IAEA
International Atomic Energy Agency

NSNI/OSART/017/178F
ORIGINAL: English

Report
of the
OPERATIONAL SAFETY REVIEW TEAM (OSART) MISSION

to EPZ – BORSSELE

NUCLEAR POWER PLANT

THE NETHERLANDS

1 – 18 September 2014

And FOLLOW UP MISSIONS

5 – 9 December 2016
6 – 10 November 2017

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/017/178F

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of EPZ, the Netherlands. It includes recommendations for improvements affecting operational safety for consideration by the responsible Dutch authorities and identifies good practices for consideration by other utilities. Each recommendation, suggestion, and good practice is identified by a unique number to facilitate communication and tracking.

Upon agreement with Dutch authorities and EPZ, the Netherlands, the IAEA OSART Follow-up mission to EPZ involved two stages. This report therefore includes the results of the IAEA's OSART Follow up, including the first and the second stage review. The Follow-up review was completed 38 months after the OSART Mission. The purpose of the IAEA's OSART Follow-up review was to determine the status of proposals for improvement in the areas of Management, organization and administration, Training and qualification, Operations, Maintenance, Technical support, Operating experience feedback, Radiation protection, Chemistry, Emergency planning and preparedness, Safety culture, Severe accident management, Corporate functions, to comment on the appropriateness of the actions taken and to make judgements on the degree of progress achieved.

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

FOREWORD

by the

Director General

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

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

Essential features of the work of the OSART team members and their plant counterparts are the comparison of a plant's operational practices with the IAEA Safety Standards and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Series documents, including the Safety Standards and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organisation 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 organisation and considers additional comments made by plant counterparts. Implementation of any recommendations or suggestions, after consideration by the operating organisation 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.

CONTENT

INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the Dutch nuclear regulatory authority - KFD (inspectorate for nuclear safety, radiation protection, safeguards and security), an IAEA Operational Safety Review Team (OSART) of international experts visited EPZ and the Borssele Nuclear Power Plant from 1 – 18 September 2014. The purpose of the mission was to review:

- Corporate functions in the areas of corporate management, support to provide human resources, independent oversight, communication;
- Operating practices in the areas of Management, organisation and administration; Training & qualification; Operations; Maintenance; Technical support; Operating experience; Radiation protection; Chemistry; Emergency planning and preparedness; and Severe accident management;
- The safety culture of the organization, requested by EPZ with the consent of KFD. The methodology of this safety culture assessment is described in Annex 1.

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 Borssele OSART mission was the 178th in the programme, which began in 1982. The team was composed of experts from Canada, Czech Republic, France, Germany, Hungary, Slovakia, Slovenia, Spain, the United Kingdom, the United States of America and the IAEA staff members. The collective nuclear power experience of the team was approximately 370 years.

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

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

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

MAIN CONCLUSIONS

The OSART team concluded that the managers of EPZ - Borssele NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

- EPZ has a risk management officer who is responsible for development and control of integral risk management within the organization of EPZ. Integral risk management is the umbrella for all types of risks;
- The establishment of Young EPZ Professionals as a response to rapid demographic changes;
- Process maturity model for monitoring the progress and improvement of the integrated management system;
- The plant organizes six site-wide integrated exercises each year to ensure that all personnel with assigned duties during an emergency participate in an exercise each year;
- Requirements for Severe accident management (SAM) equipment in separate Plant Technical Specifications.

The team found also a number of areas in need of improvement to enhance operational safety performance. The most significant ones include the following:

- Leadership for safety is not recognized throughout the organization to ensure sustainable safety performance;
- The change management process is not effectively used to support changes in the organization;
- An effective Human Performance Programme has not been implemented;
- Expectations are not systematically being met by plant personnel nor reinforced by managers and supervisors, and some of them are not yet set;
- The plant's expectations and work management process are not robust enough to ensure effective personnel resource usage, completion of risk reviewed work, and safe work schedule stability;
- High standards of material condition in some plant areas are not consistently maintained;
- The process for temporary modifications does not provide adequate arrangements for their review, approval or control, to ensure that temporary modifications are handled in a safe manner;
- Analysis for some events has not been performed adequately to ensure that the root cause is identified and are not consistently completed in a timely manner;
- The plant workers and line management do not always take responsibility for ensuring their own or team's radiation protection and are not held accountable when the required radiation protection behaviours and work practices are not achieved;
- The on-site emergency arrangements are not sufficient to ensure the timely protection of on-site workers in the event of an emergency;

- The plant's abnormal operation procedures and EOPs are incomplete and do not address the scope of all credible plant states.

EPZ senior management and Plant 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 (upon agreement between EPZ, IAEA and ANVS the follow up will be done in two stages).

BORSSELE NPP SELF ASSESSMENT FOR THE FOLLOW-UP MISSION 2016

From 1-18 September 2014, an OSART team reviewed the operating practices and corporate functions at the NPP Borssele at the request of the Dutch regulator KFD (now ANVS).

In 2014 EPZ, with the consent of KFD, took the opportunity to request a safety culture assessment in parallel to the OSART mission, making this the first combined OSART/ISCA mission. The combined review areas resulted in 7 good practices, 21 recommendations and 9 suggestions. EPZ is very grateful to the OSART team. These results helped EPZ to find areas for improvement in its ambition to operate one of the safest and most reliable nuclear plants in the world.

Shortly after the OSART, a programme was set up by the (then interim) CEO and plant manager to start addressing the OSART recommendations and suggestions. Issue owners for al the items were appointed, action plans were developed and challenged, and progress towards resolution was reviewed in monthly meetings. In this way, the findings of the OSART review helped EPZ to implement a number of improvements.

In the area of work management, for example, cross-departmental improvement teams and a steering committee were installed, leading to a more robust process, higher schedule adherence and improved scope stability.

An FME programme (including new procedures, expectations, materials, training, and an FME committee) was set up with the involvement of the shop floor, leading to higher foreign material awareness and a decrease in foreign material threats.

A material condition plan was executed, leading to significantly improved material condition throughout the plant.

A project to redesign and improve the preventive maintenance basis justification was set up, and is currently ongoing.

A pilot project and WANO technical support mission were carried out, leading to an implementation plan for an equipment reliability process and system health monitoring.

An on-the-job training programme was set up, and a state-of-the-art work practice simulator is currently under construction, and is expected to be operational from January 2017.

The control room simulator scope and representativeness have been improved. The control room simulator now faithfully matches the actual control room, extended shutdown conditions are simulated, and the up-to-date core model is simulated.

The organisation has implemented a process to ensure that workers have the necessary competencies and formal qualifications for safe operations based on the risk(s) involved in their jobs or tasks.

A new organizational change process was implemented and demonstrated.

In the area of fire protection, personnel behaviours, housekeeping and fire safety awareness have improved. Open fire door incidents have decreased, and transportable fire load is better controlled.

A project to replace all existing labels on equipment and buildings was launched, starting with safety-related systems first. The project will be completed in the 2017 outage.

Defect tagging was introduced. On the plant, it is clear which deficiencies have been raised. The maintenance backlog is falling, and there are fewer housekeeping issues.

The emergency preparedness and response organization has been strengthened.

A new process was set up to review temporary modifications, ensuring that they are reviewed by technical support prior to installation.

An update of all emergency operation procedures and severe accident management guidelines is expected to be finished midway through 2017.

In the area of operating experience feedback expectations, new procedures were introduced, and training was improved, leading to a decrease in the backlog of analyses and a reduction in repeat events. In addition, EPZ has implemented a corrective action process.

A dose reduction programme was set up, workers were trained, and dose risk assessments were improved, leading to increased awareness, a decreased dose rate in the RCA, and lower collective dose during normal operation.

During the implementation of these improvements, the organization has gone through a number of extensive improvements. The CEO and COO present at the time of the OSART mission moved elsewhere, and an interim CEO was appointed in 2014. The organizational change project (FOCUS 2) that was under way during the OSART was completed, and new organizational changes aimed at developing a flatter organization with short communication lines were initiated. Also during this time, much effort was devoted to resolving the post-Fukushima measures and the areas for improvement from the 10-yearly periodic safety review. In October 2015, a new CEO was appointed, with a focus on safety and the needs of the shop floor.

As a result of addressing the recommendations and suggestions mentioned earlier, and having gone through the period of change, a great deal has been learned by EPZ about the more fundamental, cultural issues that the OSART pointed out. A number of structural improvements have been initiated which give confidence that these cultural, learning, leadership and managerial issues will be resolved in 2017.

Reinforcing nuclear safety as the number one priority

The first structural improvement was to emphasize in practice that safety truly is the overarching priority at EPZ. A new slogan was introduced, which roughly translates as 'We either work safely or we don't work at all'. Several sessions with an exclusive focus on safety were conducted in the canteen with all staff. Separate sessions were held with all the contractors that work on EPZ site.

Safety is always on the agenda for all team meetings and the communications department launched internal communication campaigns to support awareness.

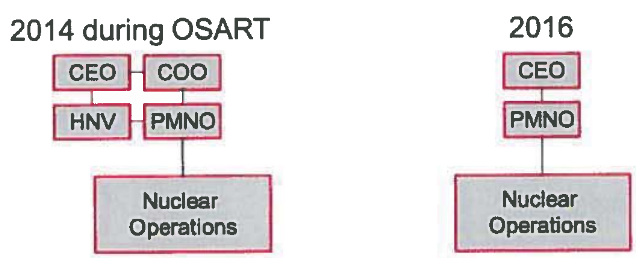
The motto of the outage in 2016 was also 'We work safely or we don't work at all', to emphasize that (nuclear) safety is the overriding priority. As a demonstration of the priority placed on safety: Two primary system check valves showed deviations. Instead of applying a quick fix, an early modification (initially scheduled for the 2017 outage) was preferred, even though it was clear that this would lead to an extension of the outage. Dose reduction measures with further impact on the outage length were preferred and granted. An otherexample is a Stop-and-Go meeting initiated by the plant manager, in which he called all contractors and staff together for an information session on safety during the outage.

To strengthen this motto further, next to finding deviations, also working safely was rewarded. There was a daily safety briefing at which outage safety indicators were discussed. Every week, based on objective criteria, the teams with the best safety performance were rewarded.

The 'Own contribution to nuclear safety' programme (EBNV) was rolled out across the entire organization. Every employee participates at least twice a year in cross-functional and cross-hierarchical sessions to discuss their own contribution to nuclear safety. The general assumption from 2014, 'We are safe', has changed to 'Are we safe?'

Reinforcing accountability for nuclear safety

The second structural improvement was a change in management structure. In 2014, during the OSART, the corporate and operational organizations were split in two, with a CEO and COO, and, as a consequence, there was no direct interaction between nuclear operations and the CEO (who was also the license holder). Also at that time, management responsibility for the nuclear plant was split in two, with one manager responsible for operations and one for nuclear safety. This situation resulted in misalignments, unclear accountability for safety, and little guidance and support from the senior management. As a consequence, expectations were not met, nor reinforced. This situation has been corrected. There is now one CEO (who has moved his office to the plant premises to be closer to the operations team) and one plant manager responsible for nuclear safety as well as operations.



