issues and align the organization's priorities and actions in a consistent manner.

However, some of the processes still show a high backlog of actions, e.g. temporary modifications. Implementation of the action plans to improve monitoring and tracking of actions and their backlog will continue in 2019.

Conclusion: Satisfactory progress to date

1.2(2) Issue: Management expectations are not systematically achieved in the preparation or execution of tasks involving the use of procedures.

The Management systems and management standards and expectations are well documented, however, the team observed and were provided with, investigation reports and analyses which indicated the standard in terms of procedure adherence was not achieved. Examples are as follows:

- Maintenance
  - Roof of turbine hall 1: On 13th October 2016 an event occurred during which fan blades were sheared off. The event was caused by a reverse wiring error resulting in the fan rotating in the wrong direction. The investigation identified that the maintainer was working with a Quality Plan that had not been correctly completed. There was no check procedure for the activity involving verification of the fan rotating direction.
- Radiation Protection
  - Unit 1 contamination survey of waste storage: The radiation protection supervisor was with the technicians in the field observing their survey method which included the use of square pieces of tissue. On checking the current procedure, a ‘standard smear’ was required to be used in to survey for contamination. The procedure had not been updated to reflect the current approved survey method.
- Operations
  - Unit 1: During observation of the back-up emergency generator test (LLS) on 13 October 2016, the operator following the procedure skipped some steps, then returned back to the skipped steps with previously collected data. This is contrary to the plant’s procedure adherence standards (step by step procedure).
  - Unit 2: During load following operations, to which a new-starter operator had been assigned under the supervision of an experienced control room operator, the experienced control room operator occasionally operated the controls instead of the assigned (new-starter) operator in contradiction of the relevant procedure.
- Procedures for risk assessment and quality plans
  - Scaffolding event –October 2016, hydrochloric acid leak following a rupture of a pipe caused by a dropped pole during scaffolding erection in the vicinity. The risk assessment from the contractor identified that nets needed to be installed before the scaffolding was erected. The risk assessment of the sub-contractor who carried out the work did not include the requirement for nets in according procedures.
  - Scaffolding event – In September 2016 scaffolding was erected that blocked access to some safety related equipment. Contrary to the relevant procedure, the risk assessment did not include the identification of risk to safety related equipment, and relevant operating experience was not taken into account.
  - Plant procedures for risk assessment of temporary storage do not consider seismic hazards. Several cases were noted where materials and equipment were stored without seismic hazard assessment, examples are:
    - Unit 1 level 0 in room LC0505 1000 kg floor blocks stored next to control room HVAC DVS042ZV and containment spray systems valve 1EAS062V1;
    - Unit 1 level 0 Mobile heavy pipes and equipment stored at a designated place in room LC0503 near the ESW heat exchangers 1 RRI054RF;

  - Unit 1 level 0 in room LC0503; large heat exchanger bolts stored at a designated area but not restrained, next to seismic qualified heat exchangers.
  - Unit 2, a scaffold erected in room KA0541 next to the turbo feed water pump, standing there since April 2016.
- Experience from OE:
  - An analysis report in 2016 identified that non- adherence to procedures was the largest contributor to all events on site. The analysis of 20 significant events (from June 2014 to June 2015) and 19 significant events (from June 2015 to June 2016) showed human performance was highlighted in 38% and 47% of event causes respectively.
  - Reactor scram: – The investigation into the reactor scram on 26 September 2016 identified non-compliances with procedures for work preparation and irregularities in following the procedures.

Non-compliance with management expectations and adherence to procedures may result in errors leading to degradation of safety.

Recommendation: The plant should ensure that management expectations are achieved and systematically applied in preparation or execution of tasks involving the use of procedures.

IAEA Basis:

GSR Part 2 Requirement 2

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

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:

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

SSR 2/2 Rev. 1

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 [2].

SSR-2/2 – Rev. 1

3.5. The management system shall integrate all the elements of management so that processes and activities that may affect safety are established and conducted coherently with other requirements, including requirements in respect of human performance and so that safety is not compromised by other requirements or demands.

SSR 2/2 Requirement 8: Performance of safety related activities

The operating organization shall ensure that safety related activities are adequately analysed and controlled to ensure that the risks associated with harmful effects of ionizing radiation are kept as low as reasonably achievable.

4.26. All activities important to safety shall be carried out in accordance with written procedures to ensure that the plant is operated within the established operational limits and conditions. Acceptable margins shall be ensured between normal operating values and the established safety system settings to avoid undesirably frequent actuation of safety systems.

4.28. Written communication shall be preferred and spoken communication shall be minimized. If spoken communication is used, attention shall be given to ensuring that spoken instructions are clearly understood.

4.29. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel.

NS-G-2.14

4.31. Operators should adhere strictly to plant policies with regard to the use of procedures, communication protocols, response to alarms and the use of methods in place to prevent or minimize human error. Operations management and supervisors should make themselves aware of the behaviour of operators in this regard and should ensure that high standards of performance are enforced at all times.

Plant Response/Action:

I Compliance with expectations

The plant has defined priority expectations, and cross-functional/craft fundamentals, that must be complied with. Grouped in a file and available in electronic form, they allow easy access to the expectations to be applied in order to improve the quality of operations. The craft fundamentals sheets were developed and shared within the departments. The fundamentals were also deployed within the 'common team' department and among contractors.

Team improvement plans are drawn up within each team at the plant, in free format, on the basis of a collective self-diagnosis exercise held on a dedicated day. Under the improvement plans, teams sign up to the shared set of expectations (fundamentals). Each team improvement plan includes the four areas of focus designed to ensure that activities are completed as expected, and meet the plant priorities in terms of operational performance.

Reminders of expectations are provided at meetings of the different operational bodies, and within teams.

The items covered at the weekly operational focus meeting (FOCOP) are presented at each department management meeting and at team meetings, in particular the various safety updates relating to the units. The priority expectations and craft fundamentals are covered at team meetings. During training on the simulator or worksite mock-up facility, trainers reinforce the plant expectations. Each shift manager commits to deploying operations fundamentals during outages as part of their performance agreement with the Operations department manager. Actions are implemented, with an individual responsible and a deadline, for each of the five Operations fundamentals. On a daily basis, the duty shift manager reinforces operational expectations in a clear and structured manner at the shift manager/plant management status update. Priority and cross-functional expectations are set out during the status update.

The management commitment to these expectations is expressed via their reinforcement at meetings of the various operational bodies, and via an organised, topic-based field presence programme that enables low-level indicators to be detected. Templates for MIF visits focused on procedure adherence, and on the various issues for the year, have been created. This allows the field presence programme to be coordinated, and enables any low-level indicators to be detected. A dedicated indicator dashboard has been implemented.

Field presence (in terms of number of field visits as well as topics to be observed) is covered in managers' performance agreements. Performance in this area is assessed and challenged at each monthly performance review. Field presence is addressed at each management meeting, operational focus meeting, EDTH meeting and department management meeting, with qualitative feedback, and a discussion on the topic among participants.

Field visits are organised with contractors during power operation and in outage. Three-way visits are scheduled during power operation with the support of the contractor consortium (involving EDF, the contractor consortium and contractors). The target is one visit every two weeks, with a representative of a contractor, the consortium representative, and a member of plant management. Visits coordinated by the industrial policy manager (RPI) are also held during outages.

New first-line managers receive training in field presence as part of their basic first-line manager training. The trainer is a corporate lead from the corporate operations engineering unit (UNIE).

The plant has also put in place a system of management coordination and support to meet managers' needs via workshops and seminars.

A seminar on management treatment of deviations was held in 2018. Actions in 2019 focused on attitudes to be adopted during field presence. Experimental training in coached field presence is to be held at the plant on May 16th.

II Procedure adherence

Following several events related to procedure adherence shortfalls in 2017 and early 2018, a working group bringing together all of the operational roles at the Golfech plant was set up in the second half of 2018 to discuss the different practices in existence at the site. This working group set itself the objective of talking to each operational team on perceptions of procedure adherence, with the aim of gaining an understanding of the cross-cutting fundamentals relating to practice in this area.

According to initial discussions, practices differ depending on the type of documents used, and on the team concerned. Step-by-step documents, such as surveillance tests, are generally followed, and procedure adherence is, in principle, fairly satisfactory.

Under an action in macro-process 3 programme for 2019, work is to be carried out 'on procedure adherence from the planning phase to the execution phase' (CSNE (Operational nuclear safety committee) decision 271.01).

- Definition of expectations for each type of procedure.
- Identification of situations conducive to failure to apply fundamentals.
- Identification of sources of improvement and good practices in the implementation of this initiative, to avoid deviation from procedures, and ensure adherence.
- Definition of arrangements for stopping and restarting when applying a procedure.

IAEA comments:

The plant's integrated management system (IMS) consists of 8 macro-processes. Each macro-process undergoes an annual performance review. Performance reviews measure the effectiveness of macro-processes and identify their strengths and weaknesses. Weaknesses identified through various means (e.g. declining trend in key performance indicators, internal operating experience, corporate findings, OSART mission findings, etc.) are graded using a risk assessment tool. Based on the risk-assessment results, priorities and measures are defined for the next year to improve the effectiveness of individual macro-processes. This process is followed at the plant level, and the results of global risk assessment are used to develop actions addressing cross-functional issues.

Issues identified by the 2016 OSART mission were included in the IMS performance reviews conducted in 2017, and the same process was followed in 2018. Examples of measures developed to address risk factors identified by the 2017 and 2018 performance reviews are shown below.

However, safety performance in 2017 and 2018 showed a declining trend. The plant experienced an increased number of events such as technical specification violations, and significant events with loss of configuration control, and an increase in the overall number of significant events with procedure violations. The plant conducted an analysis of the adverse trend and identified generic causes such as high staff turnover and lack of working experience, major organisational changes (e.g. introduction of nuclear work management system (SDIN EAM) and impact on work management), weaknesses in personnel training (insufficient training on human performance tools), and lack of leadership (low effectiveness of the management in the field programme). Change management was not always effective to ensure delivery of the necessary support to personnel and successful adaptation to new setups.

Examples of measures developed based on the results of IMS performance reviews conducted in 2017 and 2018, and aimed at improving the effectiveness of prevention of events with procedure violations, include the following:

- Updated personnel fundamentals (essential knowledge, skills, behaviours, and practices) with frequent discussions between leaders and workforce on their use.
- Improvement plans developed at the level of teams to enhance their adherence to management expectations and completion of tasks as planned.
- Reinforcement of management expectations through various means such as weekly operational focus meetings at the level of departments and teams, personnel refresher training on human performance tools, and communication campaigns. Specific attention is given to adherence to expectations during outages.
- Increased rate of just-in-time training delivered to personnel, depending on risk assessment of planned works.
- Development of fundamentals for managers – how to deal with different types of deficiencies depending on their significance (e.g. coaching the employee, reporting to a department manager or reporting to the plant manager)
- The plant has improved the management in the field programme by implementing special training courses and seminars for managers participating in the programme. Results have shown improvements in the quality and quantity of management observations focused on continuous improvement of personnel skills, behaviour and safety culture in general.

A dedicated working group was created in 2018 in response to the adverse trend in significant events with procedure violations in 2017 and 2018. The results of the analysis performed by the working group were included in the 2019 performance review, and additional actions have been recently initiated to improve prevention of events with procedure violations. These actions (currently in the process of implementation) include:

- Definition of expectations for the use of each type of procedure
- Identification of situations conducive to failure to apply fundamentals
- Defining expectations for personnel behaviour in situations involving a work interruption

The plant management is giving the highest priority to regaining solid safety performance via timely and effective implementation of the actions described above, and via improved reinforcement of management expectations. To achieve this, the following additional actions have been introduced in 2019:

- Improved use of operating experience. For example, lessons learned from configuration control events or technical specification violations shared with personnel
- Independent checks for plant line-up and system configuration activities
- Proactive identification of error-likely situations at the beginning of each shift

- Updated work risk assessment based on operating experience

Specific attention will be given to improving change management by providing necessary support in the field, such as coaching on new roles and responsibilities, fundamentals and technical skills, with the support of human performance champions.

The plant has developed comprehensive action plans in response to declining safety performance in 2017 and 2018. Most of the actions were implemented recently or are in the process of implementation. Underlying causes of the issue included shortfalls in personnel fundamentals due to high turnover and major organisational changes in recent years, and weaknesses in personnel behaviour and safety culture. The actions taken are focused on building a strong safety culture and improving personnel fundamentals. However, addressing such challenges evolves over time, and some of the actions have not yet resulted in the desired effects. The following conclusion is formulated since safety performance results relevant to the issue have declined since the 2016 OSART mission.

Conclusion: Insufficient progress to date.

2. TRAINING AND QUALIFICATIONS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

A full scope simulator, which is based on Cattenom NPP Unit 1, is available at the site. The team observed several differences between the on-site simulator and Unit 1 at the plant. These differences are well documented in plant document UFPI/GOL/OP2/10-0053, dated September 8, 2016, however the resolution time for all discrepancies is not always clearly defined. The team made a recommendation in this area.

The team noted very good performance by instructors during various classroom and simulator training sessions. Sessions were properly controlled and structured, as well as being highly interactive, and all training objectives were achieved in a timely manner. Instructors led open discussion with trainees so that trainees understood not only the appropriate activities, but also the reasons and risks associated with the activities. The plant has developed and implemented an informative and very clear training package for new comers called ‘Outage for Dummies’ and the team recognised this as a good practice.

The team observed appropriate use of the Systematic Approach to Training (SAT) methodology at the plant. Effective use of a specific software application and effective management of data obtained during the Analysis, Design and Development phases of SAT were also noted by the team. This application provides very effective support tool for skills observations in the field conducted by managers. Once a few basic fields are filled in, a template for a specific skills observation report is created. The team considers this a good performance.

The team observed the work of several training committees at the plant. Line managers, subject matter experts (craft leads) and training coordinators are adequately involved in the training process in their department. The plant has developed and implemented an IT tool called iFAP, which facilitates the writing and access to training and skills observation records for trainees, trainers and line managers and the team recognises this as a good performance.

An excellent training facility for maintenance, operations and other plant staff is available at the plant. The facility is equipped with a large number of mock-ups, various training spaces, laboratories, classrooms and other related training areas. An observation platform for instructors, built over the training spaces, is a very good tool to observe training groups at the same time from a single point. The team considers this a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.2. QUALIFICATION AND TRAINING OF PERSONNEL

2.2(1) Issue: The plant's arrangements for the timely update and modification of the full scope simulator do not ensure that it reflects current plant conditions and operating policies.

EDF policy is that Cattenom NPP Unit 1 is the reference unit for the whole 1300 MW units series. The plant simulator therefore uses Cattenom Unit 1 as a reference unit which does not necessarily ensure that the plant simulator reflects current plant conditions and operating policies. The team observed the following during the review:

- The differences between the plant and the simulator are in:
  - Functions of some systems, such as – Turbine Control System (GRE), Power Transmission and Auxiliary Power Supply (GEV, LGR), Essential Service Water System (SEC)
  - Hardware on main control room panels – as an example, the turbine control system on P07 panel - REC 70 is Cattenom Unit 1 while at Golfech units a microREC regulator is used
  - Operational procedures and alarm response procedures of Cattenom Unit 1 are used for systems, such as Turbine control system (GRE), Essential Service Water System (SEC), and reactor core characteristics for fuel cycle 16 at Cattenom are used instead of Golfech ones.
- Operations and Training departments work together to implement minor changes on the simulator, however, currently there is no Corporate plan to minimize the current simulator differences at the plant.
- Differences are not considered as significant by the plant personnel; however, a separate Turbine control system simulator tool specific for Golfech NPP was developed some years ago, it is used in initial training and freely accessible for trainees. Recently the Operations department requested more formal refresher training lessons with an instructor.
- The secondary operator was looking for a specific procedure during a simulator session. He couldn't find the procedure under the desk in the middle of the MCR, so the instructor showed him where the procedure is placed on the other shelf at the side of the room. The Shift Manager confirmed the position of procedures at the simulator is different to the actual Main Control Rooms.
- There was an event in September 22, 2014 on Unit 1, where different dynamics of the simulator were pointed out by the operators to be a contributing factor.

Without continuous, adequate and timely management of the fidelity of the plant simulator, the effectiveness of the training process cannot be ensured and knowledge, skills, behaviour and competence of the personnel could be compromised.

Recommendation: The plant should improve the timely update and modification of the plant full scope simulator to ensure it reflects current plant conditions and operating policies.

IAEA Basis:

SSR-2/2 Rev.1

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.

Plant Response/Action:

Regarding the simulator, the station is subject to EDF policy, in which the reference unit for the 1300MW plant series is **Cattenom NPP unit 1.**

The Simulator Manager maintains an up-to-date list of differences between the Golfech units and the simulator. This list is assigned a new revision level whenever any plant linked to the simulator undergoes a modification. it is presented to trainees at the start of each simulator training session.

The simulator was recently fitted with a **national alert code control panel**, in alignment with the units, under a corporate package approved by the Nuclear Generation Division. In addition, an **emergency services assembly point control panel** will shortly be installed.

At station level, actions are underway **focused entirely on the control room environment**, such as, for example:

- A cover plate on top of the core cooling monitor, as part of the Amendment Record Governing Nuclear Safety.
- A photo of the control panel for the backup generator set, as part of the post-Fukushima modification.
- Access to the shift logbooks of the units, with the establishment of unit 5.
- A screen detailing limiting conditions for operation.

In the course of the **Fleet Upgrade Programme / Third Ten-Year Outage Project**, the simulator will undergo modifications to factor-in this transition to third TYO status.

Results from the 2018 corporate Operational Excellence Assessment (EGE) and from the evaluation campaign of 'Process' qualified personnel did not indicate that trainees experienced any difficulties training in a simulator that presented differences from the station units.

Furthermore, the simulator availability rate is high.

Regarding **operational documents**, these are available in the simulator, and correspond to Golfech unit 1. Additional documents from Cattenom 1 are also available, notably alarm sheets.

The department's Documentation Manager is responsible for controlling these satellite documents, in conjunction with the Site Logistics Department. He conducts regular checks, in particular at each integration campaign for new documents.

As with the simulator itself, the 2018 corporate Operational Excellence Assessment (EGE) did not identify any shortfalls in the management of operational documents in the simulator.

Plant Self- Assessment regarding recommendation TQ 2.2 (1) : SATISFACTORY PROGRESS TO DATE

IAEA comments:

Following the OSART mission the training department carried out an analysis of the factors impacting on the issue. This review concluded that while there were differences between the simulator and control room operations, these differences did not significantly impact on the quality of the training provided to control room personnel. However, actions were put in place to manage and minimise the impact on operator training as some of the differences required plant or simulator modifications and would therefore take some time before a permanent resolution was in place. These actions included: updated list of the differences which is briefed to the operators at the start of each simulator session, the shift manager in charge of the simulator visits the control room after each outage to verify that all modifications impacting on simulator training have been identified and the re-arranging where practicable, of the simulator layout and documentation placement so that it matches that of the main control room.

Currently the main safety related difference between the simulator and the plant is associated with the operation of the turbine regulation system (REC). For this system the differences are explained during simulation exercises and again when trainees return to the control room. In addition, there is a turbine regulation simulator in the control room which mimics in a more representative way, actual plant control. Operators are encouraged to use this simulator and are also closely monitored by a more experienced operator when they use the turbine regulation system for the first time on plant.

Since the OSART review there have not been any events where the different dynamics of the simulator was a contributing factor.

The station has a major modification programme scheduled for 2022 which will result in a closer alignment between the simulator and control room operations.

An interview with six control room operators including one who had recently qualified, confirmed that the managerial arrangements which had been put in place to minimise the impact of these differences were being implemented. Furthermore, the operator feedback questionnaires from simulator training did not mention the differences between the simulator and the control room as an area for concern.

However, it will be another two years before the plant controls on the turbine regulation system will match that of the simulator. A recently qualified operator had not used the control room-based turbine regulation simulator. In addition, even after the major plant modification programme scheduled for 2022, there will still be differences between the simulator operation and that of the control room.