Engaging all employees in improvements through the improvement programme

The third step was taken in February 2016. At that time, there was abundant evidence that fundamental, cross-departmental issues could be resolved at EPZ by working together in multi-disciplinary teams. This way of working was extended to form the EPZ improvement programme. The programme was based on WANO GL-2015-01 and IAEA-TECDOC-1491 (Management of continual improvement for facilities and activities: A structured approach). The programme was formally kicked off in a session with all staff in February 2016. The programme was the subject of preliminary discussions with management, the EPZ young professionals (YEP), external experts and the Works Council. Seven focus areas were selected by senior management for 2016, and each was assigned to a sponsor manager who was responsible for implementing the improvement. The programme itself is viewed as a learning process. At this moment, the approach is still evolving.

60 volunteers (about 15% of employees) signed up to participate in the programme. Initially, some simpler issues raised by employees and management were dealt with to get acquainted with the method. Subsequently, more challenging issues were fed into the programme. Multi-disciplinary teams always include employees who are in direct contact with the issue. The programme is headed by a steering committee made up of the director, plant manager, programme leaders and a number of employees from the shop floor. The committee meets on a weekly basis. A programme 'sounding board' of experts meets on a monthly basis to challenge progress. Progress is also tracked in regular management and work meetings. It is expected that by the end of 2017, once the programme is firmly rooted in the integrated management system, the steering group will disappear and the existing organization will take over. There is a strong focus on open and direct communication. For example, the steering committee meets in an improvement room (located in the hallway between the maintenance and operations buildings) which is open to all staff. In the quarterly canteen meetings, progress is openly discussed. The programme is discussed at team meetings. All staff are free (and are encouraged) to submit ideas.

Humble leadership

With the introduction of the improvement programme, a new 'humble' leadership style was also introduced in a collaborative effort between senior management and shop floor. A vision statement on Leadership is now formalized, which focusses on:

- Authenticity
- Giving responsibility and taking accountability
- Appreciation
- Empowerment
- Cooperation

Managers have the role of sponsor, and are expected to listen, take decisions, facilitate, lead implementation, and discuss cross-functional issues. Improvements are shared with the entire organization. Improvement analyses and implementation are planned and followed up. Improvement selection is based on a mix of people and company needs.

Management in the field

In addition to the introduction of a humble leadership style within the framework of the improvement programme, many other leadership initiatives (leadership training, leadership lunches, management in the field) are aimed at improving leadership for safety.

Culture for safety programme

The fourth step that will continue in 2017 is to further develop and sustainably improve leadership, continuous improvement and management system activities. This will be consolidated into a single culture for safety programme. This programme is based on IAEA GSR 2, Leadership and Management for Safety. Multidisciplinary teams, together with process owners and supported by management, will resolve issues and improve the integrated management system by using the improvement plan approach. This approach,

which combines the insights provided by the OSART and the lessons learned in the past two years, will help EPZ to arrive at a situation where there is clear leadership for safety, continuous learning, an integrated management system that promotes safety, and a culture in which safety remains the fundamental value. The picture below shows the transition that EPZ has embarked upon.

The experience gained from the 2016 improvement programme is used in the Culture for Safety programme, meaning the shopfloor will be in the lead, where managers act as sponsors and cooperation is the key element to success.

A steering committee consisting of staff members from each hierarchical layer of the organization (including director and plant manager) steers the programme, which is led by a programme manager. Dedicated owners of each programme element are selected; the owners are supported by multi-disciplinary teams to help them drive change.

OSART TEAM FIRST STAGE FOLLOW-UP MAIN CONCLUSIONS

An IAEA Operational Safety Review first stage Follow-up Team visited the EPZ-Borssele NPP from 5 to 9 December 2016. There is clear evidence that EPZ-Borssele NPP management and staff have gained benefit from the OSART process. Benchmarking activities with other nuclear power plants abroad were used during the preparation and implementation of the corrective action programme.

The plant analyzed thoroughly the OSART recommendations and suggestions and developed appropriate corrective action plans in the areas of Training and qualification, Operations, Maintenance, Technical support, Operating experience feedback, Radiation protection, Chemistry, Emergency planning and preparedness, Severe accident management. These corrective actions, in some cases, cover a much broader scope than was intended with the OSART recommendations and suggestions. The willingness and motivation of plant management to use benchmarking, consider new ideas, reinforce its expectations and presence in the field and implement a comprehensive safety improvement programme was evident and is a clear indicator of the potential for further improvement of the operational safety of the EPZ-Borssele NPP.

The plant resolved issues regarding:

- competencies and qualifications of personnel,
- labelling of plant equipment,
- reporting minor deficiencies in the field, management of plant storage, and use of

unauthorized operator aids,

- work management process,
- fire protection and prevention programme,
- foreign material exclusion programme,
- material condition of plant systems, structures and components,
- analysis of the results of maintenance, surveillance and inspection activities,
- temporary modifications,
- effective use of operating experience programme,
- working practices for handling of chemicals,
- responsibility of workers and line management for ensuring required radiation protection behaviours,
- effectiveness of dose reduction and contamination control techniques and practices,
- on-site emergency arrangements to ensure timely protection of workers in the event of an emergency.

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

The plant has made improvements regarding the capabilities of the full scope simulator. A work practice simulator (WPS) facility has been designed and constructed at the plant's site to enhance the plant capabilities and practices in the area of the on-the-job training. As of December 2016 the WPS was at the final stage of construction followed by installation and commissioning of systems and equipment. The plant needs to start and complete a pilot application of the WPS facility in the training process and confirm it's effectiveness.

The plant has analyzed the causes and defined an action plan to resolve the issue concerning the quality of plant Root Cause Analyses (RCA). The plant has updated the plant procedure for events analyses PU-A27-02 and defined detailed criteria for performance of RCA and apparent cause analyses. Criteria for conducting trend analyses are not yet clearly defined. In 2015 the plant issued, which provides detailed instructions on the way to conduct RCAs, however 'extent of conditions' and 'contributing causes' attributes are not yet addressed in this document. The plant has reduced the number of repeat events; however, the plant long term target of having systematically less than 10% of repeat events is not yet achieved.

The plant has evaluated the adequacy of its emergency functions and response capabilities. The qualification, competence and responsibilities of the emergency planning and preparedness teams have been defined and documented in N14-22-600. The plant has paid special attention to team work and special team building activities are planned for 2017. The plant has prepared a 5-year emergency exercise plan to ensure all response functions are tested within a given period. Since the original OSART mission no integrated emergency exercise has been performed to address severe accident scenarios; however, such exercises are planned for 2017 & 2018. The deficiencies concerning administration of iodine thyroid tablets have not yet been fully resolved as the plant needs to ensure compliance with relevant national standards for the use of medicines. The plant has developed also a new set of 13 performance indicators that are used to measure the effectiveness of the emergency preparedness programme, but some further work is needed to confirm that appropriate target values are used for these indicators.

The plant contacted Westinghouse for support to revise, update and validate the plant Emergency Operating Procedures. In 2016 EPZ became a member of PWROG and received access to Westinghouse state-of-the-art generic EOPs and SAMGs. The revision of EOPs was initiated in 2016. The revision process takes into consideration Westinghouse's generic

approach, results of the plant specific Periodic Safety Review and designer's advice provided by AREVA. Plant specific procedure P0-N07-40 using Westinghouse generic approach was developed for writing, verifying and validating EOPs and SAMGs. The revision of plant procedure NBP-E-O 'Diagnostic procedure' was completed in November 2016 as a pilot project. The plant has completed the work on shutdown and spent fuel pool EOPs and the rest of the EOPs will be updated by July 2017.

The update, verification and validation of the plant specific SAMGs was initiated in 2016 and also took into considerations lessons learned from Fukushima-Daiich accident (F-DA), EU NPP stress tests and the plant specific Periodic Safety Review. The latest version of generic PWROG SAMG issued in February 2016 is being used as a basis. The plant revision will take into consideration all post-Fukushima plant specific upgrades including installation of additional emergency mobile equipment and plant implementation of the 'in – vessel retention' concept. The new version of plant specific SAMGs will be implemented by December 2017.

The original OSART team developed 11 recommendations and 8 suggestions in the areas of Training and qualification, Operations, Maintenance, Technical support, Operating experience feedback, Radiation protection, Chemistry, Emergency planning and preparedness, Severe accident management to further improve operational safety of the plant. As of the date of the first stage Follow-up review, some 26 months after the OSART mission, 74% of issues that comprised the first stage of the Follow-up review scope were fully resolved and a further 26% of issues were progressing satisfactorily. It has been agreed that the latter issues will be looked at again by the IAEA during the second stage follow-up mission in November 2017.

The team received full cooperation from the EPZ-Borssele NPP management and staff and commended the comprehensive actions taken to analyze and resolve the findings from the original mission. The team was supported as needed and allowed to verify all information that was considered relevant to its review. In addition, the team concluded that the managers and staff demonstrated good commitment to safety and were very open and frank in their discussions on all issues. This open discussion made a considerable contribution to the success of the review and the quality of the first stage Follow-up review report.

BORSSELE NPP SELF ASSESSMENT FOR THE FOLLOW-UP MISSION 2017

In the 2016 follow-up mission the OSART team assessed all operational issues (TQ, OPS, MA, TS, OEF, RP, CH, EPP, SAM) and reviewed progress on the stage 2 issues (MOA, Corporate Functions, and SC). The team appreciated the work EPZ had done on all issues and of the 19 operational issues assessed 14 as 'fully resolved'. The remaining 5 were assessed as 'satisfactory progress to date' and EPZ asked the team to reassess these issues in addition to MOA, Corporate Functions and SC during the stage 2 follow-up. Furthermore the team would review sustainability of the already resolved issues as well.

After the 2016 follow-up mission EPZ continued addressing all issues with the ambition to resolve all issues and ensure sustainability for the resolved issues.

The Work Practice Simulator (WPS) has been commissioned shortly after the 2016 follow-up and is in use ever since. Sessions in the WPS have been added to personnel qualifications and a multi-year training programme is defined for initial qualification and proficiency.

With revised criteria and an improved procedure for performing root cause analyses, EPZ has improved speed and quality of RCA's. Together with an improved corrective action programme a significant reduction of repeat events has been obtained.

Several team building sessions increased involvement of and ownership at the emergency planning team. An extensive set of indicators have been defined and is used to monitor and improve performance of the EPP process and of the plant's emergency preparedness. Systematic training and exercising is based on formal qualifications and ensured with a 10-year schedule in which all relevant aspects of emergency response are covered. Formal validations and use of operational experience have been implemented in procedures and are being practiced.

The plant has expanded its set of emergency operating procedures and revised their layout to the latest generic PWROG format. Verification has been finished and validation, mostly on the full scope training simulator, is ongoing until October 2017.

17 procedures for use of mobile accident management equipment have been prepared and are ready for use during severe accidents. The set of SAMG's has been expanded and modified to include the recent plant modifications and use of mobile AM equipment. In Q3 the concept has been validated in a series of integrated emergency exercises. The evaluation of these exercise will be finalized in December 2017.

The revision of the SAMG's to the new PWROG's format is scheduled for early 2018. Validation of these revised SAMG's is planned to be done mid 2018.

The scope of the Integrated Management System has been expanded and is virtually complete. Also the use of KPI's has been improved. Process indicators have been defined and implemented and KPI's are used at the business level as well. Monthly and quarterly reports are used to monitor process performance and business plan progress. Continuous improvement is fully implemented in the IMS. The mandatory 2-yearly Periodic Safety Review over 2015-2016 includes an evaluation of the IMS.