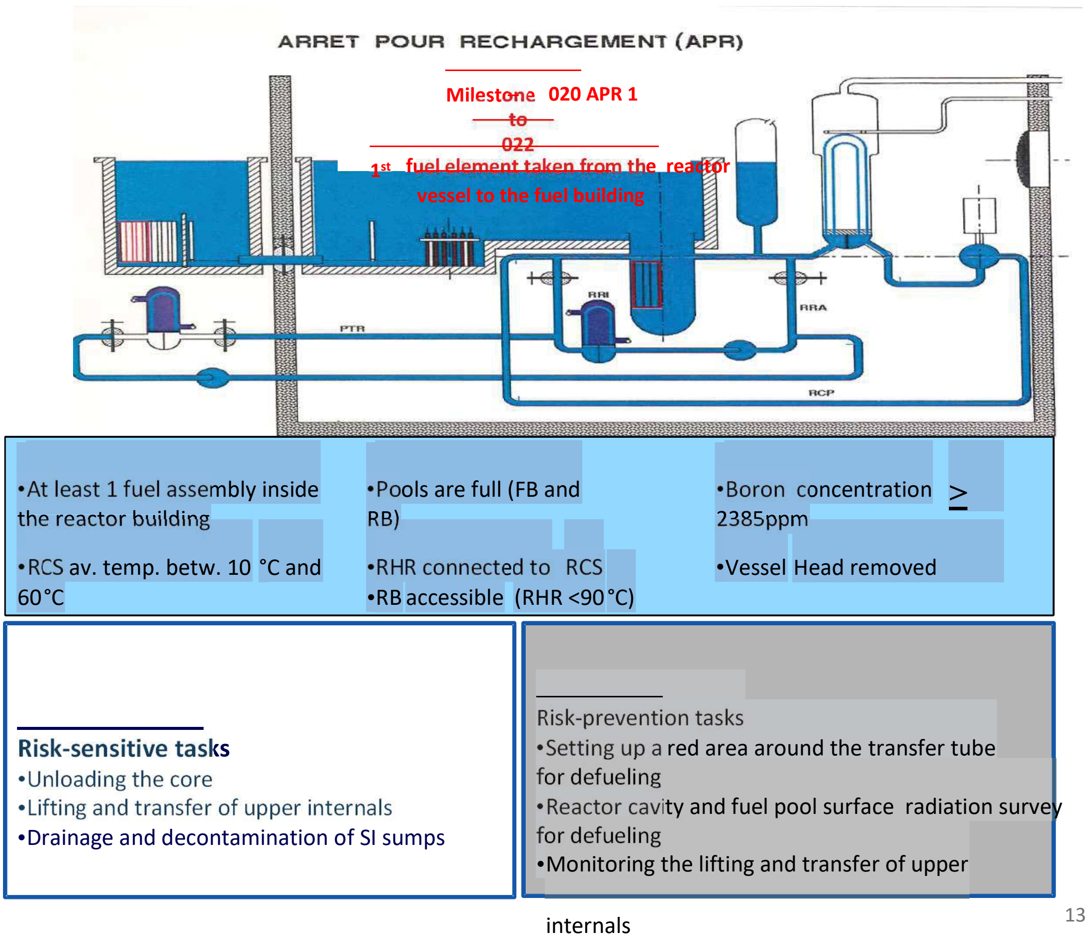
Conclusion: Satisfactory progress to date

2.2(a) Good practice: Informative and very clear training package for new comers called ‘Outage for Dummies’.

In view of the large number of newcomers, the Risk Prevention department decided to compile a description of all major tasks affecting risk-prevention technicians during outage and developed and implemented an informative and very clear training material for new comers called ‘Outage for Dummies’. Produced by four risk-prevention technicians, this document identifies the risk-sensitive phases in each stage of an outage, while also matching the corresponding risk-prevention tasks to each of the phases. The document contains information on conventional safety, radiation protection and fire safety.

The booklet is geared towards recently hired and inexperienced radiation protection technicians. It illustrates the major risks associated with their professional activity, whether in the area of conventional safety, radiation protection or fire safety. For each of the reactor coolant system levels, the booklet lists:

- The technician’s main tasks
- All associated risks



3. OPERATIONS

3.1. ORGANIZATION AND FUNCTIONS

The plant has introduced a visual system for identifying all valves that are used when applying emergency operating procedures (EOPs), in the form of fluorescent tags. In emergency operating conditions (requiring entry into EOPs or 'APE' in French), if a loss of power or lighting occurs on the unit, field operators can spot the required valves quickly and easily. Another benefit is that field operators can familiarize themselves with valves used in emergency operating conditions during their daily routines. During EOP practice sessions conducted during operator training, the tags have been used and their effectiveness has been proven. The team recognizes this as a good practice.

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

In emergency operating situations involving unavailability of the Main Control Room (MCR) the station relies either on quick revitalization of the MCR and return of operators back to the MCR, or quick transfer of responsibility for mitigation of events to the local Emergency Crisis Centre (within one hour) or the Corporate Emergency Crisis Centre (24 hours). However, the design or Periodic Safety Review (PSR) analyses have not demonstrated that operators will not be required to remain at the Remote Shutdown Panel Room (RSP) for prolonged periods in all emergency events involving unavailability of the MCR. The combinations of emergency events or common cause events when access to the RSP could be blocked for a long time are not taken into account. The team encourages the plant to demonstrate that operators will not be required to remain at the RSP for prolonged periods in any emergency event involving unavailability of the MCR, and to address the RSP habitability.

The plant uses the Radwaste remote control room (RCR) to operate the radioactive waste facility. The team noted several deficiencies in operational conditions of the RCR, which were not identified during regular checks or were not reported, such as equipment and alarms indications. The reported defects are not addressed by maintenance in a timely manner, as they are considered to be of low priority. It was noted that no medical kits are provided in the RCR; the closest medical kit is located in the corridor at the entry to the MCR, which is about ten minutes' walk from the RCR. The team encourages the plant to consider improving operational conditions in the RCR.

3.4. CONDUCT OF OPERATIONS

The team noted that the plant does not consistently use the human performance tools, such as three-way communication, and does not control the use of temporary operator aids in the Main Control Room (MCR). The team made a suggestion in this area.

The plant conducts grid load following on a regular basis. Some plant operational events show that transients have occurred during reactivity manipulations. The team observed some deviations by operations personnel from plant expectations during load following operations and encourages the plant to reinforce management expectations and adherence to procedures during reactivity manipulations.

Prior to the outages, the plant identifies periods of elevated risks for the operators in the main control room and provides just in time training (JIT) in the simulator for the affected shift crew, in order for them to be better prepared. The team recognises this as a good performance.

3.5 WORK AUTHORISATION

The work authorization process is well structured and the responsibilities are clearly defined. A designated tagging officer from every shift reduces the duty operators' workload by being part of the authorization process for work permits. In addition, the risk prevention department also assesses the risks associated with the work in a thorough way. However, in the control rooms the team noted many work requests at the panels. Even though many of them have a lower priority the team encourages the plant to reduce the amount of equipment deficiency tracked in deficiency tags in the control rooms.

3.6 FIRE PREVENTION AND PROTECTION PROGRAME

The plant has a program for preventing, detecting and minimizing the spread of fire, however the team found that the plant's approach to fire prevention activities is not sufficiently rigorous to foster continual improvement. The team made a suggestion in this area.

MANAGEMENT OF ACCIDENT CONDITIONS

International experience shows that endurance tests can provide plants with additional information regarding the reliability of the EDG. As the plant does not perform such tests regularly, the team encourages the plant to consider extended endurance tests of the diesel generators of an appropriate time period.

DETAILED OPERATIONS FINDINGS

3.1(a) Good practice: The plant has introduced a visual system for identifying all valves that are used when applying emergency operating procedures, in the form of fluorescent tags.

Benefits:

- In emergency operating conditions (requiring entry into EOPs or 'APE' in French), field operators may have to operate certain valves in the field at the request of MCR staff. Depending on how serious the situation is, field operators may need to respond as a matter of urgency;
- In emergency operating conditions, these fluorescent tags can be spotted more quickly as soon as field operators enter the area. If a loss of power or lighting occurs on the unit, the tags are easier to see with a flashlight;
- Another benefit is that field operators can familiarize themselves with valves used in emergency operating conditions during their daily route tours. In the event of actual entry into emergency operating procedures, they would know which area to get to and respond more quickly. These tags are not a substitute for equipment identification tags and do not exempt operators from having to perform a self-check before operating the component;
- Plant results demonstrating that this good practice is achieving the expected outcome: during EOP practice sessions conducted during operator training, the tags have been used and their effectiveness has been proven.

3.4. CONDUCT OF OPERATIONS

3.4(1) Issue: Operations personnel do not consistently use human performance tools and do not control the use of temporary operator aids in the main control room (MCR).

The team noted the following:

- A Corporate initiative advocates full application of 4 (out of 6) human performance tools by the whole plant including Operations. The stated aim is to supplement the currently expected use of 2 (out of 6) human performance tools (self-check, and time-out) with two additional tools for process related activities; namely, pre-job and post-job briefs. The plant is conducting steps to this goal, which are currently in progress. Interim goals have been defined for activities that are vulnerable to Operations/Maintenance error but the timeframe to reach full compliance has not been established;
- The expectation is that three-way communication is used during operations activities identified as 'risk-sensitive'. For other activities, 'clear communication' is recommended. There is no document which stipulates each activity where three-way communication is to be used; As an example, no expectation exists for use of three-way communication during the test of the Back-up emergency diesel generator. Each Shift Manager does a risk assessment prior to the test and decides whether to use three-way communication and to what extent;
- Reported event of 14/03/16: Due to insufficient communication, a lead maintenance worker in the unit-1 fuel building called the unit-2 main control room instead of unit 1. The unit-2 operator did not detect the confusion as similar activities were scheduled during the day in the unit-2 fuel building. The operator inhibited the fire detection loop as requested by the lead maintenance worker;
- MCR-1. Extensive use by Operations' staff of handwritten tags – reminders (mostly white), but also green and yellow, along with regular tags: some torn isolation tags (potentially causing the tags to fall off the keys);
- MCR-2. Excessive use of different types of operator aids (handwritten reminders on white tags, print-outs attached to panels, and handwritten notices related to equipment defects on many panels, devices, walls or doors on discretion of personnel);

A lack of consistent reinforcement and implementation of human performance tools, and control of the use of operator aids and materials, could lead to operator errors and degrade operational safety of the plant.

Suggestion: The plant should consider developing consistent use of human performance tools and controlling the use of temporary operator aids in MCR.

IAEA Basis:

SSR-2/2 Rev. 1

4.29. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel.

NS-G-2.14

4.45. In communications, the full description of any plant item should be given and the phonetic alphabet should be used where appropriate. To reduce the likelihood of error in verbal communication, both in the plant and in control rooms, training should be provided in the use of three way communications. The following three steps establish three way communication:

(i) clear delivery of the message by the sender; (ii) acknowledgement by the receiver that the message is clearly understood; and (iii) confirmation of the acknowledgement by the sender. This final step is also the final command to proceed to the action stated in the message between the sender and recipient and this method should be used as widely as practicable, especially in abnormal situations.

4.46. Recipients of verbal instructions should proceed only when they fully understand the task to be undertaken. Where appropriate, they should check that the action that they have taken delivers the expected results.

4.47. When verbal or written instructions or orders are used in operational practice at a plant, administrative procedures should be put in place to ensure that the verbal or written orders do not diverge from the established procedures and do not compromise established operational limits and conditions.

6.15. Operator aids may be used to supplement, but should not be used in lieu of, approved procedures or procedural changes. Operator aids should also not be used in lieu of danger tags or caution tags. A clear operating policy to minimize the use of, and reliance on, operator aids should be developed and, where appropriate, operator aids should be made permanent features at the plant or should be incorporated into procedures.

6.17. The system for controlling operator aids should prevent the use of unauthorized operator aids or other materials such as unauthorized instructions or labels of any kind on equipment, local control panels in the plant, boards and measurement devices in the work areas. Operator aids should be placed in close proximity to where they are expected to be used and posted operator aids should not obscure instruments or controls.

Plant Response/Action:

With regard to the process for periodic review and updating of operations procedures, the site took this remark into account by modifying its organisation in 2018. The current situation is that the site logistics department (SLS) periodically sends the Operations department a list of documents that are approaching the deadline for review. Review progress is then overseen by the Engineering group, and the reviews are carried out by the shift crews.

Plant version of HU tools: With regard to the implementation of HU tools at the site, the plant modified its organisation in 2016 by setting up a dedicated task force with representatives from all departments, with the aim of improving management of the site HU tools action plan.

At the level of workers, the site has defined a new expectation linked to the maintenance and operations quality (MQME) initiative, whereby the worker states ‘I am ready’ at the end of the pre-job briefing, and makes a commitment that they are fully prepared and familiar with the activity.

In terms of communication, the operational lead sends communications material for managers every month to improve the implementation of HU tools in teams (for example: what is meant by use of HU tools as a ‘reflex action’, or in ‘systematic’ mode?).

The plant’s objective in 2019 will be to roll out the corporate scheme for securing the use of HU tools (this began at the start of the year), involving in particular a self-assessment to be carried out by all teams. All team performance agreements must include the rollout and facilitation of HU tools. With regard to training, refresher training is planned for all personnel.

Finally, regarding the coordination of HU champions, two meetings are scheduled in 2019 with the involvement of external actors in order to impart a new dynamic to the plant's HU tools network. Externally, the site has set up links on HU tools with the Civaux and Blayais plants, in order to carry out peer reviews on HU tools at each of the sites, and to benefit from regular feedback from them.

In Operations, a benchmarking exercise with the Cruas plant is scheduled for 2019, to draw on good practices in the facilitation of HU tools. Three HU tools working group meetings are planned in 2019, with the aim of repositioning HU champions to support teams. At each working group, one HU tool will be studied in theoretical and practical terms.

Focus on HU tools in Operations department: Regarding the use of HU tools in the Operations department, a support tool was put in place in 2017 and 2018 to measure the level of use of HU tools in the crews. We decided that the support arrangements for the use of HU tools were too optimistic, and did not necessarily reflect the results that we were getting in that area. As a result, several actions were launched/implemented in order to improve the implementation of HU tools:

- **For workers:**
  - Refresher training in the use of HU tools was delivered in 2018 with the aim of improving the performance of actions based on the expectations in the HU tools booklet.
  - Fleet operating experience on HU tools is now distributed to all operations personnel to make all actors aware of the need to use HU tools, highlighting good practices and deviations from around the fleet.
- **For HU champions:**
  - The running of the HU tools working group has changed, to ensure that it listens more effectively to the needs of HU champions, and to make it more focused on providing support. The next working group meetings (three are scheduled for the year) will, as a result, be jointly led by a senior HU champion and a trainer, in order to provide improved support for HU champions by providing them with situation-based training in one of the HU tools.
  - A file containing best practices in the use of HU tools will be provided for champions in the control room.
  - It is planned to redistribute HU tools booklets to HU champions.
  - Links have been created with the Blayais and Civaux sites for the purpose of conducting peer reviews (scheduled for May 22nd and 23rd), with the dual aim of peer-reviewing the other sites and improving support for HU champions.
- **For managers:**
  - Managers are still required to monitor and support the use of HU tools in the field.
  - Since 2017, shift managers have given feedback to crews on the use of HU tools at the end of simulator sessions.
- **Facilitation of HU tools in the department**
  - A benchmarking exercise in the Operations department at the Cruas plant (chosen because of the quality of its facilitation work on this topic) will take place in 2019, to improve facilitation of the use of HU tools in the department.

With regard to housekeeping in the control room, the Operations department took the remark from the OSART into account by creating standard tags for different uses (temporary operating procedure, work request, specific line-up, prohibited operation due to blocking work permit, fool proofing). This practice is in the process of being rolled out on both units.

Organisation memo 03651 (control room monitoring) has been updated in anticipation of rollout.

With regard to reactivity management, the site took the remark from the OSART into account by implementing ‘stress test’ training which aims to closely examine the plant’s lines of defence in light of a significant safety event from the fleet (by challenging organisations, skills and documentation). It is planned to carry out two of these tests per year in the Operations and I&C departments.

Monitoring of transients with a significant impact of reactivity was introduced in 2018. It has not so far shown any gap in skills, but it allows regular assessment of skills needs in each unit, with personnel adjustments on a case-by-case basis.

In terms of facilitation, reactivity management is covered in two Operator facilitation group meetings per year, and refresher training on reactor operation is maintained on an annual basis.

The corporate expert from the Core and fuel operation group (GECC) at the operations engineering unit (UNIE) and the plant core operations engineer are now systematically called on to provide support and advice for scheduled activities that are important for reactivity (for example, several shutdowns associated with rod drop time, availability of graduated modulation of a unit after calibration test of grey control rod banks).

With regard to the reduction in the number of defect labels and tags in the control room, the Operations department took this remark into account by:

- Introducing a weekly operational report in 2018 which provides a comprehensive vision of operations problems, including the number of deviations in the control room.
- Rolling out a new organisation known as the ‘consistent operations core’ (‘*noyau de cohérence conduite*’), with a dedicated individual to oversee personnel in the different roles in order to address deviations in respect of operations standards.

IAEA comments:

The plant performed an analysis of the issue and identified its causes as follows:

- Personnel were not fully trained in the use of human performance tools (HPT);
- Operations personnel did not pay proper attention to HPTs, so their behaviour did not meet management expectations.

An action plan was developed to reinforce expectations on the use of HPT and to ensure proper training of staff.

The plant has 6 HPTs that must be used:

- Pre-job briefing (PJB);
- Post-job debrief;
- Self-check;
- One minute stop;
- Three-way communication;
- Peer check.

The plant has developed a specific memo which describes in detail when and how to use each HPT. This memo also includes a check-list for HU champions to check the quality of HPT use by staff. This memo was distributed to the personnel to reinforce its use.

Plant managers, within the scope of the manager in the field programme, have extended their observations on the use of HPT, focusing on the performance of PJBs. A specific performance indicator was put in place to track these activities. The procedure for PJBs was revised, and specific requirements to check the readiness of operators to perform manoeuvres were added. This has led to significant improvement in the quality of pre-job briefings.

A specific working group was created to foster proactive communication and resolve issues related to HPTs.

Additional training of staff was provided.

Since 2017, all activities have been classified in 3 categories based on potential risk. Specific requirements were established for each category, including use of HPTs and supervision by managers.

Operations managers have made efforts to reduce the pressure on shift staff during outages, thereby improving the planning and preparation of activities.

The procedure relating to the use of operator aids was revised. All labels and posters in the main control room (MCR) were standardized, and daily checks were organized to ensure their proper use.

A set of specific performance indicators related to all operational activities was introduced. A weekly report with analysis of current operational conditions and problems is prepared and analysed to solve problems at an early stage. This set includes such indicator as ‘Number of deviations in the MCR’. This allows monitoring and timely improvement of conditions in the MCR.

Use of operator aids in the MCR has visibly improved.

However, the plant still needs to continue its efforts to achieve visible progress in the area of HPT use.

The plant had 5 significant events related to human errors in 2018, which is significantly more than in previous periods.

Not all planned activities related to HPT use were completed. The work on improvement of procedure adherence, which was a cause of some events, is still in progress.

Conclusion: Satisfactory progress to date

3.6 FIRE PREVENTION AND PROTECTION PROGRAME

3.6(1) Issue: The plant's approach to fire prevention activities is not sufficiently rigorous to foster continual improvement.

The team noted the following:

- According to Operations' personnel, there can be a distraction of control room monitoring if the number of hot work permits exceeds 15. Statistics show that the average amount per day is about 17 over a 3-month period.
- The amount of fire alarms is greater than the plant's expectations.
- One false alarm was caused by maintenance as they failed to request the suppression of the fire detector and alarms although this was required by the risk assessment for the hot work permit.
- For the period of January-June 2016, the risk prevention department has found deviations in 34 % of the cases in the process for handling hot work permits.
- The number of walk downs, related to the hot work location after work has been completed, does not meet the plant expectations. There is also no performance indicator to track deviations discovered at the workplace after the work has been completed.
- When walk downs are done after outage, the components 'as found' in storage areas do not meet the inventory lists in 47% of the cases. Last year, 9 storage areas exceeded the fire load limit.
- A temporary combustible substance store in the turbine hall of Unit 1 did not have an inventory list with dates and responsible departments as required.
- There are no formalized expectations or requirements to conduct post-job debriefing (PJD) with all involved persons after work that is assessed to have a high degree of fire risk.
- The interval for reviewing the fire response cards for the plant is not identified.
- Fire fighting and fire detection equipment is not always clearly labelled i.e. isolation valve for fire hydrant 0JPD519BI with unreadable label, fire extinguisher 1JSD77 2 EZ with handwritten change to label, fire detection system mimic panel 9JDT416CR with adhesive tape stuck over decommissioned indicator light, fire detection system mimic panel in corridor NB 0703 at 6.6 m level in nuclear auxiliary building with adhesive tape stuck over fire alarm response procedure number.

Lack of a rigorous approach that fosters continual improvement in fire prevention may increase the plant vulnerability to fire hazard.

Suggestion: The plant should consider enhancing the rigour of its approach to fire prevention activities to foster continual improvement.

IAEA basis:

NS-G-1.7

2.7. Fire loads in nuclear power plants should be kept to the minimum by the use, as far as practicable, of suitable non-combustible materials; otherwise, fire retardant materials should be used.