A clear and simple definition of nuclear safety at EPZ has been written and is continuously communicated. A specific programme called "Eigen Bijdrage aan Nucleaire Veiligheid (EBNV)", which loosely translates into "My own contribution to nuclear safety", has been developed and implemented in 2015. Workers discuss in a small, diverse group what nuclear safety means to them in their daily work. It has improved a common understanding of nuclear safety and his/her contribution to nuclear safety. Due to the group's diversity understanding and appreciation of each other's work improved.

In 2016 EPZ has set clear expectations for her leaders to create a culture of trust and openness. In 2017 the "humble leadership" was selected as the EPZ leadership model. Assessments of all managers and other (potential) leaders have resulted in collective and personal development initiatives and some changes in management positions.

In 2016 EPZ also launched the improvement programme "Samen Steeds Beter", which loosely translates into "Better and better together". Clear identification of manager's accountability and responsibility for key processes resulted in improved management involvement in improvement activities. Small cross-departmental groups were assembled, each taking on an issue to solve. Focusing on a tangible problem and active involvement of the shopfloor in these groups resulted in many practical solutions with a high degree of acceptance and improved co-operation between departments.

The management expectations have been updated and are now better aligned throughout the organization. 5 basic expectations have been formulated and are the fundamental expectations on which all other management expectations are based. A 'sounding board' with members from all levels in the organization was founded for the rewriting and implementation phases. Availability has been improved (intranet) and new booklets have been handed to each employee. Discussion in team meetings and a new Management in the Field programme are essential elements in communicating the management expectations and enforcing adherence.

The procedure for organization changes has been updated and validated during several organizational changes since 2014, such as the merging of the corporate and plant management teams into a single Site Management Team. Nuclear safety impact and risk evaluation are mandatory steps in this procedure. Phases and key decisions for non-technical projects, such as organizational changes, have been aligned with the procedure for technical projects, ensuring a structured and thorough process from initiative to implementation and evaluation.

A dedicated Human Performance Coordinator started January 2017. Responsible for the HP programme development and implementation, the coordinator presented a 3-year programme that was approved by plant and site management in April 2017. Benchmarking other operators was used as input for the HP programme and support from WANO was obtained in the process. The WPS, invaluable for training in the use of HP tools, is incorporated in the HP program. HP is incorporated in the Integrated Management System under Leadership for Safety and the 3-year programme is included in the EPZ business plan. KPI's have been defined and show positive trends.

A true Corrective Action Process has been installed. A CAP coordinator has been appointed, procedural guidance has been updated and separate action lists have been merged into one site wide action database. Improvement of the CAP process is supported by KPI's. The Site Management Team uses the CAP to decide on priorities and to monitor progress and CAP performance. KPI's show a positive trend in action backlog and timely implementation of actions.

Examples of continuous improvement in areas assessed in 2016 as resolved include completion according to plan of the labeling project, increasing performance in housekeeping and material condition, improved work schedule stability, reduction in FME events, and better use of operating experience feedback.

OSART TEAM SECOND STAGE FOLLOW-UP MAIN CONCLUSIONS

An IAEA Operational Safety Review Follow-up Team visited the EPZ-Borssele NPP from 6 to 10 November 2017. There is clear evidence that EPZ-Borssele NPP management and staff have gained benefit from the OSART process. Benchmarking activities with other nuclear power plants abroad were used during the preparation and implementation of the corrective action programme, the Management in the Field programme, the Human Performance programme, and the Equipment Reliability process development.

The plant analyzed thoroughly the OSART recommendations and suggestions and developed appropriate corrective action plans in the areas of Management, Organization and Administration, Independent Safety Culture Assessment and Corporate Functions. These corrective actions, in some cases, cover a much broader scope than was intended with the OSART recommendations and suggestions. The willingness and motivation of plant management to use benchmarking, consider new ideas, reinforce its expectations and presence in the field and implement a comprehensive safety improvement programme was evident and is a clear indicator of the potential for further improvement of the operational safety of the EPZ-Borssele NPP.

During the OSART follow-up 2nd stage the team noted activities performed by the plant in 2017 to ensure sustainable results are maintained and continuous improvement is sought in areas where during the OSART follow-up 1st stage issues were evaluated as resolved. In particular, the plant has used a comprehensive set of KPIs to monitor and confirm the positive trends in:

- competencies and qualifications of personnel,
- labelling of plant equipment,
- reporting minor deficiencies in the field, management of plant storage, and use of unauthorized operator aids,
- work management process,
- fire protection and prevention programme,
- foreign material exclusion programme,
- material condition of plant systems, structures and components,
- analysis of the results of maintenance, surveillance and inspection activities,
- temporary modifications,
- effective use of operating experience programme,
- working practices for handling of chemicals,
- responsibility of workers and line management for ensuring required radiation protection behaviours,
- effectiveness of dose reduction and contamination control techniques and practices,
- on-site emergency arrangements to ensure timely protection of workers in the event of an emergency.

During the 2nd stage OSART Follow-up the team also evaluated the progress implemented in the review areas where satisfactory progress was observed during the 1st stage OSART

Follow-up. Issues related to plant training facilities, event root cause analyses, development and validation of EOPs and evaluation of emergency functions and response capabilities were found resolved. The team noted the plant modifications performed in 2017 for easy connection of mobile emergency equipment to the plant, e.g. to allow utilisation of "in-vessel retention" concept in the plant severe accident management strategy and development of associated procedures. The plant is continuing to perform the work necessary to complete the revision and validation of the new SAMGs and is expected to finalise this process by mid-2018.

The original OSART team developed 22 recommendations and 8 suggestions in the areas of Management, Organization and Administration, Training and qualification, Operations, Maintenance, Technical support, Operating experience feedback, Radiation protection, Chemistry, Emergency planning and preparedness, Severe accident management, Independent Safety Culture Assessment and Corporate Functions to further improve operational safety of the plant. As of the date of the second stage Follow-up review, 11 months after the first stage OSART Follow-up review, 29 issues made by the OSART team have been fully resolved and 1 issue was progressing satisfactorily.

The team received full cooperation from the EPZ-Borssele NPP management and staff and commended the comprehensive actions taken to analyze and resolve the findings from the original mission. The team was supported as needed and allowed to verify all information that was considered relevant to its review. In addition, the team concluded that the managers and staff demonstrated good commitment to safety and were very open and frank in their discussions on all issues. This open discussion made a considerable contribution to the success of the review and the quality of the second stage Follow-up review report.

1. MANAGEMENT, ORGANISATION AND ADMINISTRATION

Some documents describing the organisational chart have not been updated since 2009, and some job descriptions have been reviewed very recently, although the organisational changes took place more than one year ago. The implementation of the Nuclear Safety Section was undertaken without performing a preliminary safety evaluation due to time pressure. The team encourages the plant to include the documentation updates in the planning for organisational changes.

The functions and responsibilities of processes owners and leaders are not described. Senior managers have been appointed as sponsors for SOERs, but their role is still to be defined. The team encourages the plant to develop and communicate the functions and responsibilities of the staff involved in process management or acting as sponsors in any area.

1.2 MANAGEMENT ACTIVITIES

The team observed weaknesses in the implementation of the plant's Human Performance programme, such as lack of resources, actions from the implementation plan being late and no tracking of its effectiveness by management. The team recommends the plant undertakes the effective implementation of a Human Performance programme and ensures that it is sufficiently staffed and continuously improved.

The plant has developed a process maturity model for easy and timely communication on the developments and improvement of the integrated management system. The team considers this as a good practice.

There is no systematic and formal review of the effectiveness of communications undertaken by the organisation, such as surveys, interviews or assessments. The team encourages the organisation to develop an effectiveness review of its main communications in order to check that messages reach the intended recipient and are properly understood.

1.3 MANAGEMENT OF SAFETY

The team observed examples of the organisation responding reactively in some of the programmes or processes for which no actions have been undertaken until performance has decreased (e.g. SOER implementation, safety culture improvement, work management and corrective action programme). The team recommends the plant implement the necessary tools, programmes, monitoring and trending systems to ensure that a comprehensive and effective Integrated Management System is used to manage and continuously improve performance.

Some examples of deviations from the plant's standards and expectations were observed during plant tours or observations performed by the team. Some expectations in the radiation protection area were not set. Signs of a non-challenging attitude among managers and supervisors were detected. The team recommends the plant ensures that expectations are set and being met by plant personnel and reinforced by managers and supervisors.

The Integrated Management System (IMS) Handbook does not describe the graded approach used to prioritize the improvements needed in the system itself and on the activities within its scope. The satisfaction of stakeholders or interested parties assessment is not included within the IMS scope and there is no formal management review of the overall IMS. The team encourages the plant to develop its IMS in order to cover all these aspects.

1.4 QUALITY ASSURANCE PROGRAMME

Nuclear-grade items, products and services are qualified through the German VGB group list (audits of suppliers by other plant's QA are accepted). This list might not be available after the phase out of the German plants in 2022. The organisation does not perform audits to approve suppliers that provide nuclear-grade equipment or services and are not in the VGB list. Even though the cause of an unplanned outage was a weakness in the quality system of a supplier (it did not configure a design change and supplied a rotor that was not suitable), QA has not undertaken any additional independent check or audit on this supplier. The team encourages the organisation to plan the necessary arrangements in order to ensure that the necessary audits and inspections are performed on nuclear-grade suppliers in the long-term.

1.6 DOCUMENT AND RECORDS MANAGEMENT

The site process for procedures (working instructions) requires review and approve by the line manager and then by the department manager. For various reasons, this can mean that the reviewer may have no technical knowledge of the area covered by the procedure, when in some cases it may be more appropriate to ask a peer to undertake the review. For example, a radiological protection (RP) procedure for the calibration of RP instrumentation is reviewed by two people without specific knowledge of what is involved. The team encourages the plant to ensure that safety procedures are reviewed by personnel with appropriate technical knowledge.

DETAILED MANAGEMENT, ORGANISATION AND ADMINISTRATION FINDINGS

1.2. MANAGEMENT ACTIVITIES

1.2(a) Good Practice: Process maturity model for monitoring the progress and improvement of the integrated management system.

EPZ has developed a process maturity model. Its main purpose is to make communication about the status of a (complex) Integrated Management System (IMS) easy and to help process owners and management improve the management system.

The maturity model is a powerful tool because:

- It serves as a common reference for talking about processes, which makes communication about the status of the IMS easier;
- It helps to create awareness about the gaps within the IMS;
- It shows which aspects of a process need the most improvements;
- It stimulates process ownership;
- It helps to make objectives SMART and to make progress visible.

The model is based on six areas that are key for any process: process ownership, process performance, process risk control, process compliance, process structure and process execution. For each area the maturity level is determined periodically. Characteristics of the levels are:

- Not present;
- Activities are only done when necessary;
- Activities are done but not organized as a process;
- The process is well organized and executed;
- Pro-active behaviour and continuous improvement are normal.

In December 2012 two internal auditors assessed twenty processes. The average maturity level of the assessed processes was 3.1. This was communicated to the senior and middle management and created the awareness and sense of urgency required to start the IMS improvement project that is currently on-going. Now the maturity of a process is assessed during the execution of internal audits and progress is monitored and reported by the Quality Assurance Department.

Currently the average process maturity level (same processes as in 2012) has increased to 3.3. The best example of a single process improvement is the ICT process: 2.2 (Dec. 2012), 2.5 (Sept. 2013) and 3.6 (July 2014).

1.2(1) Issue: An effective Human Performance Programme has not been implemented. The following observations were made:

- A plan for the implementation of the HP programme was approved by the interim Plant Manager in May 2013.The required resources are not in place;
- The HP programme has no metrics to measure effectiveness;
- Approximately 50% of the actions to implement the HP programme are postponed;
- Supervisors are expected to provide informal and verbal feedback to managers about what they observe in the plant. They are only expected to make a formal report when something significant happens. Due to this, no reporting data is available for trending, evaluation or setting improvement actions;
- Only 24 selected people have been trained as HP-leaders two years since the programme was initiated; the training of more HP Leaders is progressing slowly;
- Expected personal behaviours for leaders, supervisors and employees are neither defined nor systematically reinforced;
- The Maintenance Division has 4 indicators for leadership and safety culture. All of them are associated with the revision status of documents and procedures;
- Managers of the plant stated during the interviews that leadership is not demonstrated in the field mainly due to the volume of work that managers must perform in their offices;
- The plant observation programme focuses on plant status and condition rather than on personal behaviours. No feedback on behaviours is provided in the quarterly reports from Class Base or the semi-annual report of WANO observations;
- Task observations are not included in the station toolbox for HP;
- Human Performance is not being tracked by the plant's annual plan and it is not a focus area of the company's business plan;
- Deviations observed during plant tours are assigned to the department responsible for their resolution. There is no follow up by management and no improvement actions are established as a result of the overall programme assessment;

Interview with field operator and review of walk down report:

- The Operator had two walk downs with managers in last three month. Only housekeeping and technical details were addressed by the managers during the walk downs. None of the Human Performance expectations, listed in the 'red booklet', were addressed;
- A review of the latest report, submitted by a manager following his walk down with field operator contains only 2 comments, both technical.
- The team identified that Human Performance and Safety Culture (HPSC) topics are integrated into training programmes for Field Operators, HPSC topics are included in the exit test. There is a procedure A09-26-N009 'Human Performance Techniques for employees'. The 'Learning goals for the Control Room Simulator (CRS)' PO A 11-23-009 include the use of Human Error Prevention Tools (HEPT) at CRS. However, the observations and interview revealed the following;

- Field operators only partially receive training in HEPT (classroom training only) as they are not part of CRS training;
- Management expectations, recorded in a booklet for plant personnel, require use of 3-way communication when performing activities in step-by-step procedure, switching 'ON' or 'OFF' equipment, or communicating equipment statuses ('opened/closed'), but in an interview plant operators stated that 3 way communication has to be used only in a real emergency or in case of misunderstanding, caused, for example, by noisy environment;
- Some managers stated that use of HEPT needs reinforcement, for example by proper coaching in the field;
- Records of trainer's comments/post job critique after specific CRS session are not available, formal protocols of CRS training 'Jahresgesprach' reflect very good use of HEPT by operators during CRS sessions, which contradicts the real performance of MCR and field operators observed during Safety Systems test.

Interview with OE department head and review of OE documentation:

- 77 events out of 79 analysed during 2013 are identified as caused by Human Factors, 57 of which are related to OPS practices;
- When asked why OE is not included in the pre-job briefing (PJB) for surveillance tests of safety systems and not addressed by plant operators during their PJB, an OE manager replied that this is also their concern and expectations to use OE have to be reinforced;
- Review of the latest INES Level 1 event report (Event 13/004) – Electrical short in DA Busbar during insulation resistance measurement (0,4 kV, Safety Busbar) led to Reactor transfer to Mode 5 (Cold shutdown) – caused by a chain of human performance shortfalls, including:
  - Potential for mistake was not discussed in PJB;
  - Lack of attention;
  - Lack of questioning attitude;
  - Lack of self-assessment;

Without implementing of an effective Human Performance programme the probability of events caused by undesired behaviours may increase.

Recommendation: The plant should undertake the effective implementation of a Human Performance programme and ensure that it is sufficiently resourced and continuously improved.

IAEA Bases:

SSR-2/2

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 leadership, protection of health, human performance, protection of the environment, security and quality, and so that safety is not compromised by other requirements or demands.

4.29. Aspects of the working environment that influence human performance factors (such as work load or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel.

NS-G-2.4

6.61. A suitable working environment should be provided and maintained so that work can be carried out safely and satisfactorily, without imposing unnecessary physical and psychological stress on personnel. Human factors which influence the working environment and the effectiveness and fitness of personnel for duty should be identified and addressed. The operating organisation should establish an appropriate programme for these purposes.

Plant Response/Action:

Summary of underlying causes:

An effective Human Performance Programme, that is sufficiently resourced and continuously improved, had not been implemented in our organisation. A multidisciplinary root cause analysis revealed a lack of clear management expectations about the need of a company wide Human Performance programme. Before 2014, different initiatives had been implemented, but never as an integrated programme. The total of initiatives was too complex, nor adequately managed.

Summary of improvement activities:

Without implementing an effective company-wide Human Performance (HuP) programme, the probability of events caused by undesired behaviours may increase. Nowadays, management clearly acknowledges and supports the need of a company-wide HuP programme. As a result, an HuP programme has been introduced (based on WANO best practice), and a fulltime HuP-coordinator has been appointed. The programme is linked to the Management In the Field Programme to reinforce (HuP-) expectations in the field. One of our basic organization wide management expectations is: “We use HuP tools to perform our work safely”.

The official HuP programme started with the reintroduction of existing HuP tools to ensure that we use them in our daily work, to work safely and correctly. This part of the programme is known as ‘the HuP theme campaigns’. The goal is to focus, to repeat and to pay attention to all HuP tools by one at a time. In this way, workers will be confronted with all HuP tools, and they will know/learn why we need them, and how and when they have to be applied. Many employees are involved in this process to secure that the improvements are in line with our daily work practices.

Additionally, HuP trainings are being organised at the new Work Practice Simulator (WPS). In the WPS, it is possible to practice the use of the HuP tools, attitude and behaviour in real(istic) working conditions.

The number of Human Performance trainings, as part of the yearly refresher trainings for Operations and other departments, has been increased substantially.

In order to support the use of HuP tools, Human Performance leaders (~60) were trained to assist the organization with the usage and reinforcement of HuP tools.

Effect:

Pre-job briefings have improved significantly in both frequency and quality. This will eventually result in less human errors.

In the control room, NATO alphabet for communication is consistently being used for identification of plant components.

HuP is becoming a more positively discussed topic in the organisation. The HuP programme is implemented, monitored and will be continuously improved. The Management in the Field programme is being used to improve and reinforce the use of HuP tools.

IAEA comments:

The plant performed a root-cause analysis to recognize that there was no structured Human Performance (HuP) programme and no clear expectations from the management on the need to have such program. However, some elements existed such as 3 way communication, the HuP leads (ambassadors) and NATO alphabet.

From 2014 to 2016 there was no full time dedicated resource to ensure a proper development of a comprehensive HuP program. From January 2017, a Human Performance Coordinator was appointed with the responsibility to conduct the HuP programme development with the full support of the senior management. The programme was presented to and approved by the Site Management Team in April 2017. The use of HuP tools is one of the 5 basic management expectations which makes visible the commitment of the Senior Management Team in this respect.

The programme is structured on preventive measures and corrective measures.

Preventive measures are:

- Training sessions for all staff included contractors,
- Theme campaign to promote each of the tools
- Tasks observations and coaching that are part of the Managers in the field program.

Corrective measures are essentially event screening and analysis where human performance is identified as a potential implication.

An important benchmark with other operators has been made to define the programme and the plant also got a strong support from WANO.

The human performance process is part of the Integrated Management System under the Leadership. The 3 year HuP programme is in the business plan and associated with a set of performance indicators. A process performance review is performed monthly, and a QA report produced quarterly. Associated KPIs are analysed:

- leading KPI's to evaluate process effectiveness and identify necessary improvements
- lagging KPI's to evaluate the output of the process across the whole organization.

The Work Practices Simulator (WPS) is now operational. About 60 HuP Leads (ambassadors) have been trained on the simulator to reinforce the use of HuP tools in the field. The team had the opportunity to observe a session on the pre-job briefing for the conventional work.

The WPS is used for specific HuP training and other training sessions where HuP tools have to be used. Totally 186 employees have participated in a training on the WPS since the official start of the trainings on the WPS in September 2017, 61 of them have been trained in a specific HuP training and 125 on other type of training. Additionally, 82 employees participated in the HP training "Teamwork" and 23 employees in the HP training "communication".

A HuP toolbox campaign has been launched to embed the understanding and use of HuP tools. These campaigns are designed to be interactive and spread over 3 sessions:

- Introduction of the tool e.g. PJB, dialogue and exercise to be prepared for 2nd session,
- Feedback on exercise, practice and experience,
- Resulsts analysis.

The team clearly perceived that human performance is the object of a permanent attention in all activities including non-technical ones (finance).

The number of events involving human performance has decreased from 30 in 2nd quarter 2017 to 7 in 3rd quarter.

Conclusion: Issue resolved

1.3. MANAGEMENT OF SAFETY

1.3(1) Issue: A comprehensive and effective Integrated Management System (IMS) has not been applied to manage and continuously improve performance.

The following observations were made:

- 54% of processes have a maturity level in their 'Execution Phase' ranked as 3 (on a scale from 1 to 5) or lower, meaning that they have a reactive response on deviations;
- Only one of the SOERs that were identified in the last WANO Peer Review (2012) as 'requiring further action' has been re-evaluated. Around 50% of the SOER's recommendations required further action;
- Operations and Maintenance KPIs do not develop all the plant's KPIs. They are not always specified at the shift/department level, thus losing an opportunity to be used as an accountability tool. Maintenance has no internal measures for some critical activities such as pre-job briefs, post-job debriefs or supervisor observations;
- The company has no active multidisciplinary teams systematically working on continuous improvement of the processes unless it is required for the management. For 2014, four teams were working to improve the existing processes (work package preparation, improvements in the work permits process, financial investments projects and fuel management);
- Some of the main processes have no KPIs (e.g. equipment reliability, emergency preparedness, portfolio management) to determine their efficiency;
- There is no global and shared vision among the managers of the results achieved by each of the processes;
- No metrics or tracking system have been established to measure progress of the work management implementation project;
- In 2013, 17 process owners were requested by the management team to develop a project plan to improve their processes. This request was not met due to lack of sponsorship;
- The status of the annual plans is not formally reported during the year to the corporate management;
- The Integrated Management System does not require a management review of its performance and effectiveness;
- Post job debriefs are not implemented at the site, although they are part of the management expectations;
- There is no plan for embedding the continuous improvement of safety culture in the organisation once the project FOCUS-3 is finished (December 2014);
- Senior managers are not knowledgeable about the progress of the FOCUS-3 project;
- The KPIs of the plant divisions are lagging indicators. Leading indicators are missing. As an example, for RP: contamination events per entry to RCA, dose (CRE), total solid waste volume and activity and liquid discharges;

- Overdue corrective actions show adverse trend. Currently 29.6% of corrective actions are late;
- The backlog of work orders is 1846, and it has been increasing over the last four months;

Without a comprehensive and effective Integrated Management System to manage and continuously improve performance, the plant does not have the opportunity to act to prevent a negative impact or events affecting the safety of the installation;

Recommendation: The plant should implement the necessary tools, programmes, monitoring and trending systems to ensure that a comprehensive and effective Integrated Management System is used to manage and continuously improve performance.

IAEA Bases:

SSR-2/2

4.5. The safety policy of the operating organisation shall include a commitment to achieving enhancements in operational safety. The strategy of the operating organisation for enhancing safety and for finding more effective ways of applying and, where feasible, improving existing standards shall be continuously monitored and supported by means of a clearly specified programme with clear objectives and targets.