NS-G-2.1

2.10. Staff should be encouraged to adopt a rigorous approach to their firefighting activities and responsibilities and a questioning attitude in the performance of their tasks, to foster continual improvement.

6.3. The total fire load due to combustible materials in each area identified as important to safety should be maintained as low as reasonably practicable, with account taken of the fire resistance rating of the compartment boundaries. Records should be maintained that document the estimated or calculated existing fire load as well as the maximum permissible fire load in each area.

10.3. The quality assurance provisions should be applied to the following aspects of fire safety:

—fire safety procedures and the emergency plan and procedures;

—the storage and use of replacement fire protection materials, systems and equipment;

—records of the combustible fire load in each fire area;

—control of combustible materials and ignition sources;

—false alarms and other non-fire responses;

—operational failures of fire safety measures, including failures of computer software;

NS-G-2.4

5.11. The operating organization should demonstrate a commitment to achieving improvements in safety wherever it is reasonably practicable to do so as part of a continuing commitment to the achievement of excellence. The organization’s improvement strategy for achieving higher safety performance and for more efficient ways to meet existing standards should be based on a well defined programme with clear objectives and targets against which to monitor progress.

NS-G-2.14

1.2 The organization of the operations department, the management standards and administrative controls should be such that it is ensured to a high degree that policies and decisions for safety are implemented, that safety is continuously improved and that a strong safety culture is developed and promoted.

Plant Response/Action:

- **Monitoring of hot work permits in the control room:**

  Tech. spec. analysis is carried out by off-shift operations personnel during power operation. In outages, an initial impact analysis is carried out by a contractor, then presented to the operator. The fire detection upgrade programme (the ‘control of fire risk/fire detection system’ (‘MRI JDT’) project) has been partially implemented at the plant. It will enable entry into Tech. Spec. Limiting Conditions for Operation to be avoided, via the application of a special requirement (PP35), thanks to the presence of personnel and addressable detectors (only one room is affected by the disablement).

  ⇨ An internal check conducted regarding the service delivery in early 2019 revealed that the process during power operation was robust.

– **2) Spurious alarms:**

Spurious alarms with a human cause are traced via a finding report in the 'caméléon' application, classed as level 3 so that no management action is carried out.

⇨ The overall upgrade of the fire detection system will allow spurious (equipment) alarms to be reduced, which will allow us to reach the set target (less than six per month).

– **3) Hot work permits:**
We issue monthly indicators regarding hot work permits. The analysis is carried out for the Mechanical Maintenance, Engineering for New Works/Modifications, and Regional real estate (DIRGO) departments, as these are the main users of the application. We have set a target of **less than 20% quality defects in risk assessments.**

In 2017, we had **50% defects** in risk assessments in the Mechanical Maintenance department, and **11%** in Engineering for New Works/Modifications.

In 2018, we had **28% defects** in Mechanical Maintenance, **16%** in Engineering for New Works/Modifications, and **15%** in DIRGO.

In 2019 (end of February), we have had **18% defects** in Mechanical Maintenance, **8%** in Engineering for New Works/Modifications, and **3%** in DIRGO.

The results have shown a constant improvement since 2017.

⇨ Finding reports are issued on a monthly basis if targets are not met, with actions on the departments. The technical supervisor took action to explain the expectations regarding risk assessments to the Mechanical Maintenance department in 2017.

The end-of-day round is carried out by operations or by the work team leader. It is traced by the operator on the hot work permit sheet. The aim is to check that there are no longer any hot spots in the work areas. We have set a target of **less than 20% deviations in respect of the execution and recording of the round**.

In 2019, we have had 20% deviations; in 2018, we had 14%. No deviations have been observed in the field after activities (for example a part that is still hot that could cause a fire outbreak). If this were to happen, monitoring would be carried out, and a finding report would be raised.

⇨ Finding reports are issued on a monthly basis if targets are not met, with actions on Operations (reminders to operators about the need to keep a trace that the round has been performed).

4) Storage areas.
When each annual check of storage areas is carried out, the Industrial Safety/RP department issues finding reports to the departments responsible for storage areas where deviations (in terms of administration or management) are identified.
The traceability of the quarterly check of areas carried out by the departments is also checked by the Industrial Safety/RP department, and finding reports are issued as a sanction in the event of any breaches.

- ⇨ A cross-functional work order was raised in order to track the performance of quarterly checks by the departments. Outstanding items in the work order are addressed by the fire technical supervisor.
- ⇨ The new application for managing storage areas (EPSILON) is being introduced in line with a special process (P40) validated internally by all departments and by plant management.
- ⇨ Simpler requirements regarding inventory have been implemented in order to clarify expectations for the departments. The fire risk assessment no longer contains the inventory of the area, but only the maximum authorised fire load quantities and densities. The inventory is contained in the EPSILON record.

– **5) Fireproof cabinets:**

  'Self-service' fireproof cabinets have been eliminated at the plant.

  - ⇨ The cabinets were eliminated because of the large number of deviations observed. They have been replaced by a multi-compartment cabinet with a code, which is currently being installed by the mechanical maintenance department in the SUT (technical group) workshop. The code is issued to the work team leader by storekeepers. Work team leaders can be identified if they do not remove the products they have placed in the cabinet.

6) Worksites with significant fire challenges:

A briefing is organised by the work coordinator responsible for the package the first time a hold point is lifted. Corporate and local OPEX is taken into account in risk assessments by the work coordinator.

7) Fire response sheets:

The frequency for revision of fire response sheets is three years, as defined by the documentation section of the site logistics department.

8) Fire protection and fire fighting equipment:

The contractor responsible for maintenance of fire extinguishers and fire hydrants checks that labelling is present and of good quality when carrying out maintenance. A complete upgrade of fire detection cabinets is currently under way as part of the 'control of fire risk' (MRI) project.

IAEA comments:

After the mission, the plant analysed the suggestion and identified weaknesses in the fire prevention programme, such as:

- Unclear objectives regarding fire safety;
- Lack of rigor in the fulfilment of existing requirements. Personnel behaviour did not always meet the management team's expectations;
- The implementation of all corrective actions and improvements was not comprehensive or timely;
- Lead workers did not always pay proper attention to fire safety.

A set of actions has been developed and partially implemented to eliminate these weaknesses.

Clear fire prevention objectives were set, such as:

- The quality of risk assessments should be improved. A specific performance indicator was introduced – number of quality defects in risk assessments for hot work permits. A challenging target was set to have less than 20%.
- The number of spurious alarms should be reduced. Set target – less than six alarms per month.
- Conditions of the areas where hot work is being performed should be compliant with expectations. The target values for the number of deviations revealed during the end-of-day rounds of the areas where hot work is being performed is set to have less than 20%.

The plant management team reinforced expectations in fire safety. For example, hot work lead workers were instructed to rigorously fulfil requirements to notify main control room operators before the beginning of hot work. The plant has instructed all departments to issue condition reports for all identified deviations in fire prevention.

Each negative finding during risk assessments, quality control or walkdowns in areas where hot work is performed results in a level 3 condition report, which initiates investigation and corrective actions.

The quality of the walkdown procedure for storage areas was improved. Instead of work orders being initiated by different departments, the risk prevention department now initiates cross-functional work orders under the control of the fire technical supervisor.

Some procedures were simplified and revised to eliminate ambiguity. For example, signage requirements for storage areas were changed.

However, the team noted that weaknesses in fire prevention remain. The plant has not completed all planned actions and progress in some areas cannot be clearly demonstrated. Modification of the fire detection system is still in progress and the number of spurious alarms demonstrates a stable trend. Although the plant significantly improved the quality of risk assessments, the number of assessments with deviations is still high (18%).

An indicator (number of spurious alarms) has not been tracked and trending data was not available for the September 2018 to December 2018 period due to a lack of workforce. The arrangements for control of storage areas were revised and improved. However, specific metrics were not introduced to measure the effectiveness of taken actions.

Conclusion: Satisfactory progress to date

4. MAINTENANCE

4.1. ORGANIZATION AND FUNCTIONS

The plant has implemented a fortnightly walk-down scheme where safety issues regarding contractors are also taken into account. These walk-downs are performed by a representative of the plant management, a contractors' representative and contractors from site. Any problems for contractors are discussed and this group forms a strong platform for contractors to address health and safety issues to the plant. The team recognises this as a good performance.

4.3. MAINTENANCE PROGRAMMES

The current status of the maintenance backlog for 'unit in operation' is about 550 with a decreasing trend and about 400 for 'outage' with an increasing trend. Both KPIs are in line with the plant's expectation and better then the figure set by the Corporate, but still showing a high level. The team encourages the plant to set a more ambitious objective for the size of backlog at the end of an outage and further to reduce the total backlog.

4.5. CONDUCT OF MAINTENANCE WORK

The maintenance department has defined 'maintenance fundamentals' to increase the quality of work performed. Human performance tools are included in these fundamentals. The team noted, however that maintenance fundamentals were not always fully applied by the maintenance personnel in the field and made a suggestion in this area.

4.7. WORK CONTROL

The plant provides a strict 8 week plan of maintenance work activities (functional equipment group system), where all systems are allocated to specific weeks according to the plant configuration and nuclear safety principles. There are exceptions when an activity has to last over one week or in the case of contractors not being available. These exceptions are identified in the weekly work schedule. The team has noted that about one third of all planned work over the year did not match the functional equipment group system plans and encourages the plant to increase the stability of the schedule.

4.9. OUTAGE MANAGEMENT

The plant has designed a mobile power supply box which is used to transform the 24V power supply provided in the reactor building during outages to 220V. This novel device uses 24 Volts to power instruments in the RCA. Its working principle is to convert 24V into 220V using a transformer. The device comprises a transformer, a 15m power lead equipped with a 24V 'Maréchal' socket and a 220V triple-socket distribution panel. The latter is protected by a short-circuit mechanism and a differential circuit breaker in order to prevent transformer overload. The team recognises this as a good practice.

DETAILED MAINTENANCE FINDINGS

4.5. CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: Plant maintenance activities are not always consistently performed and monitored in a way that ensures adequate equipment reliability.

The team noted the following:

- Following a modification, an auxiliary ventilation system transducer (1 DVN 121 RG) was not labelled with its number. Several other transducers in switch board 1 DVN 101 AR were marked with handwritten labels. Two power cables from transducer 1 DVN 121 RG to the valve actuator were twice connected the wrong way around. This resulted in insufficient insulation and grounding during calibration work, as the actuator was still energized when it was opened.
- While filling the unit 2 turbine oil tank (2GGR 001 BA) using a mobile filling device, the oil level was checked and the charger pump was switched off without closing the main flow valve of the charger pump. Turbine oil flowed back for about three minutes to the charger tank before this was noticed. The use of the device without a check valve, compounded by a maintenance procedure not specifying the need to close the main flow valve, did not cover the risk to the turbine or the environment.
- Several signal and control cables on safety related equipment were routed with flexible metal tubing that was not attached to the connector of the transducer equipment (e.g. safety-injection system pump 2 RIS 041 PO).
- Cable housing entry to component-cooling system temperature transducer 2 RRI 044 MT of safety related component-cooling system pump 2 RRI 024 PO was coming off due to the heavy weight and wrong cable attachment.
- 7 ropes are hanging into the unit 2 Spent Fuel Pool. Six are attached to the handrail and one is attached to a tube.
- Instead of using the pink FME plastic pouch provided for dosimeters and personal effects in the Spent Fuel Pool area of unit 2, a transparent bag was used by worker for dosimeter and personal effects.
- The plant expectation is that work packages with Level 1 and Level 2 risks should be labelled with the respective stickers (NQ1 or NQ2). The sticker on the work package for level 1 work on a generator excitation system panel (2 GEX 003 AR) was missing and the risk level was not mentioned in the work package.
- The work site identification sheet (FIC) for a temporary storage in corridor NA0792 of unit 1 was dated from 2016-09-19 to 2016-10-19. It was found that the due date had been exceeded by two days and the equipment had not been removed.

Without effective implementation and control of maintenance activities, and adherence to human performance tools, equipment reliability may be compromised.

Suggestion: The plant should consider improving performance and monitoring of maintenance activities to ensure adequate equipment reliability.

IAEA Bases:

NS-G-2.6

2.4. Corrective maintenance includes actions that, by means of repair, overhaul or replacement, restore the capability of a failed SSC to perform its defined function within the acceptance criteria.

NS-G-2.6

2.5. A systems approach to maintenance of safety relevant SSCs should include the following elements:

a) A systematic evaluation of the functions and objectives of SSCs, to determine the necessary maintenance activities and the related requirements

NS-G-2.6

2.7. The operating organization should monitor the performance or condition of SSCs against the goals it has set so as to provide reasonable assurance that the SSCs are capable of performing their intended functions. Such goals should be commensurate with safety and, where practicable, industry-wide operating experience should be taken into account. When the performance or condition of an SSC does not meet the established goals, appropriate corrective action should be taken.

NS-G-2.6

2.11. The objectives of the surveillance programme are: to maintain and improve equipment availability, to confirm compliance with operational limits and conditions, and to detect and correct any abnormal condition before it can give rise to significant consequences for safety. The abnormal conditions which are of relevance to the surveillance programme include not only deficiencies in SSCs and software performance, procedural errors and human errors, but also trends within the accepted limits, an analysis of which may indicate that the plant is deviating from the design intent.

NS-G-2.6

5.28. Before returning to an operational state, it is important to ensure that:

- appropriate post-maintenance testing has been carried out;
- the configuration of affected systems is verified;

Plant Response/Action:

1. **Summary of actions implemented following the OSART, and assessment of their effectiveness (effectiveness measurement, results, indicators)**

Maintenance and operations quality (MQME):

The ‘maintenance and operations quality’ (MQME) initiative has been strengthened, initially by focusing on more effective selection of level 1 (NQ1) and level 2 (NQ2) activities and on the implementation of associated mitigations, including training and supervision. To support more effective deployment among personnel, a set of cross-functional fundamentals in maintenance and operations quality was drawn up, restating in particular the expectations regarding identification of folders containing level 1 and level 2 packages, as well as sensitive phases in packages.

The focus on the initiative has been further intensified since the beginning of 2018, with work being extended to drivers which also relate to level 0 (NQ0) activities, including:

- Worker familiarisation with activities. The arrangements for implementing this have been defined in each department with the help of working groups.
- Use of human error reduction tools in ‘reflex action’ mode.

To improve the management and implementation of the initiative, a maintenance and operations quality correspondent has been appointed in each department. The network of department correspondents meets on a quarterly basis. In addition, the following are carried out: a monthly review by the management committee during performance reviews; internal audits; dedicated manager-in-the-field tours; and a quarterly assessment by peers from other sites.

Post-maintenance testing:

The method for defining post-maintenance testing following activities has been enhanced by means of a new analysis support tool (AdS). The post-maintenance testing process, with one individual having dedicated responsibility for post-maintenance testing, was redefined as part of the transition to the SDIN system. This has enhanced post-maintenance testing for outage activities. This process is currently being consolidated for activities during power operation.

Risk assessment:

The quality of our risk assessments had deteriorated. In cooperation with the corporate-level coordinator, we have implemented several actions, concerning the following: clarification of the key points of a risk assessment via a memorandum; internal communication; specific training; and changes in the application used for creation of risk assessments. Although some risk assessments are still not up to the expected level, good progress has been made regarding the risk assessment approach. Analysis of the events that occurred in 2017 and 2018 is helping us to improve. (For example, work permits for urgent unplanned activities can only be issued after presentation of the risk assessment to the shift manager or his/her representative.)

Reliability:

Maintenance programmes exist and are implemented during power operation and in outage. A surveillance test programme exists and is carried out. If criteria are not met, the shift manager is notified, an action plan is initiated, and corrective actions are implemented. When we encounter a significant problem, we open a ‘contingency’ file, managed, according to the scale of the problem, on the basis of cross-functional collaboration (involving internal and, if necessary, external capabilities). Around twenty contingencies were handled during the last outage. The aim is to find a sustainable solution to problems. Equipment and system health reports are produced, and action plans can be drawn up. (For example, in instrumentation and control, regarding the Controbloc programmable logic controllers.)

FME:

Consideration of FME risk has been strengthened via the following actions: procurement of distribution trolleys containing equipment for securing tools; use of FME zone advisor/guardian services during outages; communications actions by the FME lead using dedicated communications material in A4 format; implementation of an FME test for all EDF personnel and contractors likely to carry out work in an FME zone; inclusion in the maintenance and operations quality initiative as part of the ‘four essentials’; and selection of FME-risk activities as level 1/level 2 activities.

Management of activities:

The work request portfolio is tracked using indicators, with a target for reduction. The maintenance departments are challenged on their activities every week in a discussion with the in-cycle project and plant management.

2. **Summary of actions in the process of implementation within the scope of the 2019 plan or macro-processes, linked to the recommendation/suggestion**

Maintenance and operations quality (MQME):

As priority 2 of the 2019 plan, the strong focus on the maintenance and operations quality initiative is maintained, with priority actions aimed at: enhancing selection of level 1/level 2 activities, particularly during power operation, and improving risk assessments for level 1/level 2 activities; ensuring that workers familiarise themselves with activities on a systematic basis; improving reporting and handling of quality defects and the use of human error reduction tools; and continuing to provide support to personnel.

Post-maintenance testing:

The action with regard to post-maintenance testing concerns the integration of the new corporate-level reference requirements on post-maintenance testing and the new revision of the Methodological Guide to post-maintenance testing. The criteria for exiting Tech. Spec. LCOs were clarified at a meeting of the plant safety committee in early 2019. Workshops are scheduled during the first half of 2019.

Risk assessment:

Support for personnel is continuing with regard to the method for drawing up risk assessments, and the arrangements for presenting risk assessments for urgent activities to Operations. Transfer of risk assessments leveraged for the purpose of capturing OPEX from the old application to the AdREX application continues, and is tracked via an action in the MP3 (macro-process 3) programme for 2019.

FME:

Development of FME culture is an objective to be pursued, and is the subject of an action in the MP2 (macro-process 2) programme for 2019.

Miscellaneous:

An action in MP2 (macro-process 2) involving the integration of logistics and spare parts requests into modular planning should enable the execution of activities to be improved.

Regarding the finding made by the OSART in 2016 that the equipment used for oil makeup to the turbine oil tanks was unsuitable, a modification of the makeup and drain down equipment is currently being analysed (this also falls within the scope of actions to ensure effective liquid containment). Temporary actions have been implemented in the meantime.

There is good momentum in the maintenance area. Action plans have been drawn up; they are tracked and updated.

IAEA comments:

The station carried out a detailed analysis of the conduct of maintenance issue and identified 4 areas where improvements were required; the quality of maintenance work, foreign material exclusion practices, post maintenance testing and the work preparation and risk assessment processes.

The need to improve the quality of maintenance work was identified as one of the main priorities for the station during 2018 and continues in 2019 (MQME programme). The station carries out a detailed analysis of all safety significant non-quality maintenance (NQM) related events. In addition, in 2018, the station introduced a software package to track all lower level NQM occurrences so that analysis, trends and actions could be put in place to prevent repeat occurrences. A lead non-quality maintenance and co-ordinator have been put in place to oversee this process.

Furthermore, all maintenance activities have now been graded on a scale of NQ0, NQ1 or NQ2 to ensure that sufficient countermeasures were put in place and implemented at the workface to reduce the probability of an event occurring. So, for example, all maintenance activities now require a work package and updated risk assessment, and sufficient time is allocated in the work planning schedule for the maintenance worker to read and prepare to undertake the task (NQ0). All NQ1 rated activities require just-in-time training as an additional countermeasure and NQ2 rated maintenance activities requires the additional supervision of the maintenance activity by senior management or representatives from the engineering department.

The index which measure the unplanned unavailability of equipment during normal operations (KIF) showed a 50% improvement in 2018 compared to 2017. Furthermore, the indicator

(ER1.3), which most closely monitors the impact of maintenance on equipment performance, showed an improving trend for the past three years.

The station also set up additional actions to enhance its post testing maintenance testing practices such as the use of a new software tool (Ads) as it had one post maintenance testing related safety significant event in 2018 and one in 2017.

The station had enhanced its foreign material exclusion (FME) practices through additional training, communications and the appointment of an FME subject matter expert and FME lead. The station had also proposed a number of FME good practices which have been adopted by other plants in the fleet. A recent example was the placement of an FME toolbox on the reactor polar overhead crane to prevent the dropping of tools during transit. All outage activities are now reviewed by the FME expert/lead to ensure that any FME risk is included within the risk assessment. There were no safety significant FME related events within the first 5 months of 2019, or in 2018 or in 2017. The number of FME events which had the potential to affect equipment performance was 3 in the first 5 months of 2019, 12 in 2018 and 18 in 2017. During a plant walkdown of the unit 2 diesels, turbine hall and spent fuel pool, no foreign materials were observed and during the maintenance activity to remove pump (2TEP421PO), FME covers were in place over the open pipework.