GS-R-3

2.1. A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organisation and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by:

- Bringing together in a coherent manner all the requirements for managing the organisation;
- Describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied;
- Ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible negative impact on safety.

3.1. Management at all levels shall demonstrate its commitment to the establishment, implementation, assessment and continual improvement of the management system and shall allocate adequate resources to carry out these activities.

NS-G-2.4

1.3. The attention to be paid to safety requires that the management recognize that personnel involved in the nuclear power programme should understand, respond effectively to, and continuously search for ways to enhance safety in the light of any additional requirements socially and legally demanded of nuclear energy. This will help to ensure that safety policies that result in the safe operation of nuclear power plants are implemented and that margins of safety are always maintained. The structure of the organisation, management standards and administrative controls should be such that there is a high degree of assurance that safety policies and decisions are implemented, safety is continuously enhanced and a strong safety culture is promoted and supported.

GS-G-3.1

2.36. A strong safety culture has the following important attributes: (...)A proactive and long-term approach to safety issues is shown in decision making.

6.76. (...) A process for preventive actions should take proactive steps to ensure that a potential non-conformance does not occur.

GS-G-3.5

2.10. Senior management should establish and promote a set of principles to be used in decision making and promoting safety conscious behaviour. Examples of such principles used in some organisations are as follows: (...) (i) A proactive approach to safety is taken.

2.27. To prevent a significant degradation of safety, a proactive approach to the management of safety and safety culture should be established so that any problem may be detected and acted upon at an early stage.

Plant Response/Action:

Summary of underlying causes:

In 2014, the scope of the IMS management system was not comprehensive, nor used as instrument for improvement. The root-cause analysis revealed that: - an integral approach was lacking;

- management did not use process PI's for improvement, process PI's were not always available, and the process performance was not evaluated;
- bottlenecks in process ownership, accountability and process interactions did exist.

Summary of improvement activities:

Scope

The scope of the IMS has been extended. The following aspects are now included:

- policy & strategy;
- (nuclear)safety, production, and finance;
- stakeholder relations, people, processes & organization, technology, and learning & improvement.

In order to visualize the scope and structure of the IMS, a strategic model has been developed and the IMS manual has been revised. Bottlenecks in process ownership, accountability, and interactions were identified and clarified. Most of the bottlenecks are resolved.

Performance Indicators and performance reviews

The use of PI's has been improved on two levels: business and process.

- The structure of the IMS and of the business plan 2017-2020 are now both based upon the strategic model. In this way, the business plan defines the objectives for the IMS (organization). KPI's and objectives are defined for all aspects of the IMS. The performance is reported quarterly to the Site Management Team (SMT).

- For all processes within the IMS, KPI's and objectives have been defined. Process performance reports have been developed and process performance reviews are implemented, leading to improvement of the processes.

Continuous improvement process

A continuous improvement process has been developed and is included in the IMS. It has successfully been used to improve the performance of other processes like radiation protection, management of organization changes, human performance, work management, and sign in process (outage period).

Self-assessment of the IMS maturity

In the OSART 2014, the use of a process maturity matrix was identified as good practice. EPZ uses the matrix to quantify, and to create awareness on, the IMS maturity. After the OSART 2014, a "Culture for Safety" programme was employed, and as a result many processes were improved. The actual IMS maturity will be established as part of the ongoing 2-yearly safety evaluation.

Effect:

The scope and structure of the IMS is comprehensive and well documented. All processes have KPI's and owners. The processes are evaluated on a regular basis by means of process performance reviews, resulting in process improvements.

Management applies the management system to improve the performance of the organization (business).

The IMS process maturity, measured by the ongoing 2-yearly safety evaluation, will be available in October 2017. Today's information show significant increase of the process maturity for ICT (from 2.2 to 4.0), management of the IMS (from 2.7 to 3.6) and risk management (from 3.2 to 4.2).

IAEA comments:

The root causes analysis was performed in 2015 by a multidisciplinary team leading to 13 actions to be led to answer the problem: emergency preparedness, environment, nuclear safety, radiation protection, compliance, fuel management, configuration management and projects, fire safety, equipment reliability, management review, 2 yearly evaluation, self-evaluation maturity and PI's and performance review.

As of today, 11 actions are completed and 2 will be finalized in 2018 according to the schedule. These 2 actions are improvements in the fire prevention and equipment reliability organizations but have no negative impact on the IMS and safety.

The Integrated Management system is based on IAEA Safety Requirement GSR Part 2. It is now comprehensive, covering 32 processes. The business plan and the IMS are fully aligned in term of processes, objectives and KPI's.

Process owners are responsible for the management of their process, including KPI's, performance reviews, results, deviations, and corrective actions.

Process ownership maturity, based on the EPZ maturity matrix, is more than 90% in category 4 in 2017 while it was only 50% in 2014. More globally IMS process maturity has improved from 30% in 2014 to 79% in 2017.

The continuous improvement plan is based on processes and IMS reviews. A “sounding board” has been set up to get the feedback from employees of all department and all levels of the organization concerning the improvement plan.

In 2014 less than 15% of the processes were subject to a “not structured” process review, in 2017 70% of the processes are reviewed according to a standardized procedure.

Quarterly management reviews of the IMS are done focusing on KPI’s, while yearly management reviews are done focusing on processes effectiveness.

A self-assessment of culture for safety has been done recently with the support of an external consultant to coach the EPZ reviewers.

The IMS contributes to safety performance improvements in reducing among others the TCDF factor, daily doses exceedances, number of contaminations and the number of repeated events.

Other improvements can also be highlighted like SOER’s on target (78%), reduction of work orders backlog (from 2000 to <1500), sign in process for outage, work management process.

Conclusion: Issue resolved

1.3(2) Issue: Expectations are not systematically being met by plant personnel nor reinforced by managers and supervisors, and some of them are not yet set.

The following observations were made:

- Supervisors are not systematically reporting issues regarding organisational or behavioural aspects observed in the field;
- The Operations Division has no formal feedback of the results of observations performed by shift supervisors or shift managers. There is no information about how many observations are performed, what the conclusions are, and the role of the shift manager in them. As a result, no actions are taken;
- Several deviations in scaffolding were identified by the team during the plant inspections;
- The Managers in the Field programme shows a decreasing participation in several areas down to 53 %. Two of the managers do not participate although they are in the programme;
- A person with no personal protection equipment was observed walking through an exclusion area when the reception of fuel elements was taking place;
- The job description for supervisors does not include functions or responsibilities for the training of their teams;
- A person was observed working in a workshop with a power saw without safety glasses or ear protection, as required by the signs on the entrance door. When highlighted by the reviewer, the person escorting him did not take any action and the reviewer was the one that challenged the behaviour;

In the area of radiation protection, the following was observed:

- Expectations for worker behaviour in the radiation controlled area (RCA) are not set or reinforced by line management;
- Expectations for dose reduction are set at management level, but are not visible to the working teams;
- Local rules do not contain all of the required information and are not well known by the plant workers;
- RCA clearance monitoring routinely identifies unanticipated contamination above action levels on items and equipment and these events are not recorded or trended;
- Contaminated items found inadequately wrapped and with no labelling for
- radiological results nor ownership, there is no specified standard for this;
- There is no site owned procedure for the control of Radiography;
- There is no training or standards for RP staff on how to apply shielding or to fix signage to it;
- There is no checking, coaching or observation programme for workers entering the RCA to ensure compliance with local rules;
- Contaminated clothing bins and clean clothing storage racks are observed to be located on different sides of the step-over barrier, not in line with a standard approach;

- Persons do not always use the hand & foot monitors after exiting contamination controlled areas as required by the plant.
- The team noted the following during observation of safety diesel No1 test:
- No check list was used for the pre-job briefing (PJB);
- The PJB covered technical aspects of test procedure only. No OE or safety aspects were addressed;
- After the completion of the PJB, an electrician came to MCR to check the execution of the test. He did not participate in the PJB;
- No 3-way communication was used during the test, even though management expectations clearly require use of three way communication for safety related activities.

Without expectations being set and systematically met by plant personnel and reinforced by managers and supervisors, undesired personal or organisational behaviours and practices could take place at the plant and result in a risk for individuals and for the installation.

Recommendation: The plant should ensure that expectations are set and systematically met by plant personnel and reinforced by managers and supervisors.

IAEA Bases: SSR-2/2

4.2. The safety policy shall stipulate clearly the leadership role of the highest level of management in safety matters. Senior management shall communicate the provisions of the safety policy throughout the organisation. Safety performance standards shall be developed for all operational activities and shall be applied by all site personnel. All personnel in the organisation 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.

NS-G-2.4

3.16. This is part of a manager's role in setting the standards and expectations for all staff in all aspects of safe management of a plant. In addition, managers themselves should visibly meet these standards and should help staff to understand why they are appropriate.

GS-G-3.1

2.17. Managers and supervisors should talk to other individuals during workplace tours and should take these opportunities to reinforce awareness of management expectations.

GS-G-3.5

6.3. Managers normally perform oversight reviews and assess the performance of activities through their day-to-day line management activities. Other, more structured mechanisms include:

Line management monitoring: In order to become proactive and to maintain control over emerging problems, line managers and supervisors should be aware of what is going on in their areas of responsibility and should assess actual performance against expected results. Line management monitoring necessitates that managers be individually involved inassessing the performance of work, posing informed and probing questions and reviewing the results of work completed. To achieve these objectives, line managers and supervisors;

Should observe the work being carried out to ensure that the applicable standards are being met;

Should be visibly present and available and should listen to suggestions and complaints from personnel;

Should examine trends in performance indicators;

Should review the results and lessons to be learned from self-assessments, independent assessments, observation and surveillance programmes;

Should carry out pre-job briefings and post-job briefings where necessary; Should coach and mentor individuals to improve their performance.

Plant Response/Action:

Summary of underlying causes:

- Expectations are not everywhere well known, nor clearly defined, nor always reinforced.
- Managerial focus on behavioural areas is not sufficiently expressed.
- Management in the Field programme is not effective.

Summary of improvement activities:

- The red booklets "Management Expectations" were updated and distributed amongst all personnel. They now include the basic, generic and department specific expectations. These three levels of expectations help to explain and to emphasize the importance of expectations. The expectations are being discussed in team meetings and reinforced by the MiF programme. Management expectation deviations are being recorded and trended in our classbase system.

The expectations have been communicated by management directly to the personnel. Feedback about the communication was requested, and acted on.

Self-assessment is used as a instrument to monitor the effectiveness of our Management Expectations. The results are analysed by the plant manager, and acted on.

EPZ participated in a WANO-TSM in Oskarshamn and implemented the learnings about "standards & expectations" in the updated Management Expectations and in the MiF programme.

The Management in the Field (MiF) programme was updated. Managers are expected to perform visits in the field on a regular basis. The previous programme was inconsistent and incomplete. The focus is now on Human Status (task observations & human interaction), and on Plant Status (system rounds & building rounds). The new types of visits are each focused on a specific area that needs attention. The updated programme includes instructions how to perform the MiF tasks. For example, task observations are being performed by the manager accompanied by another person, preferably from another department. In this way, experience and different views are being exchanged and can be put into practice.

The main purpose of the updated MiF programme is to reinforce standards and expectations, as well as to focus on the coaching role of leaders. The MiF programme will be extended to attend pre-job briefings as well, and to join regular work where management can facilitate and coach employees.