The station had implemented several actions to improve the preparation of work packages. Consequently, the on-line work package preparation stability indicator (ERI 5.0) was consistently above the station target for the past two years and a similar trend was observed for outage work package preparations. However, the station did have a safety significant event in 2018 due to documentation not being updated. The updating of risk assessments was carried out during the work preparation phase and the station now utilises a software package (AdREX) to ensure that any fleet operating experience is included in the station risk assessments.

However, the station continues to have safety significance events where NQM was identified as a causal factor. For 2018 the station had five safety significance maintenance related non-quality events and none in 2017. Furthermore, the number of lower significance non-quality maintenance events was 40 in 2018 and 49 in 2017.

Conclusion: Satisfactory progress to date

4.9. OUTAGE MANAGEMENT

4.9 (a) Good Practice: Portable power-supply box for energizing equipment on worksites (24V/220 V).

The plant has designed a mobile power supply box which is used to transform the 24V power supply provided in the reactor building during outages to 220V.

This compact device is equipped with the necessary cables for connection to a 24V electrical feeder, and converts the voltage to 220V in order to power three outgoing 220V lines.

This device uses 24 Volts to power instruments in the RCA.

Its working principle is to convert a 24V supply into 220V using a transformer. The device comprises a transformer, a 15m power lead equipped with a 24V 'Maréchal' socket and a 220V triple-socket distribution panel. The latter is protected by a short-circuit mechanism and a differential circuit breaker in order to prevent transformer overload.

All these components are built into a sealed and water resistant carrying case for ease of transportation. There is an option for the case to be delivered with a padlock to prevent the instruments from being disconnected during use.

Advantages/Benefits:

The box's design takes account of weight, power capacity and worker safety.

Capacity is limited to 100 VA and is enough to power three MIP-10 or COMO contamination friskers, or any other low-capacity industrial safety instruments. This innovative system provides much more flexibility in the choice of power sources. 220V connections are a rare commodity in the reactor building during an outage, and equipment is sometimes disconnected, or extensions are used for functions other than their primary function. 24V connections, on the other hand, are used rarely or not at all, but they are widely distributed at each level of the reactor building.

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

The plant has comprehensively and effectively embedded the processes and approach to managing equipment reliability. In particular, it was noted that system health reports are comprehensive and include detailed operating experience and oversight of critical component performance. Furthermore, the engineering department utilises the Integrated Management System (SMI) to ensure the continuous improvement of this approach.

The site uses a detailed and comprehensive set of performance indicators to manage equipment reliability, which clearly identify systems that need attention and concerns over critical components. Performance is overseen by the Equipment Reliability Committee (COFIAB) which places and tracks appropriate action plans.

The process to manage equipment reliability is systematically and consistently applied throughout the year, including during outages. The team recognised this as a good performance.

5.2. PERIODIC SAFETY REVIEW

The plant carries out a Periodic Safety Reviews (PSR) in accordance with national regulatory requirements. However, the EDF PSR scope does not include all of the 14 safety factors recommended in the IAEA Safety Guide SSG-25. The safety factors not addressed within the scope of the PSR are Human Factors, Emergency Planning, Organization and Environment. These factors are evaluated independently of the PSR.

It is recognized that EDF is undertaking a programme to align its PSR scope to the IAEA standards, but that this is not yet completed. The team encouraged the plant to develop the scope of its PSR to align to the IAEA standards in a timely manner.

5.3 LONG TERM OPERATION SAFETY REVIEW

During the OSART mission, the status of Long-Term Operation (LTO) related activities was discussed with the plant staff and EDF Corporate staff on 12-13 October 2016. Minutes of the meeting were prepared to summarize the conclusions and proposals for future activities needed to support the plant's preparations for long term operation.

5.5. USE OF PSA

Probabilistic Safety Assessment (PSA) is used at the Corporate level to assess modifications. The PSA scope does not currently include aspects such as internal and external hazards and is not used for daily operational assessment of plant risk and emergency situations. The team encouraged the plant to consider opportunities to develop its use of PSA analysis for plant operational activities and emergency situations.

5.7. PLANT MODIFICATION SYSTEM

The plant has processes and procedures in place to manage modifications. However, the plant does not always ensure the effective planning of permanent modifications and that relevant documents and procedures are revised accordingly. The plant has procedures in place for the control of temporary modifications; however, the plant does not limit temporary modifications in time and number and does not assess the aggregate impact of temporary modifications either in the Periodic Safety Review or annually. The team made a recommendation in this area.

The plant is currently implementing safety-hardened core facilities to provide diverse ultimate cooling in the event of a beyond design basis accident. These comprise the Ultimate Safety Diesel (DUS), Reserve Ultimate Heat Sink (REFu), Backup Reservoir (APU) and Local Emergency Centre (CCL). The team reviewed the DUS modification and its integration with the plant which is managed through a joint team of EDF central and plant personnel. It was noted that the modification is one month behind construction schedule; however, there is approximately a year’s planning margin before the final commitment date. Currently there is no forward site resource plan prepared in anticipation of the start of commissioning in September 2017.

The other projects are underway and were noted to be progressing. The APU design work is complete and the civil construction will commence in 2018. The CCL is undergoing its design phase taking account of fleet operating experience and the REFu is in the technical study phase. The team encouraged the plant to continue to anticipate, and plan ahead with adequate time, all of the plant resources and support necessary to ensure the effective implementation of all significant design modifications.

DETAILED TECHNICAL SUPPORT FINDINGS

5.7. PLANT MODIFICATION SYSTEM

5.7(1) Issue: The plant does not always ensure effective implementation of permanent modifications and does not ensure that temporary modifications are limited in time and number.

The team noted the following:

- The team identified several permanent modifications that were not adequately implemented, which included:
  - Modification PNPP3603A for the change to an ammonia toxicity emergency alarm in the Main Control Room (MCR) where the MCR procedures were hand-amended and incorrectly configured relative to the actual plant status and alarms.
  - A main control room operator tool for reactivity calculations which had software defects upon implementation leading to improper functioning.
  - An inadequate modification to the Unit 2 polar crane control system caused the unavailability of the crane for several days adversely affected the Unit 2 2016 outage.
- A summary of 2015 modification performance shows that only 76% of online modifications were completed as planned and only 72% of outage modifications were completed as planned. A yearly plan is prepared in March in which completion dates are placed into the cycle plan and which is then reviewed in September. There is not a live management level set of tracking indicators for the number of open modifications, completion on time and the number that are later than planned.
- Some planned modifications on the plant were observed to be hurried or delayed due to failures in planning and design; for example;
  - The PNPP3603A modification for amending the set point of the ammonia toxicity emergency alarm was requested by Corporate EDF in order to align with expectations to have a lower action level. The plant was requested to implement the modification as soon as possible, which they did in June 2016. However, Corporate EDF had not yet confirmed the required setting at the time when the system was physically modified. As a consequence, the plant has had to implement a new temporary modification to bring the alarm setting back to the original levels.
  - There is a temporary modification on Unit 2 Essential Diesel 2 to remove a redundant water injector alarm. This has been in place since May 2005 and inhibits a redundant alarm to MCR. The original plan was to complete this by the end of 2016 but the EDF central team have requested a postponement to the end of 2017 because the Corporate design works and analysis are late.
- The plant currently has 96 temporary modifications of which 76 are greater than 1 year old. More than 20 are greater than 10 years old. More than 10 temporary modifications greater than 10 years old are on safety related systems (380V battery) and Unit 1 and 2 diesel generators.
- There are no expectations or time limits for temporary modifications set by Corporate or plant management.
- The Periodic Safety Review does not take into account the temporary modifications on the plant, and there is no global assessment of the cumulative impact of the temporary modifications on overall plant safety.

– A review was carried out in 2011 of all historical temporary modifications. This justified their continued use; however, it did not make them all permanent or set specific dates for their closure.

Without effective implementation of permanent modifications and ensuring that temporary modifications are limited in time and number, plant operation to its design intent could be compromised.

Recommendation: The plant should ensure effective implementation of permanent modifications and that temporary modifications are limited in time and number to ensure plant operation to its design intent.

IAEA Bases:

SSR 2/2 Rev. 1

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

4.39. Before commissioning a modified plant or putting the plant back into operation after modifications, personnel shall be trained, as appropriate, and all relevant documents necessary for plant operation shall be updated.

4.41. Temporary modifications shall be limited in time and number to minimize the cumulative safety significance.

4.42. The plant management shall establish a system for modification control to ensure that plans, documents and computer programs are revised in accordance with modifications.

Plant Response/Action:
Permanent Modifications

I. **Process for integration of modifications at the plant**

A distinction is made between two types of modifications, based on their design and execution:

1. ‘Corporate’ modifications: designed by corporate engineering centres, and executed by ‘Common Team’ (modification) departments, seconded from corporate engineering centres.
2. ‘Local’ modifications: designed and executed by a plant department.

In both cases, the plant departments are responsible for integrating the modifications.

There are two key stages in the integration of equipment modifications by the plant departments:

1. **Planning phase:** the plant department conducts an analysis of the impact of the modification on documentation, databases and equipment. The start of the modification work depends on the completion of these analyses.

2. **Execution/integration phase:** updating of impacted items following equipment modification.

II. Organisation

There are various management meetings that track the integration of modifications: the Cross-Functional Analysis Group (GAT), the Engineering Technical Group (GTI), and the Outage Document Review.

	1. **Planning phase** before modification	2. **Execution phase** after modification
Corporate modification	**Planning GAT*** before execution of the modification: - Analysis of modification - Identification of impacted departments	**Integration GAT**** after execution of the modification: - Analysis of execution of modification - Tracking of integration by departments - Formalisation of handover of equipment to Operations **Document Review****: trial in outage 1R2119, with identification of 'Department actions' to be completed before reactor mode change (OPEX from other 1300-MW sites with third ten-yearly outage).
Local mod.	**GTI:** - Analysis and validation of local modifications - Identification of impacted departments	**Integration GAT**** after execution of the modification: - Analysis of execution of modification - Tracking of integration by departments - Formalisation of handover of equipment to Operations

**Since 2016 (SDIN)*

***New in 2019*

III. Applications/Information system

Since 2016, integration of modifications is managed in the SDIN EAM information system, in process P03. Both types of modifications (local and corporate) must follow this process.

Objects in the application allow the integration of the modification by the departments to be traced ('Department Actions' are contained in an 'Equipment Action Plan' (PA EQT), linked to a modification on one of the units, designated as 'Configuration Modification – Works' (MC TX)).

The actions to be carried out in the application are as follows, depending on the different stages of integration:

1. **Planning phase**:
    - Formalisation of the analysis and planning of integration by the departments in the 'Actions' in the Equipment Action Plan
    - Formalisation of department approval to start work in the 'Department Analyses' in MC TX
2. **Execution phase:**
    - Updating of information system databases and documentation.
    - Commitment by departments, with close-out of 'Actions'.

The information system allows the integration of modifications to be managed by tracking the 'Department actions' in the 'Action plans' (BI reports).

IV. 2018 status review

	1. **Planning phase** before modification	2. **Execution phase** after modification
Corporate mod.	• Equipment Action Plans have been created, and allow Equipment and Documentation impacts to be traced in actions • Planning GATs held to analyse modification files	Delay in processing of Department Actions for updating: 60% (300 actions not processed out of 500)
Local mod.	Handled via two processes up to end of 2018: • Former process with Lotus Action Sheet • New process in SDIN/EAM	35% of modifications to be 'regularised' (40 out of 113), (modification executed but integration not complete).
EGE 2018	EGE (EDF plant safety review) strength: Conduct of GAT and GTI meetings	EGE concern: Significant number of modification files with delays in documentation integration following modification.

V. 2019 actions in progress

– Priority 3 of the site's 2019 performance agreement identifies the need to adapt our organisations to place the integration of modifications on a secure footing (MP8 objective). This objective is broken down into two targets:

1. Adapt processes and organisations for handling external requirements and modifications to absorb the workload due to the major plant refit and ten-yearly outage programmes. => Progress: 20%.
2. Integrate and execute the 2019 programme of external requirements and modifications. => Progress: 10%.

   The progress of these two actions is tracked in the CAMELEON application.

– New indicators are currently being developed, with a new tracking table for modifications (use of BI reports from the information system).

– Work is under way with the departments to deal with delays in integration.

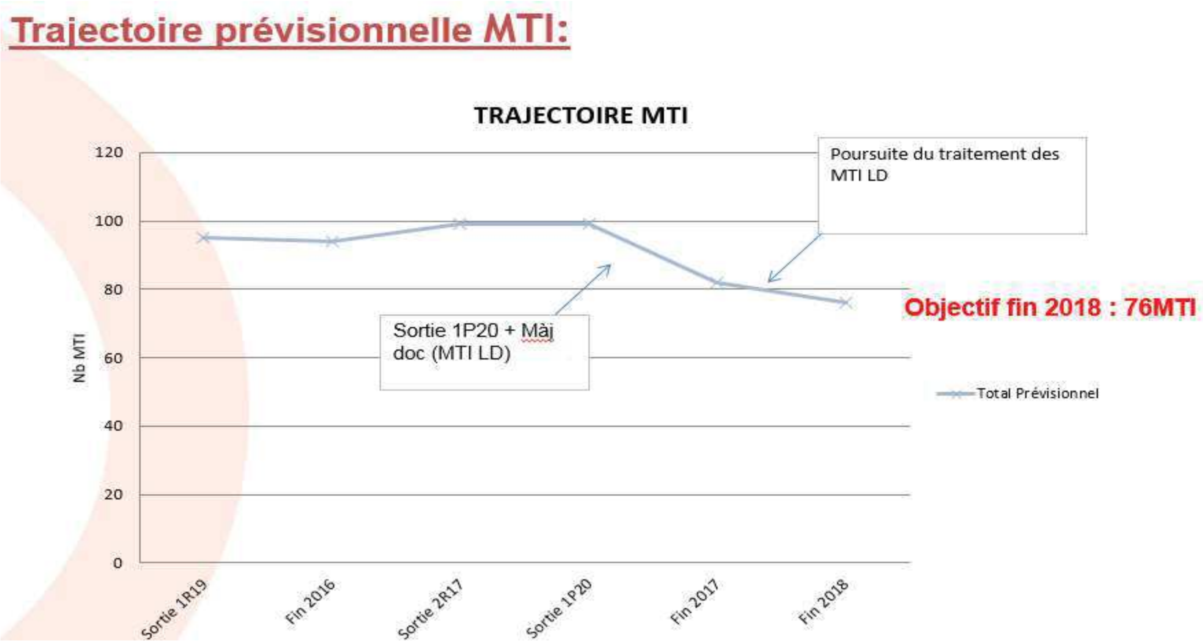
Temporary modifications

Since 2017, the plant has implemented a plan to reduce the number of long-duration temporary modifications (MTIs) (in place for more than 1 year), with the aim of reaching 76 long-duration temporary modifications by the end of 2018. Under the reduction plan, incoming flows of temporary modifications are analysed, and actions are defined to reduce the total number of temporary modifications.

The plant lead on temporary modifications (DMP and MTI type) is monitoring the progress of the temporary modifications reduction plan and the temporary modifications action plan. This individual provides an annual progress report to the plant safety committee.

The action plan has enabled a reduction in the number of long-duration temporary modifications, from 85 at February 12th, 2018 to 77 at April 16th 2019.

The actual reduction achieved has been in line with the forecast trajectory presented to the plant safety committee:



Captions for graphic:

Trajectoire prévisionnelle MTI:	Provisional trajectory for temporary modifications:
TRAJECTOIRE MTI	Trajectory for temporary modifications
Nb MTI	No. of temporary modifications
Sortie 1P20 + Màj doc (MTI LD)	End of outage 1P20 + doc. update (long-duration temporary modifications)
Poursuite du traitement des MTI LD	Continued treatment of long-duration temporary modifications
Objectif fin 2018 : 76 MTI	Objective for end 2018: 76 temp. mods
Total Prévisionnel	Forecast total
Sortie 1R19	End of outage 1R19
Fin 2016	End of 2016
Sortie 2R17	End of outage 2R17
Sortie 1P20	End of outage 1P20

Fin 2017	End of 2017
Fin 2018	End of 2018

A new lead on temporary modifications (DMP and MTI type) was appointed in January 2019, when the individual in post moved elsewhere within the company.

In April 2019, the temp. mods lead counted a total for the site of 77 temporary modifications older than 1 year, and 33 temp. mods in place for less than 1 year.

The 33 temp. mods in place for less than 1 year were installed for the following reasons:

- Emergent issue: 16
- Modification: 8
- Suppression of control room alarms: 6
- Regularisation: 3

		Summary of DMP/MTI temp. mods at 16/04/2019		
	MTI temp. mods in place at 12/02/2018	**MTI temp. mods in place at 16/04/2019**	**MTI temp. mods in place for more than 1 year at 16/04/2019**	**MTI temp. mods in place for less than 1 year at 16/04/2019**
Unit 1	**44**	49	40	9
Unit 2	**45**	45	24	21
'Unit 0' (common plant)	**14**	16	13	3
TOTAL Golfech	**103 (of which 85 long-duration)**	**110**	**77**	**33**

Orientations for 2019:

The action plan has three main areas of focus:

1/ Following the status review in April 2019, we are in the process of placing **the tracking tool on an established footing** on order to facilitate the management of temporary modifications.

2/ **The plant lead holds bilateral meetings with departments** who have been identified as requesting the installation of a temporary modification (MTI), in order to define the actions to be implemented to reduce the number of temporary modifications for which the department is responsible. The meetings also enable the project codes assigned to the Work Order Task for removal of temporary modifications to be updated on the basis of examination of the temporary modification, and allow the departments to be challenged on the development of lasting solutions for the causes of temporary modifications.

3/ **A monthly status review with shift managers and the in-cycle project** to identify the temporary modifications to be removed, and flag them as shift manager's priorities, tracked by the in-cycle/outage project (as is done for the 'Operations quality' initiative to reduce alarms and temporary instructions).

The implementation of a temporary modifications action plan, with a significant reduction over the period 2017/2018, clearly shows the improvement we have made in managing and tracking temporary modifications. We must continue our efforts in this area, particularly with regard to long-duration temporary modifications, while at the same time controlling the flow of incoming requests associated with emergent equipment problems.

IAEA comments:

The new computer tool significantly improved the overview of the permanent modification management process, but it increased the number of actions required to be performed by plant staff. The plant simplified some steps in the process to make the use of the computer tool easier for plant staff.

Periodic coordination meetings are held with all departments involved in the modification process, the purpose of which is to provide assistance and confirm readiness.

Operational coordinators were appointed to supervise the implementation process of major modifications.

A cross-functional analysis group was established to control transfer of equipment from the modification team to operations. This made it possible to improve the efficiency of this process and reduce the number of overdue and unnecessary actions.

New indicators (number of modifications to be implemented, number of pending actions and number of actions to be implemented) were established and are monitored on a quarterly basis by the modification implementation coordinator. This helped to begin the automation of process monitoring. These indicators are included in the integrated management system macro process MP8. The plant plans to revise them by June 2019 to make them more accurate.

Each department analyses the effect of each modification during the planning phase, the purpose being to improve the quality and completeness of related action plans.

However, the plant still has a significant number of overdue actions related to permanent modifications. The trending of the number of overdue modifications and actions is not performed on a regular basis.

An action plan to deal with delays in modification implementation is still under development.

The plant analysed the root causes of existing long-term temporary modifications (TM) in 2017 and defined a goal to reduce their number to 76 by the end of 2018. Actions required to close out each TM have been identified.

Progress made in reducing the number of TM was reviewed in Safety Committee Meetings in June 2017, October 2017 and July 2018. The plant senior management team identified weaknesses in the process and developed improvements to achieve set objectives.

A new tracking tool is being implemented to improve management of TMs.

A process for control of TM closure was revised and new meetings with all involved departments were introduced. This has improved communication on TM problems.

New priorities were set for the shift managers and departments to reduce the number of TMs, so they initiate certain actions.

The number of long-term TMs is decreasing constantly and has been reduced from 144 in 2009 to 77 (including 19 TMs on safety related equipment) as at April 2019. In 2017 and 2018 the plant closed 39 long-term TMs, including 15 which existed for more than 5 years. The station plans to close 8 long-term TMs in 2019, 3 in 2020-2022 and 20 during the 10-year outage (in 2022 in Unit 1 and in 2024 in Unit 2).

The plant will continue its efforts to improve management of TMs.

The corporate organisation and station management have not set clear expectations for the maximum number or closure time of TMs.