The MiF programme will restore trust and create openness between management and workforce (see issue 13.2.(1)). There is in particular time reserved for personal informal contact; also to discuss non-work related issues.

Effect:

Having a set of five basic expectations made it easier for personnel to embody these expectations. A high percentage of the personnel, including contractors, is familiar with the basic expectations.

By enforcing the expectations through management on a personal level and by addressing them in team meetings, the importance of our expectations is being expressed and they are becoming part of our culture.

The updated MiF programme is resulting in systematic workplace tours by the managers. The participation of the managers has significantly increased. As a result, expectations are widely being expressed and reinforced.

IAEA comments:

The plant performed a root cause analysis to identify the underlying causes of the issue, which are as follows:

- Existing expectations in the 'management expectations' red book had neither been communicated nor explained to each employee in detail.
- Only parts of the operation, maintenance and RP departments were using the red book.

The red book has been updated and particularly the 5 basic management expectations have been added to the existing document, core expectations of the Site Management Team.

Communication has been organized so that every employee, including contractors, knows and understands management expectations through several 'canteen' meetings and individual dialogues where the managers gave hand to hand the red book, underlining the importance of these expectations for safety. At the last OSART 'market' 95% of the staff scored 100% as regard to knowing the expectations.

Management expectations are part of the IMS to ensure their sustainability and continuous improvement through self-assessments (surveys) and independent assessments.

The managers in the field and tasks observations programs also contribute to evaluating how expectations are known and understood by the staff and are considered the most important tools to reinforce expectations.

The 'sounding' board where members, coming from all 'layers' of the organization, can express their difficulties and propose improvements enable everyone in the organization to get feedback on the use and understanding of the red book.

The management expectations programme has helped to develop a dialogue about standards between senior managers, managers, supervisors and shop floor.

Understanding expectations led to integrate them fully in the daily work and brought pride among the employees, demonstrating that management expectations can indeed be met. Correcting each other is becoming a normal practice throughout the organization.

Conclusion: Issue resolved

2. TRAINING AND QUALIFICATIONS

The organisation lacks an overall quality assured process for staff qualification. Qualification is understood as a formal document certifying that the employee is fully competent to perform the job he/she is assigned to. The policy and process to ensure that all personnel in the organisation are competent for the activities they have to perform are not adequate. The formalization of the qualification process at the organisation level should ensure structure and consistency across the organisation. It could also be extended to main contractors, eventually.

The plant does not reinforce the ownership and responsibility of operational managers and supervisors for both defining training needs and evaluating personnel competencies in the field. The needs and results of managerial observations in the field are not transmitted to the training department (TQ) in a written form. The systematic approach to training loop is presently not always closed and it is not used in the continuous improvement process. The team recommends that the organisation publishes a formal qualification policy and implements the corresponding processes.

2.2 TRAINING FACILITIES, EQUIPMENT AND MATERIALS

The simulator is not a full-scope simulator as its scope does not include all open vessel operations. The nuclear model is presently limited to temperatures less than 700°C. The current core model does not take into account the new fuel configuration of the plant (MOX). The distance between the simulator and the plant does not allow effective just-in-time training on major plant evolutions.

A project to build a Work Practical Simulator on site (WPS or workshop for practical training) approved by the plant management is not yet launched after several years of delay. Without such a facility, acquiring effective work practices in a risk-free environment with the integration of radiation protection requirements is hampered. The current organisation does not facilitate the formalization of all on-the-job training (OJT) activities.

The team suggests that the organisation provide adequate facilities to ensure that practical training (OJT) is effective and documented.

2.3. QUALITY OF THE TRAINING PROGRAMMES

All trainee feedback sheets are managed through an independent external software company (using hand writing recognition), providing within a week, statistics and analysis to the relevant instructor and the TQ manager. The team considers this as a good performance.

2.4 TRAINING PROGRAMMES FOR CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

An experienced shift manager is integrated in the TQ instructor team to ensure credibility and quality of operator training. The team considers this as a good performance.

The glass simulator helps personnel to visualize physical phenomena during specific transients or during training on the industry main events (e.g. TMI accident). It also enhances training in thermodynamics and hydraulics. Several training scenarios have been developed to provide understanding of the links between plant operations and actual physical phenomena. The team considers this as a good performance.

2.8 TRAINING PROGRAMMES FOR TRAINERS

Trainers must have a technical Bachelors degree to be recruited. They then have to augment their technical experience with a formal degree in adult education instructional skills. This requirement is included in their individual training plan and it constitutes a necessary qualification, which is to be renewed every five years. Instructors are qualified (formal document) after several course deliveries for which the evaluation mark has to be greater than 7.5 over 10. The team recognizes this as a good performance.

2.9 TRAINING PROGRAMMES FOR TRAINING GROUP PERSONNEL

To reinforce understanding of work constraints from different categories of personnel, the organisation has implemented an interdepartmental training support process. For example, an experienced operator undertakes shadow training with a maintenance engineer for a full week, and maintenance personnel (including technicians and mangers) and a few managers in the emergency preparedness organisation attend a four-week simulator course. The team considers this as a good performance.

2.10 GENERAL EMPLOYEE TRAINING

The plant has implemented a specific induction programme for newly recruited engineers. This is a flexible three-year training programme with a one year possible extension if necessary. Along with attending all the basic training courses, the engineer spends six to nine months in different departments in which he/she is given a specific project. This project oriented training allows new engineers to familiarize themselves with day-to-day nuclear safety requirements as well as the soft skills to lead and manage projects. At the end of the programme the engineer makes a choice for his job position, with good organisational awareness and knowledge. The team considers this as a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1. TRAINING POLICY AND ORGANISATION

2.1(1) Issue: The organisation processes do not consistently ensure that all staff have the necessary competencies and formal qualifications for safe operations.

- No overall qualification policy exists at the organisation level;
- No formal procedures exist to provide an assessment of the competence of all personnel (except Operations-Ops, Training and qualification-TQ and Emergency Response Organisation-ERO), including contractor personnel;
- On-the-job training (OJT) practical training is not always assessed. Therefore, controls are not in place to ensure that radiation protection (RP) and maintenance personnel are fully competent;
- Managers and some supervisors do not evaluate work practices and competency deficiencies in the field (tasks observation). Also, there is no requirement for them to provide input for training in written form;
- There is neither formalized OJT, nor formal qualification in the maintenance and monitoring departments;
- A missed re-qualification does not automatically cancel the ERO qualification;
- There are no RP formal qualifications in the maintenance department, only a few basic qualifications.

Without adequate processes to consistently ensure competencies and formal qualification for all staff, the plant cannot ensure competent resources for safety - related tasks.

Recommendation: The organisation should implement processes to consistently ensure that workers have the necessary competencies and formal qualification for safe operations.

IAEA Bases:

SSR-2/2

Requirement 7: Qualification and training of personnel

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

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

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

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

NS-G-2.8

4.5. The training needs for duties important to safety should be considered a priority, and relevant plant procedures, references, resources, tools, equipment and standards should be used in the training process to ensure, as far as practicable, that errors, omissions and poor practices are not accepted. For these critical duties, the training environment should be as realistic as possible, to promote positive carry-over from the training environment to the actual job environment.

4.8. It should be the responsibility of the plant manager, with reference to each position important to safety, to ensure that:

- Training needs are continuously analysed and an overall training programme is developed;
- The training unit is provided with all necessary resources and facilities;
- The performance of all trainees is assessed at various stages of the training;
- The effectiveness of the training is evaluated;
- The competence of the persons occupying such positions is periodically checked, and continuing training or retraining is provided on a regular basis so that their level of competence is maintained;
- In allocating resources, the implementation of training programmes is given high priority.

4.9. The training unit will be responsible for assisting the plant manager in establishing, verifying and maintaining the competence of plant staff. Line managers and supervisors should be accountable for the qualification of their personnel; they should be involved in defining training needs, evaluating the job performance of personnel, providing feedback to the training department and ensuring that the training provided reflects operating experience. Managers and supervisors should ensure that production requirements do not interfere with the conduct of training programmes.

4.10. The existence of full time training staff should not relieve plant line managers of their responsibility to ensure that their workers are adequately trained and qualified. Supervisors should recognize and make provision for the training needs of their subordinates. The responsibilities and authority of training personnel, as distinct from those of line managers, should be clearly defined and understood.

4.11. Consideration should be given to enhancing training programmes for staff at ageing plants to compensate for losses of personnel due to retirement or job changes and for other reasons. Training programmes should also be adapted to accommodate the special technical, administrative and operational needs of an ageing plant.

Plant Response/Action:

The main underlying cause for this issue is that for many years EPZ had a very experienced workforce. As a consequence qualification of the workers was informal. This informal process led to a lack of oversight on workers' qualification. The EPZ qualification policy was mainly focused on the operations department.

Summary of improvement activities:

- Implementation of an overall qualification policy, as well as procedure 'PU-A31-10, Qualification register' covering the qualification process
- Selection and implementation of electrical and mechanical maintenance qualifications.
- Formalizing radiation protection OJT in a learning programme.
- Selection and implementation of radiation protection qualifications.
- Missing qualifications for RP and maintenance staff have been defined, and training requirements are being identified. An OJT programme for RP has been developed and training sessions are scheduled.

Effect:

The organisation has implemented a policy and quality-assured process ensuring that workers have the necessary competencies and formal qualifications for safe operations based on the risk(s) involved in their jobs or tasks.

IAEA comments:

The plant has identified the causes of the issue and introduced an action plan that is monitored and evaluated for effectiveness. The causes involve the informal nature of the qualification process, an ageing and retiring workforce, recruitment of new employees and managers leading to a lack of oversight of workers' qualification and experience. The issue included programmatic and performance based deficiencies of the plant activities in this area. The plant has developed an overall qualification policy and adopted a process which is supported by a procedure on the qualification of the plant personnel. Priority has been given to high risk job and task qualifications required for activities within operations, radiation protection, emergency planning and preparedness, electrical maintenance and http://www.atominfo.ru/newsr/y0161.htm mechanical maintenance. The plant qualifications for middle risk activities are managed by a process for general employee training – 'working safe' that includes an e-learning process with appropriate tests. To further develop and maintain the personnel qualifications and competences the plant uses an approach that provides basic knowledge through classroom and e-learning training and relevant skills and experience via simulator and on the job training. This approach is supported by numerous tests, assessments and task observations that ultimately results in getting required qualifications for the particular jobs or tasks. The plant has already benefited from the improved process since the systematic approach to training and qualification leads to a training plan based on needs derived from field observations and a better focus on practical training. The plant will apply the same approach to the activities with lower risks and tasks demanding specific qualifications.

Conclusion: Issue resolved

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

2.2(1) Issue: The existing training facilities do not cover all activities which can impact on nuclear and industrial safety.

The team observed the following:

- The simulator in Essen is limited both in scope e.g. no open activities, reactor temperature less than 700°C, and in fidelity e.g. differences with actual control room, no separate instructor cabinet. It is not representative of the plant main control room;
- There is no video recording system;
- There is no extended shutdown state simulation or severe accident capabilities;
- The simulator facility is located 3.5 hours' drive from Borssele. This location is a barrier to effective use as just-in-time training or validation work;
- The long term operation of the simulator is at risk due to Germany NPP's shutdown programme. There is no approved project for long term operation of the simulator;
- Not all personnel receive formal practical training in RP. RP requirements are not incorporated in work practices. RP OJT is performed in the controlled area and as such, cannot be risk free;
- Human performance and maintenance OJT are mostly performed directly on the installation increasing potential risk without always allowing for thorough practical learning process;

Without effective practical training, the organisation's personnel cannot demonstrate that they can safely perform all required activities in all plant conditions.