Not all long-term TM have time limits for closure, some of them (15) still waiting for corporate decision.

Conclusion: Satisfactory progress to date

6. OPERATING EXPERIENCE FEEDBACK

6.6. CORRECTIVE ACTIONS

Findings and adverse trends derived from operating experience (OE) are used as inputs in annual IMS macro- and sub-process effectiveness reviews. Comprehensive macro- or sub-process effectiveness reviews include developing actions to achieve improvement. Progress is tracked by the plant integrated management system (IMS) committees.

A comprehensive system is in place for the screening of OE findings reported through the 'Terrain' database. These are managed by managerial meetings on a daily and weekly basis. Low level findings (Category 3 and 4) are addressed by simple actions, findings of higher safety significance (Category 1 and 2) are analysed and actions are taken to prevent or minimize risk of event reoccurrences. OE data trending results are reviewed by monthly and quarterly managerial meetings to detect any drift and correct it before more serious events occur.

However, the team observed that the plant does not systematically conduct an effectiveness review of corrective actions taken in response to significant events (Category 1). Extent of cause and extent of condition are not systematically evaluated in the analysis of human performance-related significant events. Some of the recent adverse trends identified by the plant were not addressed by timely effective corrective actions, and some recent events indicate the corrective actions taken after previous similar events were not effective enough. The team has made a recommendation in this area.

6.7. UTILIZATION AND DISSEMINATION OF OPERATING EXPERIENCE

Operating experience is delivered to maintenance workers during (initial, just in time, refresher etc.) training at the mock-up training facility in the form of Operating Experience sheets. These OE sheets are attached to mock-up components requiring special attention during maintenance activities on the plant based on previous operating experience. This method has been recognized by trainees as a very effective method of raising their awareness to potential issues on the equipment they are trained on. The team recognises this as a good performance.

The team also observed a high number of positive OE findings reported through the operating experience database Terrain and used to reinforce expected behaviour in a positive manner. This was recognized by the team as a good performance.

Reporting and use of operating experience by shift personnel in operations is reinforced through a set of individual performance indicators monitored and evaluated by shift managers. Shift managers regularly reinforce the expectations during individual coaching and shift training sessions. This was recognised by the team as a good performance.

DETAILED OPERATING EXPERIENCE FINDINGS

6.6 CORRECTIVE ACTIONS

6.6(1) Issue: The plant system for developing and reviewing corrective actions does not always prevent reoccurrence of events.

The team noted the following:

- Effectiveness reviews of corrective actions taken to most significant events requiring in depth root cause analysis (Category 1 events) are not systematically implemented.
- For Category 1 events, the OE procedure for event investigation requires identification of event reoccurrence. However, no further information is provided in the investigation report if an event is identified as repeated (the question 'repeated?' is answered as 'yes' only), e.g.:
  - 27/11/13 - Incorrect configuration of sensors in the main control room
  - 26/11/14 - Incorrect configuration of sensors in the main control room

  The second event was recognized by the plant as repeated ('yes'), without any additional explanation in the report.
- Identification of event reoccurrence in significant event reports covers only Category 1 events and does not require other sources of OE to be reviewed in assessing previous operating experience.
- Investigation reports of Category 2 events do not include assessment of previous operating experience.
- The OE procedure for event investigation requires evaluation of extent of cause and extent of condition. In 2014, two Category 1 events with excursions outside the operating range of reactor coolant system pressure occurred. Both events included similar deficiencies in pre-job briefing and monitoring pressure in the main control room, but the extent of cause and extent of condition were assessed as not applicable.
- In other several reviewed Category 1 event investigation reports with human performance issues (e.g. 15/01/15 - Very low insertion limit reached on the control rods during reactor coolant system dilution), the extent of cause and extent of condition were assessed as 'not applicable'.
- On 17/01/2013, it was identified that the 2DVK122ZV fan (Fuel Building Ventilation System) was rotating in the wrong direction because two motor supply wires had been reversed by the contractor during maintenance. On 14/10/2016 a similar issue was identified on one of the fans located on the roof of Unit 1 turbine hall – the cable connections to the motor were reversed resulting in the fan rotating in the wrong direction.
- Because of recurring damage to radiation monitoring system mass-flow sensors (KRT037, 039) during a surveillance test, an action was initiated in June 2014 to analyse the possibility of a test procedure change. The problem was not treated through the corrective action programme (OE), but by the equipment reliability process. As a result of the action, the test procedure was modified without risk analysis. Incorrect implementation of the action resulted in isolation of containment activity monitoring channels 2KRT037 and 039 in compliance with the revised test procedure, causing an unplanned entry into a limiting condition for operation action statement.
- A tagging near miss occurred in March 2016. Instead of a 380 V motor tagged out for work, maintenance workers performed their tasks on a 6.6 kV non-isolated motor. The conclusions in the investigation report identified a labelling issue on the two motors, weak pre-job briefing, inappropriate equipment identification and ineffective use of error reduction tools. The corrective actions listed in the report included improvement of labelling on the two motors and briefing of electrical maintenance staff only on lessons learned, thus missing an opportunity to raise risk awareness of other personnel at the plant.

- Category 3 and 4 findings are collected for coding and trending purposes. Actions derived from trending are used as an input in the relevant process effectiveness review, but no formal causal analysis of adverse trends is conducted.
- An adverse trend in scaffolding practices was identified in the August 2016 monthly plant OE trending report. The report did not list an action to address the trend because an action had already been put in place to improve the issue. However, on 26 September 2016, a Category 1 event occurred, due to blocking of access to safety related equipment by scaffolding. On 18 October 2016 another Category 1 scaffolding event occurred, when a piece of scaffold hit a nearby pipe leading to a hydrochloric acid leak at the water demineralisation station.
- The Corporate OE procedure for trend analysis (D455014-02/1577) does not define a method of adverse trend causal analysis. Appropriate tools are not utilised in the process of adverse trend identification and evaluation.
- The plant trends causal factors in Category 1 events but does not cover Category 2 events separately.
- Corrective actions taken in response to different types of findings and issues are kept in different databases:
  - SDA for Category 1 events, WANO SOERs and other safety related matters (action from safety committees, regulator...)
  - Terrain for Category 2, 3 and 4 findings
  - IMS (SMI) database for macro and sub process effectiveness reviews
  - SYGMA for equipment condition reports

  Multiple databases render overall tracking of corrective action progress more difficult.

Without effective corrective actions, events can reoccur, and safety could be compromised.

Recommendation: The plant should improve the system for developing and reviewing corrective actions to prevent reoccurrence of events.

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.

5.30. 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.

NS-G-2.11

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 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.

6.2. The goal of any trending programme should be to identify an abnormal trend early enough that the operating organization can initiate an investigation and take corrective actions to prevent a significant event.

6.10. Once an abnormal trend has been identified it should be treated as an event, and the established deficiency reporting programme should be used to initiate an appropriate analysis and to determine whether the trend is identifying adverse performance. The level of the analysis should be based on the significance of the trend and its potential consequences. A thorough root cause investigation can be made so as to identify causal and contributing factors to explain why a trend is occurring. Corrective actions should be focused on addressing the causes and should be incorporated into the organization’s process or programme for corrective actions. Subsequent follow-up actions should be taken to verify that the adverse trend has been corrected or to modify the original corrective actions.

Plant Response/Action:

The In-Depth Event Analysis and Simplified Analysis mechanisms:

The Effectiveness Review of Actions (MEA) process is applied only to In-Depth Event Analyses (AAE) and not to Simplified Analyses (AS). The type of analysis (in-depth or simplified) is determined according to the challenges presented by each event (through adjudication or via a Corrective Action Programme Management Meeting - RMPAC).

In addition, on a yearly basis, in the course of establishing the Annual Safety Diagnosis (DAS), the Human Factor Consultant performs an analysis of the station’s recurring causes of significant events and of low-level events. On completion of these analyses, actions are defined for recurrent issues identified, such as in 2017, for example, when the issue of lack of procedure adherence led to the designation of a Lead and the creation of a Working Group to address the topic.

*** Summary of actions implemented after the OSART mission, and assessment of their effectiveness (effectiveness reviews, results, indicators).**

2017 synopsis

‘The station organisation - and its scope for 2017 – was defined (actions in response to Significant Safety Events exclusively) and meets part of the regulatory requirements of the decree governing licensed nuclear facilities (Arrêté INB) and fulfils station commitments to the Nuclear Safety Authority. This organisation was incorporated into an elementary process under the Integrated Management System (elementary process 3.ASQ01: Reporting and analysing a significant event). This process was amended accordingly. In addition, effectiveness reviews were added to the new ‘Cross-cutting fundamental: analysis of a significant event’. The station took part in the Corporate Working Group.

The organisation was rolled out gradually and was set up throughout 2017. This ensured that difficulties in implementation were identified and an action plan was drawn up:

- The organisation is not sufficiently well known, or reinforced.
- The trades must give training or refresher training on the AAE methodology to their Operational Leads for In-Depth Event Analysis (in 2017, some Operational Leads for In-Depth Event Analysis have not been trained).
- Half of the Effectiveness Reviews of Actions have not been defined and/or drafted by the time the Significant Safety Event report is approved.

- Further improvement must be made in the quality of the writing of corrective actions, to facilitate the development of corresponding effectiveness reviews and their execution; the application SMARTER for In-Depth Event Analysis is highly recommended (OE from second-level checks at Cattenom NPP).

2018 synopsis

Satisfaction can be drawn from actions that have been implemented, such as:
- The results of the Nuclear Safety Authority 'Compliance with commitments' inspection and of the corporate Operational Excellence Assessment (EGE) in 2018 (no negative observations on effectiveness reviews, and only one request for action which was promptly acted upon and incorporated into the organisation).
- A broadening in scope to the areas of environment, radiation protection and transport, as planned.
- Approval of Cross-Cutting Fundamental n°21 'Analysing a significant event', which factors in the concept of effectiveness of actions (February 2018), and which was made available to the trades when it was added to the Compendium of Fundamentals revision 1, dated May 2018 (July 2018).
- Implementation of the actions selected in 2017 (delivery of training to Operational Leads on the In-Depth Event Analysis methodology; notification through a Resident Inspection Group (FIS) report; reminder to the Strategic Leads via a Safety Committee meeting).
- Participation in the Corporate Working Group, the output from which (still in draft version) is consistent with what has already been initiated at Golfech NPP.
- Establishment of an annual report through the Safety Committee.

The 2018 results are improving - and are seen as improving by the Nuclear Safety Authority in its 'Commitments and observable evidence' inspection in January 2019 – but can be further enhanced, considering that:
- The volume of Effectiveness Reviews of Actions not yet developed at the Significant Safety Event report approval stage is still 40 %.
- The 3. ASQ01 process is not systematically implemented. This leads to parallel coordination of the process to develop Effectiveness Reviews of Actions.
- The quality of writing of actions and Effectiveness Reviews of Actions is not uniform.

The station's difficulties are predominantly linked to the fact that compliance with the process relies on the Strategic Leads, who decide on Effectiveness Reviews of Actions, and instruct the trades to conduct Effectiveness Reviews, at validation meetings. As a result, some trades do not spontaneously suggest Effectiveness Reviews, whereas the process requires them to do so. Furthermore, the station has produced a computer-based template to help the Operational Leads write their Effectiveness Reviews of Actions, but this system does not require users to make an early decision to perform an Effectiveness Review. Lastly, as no rule or criteria have been defined, the proposal of an Effectiveness Review is not mandatory or systematic.

*** Summary of actions under implementation as part of the station's 2019 Annual Performance Contract or as part of the macro-processes linked to the recommendation/suggestion.**

To make further progress on this issue, the following actions will be deployed in 2019:
- Promote proposals of Effectiveness Reviews by the trades, prior to the approval committee meeting, by adding an 'Effectiveness Review of Actions' tick-box in the regulatory analysis template.

- Reinforce compliance with the organisation, by ensuring the Human Factor Consultant provides greater support to the Operational Leads, and by establishing a Human Factor Networking Group.
- Improve the quality of the writing of corrective actions and Effectiveness Reviews of Actions, by producing an application tool to aid the quality of drafting.
- Organise the transfer of the new application tools to the CAMELEON OE database.

IAEA comments:

The 2016 OSART mission observed that the plant did not systematically conduct corrective action effectiveness reviews and extent of cause and extent of condition evaluations in human performance related significant events, and that some corrective actions were not effective in preventing repeat events. The plant analysed the issue and identified that the cause was an inadequate process for corrective action effectiveness reviews.

In 2017, a new effectiveness review process was put into place. Deficiencies identified during the implementation phase revealed a low number of effectiveness reviews, inconsistent application of the process across the plant and low quality of such reviews. Some departments did not conduct effectiveness reviews despite the process requirements.

A new action plan has been launched in 2019 that includes promoting proposals for effectiveness reviews, reinforcing the process expectations, and improving the quality of corrective actions and subsequent effectiveness reviews.

However, several recent significant events were evaluated by the plant as repeated. An initiative to improve performance of the corrective action programme is being put into place, with areas for improvement that include developing more effective corrective actions. More rigorous analysis of extent of condition and extent of cause would contribute to developing more effective actions. The implementation of the action plans to address the issue will continue in 2019.

Conclusion: Satisfactory progress to date

7. RADIATION PROTECTION

7.1. ORGANIZATION AND FUNCTIONS

A radiation protection programme is implemented and collective worker dose and planned radiological effluent releases are maintained below authorized limits and, generally, as low as reasonably achievable. However, the requirements for doses to the lens of the eye are not in line with the latest revision of IAEA General Safety Requirements Part 3 (GSR Part 3). In addition, the plant is using a minimum value for setting the alarm on electronic dosimeter at 2.0mSv/h, even when working in areas with much lower dose rates. Consequently, unexpected dose rates above the estimate for the working area may go unrecognized. The team encouraged the plant to consider the application of the new limits for doses to the lens of the eye and setting the dose rate alarms according to dose rates forecast in the work area to help prevent unnecessary doses as well as the early detection of an ongoing event.

The plant delegates several activities related to radiation protection at the plant to a contractor. However, it was observed that in some instances the standards in use are not the same for the plant radiation protection organization and the contractor. The team encouraged the plant to improve its oversight of contractors performing radiation protection activities on the plant.

The plant has implemented a training program to ensure qualification and retraining of radiation protection staff. However, the team observed that the radiation protection technicians do not routinely check the validity of their training before being assigned to a task. In case of an event involving an untrained worker, the management team could be held solely responsible. The team encouraged the plant to ensure a check of the training validity is performed daily by the worker or before every specific activity starts in the field.

7.2. RADIATION PROTECTION POLICY

The plant has established a radiation protection policy to develop the radiation protection program and related subprograms, to set expectations and to verify such expectations are met in the field. However, in some cases it was observed that worker contamination control processes were not fully followed and workers performance and behaviors did not always meet management expectations. The team made a suggestion in this area.

7.5. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING AND FACILITIES

The control of discrete radioactive particles with high activity (hot particles), is a challenging issue at nuclear power plants. To improve the detection and capture of hot particles, the plant developed a simple but effective device to capture hot particles on shoes used in the working areas of the plant using a rotating brush and a vacuumed HEPA filter unit. This process makes it easier to detect possible presence of hot particles on the filter of the HEPA units, thus reducing the potential for transferring hot particles outside the controlled area on the shoes. The team considered this as a good practice.

To perform tasks on radioactively contaminated materials, the plant constructs ventilated tents providing negative pressure inside. The plant produced a simple tool, combining an anemometer and an acrylic plate with a small window with feathers. With this equipment, radiation protection technicians can ensure the airflow is entering the tent and the flow rate measured by the anemometer complies with regulatory requirements. The team considered this as a good practice.

DETAILED RADIATION PROTECTION FINDINGS

7.2. RADIATION PROTECTION POLICY

7.2(1) Issue: The plant radiation protection program is not fully comprehensive, and management expectations are not always adhered to by workers and radiation protection personnel in the field.

The team noted the following:

- Contamination control practices:
  - In the radiological controlled area in Unit 1, a person had placed radioactive waste bags on the floor in the corridor while waiting for the elevator. The information regarding dose rate was missing from the bag label. This does not comply with plant expectations.
  - At the barrier between a contaminated area and non-contaminated area (area N to area NP), a worker using anti-contamination protective clothes leaned over and touched the top of the barrier.
  - At the end of a task in a contaminated area, a worker left the contaminated area without removing their protective clothes and overshoes and walked over to the clean area. After being alerted, the radiation protection supervisor challenged this behaviour.
  - In order to perform checks outside the contamination controlled area (border between area N and NP), a radiation protection technician removed air cylinders and face piece masks from the contaminated area, transporting them over the clean area without bagging them.
- Exposure and work control practices:
  - Radiation protection technicians and the work teams do not use the same radiological work permit; each person uses their own radiological work permit, with different settings.
  - Radiation protection technicians do not use maps with indexed points related to the smears, which would allow prompt identification of any contaminated area or existing dose rates inside a surveyed room.
  - A technician obtained a reactor coolant sample and a spent fuel pool sample without verifying the dose rates when handling radioactive material.
- Plant personnel are not quantitatively or qualitatively fit tested before being allowed to use of respirators.
- Operational Events at the plant:
  - On 28/04/2016, a person triggered a dose rate alarm when opening without authorization a shielded cask containing radioactive material.
  - On 23/05/2016, a worker triggered a dose rate alarm when working in an area using a non authorized radiological work permit and settings.
  - On 06/06/2016, a significant event related to contamination found in a room which led to a worker's unplanned radiation exposure.

Without a comprehensive radiation protection program and full adherence to the plant management expectations, the plant may not reduce the radiation protection related events suitably to minimize the probability of significant events at the plant.

Suggestion: The plant should consider enhancing its radiation protection program and ensuring full adherence to management expectations on radiation protection work practices.

IAEA Bases:

SSR-2/2 Rev. 1

4.1. … The safety policy shall promote … 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 [2].

4.2. …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.

4.3. Key aspects of the safety policy shall be communicated to external support organizations, including contractors, so that the operating organization's requirements and expectations for the safety related activities of external support organizations, including contractors, will be understood and met.

4.5. … The strategy of the operating organization for enhancing safety and for finding more effective ways of applying and, where feasible, improving existing standards shall be continuously

5.10. The operating organization shall ensure that the radiation protection programme is in compliance with the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources …

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

5.15. The radiation protection programme shall include the health surveillance of site personnel who may be occupationally exposed to radiation for ascertaining their physical fitness and for giving advice in cases of accidental overexposure. This health surveillance shall consist of a preliminary medical examination followed by periodic checkups.

GSR Part 3

3.94. Employers, registrants and licensees, …where appropriate:..

(d) … shall take all reasonable steps to ensure that the rules, procedures, and measures for protection and safety are observed;

3.95. Employers, registrants and licensees shall ensure that:…

(ii) Respiratory protective equipment the characteristics of which are made known to the users;…

(b) Where appropriate, workers receive adequate instruction in the proper use of respiratory protective equipment, including testing for good fit.

NS-G 2.7

3.44. … a radiation work permit (RWP) should normally be prepared. A copy of the RWP should be submitted to the supervisor of the work and it should be retained with the work …:

(d) protective equipment to be used in different phases of the work;…

3.50. … use of respiratory protective equipment may be necessary and should be considered. The protective equipment should meet the specifications in the RWP and any administrative procedures should be complied with.

RS-G 1.1

7.7. … situations may need to be considered in the initial medical examination and in the subsequent reviews:

(a) The fitness of a worker for wearing respiratory protection devices (if the work involves the use of such devices);…

7.8. The periodic reviews … depend on the type of the work that is undertaken, on age and health status, and possibly on the habits of the worker (e.g. smoking habits). ... Frequency … would typically be every year or every two years...

Plant Response/Action:

ARRANGEMENTS AND FUNCTIONS

Concerning radiation doses to the lens of the eye:

The criterion for radiation doses to the lens of the eye set out in the IAEA general nuclear safety standards, part 3 (GSR Part 3) has not yet been transcribed into French law.

The provisions for short-term exposure limits and reference levels are included in articles R. 4451-6 to R. 4451-11 of the work code. Only the exposure limit set for the lens of the eye is changed by the decree. It is now 20 mSv/year, as against 150 mSv/year previously. This new limit will come into force on **1 July 2023.** From 1 July to 30 June 2023, the total exposure limit for the lens of the eye is set at 100 mSv, provided that the dose received in one year does not exceed 50 mSv.

Concerning the minimum electronic dosimeter alarm threshold:

The minimum electronic dosimeter alarm threshold has been lowered. It has gone from 2 mSv/h to 1.6 mSv/h with the specific aim of protecting all workers from unplanned exposure to an orange area level dose rate.

It should be mentioned that the alarm does not detect dose rate fluctuations to unplanned values. The alarm indicates abnormal conditions entailing immediate withdrawal from the radiation exposure area. It is in fact the dose rate measurements carried out by the worker with comparison to their radiological work permit which should initially give warning of a fluctuation in radiological conditions (the station has set the following rule: if the measured dose rate > planned dose rate x 1,2 => suspension of the activity and further radiation protection actions)

Concerning supervision of the radiation protection contractor:

Supervision programmes contain some twenty supervision actions per month and the programme is adjusted according to the deviations identified in previous checks or radiation protection events reported on the station (e.g. radiography shots in 2018)

In addition, on so-called high-risk subjects (orange areas, red areas and radiography), the risk prevention department arranges training sessions with training on the flow loop simulator, at least before each outage. Since 2019, radiation protection contractor personnel has been included in these sessions.

Concerning the renewal of staff qualifications

Station arrangements for managing qualifications are as follows:

- During beginning-of-the-year appraisal interviews, the manager reviews qualifications with the technician and the qualification document is then drawn up for a one-year period.
- If the technician gains or loses a skill or qualification, the document is updated as necessary.
- On a day-to-day basis, the manager allocates activities on the basis of the technician’s qualifications.
- The training representative of each department ensures that training is scheduled for qualification renewal.

RADIATION PROTECTION PROGRAMME

In order to improve the application of station senior management standards in the field, a number of actions have been enhanced or implemented:

- **Specific actions under the station programme (Macro-process MP1, managing):** Under the dedicated field team (EDT) programme, a team of managers goes to watch activities every Thursday (4 days per manager/year) with several areas as the main theme each week, including radiation protection.

- Since 2017, **a specific check** is conducted by the risk prevention department called the 'risk prevention check' which covers industrial safety, fire protection and radiation protection. This check is performed by a person tasked to do so by the risk prevention department (SPR) head on behalf of the station manager. It entails carrying out a general check of compliance with risk prevention rules in the field. This is done on the basis of corporate and local requirements, ensuring that they are implemented. Reports are raised on the deviations and best practice identified, as well as the actions to be taken.
- The schedule is drawn up every year based on risk prevention macro-process reviews, proposals of the person tasked with the checks, risk prevention department needs and events.

- **A communication plan is drawn up annually** on the basis of the previous year's risk prevention minor events and validated by station senior management. It is designed to raise staff awareness (EDF and contractors) of risk prevention, to get them to commit to carrying out peer-to-peer coaching and to accept that others coach them and to involve management by ensuring that they play their role in driving standards and reporting up information from the field. Several channels are used for **c**ommunication:
  - Special communication during outage with communication material for personnel (EDF and contractors) and specific messages during the weekly meetings with contractors
  - Specific communication on a topic over a quarter with a message in print medium and on screens (e.g. the contamination control campaign in 2017, orange areas in 2018, etc.)
  - Annual communication during the '4S day' (nuclear safety, industrial safety, simplification and suggestion) with practical workshops on radiography shots and orange areas
  - Weekly messages (nuclear safety/radiation protection) circulated to managers to use in team dialogues, etc.
  - Articles in the station's monthly magazine (Watt's up)

- **Specific prevention messages** sponsored by the risk prevention department: at daily senior management-shift manager unit briefings which systematically begin with the message sponsored by the department head, at daily outage meetings by the radiation protection representative over the outage project and at weekly meetings with contractors by the outage manager.

- **Risk prevention department involvement in risk prevention training sessions:** during risk prevention refresher training: the SPR department is allocated a two-hour time slot to reinforce training on the station's specific features, weaknesses identified and events reported. The department is also involved in 'craft academy' training: dose management, planning of activities in the RCA, Everest specific features, etc. and, at the request of the crafts, on matters of concern: orange area access process, radiological work permits, etc.

The station considers that all these actions lead to a comprehensive radiation protection process, although worker behaviour, in the field, is not always up to expectations. The station needs to continue working on the radiation protection culture aspect for all the management line through manager meetings and training sessions. The 2019 programme includes an action to this effect and is supplemented by a request from the station manager regarding the reception information given to contractors and consideration of radiological work permits, specifically the orange area sub-process.

IAEA comments:

The plant analysed the issue and, to reinforce the application of expectations in the field by plant management in accordance with standards, has created a management in the field program, which is conducted every Thursday, with a follow-up every Monday. Although the program runs periodically, there are no clear metrics applied to measure its effectiveness.

Another program, known as the 'risk prevention check', covering industrial safety, fire protection and radiation protection, has been implemented; however, the indicators used do not enable demonstration that the program is effective.

Other approaches regarding communications and training are also in place, and since no other visible gaps in performance relating to radiation protection and the conduct of workers were visible during a short-duration plant tour, the team considered that the issue is likely to be resolved in a reasonable time frame.

Conclusion: Satisfactory progress to date.

7.5. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING AND FACILITIES

7.5 (a) Good Practice: The plant has developed an innovative system to remove contaminated particles with rotating brushes coupled to a HEPA filtered vacuum unit.

A shoe brush has been developed featuring a suction system to contain radioactive particles. Without causing damage to the shoe, this brush removes any contaminated particles that might have stuck to the sole.

Benefits:

– Prevents contamination from spreading outside contaminated work areas or outside the radiological controlled area.
– Contaminated shoes no longer have to be laundered, thus reducing the volume of liquid waste.
– Reduces the number of loaned shoes.
– Simplifies the shoe decontamination process

This shoe brush has proved very useful in improving radiation protection performance. The current result shows a reduction of contamination events picked up by C2 monitors and caused by shoe contamination.

7.5 (b) Good Practice: The plant has developed an innovative system with anemometer and small window with feathers to monitor the airflow coming from outside to inside a confined room or tent. This allows ensuring the working areas under negative pressure inside tents, preventing the contamination spread and complying with regulatory minimum airflow, by visual information on the anemometer and by checking the position of the feathers.

Main Benefits:

Radiation protection:

- Airborne contamination contained in vented tent.
- Very low costs involved to recreate this innovation.
- 20 devices installed on tents for the 2 units.
- Time required for sustainable implementation: less than a month.

Industrial safety:

- Can be used to calculate the allowable exposure time for heat stressing temperatures and control the inherent risks for working on environment at hot temperatures.

Approximately 300 kits have been ordered by French power plants.

8. CHEMISTRY

8.1. ORGANIZATION AND FUNCTIONS

An effective interface between the chemistry and operations departments exists through formal and documented meetings. For example, each Friday, a meeting is organized between the Chemistry Manager and the Operations Shift Manager to verify the status of chemistry and radiochemistry conditions important to safe plant operation. This includes a dashboard compiled by chemists that provides a visual illustration of the site chemistry status. The team considers this as a good performance.

The team observed some deficiencies in obtaining several plant samples and analyses performed by chemistry technicians. The team encourages the plant to make better use of the supervisor observation process to improve and reinforce expectations for standard sample and radiological practices while obtaining samples and performing analyses.

8.2. CHEMISTRY PROGRAMME

Plant shutdown chemistry procedures which are detailed and provide clear guidance to outage managers, operators and chemists. Well executed shutdown actions, effective primary chemistry control during plant operation and proper selection of materials, has resulted in low plant source term when compared to plants of similar design. The team recognized this as a good practice.

The unit's stator cooling water system cools the stator bars using demineralised water in hollow copper conductors. International industry operating experience has shown that corrosion and blockage of these hollow conductors may decrease the stator cooling flow rate and increase generator stator temperature. In response, plant chemists and operators use a two-stage process using existing plant equipment and pH adjustments that supports a controlled on-line cleaning without the need for adding chemicals. The team recognises this as a good practice.

The plant safety-related service water system (SEC) is not treated to prevent macro fouling or micro fouling. This is based on a comprehensive justification performed by EdF Corporate. As a result, the plant does not closely monitor and control the quantity and content of macro and micro fouling organisms when plant safety related service water system components are open for cleaning. The plant should consider benefits of such activity to ensure long-term reliability of the plant safety-related service water system. The team made a suggestion in this area.

8.4. CONTROL OF PLANT CONFIGURATION

Trending of increased sodium concentration at the plant on the secondary circuit was observed, but the plant lower limit of detection is above that observed at other plants of similar design. The team encourages the plant to consider setting a lower level of sensitivity especially for on-line sodium analysers to allow for prompt correction to avoid unnecessary accumulation of sodium impurities in the steam generators.

DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY PROGRAMME

8.2(1) Issue: The plant does not closely monitor and control the quantity and content of macro and micro fouling organisms when plant safety related service water system components are open for cleaning.

The plant safety related service water system (SEC) is not treated to prevent macro fouling or micro fouling based on comprehensive justification performed by EdF Corporate. However, the team noted the following:

- Despite upstream fine filtration, molluscs and silt are observed during cleaning of the safety-related service water heat exchangers. This is because the young molluscs travel through the fine filtration system screens and grow inside the components as well as the silt.
- Annual environmental studies are performed of the open water source used for the plant cooling, by the University of Toulouse INP-ENSAT Laboratoire d'Ecologie fonctionnelle et Environment. The following observations were made there:
    - Biological activity includes invasive species of molluscs.
    - Several species of algae have been identified which, during decay, are broken down by sulphur reducing bacteria.
- Silting occurs in the intake canal adjacent to the SEC intake pumps. Specific areas of the canal and river are required to be periodically dredged based on the amount of silt build-up.
- Maintenance performs routine cleaning of the heat exchangers but an analysis is not performed to identify and analyse impurities or identify any trends.
- Plant personnel have acknowledged that industry operating experience has shown that inadequate monitoring and treatment of sulphur reducing bacteria which causes Microbiologically Influenced Corrosion (MIC) and molluscs can result in degradation of safety-related service water pipe and components but have concluded that the design and conditions at the station mitigate the impact.

Lack of close monitoring and control of the quantity and content of macro and micro fouling organisms may lead to a missed opportunity for early detection of sources of impurities in the plant safety-related service water system.

Suggestion: The plant should consider benefits for closely monitoring and controlling the quantity and content of macro and micro fouling organisms when plant components are open for cleaning to ensure long-term reliability of the plant safety-related service water system.

IAEA Bases:

SSG-13

3.4 (d) The chemistry programme for auxiliary systems is in accordance with the material intent to preserve their full integrity and availability.

3.4 (n) Sources of impurities in the water systems are known and actions for minimizing these sources are implemented.

4.8. The corrosion rates of construction materials and the risk of microbiological growth and microbiologically induced corrosion within tertiary systems, particularly when there is a semi-closed cooling system with cooling towers, should be controlled. The risk is dependent on the water characteristics, the materials, the design of the circuit and the temperature. Such microbiological growth could affect plant staff in contact with the circuit and the population in contact with the released water or spray from the cooling tower. Consequently, this risk should be taken into account when deciding if a biocide containing chlorine should be added and at what concentration, or whether other techniques should be implemented.

Plant Response/Action:

The OSART team that took part in the Golfech OSART mission in October 2016 suggested that the station consider setting up a system to closely monitor the quantity and content of organisms causing macro/micro-fouling of components in the essential service water system. The review team considered that by not monitoring these phenomena, the station was missing opportunities to proactively detect sources of impurities in the ESW system and to ensure the system's long-term reliability.

As things currently stand, Golfech NPP has not changed its position since the OSART.

We believe that the performance of annual heat-sink health reviews, combined with EDF's technical monitoring programme (GOL/UNIE /DTG/R&D/7TEN) are an adequate means of challenging our maintenance practices and adjusting them where necessary, thereby ensuring the long-term reliability of our equipment, including that of the essential service water system with regard to fouling. Since 2016, our station has therefore not conducted any investigations, monitoring or trending to determine the content or quantity of organisms found inside ESW components when these are opened. The station does not consider that this type of systematic monitoring is warranted.

To begin with, we should point out that EDF's central organisation (the UNIE engineering support group) requires each station to carry out an annual health review of the heat-sink function. A certain number of performance indicators are mandatory, including:

- ✓ The number of unplanned group-1 tech spec LCOs per plant system (safety case).
- ✓ The number of work requests raised in response to component abnormalities (DT/AM) and an analysis of recurring defects (since 2019, these indicators have to be trended over a multi-year period).

  ** A work request is categorised as a component abnormality (AM) if it affects operational safety, environmental safety or power generation).*

Owing to the design of Golfech's ESW system, we have focused our response on CCW/ESW heat exchangers, which are the only components having to be opened for cleaning purposes. These heat exchangers are supplied with raw water that is finely filtered (1-mm mesh) by the SFI system (filtration system), this raw water having already been pre-filtered by the SEF system to eliminate larger debris and clogging agents coming from the external environment.

The CCW/ESW heat-exchange capacity is monitored by Operations on a daily basis in order to maintain a sufficient ESW flowrate (> 0.7 Qn or 2520 m3/h) and a positive fouling margin. If one of these criteria is not met, Operations then considers that the CCW/ESW heat exchanger is fouled and unavailable (uncertainty as to longer-term reliability):

- ✓ As the heat exchanger is considered to be fouled, Operations would raise a work request which would be sent to maintenance for the latter to schedule and perform cleaning work on the affected heat exchanger.

- ✓ When the heat exchanger is tagged out for cleaning, it is considered unavailable and Operations is required to enter a group-1 tech spec LCO (ref. RRI3).

As mentioned above, the number of cleaning work requests is tracked and they are trended like group-1 LCOs. In addition to the trending of these two indicators, the total down-time of CCW/ESW heat exchangers is also monitored (by Operations) as tech specs do not allow total down-time to exceed 16 days a year. Golfech NPP therefore has three separate indicators that would highlight abnormal trends in the fouling rate of its heat exchangers (recurrence of work requests and 'RRI3F' LCOs) and the amount of fouling material (extended down-time because cleaning operations would take longer).

In the past, Golfech has already had the opportunity to challenge its maintenance practices based on data gathered from the monitoring of its heat sink. In 2010, the station decided to stop cleaning its CCW/ESW heat exchangers with an acid solution and in the following years, noted that their down-time increased. In 2015, the station consequently decided to clean its heat exchangers with an acid solution once a year, thereby reducing their average annual down-time by about one day (approx. 11 days of remaining credits over the period of 2010/2015 as against 12 over the period of 2015/2017).

In addition, EDF has implemented a heat-sink monitoring programme including the pre-filtration system (SEF), in order to check for the presence of clogging agents. A specific operating procedure* relating to the heat sink (ref. D455031125353) recommends that in the event of clogging-agent ingress, a sample should be taken and sent to DTG (corporate technical division) for analysis. The last sample was taken by Golfech on 23 August 2018. Thanks to this technical monitoring programme, Golfech has regular exchanges on heat-sink clogging risks. In addition, the station's heat-sink engineer submits six-monthly indicators to DTG so that our filtration components can be monitored. These regular exchanges have also prompted the station to challenge its field-operator rounds of the pre-filtration (SEF) system (updated in late 2018) in order to ensure that they align with the expectations of our corporate organisation.

** This procedure was implemented on a permanent basis following on from version 2 of temporary corporate directive ref. DT222, issued in August 2012 and following on from actions taken in response to corporate investigation ref. AP05-03, which commenced in 2005. We can therefore state that EDF has been monitoring clogging and fouling hazards on heat-sink components for a long period of time.*

As part of the station's MP3/MRA sub-process, plant walkdowns are conducted by the station's MRA leads. During such a walkdown on 26 January 2018, shellfish were found in a sump that collects finely-filtered raw water that flows through the stuffing boxes of a forced-ventilation system pump. These shellfish developed from larvae (<1mm) that were growing inside the sludge contained inside the sump. The shells were sent to our R&D analytical laboratories at Chatou. The laboratories' feedback highlighted that this was a common species of shellfish (Corbicula fluminea) and as a consequence, no follow-up measures were taken by the station.

IAEA comments:

Just prior to the OSART, following a review of the frequency and duration for the cleaning of the heat exchangers in the safety related component cooling and essential supply water systems (RRI/SEC), the enhanced method of chemical cleaning was re-introduced (acid cleaning). Consequently, the RRI/SEC heat exchangers are now chemically treated to remove the presence of any molluscs which have the potential to extend the duration to clean the internals of the heat exchanger. This enhancement to the chemical cleaning process has reduced the time the heat exchanger is out of service for cleaning by 10% of the permissible time and increased the operating margin for the RRI/SEC systems. Since the chemical cleaning dissolves any molluscs retained inside the heat exchanger, it is not useful to carry out any chemical sampling to determine the presence of macro or micro fouling organisms when the RRI/SEC heat exchangers are opened for mechanical cleaning.

The frequency and duration of the heat exchanger cleaning is monitored and has been controlled within the technical specification limits for the past 3 years. Consequently, there have been no safety significant events associated with extended durations for cleaning of the heat exchangers and subsequent extended unavailability of the RRI/SEC systems. For 2017 there were a total of 18 occasions when the RRI/SEC heat exchangers required cleaning and for 2018 16 occasions.

The station has appointed a cooling system engineer who participates in a fleet wide heatsink network which holds conference calls every 3 months and an annual conference to exchange best practice in this field.

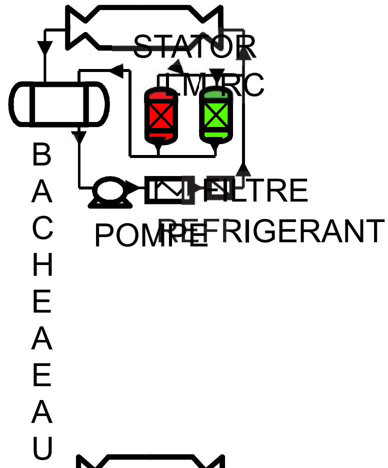
Conclusion: Issue resolved

8.2 (a) Good Practice: On-line stator cooling system purification and cleaning

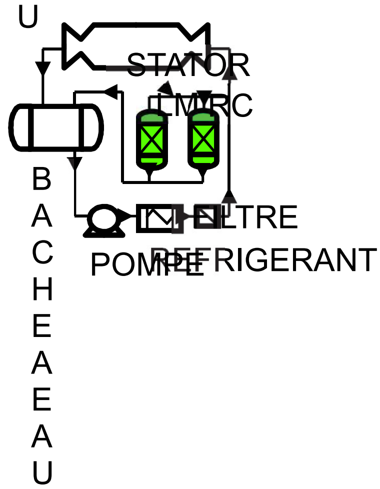
The Unit 1 stator cooling water system (GST) cools the stator bars using demineralised water in hollow copper conductors. Corrosion and blockage of these hollow conductors may decrease the stator cooling flow rate and increase generator stator temperature. International industry operating experience has shown that this has resulted in plant temporary power de-rates or shutdown to perform cleaning.

In contrast, station chemists and operators use a two-stage process using existing plant equipment, air and pH adjustments that supports a controlled on-line cleaning without the need for adding chemicals.

1. **Acidification** : a cationic resin is used on its own. Cu^{2+} ions are retained and exchanged with H_3O^+ ions, which decrease pH (acid pH). Acid pH makes the CuO copper oxides soluble.



2. **Purification** : a mixed-bed resin is used joint with the cationic resin in order to clean the stator cooling fluid.



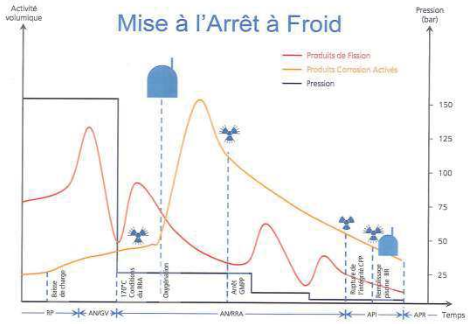
8.2 (b) Good Practice: Comprehensive actions for controlling radiation source term during plant shutdown are effective in reducing work area dose rates.

International operating experience has shown that chemistry impact on source term can be significant. This is especially important when shutting the plant down to perform equipment maintenance and refuelling operations. There are operating conditions when station conditions transition from a high temperature (325°C) reducing (H2) environment to an oxygen rich environment (air) at ambient temperature to support defueling. These stages results in various physical and chemical changes. The station chemists and operations' personnel have developed and implement a detailed procedure with rigorous chemical and radiochemical criteria for controlling these stages. Incorporation of operating experience from each outage is also incorporated for continuous improvement of operating practices.

<u>Advantages/Benefits</u>

Compliance with set criteria is essential to optimize and limit the following as low as practical:

- Risks for equipment and materials
- Impact of operation on work area dose rates
- Impact on the release of effluents to the environment



Results: The plant has one of the lowest operating source terms in the utility fleet and in the industry for plants of similar design and capacity. Also, contaminated areas are few supporting the ability of operators and other workers to perform work without frequent donning of protective clothing.