Suggestion: The organisation should consider providing necessary training facilities to cover all activities which can impact nuclear and industrial safety.

IAEA Bases:

SSR-2/2

4.24. Adequate training facilities, including a representative simulator, appropriate training materials, and technical and maintenance training facilities shall be made available for the training of operating personnel. Simulator training shall incorporate training for plant operational states and for accident conditions.

NS-G-2.8

6.3. Representative simulator facilities should be used for the training of control room operators and shift supervisors. Simulator training should cover normal, abnormal and accident conditions.

6.4. In some States, central training facilities are available and have proved to be beneficial. The use of training facilities located in other States may involve the additional need for trainees to learn a foreign language and to master different systems of drawing standards and component identification. The use of non-reference plant simulators, on the other hand, creates an additional need to ensure, by examination or another method that trainees are aware of the limited usefulness of some of the information given in training on a device with an instrument configuration and performance characteristics that are different from their actual working environment.

Plant Response/Action:

Without effective practical training facilities, the organization's personnel could not train or demonstrate that they can safely perform all required activities in all plant conditions. There was no possibility to perform human performance maintenance On the Job Training (OJT) and Radiation Protection OJT, except directly on the installation, which increases the potential risk and limits the training opportunities.

Summary of improvement activities:

Improvement activities are focused on two areas: the work practice simulator (OJT simulator) and the control room simulator in Essen, Germany.

– Work practice simulator (WPS)

EPZ is constructing a work practice simulator, located on the coal-fired power plant premises. Commissioning of the simulator is scheduled for January 2017. All personnel (and contractors) can be trained in human performance during OJT on a state-of-the-art simulator. Secondly, activities to be performed at the plant can be trained under simulated circumstances (e.g. radiation, noise, etc.) to gain experience.

– Control room simulator

Since the simulator is located in Essen, where technical and training support are part of a consortium of all German plants, there could be a long term operational risk due to the German nuclear phase-out. EPZ has undertaken studies to move the simulator from its location in Essen to the plant site in Borssele. The current status of this study is that the simulator will be moved in the next few years, probably in 2018 or 2019. A dialogue with the operational and training entity (KSG/GfS) has been opened. Another part of the study focusses on the scope and software platform of the simulator.

Effect:

The on-the-job training programme has improved, and the work practice simulator will enable state-of-the-art OJT. The simulator scope and representativeness have been improved. The simulator control room now matches the actual control room, extended shutdown conditions are simulated, and the up-to-date core model is simulated.

IAEA comments:

The plant has thoroughly reviewed the suggestion made by the OSART team and deployed an action plan to fix the identified deficiencies and further enhance and expand the scope of training facilities and activities. The activities related to the full scope simulator involve the following improvements:

- simulation of the reactor temperature has been increased up to 1000°C and it also include extended reactor shutdown states and open reactor vessel conditions
- severe accidents are modelled on a special simulator, including core melt.
- A closed instructor cabinet has been installed and equipped to allow video recording of training sessions to enhance feedback to trainees

– actual core cycle has been implemented

– the same rules are applied to enter the main control room and the simulator

The action plan related to realistic on–the–job (OJT) training environment has been based on the results of an extensive benchmarking made by the plant in United Kingdom, Spain, Slovenia, Belgium and Sweden.

A Work Practice Simulator (WPS) facility has been designed and constructed at the plant's site. As of December 2016 the WPS was at the final stage of construction followed by installation and commissioning of systems and equipment. The WPS will simulate different working environments and operational circumstances, including pressure, high voltage, temperature, sound, dose rates and contamination levels and provides complete simulation of the radiation control area including entrance and exit, work permit process, realistic components such as pumps, valves, controls. The plant has already developed a schedule for the personnel training at the WPS that will start in 2017 but development of the appropriate training materials is not yet complete. Currently the OJT training of the staff is still conducted in the plant's industrial and radiation control areas. The plant has not yet started a pilot application of the WPS facility in the training process to confirm it's effectiveness.

Conclusion: Satisfactory progress to date

IAEA comments during OSART follow-up 2nd Stage:

A Work Practice Simulator (WPS) facility has been designed, constructed and commissioned at the plant's site. As of November 2017 the WPS was fully operable and used in full scope for plant employee training. The 'Systematic Approach to Training' is applied for the training at the WPS in full scope. The team observed a routine training session at the WPS during the second stage follow up and found it practicable and efficient.

Conclusion: Issue resoled

3. OPERATIONS

3.2 OPERATIONS FACILITIES AND OPERATOR AIDS

A lot of progress has been made recently by the plant to properly label the technical systems and components, nevertheless discrepancies in the labelling practices still exist. Several different components were found during the OSART plant tour and field observations with no labels, illegible labels, hand written labels, other than those authorized by the plant, or labels corrected manually. The OSART team suggests the plant develops more effective means of identifying and improving consistency of labelling.

3.4. CONDUCT OF OPERATIONS

Field operators effectively monitor equipment and systems status, and verify that important plant parameters support safe operation. Some material condition and housekeeping discrepancies were reported by the field operators, however others were not. The observed field operators walk downs have shown that daily operational practices need improvement, such as reporting minor deficiencies in the field, reducing unmanaged or uncontrolled storage areas, and assuring that operator aids are authorized. The OSART team made a suggestion in this area.

3.5 WORK AUTHORIZATIONS

The plant developed a process to verify that clearance boundaries are intact, system is deenergized, and that plant conditions will support safe completion of planned work. An added benefit of this process is improved teamwork at the plant, as involved work groups verify conditions together. This is considered as a good performance.

Field operations, plant meetings and interviews were conducted at the plant, and the team found that the work management process is not being efficiently implemented. Performance areas needing improvement are effective use of personnel resources, work schedule stability, and completion of risk reviewed work. The team recommends that the plant reinforce its expectations, and improve the work management process to ensure that personnel resources are used more effectively, improve work schedule stability, and complete the risk reviewed work plan more consistently.

3.6 FIRE PREVENTION AND PROTECTION PROGRAMME

The plant exhibits good performance in the areas of training fire fighters at the plant and offsite with local fire departments, and performing a site exercise for all firefighting personnel each year. Areas that need performance improvement are personnel behaviours involving the use of fire doors, ensuring that all safety impacts are evaluated prior to propping open fire doors, accounting for combustible loading in areas containing plant safety equipment, and assessing the aggregate impact of all fire system deficiencies to ensure that the plant will be able to combat a fire successfully. The team recommends that the plant reinforce its expectations, and improve the fire protection programme, to ensure that personnel behaviours are improved, fire door authorizations are more robust, and safety system integrity is not compromised.

DETAILED OPERATIONS FINDINGS

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

3.2(1) Issue: Labelling of plant equipment is not consistent in supporting plant operational personnel in proper identification of plant installed components.

Although a lot of effort was spent recently by the plant to properly label the technical systems and components, discrepancies in the labelling practice still exists.

Several different components were found during the OSART plant tour and field observations with no labels, illegible labels, hand written labels, other than those authorized by the plant, or labels corrected manually. Some examples are indicated below:

Plant walk down:

- All three safety diesels EY010, 020 and 030D001 have handmade labelling of I&C cables;
- Label of RL023S032 (emergency feed water valve) on I&C cabinet in 05/314 room is partially hand-written on a piece of paper;
- Room 02.141: HPSI pump TJ043D001 – 6kV cable is hand-written marked '2BV0';
- Room 02.302 (Reactor Coolant Pump's (RCP) oil system) – graffiti labelling of valves;
- Room 02.317. HPSI and TV systems – graffiti labelling of Containment pipe penetrations;
- Room 02.313, RCP oil system, safety valves YD002S017 and YD002S018 have a paper sticker with hand written number '6' and '5' correspondingly. Operations say they should be removed.
- Inconsistent labelling can lead to potential operational errors.

Suggestion: Consideration should be given to reinforce and speed up the process of proper identification of plant's installations in order to eliminate labelling deficiencies of plant components.

IAEA Bases:

SSR-2/2

7.12. The operating organisation shall be responsible for ensuring that the identification and labelling of safety equipment and safety related equipment, rooms, piping and instruments are accurate, legible and well maintained, and that they do not introduce any degradation.

NS-G-2.14

5.2. The labelling standards used should be such as to ensure that the labels are suitable for the environmental conditions in the location in which they are to be mounted and that the equipment can be unambiguously identified. The format and placement of labels should allow the operators to identify the component quickly and easily and should prevent the easy or inadvertent removal or misplacement of labels.

Plant Response/Action:

There was no consistent system or procedure for labelling plant equipment and responsibilities were not always clear. A wide variety of labelling systems was visible on the plant, which could lead to misalignment of systems.

Summary of underlying causes:

A lack of structure, plus the absence of any system or procedure, resulted in an inconsistent system for labelling of components.

Summary of improvement activities:

A new procedure has been developed and implemented (N07-00-004). The new procedure and the working method in a toolbox have been communicated. Replacement of labels in the plant according to this procedure is started, starting with safety-related systems (for example EY, TJ and UJ). This will be completed in the 2017 outage.

Effect:

With the new labelling method, personnel will not make mistakes when operating the plant in the field due to incorrect labelling. In addition, people throughout the organization will know what to do when labelling is incorrect or when labels are missing. From observations in the field and the reports made of these observations, it is visible that personnel know the expectations for labelling components.

IAEA comments:

The plant has evaluated the underlying causes and has initiated modifications and actions to reinforce and speed up the process of proper identification of plant structures, systems and components (SSCs) and to eliminate deficiencies in labelling. An unambiguous identification of plants' SSCs is an essential precondition for safe and secure work of plant staff of all participated departments, sections and teams.

Based on a pilot labelling in the DG EY30 an application has been selected to be used for plants labelling. A procedure with unique criteria for the categorization and application of labelling for plants main technical SSCs has been implemented.

Responsibility for labelling has been taken by the personnel of operations shifts, assigned to the SSCs. Quality control is performed by personnel from operations support. Labelling of the plants installations started on the main operational structures, systems and components. During plant tours the team observed that graffiti and hand written labels are being removed and the application of the new standard is being applied consistently.

The degree of completion of labelling is regularly monitored and by the start of November 2016 had reached an average of about 58% of the scheduled volume. It is intended to reach 100 % completion in the outage in 2017. Although in some areas different labels are still used the team observed considerable progress during plant walk downs. Work Practice Training Facility will be used to illustrate good practice in labelling standards.

Components like cables, distribution boxes, security devices (e.g. cameras), intercoms, headphones and lighting are for the time being, not part of the procedure. Some have self-standing criteria, requirements and databases. Care should be taken that their specific labelling is unambiguous and does not compromise the identification system of SSCs in the procedure in the frame of ageing management and long-term operation.

Conclusion: Issue resolved

3.4. CONDUCT OF OPERATIONS

3.4(1) Issue: The plant does not have sufficiently demanding arrangements for daily operational practices, such as reporting minor deficiencies in the field, unmanaged or uncontrolled storage, and use of unauthorized operator aids.

During the review, the team has found the following. Not reported deficiencies in the field:

- HPSI pump, two I&C cables at TJ041V002 box are repaired with insulation tape;
- Room 02.118, Fire protection barrier in HPSI pump's room is displaced from its original position, fixed in a new place with only 50% of bolts as per design;
- Several plastic protection rings on cable's guide tubes in HPSI and LPSI pump compartments (e.g. TJ023D001) – found broken, fragmented, displaced. None of the above-mentioned deficiencies on safety systems were identified during operator rounds.