9. EMERGENCY PREPAREDNESS AND RESPONSE

9.1. ORGANIZATION AND FUNCTIONS

The plant has regular meetings dedicated to emergency preparedness with the local off-site authorities. Interactions are positive and lead to open discussions regarding potential improvements to the emergency plan. The national government and Corporate have created a joint commission in support of emergency preparedness (MARN) to ensure that joint emergency exercises are coordinated, and that appropriate exercise objectives are selected. This should lead to continuing improvements in future emergency preparedness exercises. The plant and the local fire-fighting brigade have made efforts to coordinate their preparedness for an intervention on site. There are clear protocols of support between the off-site fire-fighters and the plant. The interaction with off-site emergency responders is recognized as a good performance.

9.2. EMERGENCY RESPONSE

Personnel on call for emergency response are also on call for technical support during normal operation. For these reasons, service managers are very supportive of the emergency response recall system. This is recognized as beneficial for emergency preparedness. Once an emergency is declared, personnel on call for emergency response must be on site within one hour. For the safety engineer, the mobilisation time is 40 minutes. For all the recall exercises conducted over the last three years, the timeline was met, although several recall exercises were conducted while personnel were already on site. The plant is encouraged to consider performing unannounced recall exercises at a time when the personnel are not on site.

Although the plant has made several improvements to the emergency plan since the Fukushima accident, the team identified several issues related to the technical planning basis for these improvements. Many of these relate to the effect of severe accidents on emergency operations, and how the emergency response teams would cope with harsh conditions. The team made a suggestion in this area.

The Safety Engineer on call performs a surveillance of the conditions requiring ('emergency entry points') declaration of automatic protective actions for the population in the 2 km zone around the plant. The Plant can alert the public with sirens to shelter within 2 km if an emergency develops rapidly. The local off-site authority has delegated that authority to the on-site emergency director (PCD1). The entry conditions into the alert procedure are all based on plant measurements or dose rate measurements at the boundary of the plant, which is fully in compliance with IAEA Standards. The plant is nevertheless encouraged to consider adding further alert criteria, based on the other off-site dose rate measurements available on-line.

The team noted that there is no requirement to shave beards for Emergency Response Team personnel. Since beards can significantly reduce the effectiveness of filter masks, the plant is encouraged to consider addressing this issue.

9.3. EMERGENCY PREPAREDNESS

Although the plant has a robust emergency exercise program, the team noted that recent emergency exercises have not tested the emergency plan under the full range of conditions that could occur at the site. The team made a suggestion in this area.

The plant conducts annual inspection and testing of the emergency mitigation equipment that would be deployed during a severe accident. These full scale inspections far exceed the current Corporate and regulatory requirements. The site has shown that inspection of every piece of equipment helps ensure their availability during an emergency. The team recognized this as a good performance.

There are seven exercises per year involving emergency services (fire fighters) from adjacent departments. These exercises include rescue, medical and fire-fighting, with a radiological component. They involve the deployment of a field hospital, and mobile command post. The team recognized this as a good performance.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE FINDINGS

9.2. EMERGENCY RESPONSE

9.2(1) Issue: The on-site emergency plan does not fully address the effect of severe accident conditions on the response by plant personnel.

The team noted the following:

- The Hazard Assessment (Note de Doctrine – Gestion des situations de crise sur CNPE) that should be used to update the emergency plan dates back to 2010. Although the emergency plan has recently been updated to include post-Fukushima considerations, the Hazard Assessment has not, and is not entirely consistent with the plan.
- The plant does not have a feasibility study of the deployment of Emergency Mitigation Equipment (MLC and RLC) in severe accident conditions. A study that identifies radiological and conventional hazards during a severe accident has been drafted by Corporate but is not yet available to the plant.
- There is an alarm on the main control room ventilation system (VDC) that detects high activity and puts iodine filters into service, but the filters would not be effective for noble gases. There is a procedure to address noble gases by checking the main control room dose rate hourly, but there is no continuous monitoring of the dose rate (such as a survey meter) in the main control room.
- During an alert of severe wind conditions, the plant will declare an alert (PAM-GAT) or an emergency (PUI-SACA), but the current procedures do not include activities to prevent damage to essential equipment, such as closing doors, securing equipment, and removing objects that could become airborne.
- In addition to normal communication systems, the plant owns a satellite phone that can be used for emergency notification, and its number was provided to the off-site authorities (Prefecture). The off-site authorities have their own satellite phone for emergency communication, but the plant does not have its phone number, and therefore cannot initiate a call from satellite phone to satellite phone.
- The main control room and the radiation protection EOC (PCC) do not have a plan of the production buildings posted on a wall that would allow the team leader to warn emergency workers of hazardous areas.
- There is no off-site assembly point for the rotation of the shift crews during a severe accident. The emergency workers are expected to drive directly to the site with their own vehicles, without dosimetry or personal protection.
- There is an off-site centre used for receiving and monitoring non-essential plant personnel evacuated from the site (Local de Repli). The off-site centre cannot be used as an assembly point for emergency workers, since it is located within the automatically evacuated zone (2 km).

Without fully addressing the impact of severe accidents on response actions, the emergency plans may not ensure the safety of emergency responders.

Suggestion: The plant should consider ensuring that the on-site emergency plan fully addresses the impact of severe accident conditions on the response by plant personnel.

IAEA Bases:
GSR Part 7

4.18. Hazards shall be identified and potential consequences of an emergency shall be assessed to provide a basis for establishing arrangements for preparedness and response for a nuclear or radiological emergency. These arrangements shall be commensurate with the hazards identified and the potential consequences of an emergency.

4.20. The government shall ensure that for facilities and activities, a hazard assessment on the basis of a graded approach is performed. The hazard assessment shall include consideration of:

(a) Events that could affect the facility or activity, including events of very low probability and events not considered in the design;

(b) Events involving a combination of a nuclear or radiological emergency with a conventional emergency such as an emergency following an earthquake, a volcanic eruption, a tropical cyclone, severe weather, a tsunami, an aircraft crash or civil disturbances that could affect wide areas and/or could impair capabilities to provide support in the emergency response;

(c) Events that could affect several facilities and activities concurrently, as well as consideration of the interactions between the facilities and activities affected;

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

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

5.25 These arrangements shall take into account the full range of possible conditions affecting the emergency response, including those resulting from conditions in the facility and those resulting from impacts of postulated natural, human induced or other events and affecting regional infrastructure or affecting several facilities simultaneously.

Arrangements shall include emergency operating procedures and guidance for operating personnel on mitigatory actions for severe conditions (for a nuclear power plant, as part of the accident management programme [17]) and for the full range of postulated emergencies, including accidents that are not considered in the design and associated conditions. As far as practicable, the continued functionality of nuclear security system(s) (see Refs [9–11]) needs to be considered in these arrangements.

5.51. The operating organization and response organizations shall determine the anticipated hazardous conditions, both on the site and off the site, in which emergency workers might have to perform response functions in a nuclear or radiological emergency in accordance with the hazard assessment and the protection strategy.

EPR-Method 2003

B5.2 Off-site facilities that are not protected against a radiological release (e.g. shielding and filters) should have backups beyond the UPZ. There should be provisions to continuously monitor radiological conditions and control of contamination within the facilities and for evacuation if warranted.

Plant Response/Action :

Golfech NPP has forwarded to the EDF corporate function (National Crisis Organisation branch) five Comments Casefiles, for appraisal and analysis of a potential update to Baseline Reference Document D455034095607 revision D, dated 13/11/2014.

- Comments Casefile 2016/01 concerns the updating of corporate policy memorandum D455034090111 (policy memorandum governing the management of emergency conditions on a NPP);
- Comments Casefile 2016/02 relates to the drafting of a feasibility study report on the deployment of site emergency mitigation equipment and regional emergency mitigation equipment, identifying the radiological and conventional risks in severe accident conditions;
- Comments Casefile 2016/03 revolves around the management of a severe wind alert at the NPP, with the aim of protecting safety significant equipment on site;
- Comments Casefile 2016/04 touches on the measures to protect emergency responders during handovers in severe accident conditions;
- Comments Casefile 2016/05 concerns a significant modification to the arrangements for evacuating non-essential plant personnel to the station's off-site fallback centre. However, in the second half of 2019, Golfech NPP is to receive an Amendment Record from the EDF corporate function, authorising the abolishment of the Golfech off-site fallback centre, in agreement with the Nuclear Safety Authority, and in keeping with the new Off-Site Emergency Plan (PPI).

Golfech NPP has implemented the following measures:

- The plant system DVC (main control room ventilation system) is monitored by two gamma dose rate equivalent monitors. One detector is located at the fresh air inlet, the other, near the main entrance. If the monitors detect that the 30 µSv/hr limit is reached, the Operations shift crew switches the main control ventilation to recycling mode, in the event of a severe accident on site requiring a release of radioactive particles, in line with the 'U5' operating procedure (filtered containment venting).
- The emergency response telephone directory (D5067NOTE03920) was updated to include the satellite telephone number for the Préfecture.
- The Radiological Assessment Command Centre (PCC) and Resources Command Centre (PCM) have been equipped with site-layout maps on whiteboards, thereby ensuring that responders intervening in the plant can pinpoint high-risk and dangerous areas.

IAEA comments:

The plant analysed the issue and submitted five comments casefiles to the company´s corporate function (national emergency organisation branch) for appraisal and analysis of a potential update of the respective corporate master document D455034095607 revision D, dated 13/11/2014. Out of all the comments provided, only one is found not to be applicable to the plant. However, all the other comments have not yet been responded to by corporate, preventing the issue from being considered as resolved.

In addition, local actions are completed, such as the measurement of possible noble gases entering the control room. Even though the process is manual and reactive, progress has been made, and the team considers that the issue could be resolved in a reasonable time frame.

Conclusion: Satisfactory progress to date.

9.3. EMERGENCY PREPAREDNESS

9.3(1) Issue: The emergency exercises have not tested the emergency plan and interactions under the full range of conditions that could occur at the site.

The team observed the following:

- The national exercise completed by the site on 17 September 2013 involved a design basis accident without release to the environment. A ministerial directive issued in 2016 requires NPPs and public authorities to participate in joint exercises that test protective actions for the public. Such exercises would be conducted over two days, with the first day focused on on-site interventions, and the second day focused on off-site protective actions. However, this has not yet been implemented at the site.
- Although the plant has tested the deployment of Emergency Mitigation Equipment (MLC) under normal conditions, the plant has not yet conducted an emergency exercise that includes harsh radiological conditions on-site. Such an exercise would integrate Emergency Mitigation Equipment deployment and dose control (PCM4 – PCM5).
- The plant has exercised the deployment of the Site Emergency Mitigation Equipment (MLC), and the Regional Emergency Mitigation Equipment (MRC) separately, but not jointly. During an emergency, it is expected that workers from the plant would work side-by-side with the Regional support team.
- Every 30 min, the Local Command Post (PCL in MCR) completes a form that contains on-line radioactivity measurements in the production buildings (Message confinement). This form would be useful to plan the deployment of emergency workers carrying out interventions in the production buildings. The measurements have never been simulated (and therefore used) during an emergency exercise. As a result, the plant personnel are unfamiliar with its use for planning interventions in the production buildings.

Without testing the emergency plan under the full range of conditions and interactions that could occur at the site, safety issues may not be identified.

Suggestion: The plant should consider that emergency exercises test the emergency plan under the full range of conditions and interactions that could occur at the site.

IAEA Bases:

GSR Part 7

6.30 Exercise programmes shall be developed and implemented to ensure that all specified functions required to be performed for emergency response, all organizational interfaces for facilities in category I, II or III, and the national level programmes for category IV or V are tested at suitable intervals.

EPR-Exercise-2005

3.0 The scenarios and event types to be considered should cover a broad range of postulated events.

EPR-Exercise-2005

6.2.2 It is important to determine what the radiation fields in all areas of the facility would be as function of time so that the exercise contains some degree of realism for the emergency response teams that must circulate throughout the facility.

Plant Response/Action:

Golfech NPP has forwarded to the EDF corporate function (National Crisis Organisation branch) two Comments Casefiles, for appraisal and analysis of a potential update to the scheduling and content of corporate emergency exercise scenarios.

- Comments Casefile 2016/06 concerns the deployment of a Site Emergency Plan / Off-Site Emergency Plan over a two-day period, at Golfech NPP, with the first day focused on the topic of 'nuclear safety', and the second on 'civilian security'. However, a corporate exercise of this nature was carried out on 27 and 28 March 2018 at Golfech NPP;
- Comments Casefile 2016/07 revolves around the implementation of joint exercises, bringing together EDF NPPs and the Rapid Response Nuclear Taskforce (FARN). However, an NPP-FARN joint exercise is scheduled and approved by the corporate function, for deployment on 14 September 2019.

Golfech NPP has taken the following actions:

- An exercise to rehearse the deployment of site emergency mitigation equipment in degraded conditions was conducted on 23 and 24 January 2018. The degraded conditions applied to the exercise area were:
- Lack of site lighting,
- Hindered access as a result of an earthquake,
- Unfavourable radiological conditions and chemical hazards (requiring use of personal and collective protective equipment).
- The Site Emergency Plan's Local Command Post roleholders PUI PCL 2 and PCL 2.1 - tasked with producing the 'containment message' (online radioactivity measurement in production buildings) and '15-minute message' (dispatch sent to the Prefect every 15 minutes) - were given awareness training on drafting these messages using the simulated measurements from plant radiation monitoring channel *KRT 042 MA. The message is then sent via the collaborative information system to the Radiological Assessment Command Centre (PCC), Resources Command Centre (PCM), and Site Emergency Team (ELC), to keep the responders on site informed. However, during site exercises, the quality of the 'containment message' is not always good.

IAEA comments:

In 2018, the plant conducted an exercise over a two-day period, with the first day focused on on-site interventions, and the second day focused on off-site protective actions. A joint exercise, bringing together the company's power plants and the Rapid Response Nuclear Taskforce (FARN), is scheduled and approved by the corporate function for deployment on 14 September 2019.

On 23 and 24 January 2018, the plant conducted an exercise to rehearse the deployment of site emergency mitigation equipment in degraded conditions.
According to the plant´s evaluation, the quality of information regarding radiation levels provided to the emergency responders still needs some improvement, and the plant has addressed this item for the coming exercises.
As that, the team considers that progress has been made, and the issue could be resolved in a reasonable time frame.

Conclusion: Satisfactory progress to date.

10. ACCIDENT MANAGEMENT

10.1. ORGANIZATION AND FUNCTIONS

The plant has created training videos to demonstrate setting up specific on-site mobile emergency equipment. These videos can also be used during pre-job briefs before carrying out the action in the field during an emergency situation. Since the videos have been introduced the success of mobile equipment deployment during training exercises improved. The team recognised this as a good practice.

The plant extended the use of the integrated information system to make severe accident management guideline (SAMG) documentation, decision log information and station documentation available to the technical support centre personnel. This information is accessible from the technical support centre(s) but can also be accessed from offices on site and any off-site location in case movement around or access to the site is restricted. This tool improves the ability of the SAMG users to perform diagnosis and prognosis prior to entering the SAMGs and to verify the technical correctness of decisions made by all other command posts. The team recognised this as a good practice.

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

The current version of the SAMGs used by the station does not cover severe accidents with the primary system open, on both units simultaneously or involving the spent fuel pool. The next version of the SAMGs will include severe accidents with the primary system open and those involving the spent fuel pool, but not severe accidents concurrently on both units. Furthermore, some of the mobile equipment that could be used in the event of a severe accident is shared by the two units, which could challenge the plant's ability to respond to a severe accident concurrently on both units. The team made a suggestion in this area.

Every year, the emergency response organization performs a full scope inspection and test of every piece of Emergency Equipment to ensure its readiness. The storage conditions, material condition, test and maintenance records are verified. The connection points are inspected for access and material condition. However, the plant sets no time limit for the execution of new tests required by the Corporate directive for maintenance of mobile emergency equipment. For example, testing of the flow rates of some mobile pumps became a requirement in 2015; these tests are scheduled to be performed for the first time in 2018. The plant relies on the tests that were performed by the Corporate organisation on identical equipment prior to acquisition. The team encouraged the plant to ensure that new tests are executed in a timely manner to ensure full functionality of the mobile emergency equipment.

10.6. VERIFICATION AND VALIDATION OF PROCEDURES AND GUIDELINES

The documentation demonstrating validation of the SAMGs currently in use is not easily retrievable, which makes it difficult to demonstrate that the station's validation was indeed performed. The plant's validation of version 6 of the SAMGs is currently in progress. However, since there is no plant requirement for the filing of these documents, it was decided to only archive hard copies. The team encouraged the plant to file validation documentation in a way that is easily retrievable.

10.8. USE OF PSA, PSR AND OEF

The plant performed a benchmarking exercise with Temelin Nuclear Power Plant on the subject of severe accidents. The plant received knowledge and training material that have been later implemented in the plant's severe accident management classroom presentations. For example, the training material now includes a video of Temelin NPP's simulator demonstrating core meltdown, corium relocation, vessel failure, basemat melt-through and spreading of hydrogen in containment. This improves the ability of trainees to visualise severe accident phenomena. The team recognized this as good performance.

DETAILED ACCIDENT MANAGEMENT FINDINGS

10.2. OVERVIEW OF THE SEVERE ACCIDENT MANAGEMENT PROGRAMME

10.2(1) Issue: The plant's severe accident management programme and associated guidelines do not address severe accidents with the primary system open, on both units simultaneously or involving the spent fuel pool.

The team noted the following:

- The scope of the severe accident management guidelines version 3B is limited to plant states with the primary system closed. The station acknowledges that their SAMGs (GIAG) required by Corporate are outdated, the station validation of version 6 is currently in progress and training is planned but not yet implemented.
- Severe accident training for emergency response personnel does not cover dual-unit severe accidents, however the plant relies on nuclear rapid action force FARN to provide and install equipment to deal with severe accidents affecting both units.
- There is only one computer unit, which is used to increase the range of the radiation monitor (KRT) that is required to be installed during preparation for filtered venting (U5) on site. The nuclear rapid action force FARN does not have the radiation monitor, so it would have to be brought from another station in the event of a dual-unit severe accident. Similarly, there is only one containment spray system and low pressure safety injection system back-up connection (EAS-RIS-backup) available on site, but FARN has equipment that can replace both these functions.
- The local technical support centre (LTC) facility is currently designed to only display information from one unit (one screen that can be connected to the plant parameter monitoring system, KIT). In the event of a severe accident affecting both units, only one of the units' technical support centres will be manned until FARN arrives on site.

Without a full scope severe accident management programme the plant may not be able to cope with severe accidents with the primary system open, on both units simultaneously or involving the spent fuel pool.

Suggestion: The plant should consider including severe accidents with the primary system open, on both units simultaneously or involving the spent fuel pool in the scope of their severe accident management programme.

IAEA Bases:

SSR-2/2 Rev. 1

Requirement 19: Accident management programme

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

NS-G-2.8

5.21. Since shutdown or low power operating states contribute significantly to the risk of core degradation, the training for plant maintenance, plant modification, low power operating states or shutdown should be emphasized. It should be noted that these situations sometimes place the plant in unusual system line-ups and make extra demands on the knowledge and skills of the operations staff. Training in advance of these activities can reduce the risks to the plant and to workers.

NS-G-2.15

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

Plant Response/Action :

- **In response to the issues:**
- Version 6 has superseded version 3B. Version 6 now covers conditions with the primary system open. Training was delivered prior to implementation of the procedures, by 1 June 2017. Continuing training has been added to the September 2018 to September 2019 programme (corporate training programme under an Operations crew refresher training course).
- The SAMG do not cover a severe accident affecting multiple units. The SAMG establish mitigation actions for a severe accident on one unit, similarly to the procedures for plant operation in off-normal and accident conditions (CIA). A Site Emergency Plan for multiple-unit events (‘SACA’ – nuclear safety, extreme weather and associated hazards) has been in place since 15/11/2012 for the management of concurrent conditions on multiple units, and to prevent the consequences of an initiating event from producing several severe accidents. For Golfech NPP, the manning and resources needed to manage a concurrent accident on multiple units were tested during emergency exercises in 2017 (3 exercises), with 2 further exercises planned for 2019. The station also makes use of the OE derived from similar exercises held on other EDF sites.
- Since 13/11/2014, developments in the baseline standards for emergency response have included the deployment of the Rapid Response Nuclear Taskforce (FARN). In extreme conditions, the Taskforce can deliver manpower and equipment resources on site. It can provide support to station responders within 24 hours and can intervene within 12 hours of emergency callout. It is tasked with restoring supplies of water, power and compressed air, used to control any deterioration of the situation. Several multi-unit exercises have been led by the FARN across the fleet (in 2015, and an exercise scheduled for September 2019).
- The station is equipped with only one plant radiation measuring unit for ‘U5’ filtered venting, which is consistent with the management of a standalone accident on one unit, warranting entry into the SAMG.
- The current Local Technical Centre (LTC) has not been modified since 2016, though by 2022, the Local Emergency Centre (CCL) will deliver a Local Technical Centre that can be connected to either unit.

In response to Suggestion 10.2 (1):

- Accidents with the primary system open (excluding refuelling shutdown conditions) are covered by the V6 SAM procedures. A scenario involving a severe accident with primary system open is considered, but has so far never been exercised, either at Golfech NPP or at corporate level. The challenge is that the simulator is not designed to be representative of such unit conditions in an accident scenario. The EDF 1300 simulator can no longer simulate parameters once the 900°C mark is reached.
- The SAMG do not cover a severe accident affecting multiple units (see paragraph above).
- The SAMG do not cover a severe accident involving the spent fuel pool. However, the severe accident procedures include spent fuel pool monitoring actions, and refer back to appropriate procedures in GOR Chapter 6 in the event of deteriorating parameters. Exercises that incorporate loss of heat sink always contain a scenario in unit 6, with increasing spent fuel temperatures, triggering the deployment of emergency mitigation equipment to deliver cooling water to the reactor pool. These mitigation actions avoid core melt in the pool. The sources of water for the spent fuel pool are varied (firefighting system, conventional island demineralised water system, discharge pond) and the water is delivered via varied pumps (auxiliary feedwater pumps 0ASG701PO and 0ASG702PO, firefighting water pump 0JPP010PO). These mitigation measures are regularly tested during exercises and practice drills. These measures are also practiced in extreme conditions (at night time, without power supplies, in the dark, in a simulated earthquake).
- In 2017, the Golfech NPP emergency response organisation implemented the new SAMG, following classroom and table-top exercises during which all on-call responders involved were able to apply the procedures. The September 2018 to September 2019 Operations personnel training programme has also included a SAMG scenario in the main control room. Two exercises planned for 2019 will end with all exercise participants deploying the SAMG for approximately 1 hour and 30 minutes.

IAEA comments:

- The plant group responsible for accident management arrangements has made an evaluation of the plant's SAMGs (GIAGs) and has recognized that there are a number of limitations in the scope of SAMG application. In some cases, some information and data as well as capabilities of the plant facilities and structures appeared to be outdated and limited. This includes the following:
- severe accidents with the primary system open are not included in SAMG V3B
- severe accidents occurring on both units simultaneously and
- severe accidents involving spent fuel in the pool are not considered

Additionally, some limitations of the plant's capabilities to cope with severe accidents on both units have also been identified including the following:

- One insufficient radiation monitoring system for filtered venting (U5) on site,
- Only one containment spray system and low-pressure safety injection system back-up connection
- In each technical support centre, the display of important plant parameters is limited to one unit (however, the corporate organisation, ETCN can be connected to each unit).

As a part of the corrective action plan, the plant’s SAMGs have been reviewed and superseded by new SAMGs - version no.6 that cover conditions with the primary system open. Associated with that, plant personnel training has been timely delivered prior to implementation of these guidelines. However, although a scenario involving a severe accident with the primary system open has been considered, this has never been exercised either at Golfech NPP or at corporate level. New SAMGs do not cover a severe accident affecting both units; respective personnel training is not envisaged at the plant and known limitations to cope with the severe accidents described above still exist. The plant follows the corporate directives and relies on the nuclear rapid action force – FARN that, when on site, would be able to manage severe accidents on both units. However, such a scenario has not been exercised within the EDF fleet. The new SAMG version (no. 6) does not cover a severe accident involving the spent fuel in the pool, however, an enhanced accident procedure (CIABK), superseding IPTR/IPMC, that is being implemented, includes specific guidelines and monitoring and mitigation actions for spent fuel pool to deliver cooling water to avoid core melt in the pool. Mitigation measures stated in the guideline are regularly tested during exercises and practice drills. These measures are also practised in extreme conditions (at night time, without power supplies, in the dark, in a simulated earthquake).

EDF has implemented and is still implementing substantial material and organizational arrangements to mitigate and manage the consequences that major undesired events could cause on a nuclear power plants. On-site emergency response personnel manage multiple-unit consequences by analysing the situation and implementing the most appropriate measures to prevent the situation from escalating into a severe accident on the station’s units. However, if a severe accident were to occur on one unit, SAMG provides guidance on how to respond on the affected unit. EDF’s corporate emergency response entity, which supports the station, also has substantial means of analysis and response.

In response to the OSART finding, the station and the corporate organization will start looking into any organizational and operational improvements which could be considered regarding the response to severe accidents as part of the emergency preparedness programme, and will also implement arrangements so that these can be addressed within a reasonable timeframe.

Conclusion: Satisfactory progress to date

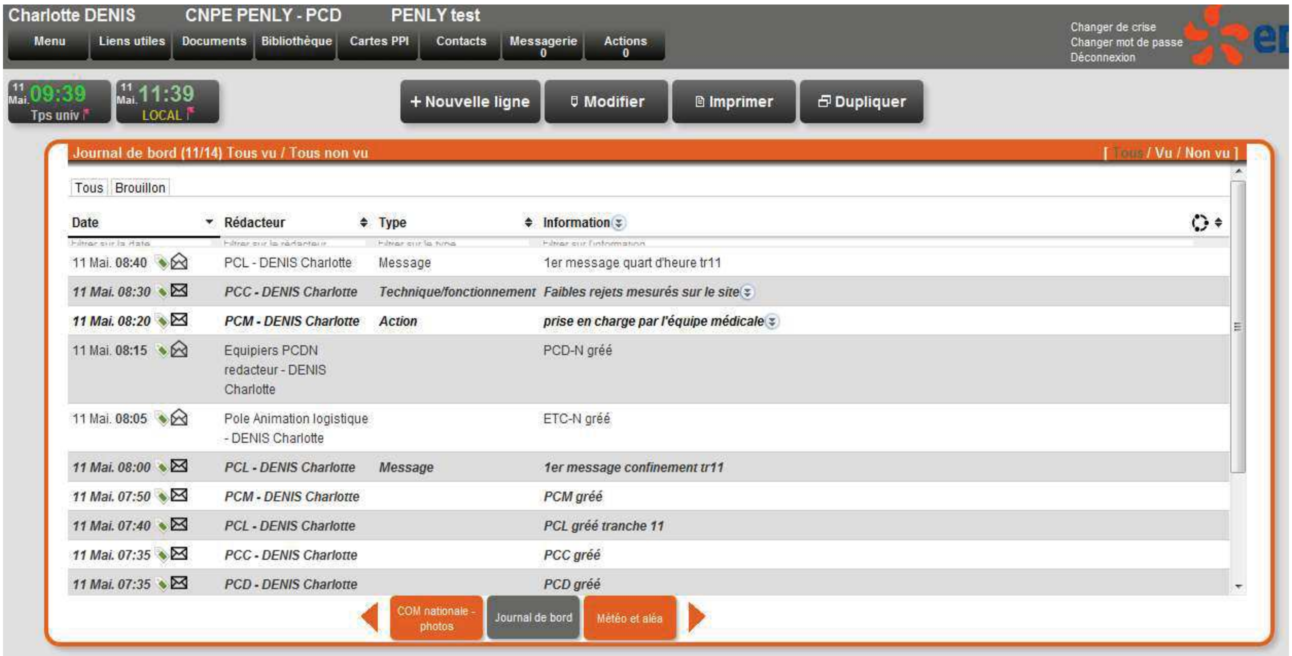
10.1(a) Good practice: Pre-Job Brief videos created to reinforce consistent deployment of plant-specific mobile emergency equipment.

The plant created training videos to demonstrate setting up of specific on-site Post-Fukushima mobile emergency equipment, for example mobile emergency air supply to the condenser bypass valves to atmosphere, flood mitigation mobile pumps and generators and make-up to the auxiliary feedwater tank.

These videos will be used during pre-job briefs before carrying out the action in the field during an emergency situation. Since the videos have been introduced the success of mobile equipment deployment during training exercises improved.

10.1(b) Good practice: Integrated information system (accessible on and off site) to make severe accident management guideline (SAMG) documentation, decision log information and station documentation available to the technical support centre personnel.

The plant has created a network information system that can be shared by all command posts during an emergency or severe accident. This system allows the technical support centre (TSC) quick access to the SAMG documentation, decision log of all other command posts and procedures used by different groups in the emergency response organisation to verify technical correctness of their action plans. For this reason, this system is particularly useful to the TSC personnel because it improves their efficiency and optimises their ability to provide oversight of technical decisions. Furthermore, the strategies recommended by the TSC are available to the nuclear rapid action force, in transit anywhere between their base and the plant, with the use of their satellite connection. This information system is accessible from the technical support centres but can also be accessed by TSC personnel from their offices and any off-site location, if movement around or access to the site is restricted.



11. HUMAN, TECHNOLOGY AND ORGANISATION INTERACTIONS

11.2 HUMAN FACTORS MANAGEMENT

Following a review in 2012, the plant recognized that Human Performance Tools (HPT) were generally not accepted and therefore not effectively utilized by plant personnel. Since then, the plant has taken several actions to improve personnel attitudes by raising awareness and understanding of the value of these tools. Since 2012, all staff have undergone general training in the use of HPT, emphasizing both technical application and understanding of why these tools are effective in preventing individuals and teams from producing errors. In addition, the plant has trained and certified 90 ‘Human Performance (HP) champions’ and 8 ‘HP masters’ (one of which is a contractor), who coach the use of HPT in the field. The HP masters receive train-the-trainer courses and regularly meet with the HP champions to give advice and identify areas for improvements. In addition to training and coaching, the plant regularly communicates aspects of HPT to staff. A magazine on HPT is distributed to all staff twice a year. Each magazine gives in-depth information on one HPT, covers the role of HPT champions, and includes OE and best practices. The plant also makes effective use of their own positive OE to reinforce the attitudes towards using HPT. The plant has developed cartoons that illustrate positive OE where workers successfully avoided an error or potential event by using HPT. Instead of stating, ‘You have made mistakes because you did not apply HPT’, which was previously shown to have a limited effect on attitudes, the message is ‘You *avoided* mistakes by implementing HPT’. By this, the plant sends out a positive message that provides clear evidence of the effectiveness of HPT. By using internal OE to develop the cartoons, positive behaviours by plant workers are publicly recognized. This practice was recognized by EDF Corporate and has since been copied by several French plants.

Although the team found some challenges with regard to the clear guidance on when to apply HPT in the field, as pointed out through a suggestion made in the Operations area, the team recognized the several coordinated efforts made to change the attitudes of individuals and teams towards the use of HPT as a good performance.

11.3. CONTINUOUS IMPROVEMENT/LEARNING ORGANIZATION (MONITORING AND ASSESSMENT)

In view of the large number of newcomers to the plant, the plant has developed training material describing major tasks affecting risk-prevention during outage. This is used by several departments in the plant, enabling experience and knowledge to be transferred effectively across the organization and was recognized as a good practice in the area of Training and Qualifications (GP2.2 (a)).

11.4 SAFETY CULTURE

A strong safety culture is comprised of several attributes that collectively demonstrate how the organization’s culture contributes to ensuring safety. The OSART team did not assess the safety culture of the plant. Nevertheless, in reviewing their cumulated observations, the team observed the plant staff as being open to share and demonstrating willingness to improve.

The team found that the plant has implemented a plan to develop the safety culture on site. Within this plan, the plant has implemented and planned activities such as workshops on the case of Davis Besse and working team discussions for the purpose of improving safety culture and leadership. These are positive developments.

To enable effective improvement of safety culture and leadership for safety, independent assessments and self-assessments of these areas, ensuring a clear and comprehensive understanding of cultural and leadership issues affecting safety, are needed.

The plant's safety culture self-assessment implemented in 2013 was the first self-assessment of safety culture implemented since 2006. It did not include all organizational levels and all functions in the organization (5 out of 12 departments) and did not sufficiently assess the characteristics of safety culture (importantly, the perception of leadership was not assessed). The assessment used only 2 methods (interviews and questionnaire), there was no document review, observations or focus groups used in the assessment. Although the plant has decided to implement self-assessments of safety culture and leadership for safety in the future, the methodology for the assessments has not yet been defined and consequently it cannot be fully demonstrated that adequate assessments will be performed. The team encouraged the plant to ensure that self-assessments of safety culture are regularly implemented in line with the newly revised IAEA General Safety Requirements on Leadership and Management for Safety (GSR Part 2) and associated guidance.

With regard to independent assessment of safety culture, the team identified that nuclear safety is independently assessed by the EDF nuclear inspectorate on a bi-annual basis, and that some aspects of safety culture and leadership for safety are partially included in this assessment. However, it is not clear that this provides a clear and comprehensive independent assessment of the organizational culture as it relates to safety and as it fosters a strong safety culture in the organization, as required by GSR Part 2. In light of this finding, the team encouraged the plant to ensure that independent assessments of safety culture are regularly and adequately implemented.

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

REVIEW AREA	RESOLVED	SATISFACTORY PROGRESS	INSUFFICIENT PROGRESS	WITH-DRAWN	TOTAL
Leadership and Management for Safety		S 1.2(1)	R 1.2(2)		2
Training and Qualification		R 2.2(1)			1
Operations		S 3.4(1) S 3.6(1)			2
Maintenance		S 4.5(1)			1
Technical Support		R 5.7(1)			1
Operating Experience Feedback		R 6.1(1)			1
Radiation Protection		S 7.2(1)			1
Chemistry	S 8.2(1)				1
Emergency Planning and Response		S 9.2(1) S 9.3(1)			2
Accident Management		S 10.2(1)			1
Human – Technology-Organization Interaction	-	-	-	-	-
TOTAL	1	11	1		13

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

Good practice

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

DEFINITIONS – FOLLOW UP VISIT

Issue resolved - Recommendation

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

Satisfactory progress to date - Recommendation

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

Insufficient progress to date - Recommendation

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

Withdrawn - Recommendation

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

Issue resolved - Suggestion

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

Satisfactory progress to date - Suggestion

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

Insufficient progress to date - Suggestion

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

Withdrawn - Suggestion

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

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

- **SF-1**; Fundamental Safety Principles (Safety Fundamentals)
- **GSR Part 3;** Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Interim Edition
- **SSR-2/1**; Safety of Nuclear Power Plants: Design (Specific Safety Requirements)
- **SSR-2/2**; Safety of Nuclear Power Plants: Operation and Commissioning (Specific Safety Requirements)
- **NS-G-1.1**; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)
- **NS-G-2.1**; Fire Safety in the Operation of Nuclear Power Plans (Safety Guide)
- **NS-G-2.2**; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)
- **NS-G-2.3**; Modifications to Nuclear Power Plants (Safety Guide)
- **NS-G-2.4**; The Operating Organization for Nuclear Power Plants (Safety Guide)
- **NS-G-2.5**; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)
- **NS-G-2.6**; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)
- **NS-G-2.7**; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.8**; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)
- **NS-G-2.9**; Commissioning for Nuclear Power Plants (Safety Guide)
- **NS-G-2.10**; Periodic Safety Review of Nuclear Power Plants (Safety Guide)
- **NS-G-2.11**; A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide**)**
- **NS-G-2.12**; Ageing Management for Nuclear Power Plants (Safety Guide)
- **NS-G-2.13**; Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide)
- **NS-G-2.14;** Conduct of Operations at Nuclear Power Plants (Safety Guide)
- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power Plants Safety Guide (Safety Guide)
- **SSG-13**; Chemistry Programme for Water Cooled Nuclear Power Plants (Specific Safety Guide)
- **GSR**; Part 1 Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements)
- **GS-R-2**; Preparedness and Response for a Nuclear or Radiological Emergency (Safety Requirements)

- **GS-R-3**; The Management System for Facilities and Activities (Safety Requirements)
- **GSR** Part 4; Safety Assessment for Facilities and Activities (General Safety Requirements 2009)
- **GS-G-4.1**; Format and Content of the Safety Analysis report for Nuclear Power Plants (Safety Guide 2004)
- **SSG-2**; Deterministic Safety Analysis for Nuclear Power Plants (Specific Safety Guide 2009)
- **SSG-3**; Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **SSG-4**; Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **GS-R Part 5**; Predisposal Management of Radioactive Waste (General Safety Requirements)
- **GS-G-2.1**; Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
- **GSG-2**; Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency
- **GS-G-3.1**; Application of the Management System for Facilities and Activities (Safety Guide)
- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
- **RS-G-1.1**; Occupational Radiation Protection (Safety Guide)
- **RS-G-1.2**; Assessment of Occupational Exposure Due to Intakes of Radio-nuclides (Safety Guide)
- **RS-G-1.3**; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)
- **RS-G-1.8**; Environmental and Source Monitoring for Purpose of Radiation Protection (Safety Guide)
- **SSR-5;** Disposal of Radioactive Waste (Specific Safety Requirements)
- **GSG-1** Classification of Radioactive Waste (Safety Guide 2009)
- **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
- **WS-G-2.5**; Predisposal Management of Low and Intermediate Level Radioactive Waste (Safety Guide)

▪ ***INSAG, Safety Report Series***

INSAG-4; Safety Culture

INSAG-10; Defence in Depth in Nuclear Safety

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

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

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

INSAG-15; Key Practical Issues In Strengthening Safety Culture

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

INSAG-17; Independence in Regulatory Decision Making

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

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

INSAG-20; Stakeholder Involvement in Nuclear Issues

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

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

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

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

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

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

- ***Other IAEA Publications***
  - **IAEA Safety Glossary** Terminology used in nuclear safety and radiation protection 2007 Edition
  - **Services series No.12**; OSART Guidelines
  - **EPR-EXERCISE-2005**; Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, (Updating IAEA-TECDOC-953)
  - **EPR-METHOD-2003**; Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)
  - **EPR-ENATOM-2002**; Emergency Notification and Assistance Technical Operations Manual
- ***International Labour Office publications on industrial safety***
  - **ILO-OSH 2001;** Guidelines on occupational safety and health management systems (ILO guideline)

TEAM COMPOSITION OF THE OSART MISSION

RANGUELOVA Vesselina – IAEA
Team Leader
Years of nuclear experience: 31

MARTYNENKO Yuri - IAEA
Deputy Team Leader
Years of nuclear experience: 32

RYCRAFT Helen - IAEA
Years of nuclear experience: 36
Review area: Leadership and Management for Safety

TOTH Alexander – SLOVAKIA
Slovenské elektrárne, a.s.
Years of nuclear experience: 30
Review area: Training and Qualification

KOTIN Petro – UKRAINE
NNEGC ‘ENERGOATOM
Years of nuclear experience: 31
Review area: Operations 1

HEIMBRAND Thomas- SWEDEN
Forsmark Kraftgroup AB
Years of nuclear experience: 12
Review area: Operations 2

CRAMER Burkhard – GERMANY
PreussenElektra
Years of nuclear experience: 23
Review area: Maintenance

BLADON Alan – UNITED KINGDOM
Years of nuclear experience: 19
Review area: Technical Support

KRIVANEK Robert - IAEA
Years of nuclear experience: 21
Review area: Technical Support

ZAHRADKA Dian - IAEA
Years of nuclear experience: 23
Review area: Operating Experience

DO AMARAL Marcos Antonia - BRA
Years of nuclear experience: 23
Review area: Radiation Protection

SEARS, Joseph – UNITED STATES of AMERICA
Institute of Nuclear Power Operations
Years of nuclear experience: 35
Review area: Chemistry

LEMAY Francois – CANADA
President, International Safety Research
Years of nuclear experience: 34
Review area: Emergency Planning and Preparedness

MOLLER Danette - SFR
Years of nuclear experience: 9
Review area: Accident Management

SKARBO Birgitte - IAEA
Years of nuclear experience: 4
Review area: Human, Technology and Organization

OBSERVERS

TARARIN Aleksei – RUSSIAN FEDERATION
Years of nuclear experience: 14

WOLTERS Carlo – NETHERLANDS
Years of nuclear experience: 0.5

BILANIC Miroslav – SLOVAKIA
Years of nuclear experience: 14

TEAM COMPOSITION OF THE OSART FOLLOW UP MISSION

MARTYNENKO YURI - IAEA
Team Leader
Years of nuclear experience: 35
Review area: Accident management

DIAN ZHARADKA – IAEA
Deputy Team Leader
Years of nuclear experience: 25
Review areas: Leadership and management for safety, Operating experience feedback

MORGAN Simon – IAEA
Years of experience: 30
Review areas: Training and qualification, Maintenance, Chemistry

TARARIN Aleksei – RUS
Years of nuclear experience: 16
Review area: Operations, Technical Support

DO AMARAL Marcos Antonia - BRA
Years of nuclear experience: 25
Review area: Radiation protection, Emergency preparedness and response