Uncontrolled temporary storage areas:

- In room 05.225, a spare 6kV switch is stored in an unlabelled / unmarked place, not fixed to prevent inadvertent movement;
- In room 05.224, three spare 6kV switches are stored in an unlabelled / unmarked place, not fixed to prevent inadvertent movement;
- In room 05.227, 4 movable tables with test equipment are stored in a undesignated area, preventing access to electric cabinets of safety system;
- In room 72.301, temporary storage of instruments, personal belongings in a undesignated area;
- Unauthorized storage of materials in room 02/301;
- On the scaffolding Nb. 151329, erected in 25.8.2014- a several scaffold parts were stored on the bottom platform;
- In turbine building at Elevation 0 m., scaffolding parts are stored in an unlabelled place, parts are mixed with other metal pipes.

Unauthorized operator's aids:

- More than 10 uncontrolled copies of technological schemes, diagrams, procedures found fixed to the wall in the Field Reactor Operator's room 03/408;
- Room 10.202, Safety diesel EY030D001: Unauthorized technological scheme on cabinet DK/ UW80-81;
- Room 72.203: Unauthorized copy of a diagram;
- Entrance to 02.125 room (TA032D001) – copy of uncontrolled drawing fixed to the wall;
- Room 10.201: Unauthorized operator's aids on electric cabinet US040H001;
- Entrance to 02.125 room (TA032D001) – copy of uncontrolled drawing fixed to the wall.

Failure to detect and/or report minor equipment defects, accumulation of uncontrolled or unmanaged storage places, and use of uncontrolled documentation could lead to random unavailability of equipment and operator errors that may affect the safety of the plant.

Suggestion: The plant should consider developing and implementing a robust programme to improve operational practices, such as detecting and reporting minor events, eliminate unmanaged storage places and use of operational aids.

IAEA Bases:

SSR-2/2

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

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

7.6. A clear operating policy shall be maintained to minimize the use of, and reliance on, temporary operator aids. Where appropriate, temporary operator aids shall be made into permanent plant features or shall be incorporated into plant procedures.

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

NS-G-2.14

4.35. Personnel assigned the task of carrying out rounds should be made responsible for verifying that operating equipment and standby equipment operate within normal parameters. They should take note of equipment that is deteriorating and of factors affecting environmental conditions, such as water and oil leaks, burned out light bulbs and changes in building temperature or the cleanness of the air. Any problems noted with equipment should be promptly communicated to the control room personnel and corrective action should be initiated.

4.36. Factors that should typically be noted by shift personnel include:

- Deterioration in material conditions of any kind, corrosion, leakage from components, accumulation of boric acid, excessive vibration, unfamiliar noise, inadequate labelling, foreign bodies and deficiencies necessitating maintenance or other action;
- Indications of deviations from good housekeeping, for example the condition of components, sumps, thermal insulation and painting, obstructions, posting of signs and directions in rooms, posting of routes and lighting, and posting and status of doors;

- Deviations in fire protection, such as deterioration in fire protection systems and the status of fire doors, accumulations of materials posing fire hazards such as wood, paper or refuse and oil leakages, or industrial safety problems such as leakages of fire resistant hydraulic fluid, hazardous equipment and trip hazards;
- Deviations in other installed safety protection devices, such as flooding protection, seismic constraints and unsecured components that might be inadvertently moved.

Plant Response/Action:

The plant did not have sufficiently demanding arrangements for daily operational practices, such as reporting minor deficiencies in the field, unmanaged or uncontrolled storage, and use of unauthorized operator aids.

Summary of underlying causes:

Standards were low, and a high number of large and small deficiencies were accepted. The deficiencies originated from a wide range of causes. Acceptance of low standards applied throughout the organization.

Summary of improvement activities:

A coaching programme for shift crew members on management expectations was started. This is monitored via reports which are required to be sent to operations management. A KPI is used to check if coaching is conducted in accordance with the plant expectations, and results are communicated in the monthly report. A housekeeping group has been set up on a formalized basis. The procedure regarding what is acceptable has again been communicated throughout the organization. Results can be seen in the reports which result from the management in the field programme (A01-24-N203). A procedure on defect tagging has been developed and implemented (PU-N07-03-005). Defect tagging has been implemented.

Effect:

On the plant, it is clear which deficiencies have been addressed, and the expected date for resolving deficiencies can also be seen. The backlog is falling, and there are fewer housekeeping issues.

IAEA comments:

The plant has evaluated the underlying causes and has initiated actions to enhance the expectations, standards, performance and monitoring of daily operational practices. Management expectations in procedure N07-00-002 have been revised and communicated within the organisation. Field operators are specifically coached on these expectations. The result of the coaching is used as a performance indicator, which shows a favourable trend.

Tagging is performed for temporary modifications, leakages and defects. For defect tagging a specific procedure has been issued and trained. Tags are recorded and followed in a database. They are classified in the categories like low level event, deficiencies and work requests and prioritized and recorded about their origin. An indicator providing an overview of open tasks from these categories clearly shows a favourable trend. Manager in the Field programmes and their results reinforce the use of tagging and the rectification of the reported deficiencies.

Defect tags for use by each staff member are provided in small boxes which are distributed throughout the production buildings. The team observed the use of these tags and no graffiti or unauthorized operator aids during the plant tours in the visited buildings.

Procedure N07-00-002 also includes expectations and guidance for the storage of material in production buildings. Storage areas in these buildings are labelled and designated. If labelled places need to be used the applying person is required to use to the related procedure and get the permission of operations. Field operator rounds and Manager in the Field rounds observe the correct or incorrect storage of material. 'Classbase' database is used to report observed violations. The number of reported violations is low.

Conclusion: Issue resolved.

3.5. WORK AUTHORIZATIONS

3.5(1) Issue: The plant's expectations and work management process are not robust enough to ensure effective personnel resource usage, completion of risk reviewed work, and safe work schedule stability.

During the review team has identified the following:

- Meetings during the formal work management process are not consistently attended by all departments, in some observed cases personnel at the meetings did not have the required knowledge or decision-making authority;
- Challenges to the work management process are not resolved in the site's corrective action program, leading to recurrences of past problems, and poor performance in completing risk reviewed and scheduled work. This was observed during work order 14856 when personnel propped open a fire door which caused a loss of train separation between class battery rooms. Plant maintenance personnel stated that this had happened before;
- Six planning and preparation steps in the site work management procedure (11, 25, 30, 43, 49, and 58) are being performed after the T-5 week. Not performing planning and preparation steps before T-5 results in less time to review work documents, perform job site walk downs, and to write clearances;
- KPI's for the 12-week process are not being used effectively to measure and detail the plant's performance in execution of the work management process. The root causes of poor performance and needed improvement areas are not fully identified currently.

Without consistent adherence to the work management process, and implementation of the safe work schedule in the field, the plant may be put into unsafe conditions.

Recommendation: The plant should reinforce its expectations, and improve the work management process, to ensure that personnel resources are used more effectively improve schedule stability, and complete the risk reviewed work plan more consistently.

IAEA Bases:

SSR-2/2

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

NS-G-2-14;

7.4. The work control process should ensure adequate interfaces between all work groups. Operations personnel should assist the maintenance department in the planning and execution of work on plant systems and components to ensure that the reliability and availability of equipment are optimized.

7.10. Planning of work on plant systems and equipment important to safety should be well coordinated to ensure that the plant remains in a safe condition at all times and in accordance with the operational limits and conditions.

7.11. Sufficient resources should be provided for operations to guide and assist in the planning and scheduling of major work sequences. The operations management should be actively involved in the process of planning and scheduling work. Additional support should be provided to operations staff for outages and other periods of high workload.

7.9. Efforts should be made to minimize the number of extended work orders. The causes of deviations from the planned schedule should be subject to a thorough analysis to identify any necessary amendments to the system covering the planning and performance of work.

NS-G-2.6

5.36. The review programme should examine the MS&I programme for features such as:

- Adequacy of the schedule and its implementation.

Plant Response/Action:

The work management process was not adequately adhered to, and insufficient guidance was provided by management and supervisors to the process. Without consistent adherence to the work management process, and implementation of the safe work schedule in the field, the plant may be put into unsafe conditions.

Summary of underlying causes:

In 2011, it was decided to implement a work management process based on INPO-AP928. This change was not implemented effectively, which led to a lack of support. This led to an unofficial process with ineffective use of personnel resources, work schedule instability, and incomplete risk reviewed work.

Summary of improvement activities:

Reinforcement of management expectations by committing departments and their teams to improve the AP928 work management process. Necessary organizational changes have been implemented (KW, KPV, KO-EU, KO-MU). Acceptance of, and ownership of, the AP928 process is ensured by interdepartmental improvement teams and a steering committee which have been formed to address and resolve issues of frustration. Among others, the risk review and scheduling processes are undergoing improvements. Work management process improvements are monitored via KPIs in the monthly reporting systems. Challenges in the work management process are addressed in Classbase and the EPZ Corrective Action Plan (CAP). Follow-up actions and progress are monitored in the EPZ CAP.

Effect:

Meetings during the procedural work management (WM) process are consistently attended by all departments concerned. Delays and discussions are minimized thanks to the appropriate knowledge and decision-making authority of the personnel attending the meetings.

In accordance with the INPO-AP928 concept, WM KPIs are used to monitor and control the effectiveness of the WM process. Actions are undertaken to address negative trends (for instance, significant improvements in schedule conformity and scope stability have been achieved since 2014).

Organizational changes have been made to improve process transparency. The maintenance department (KO) has implemented organizational changes, relating to systems and disciplines, and differentiated based on to the job execution process (W-5 -> W0) and the job preparation process (W-12 -> W-5) by introducing separate teams for maintenance preparation and execution. Additionally, a resource planner has been added to support the maintenance teams (in January 2016) in order to improve personnel effectiveness. To increase the authority of the team of schedulers and work week coordinators (KW), they are directly linked to the plant manager (they were previously within the operations department). A lock-out/tag-out team (KPV) has been newly introduced to improve safe work conditions (previously this responsibility was fragmented within the shifts).

To stimulate, evaluate, address and monitor WM process improvements, an interdepartmental WM steering committee has been formally set up (in January 2016). Since then, several improvement projects have been launched and implemented.

IAEA comments:

The plant has evaluated the underlying causes of this issue. As a result, improvements have been initiated to reinforce of management expectations, make organisational changes within the maintenance department and create interdepartmental improvement teams and a steering committee.

To address inconsistent attendance of the requested members at the related WMP meetings non-attendance is recorded in the 'Classbase' database for tracking and is announced by the chair of the meeting.

The organisation within the maintenance department has been adjusted to accommodate the phases of the WMP which are work preparation (week -12 to -5) and resource scheduling and execution (week -5 to 0). Scheduling of the work is based on Functional Equipment Group, which determines the availability of systems for work. The New Work Review Team reviews emergent work and the feasibility of combining new work with scheduled work.

To improve decision making the team of schedulers and work week coordinators is directly linked to the plant manager. A steering committee is in place since January 2016 to motivate, monitor and correct the WMP or the related organisation. Resulting actions are recorded and followed in the EPZ CAP.

Meeting and performance indicators are in place to monitor and correct the process if needed. The backlog of work orders is still in the warning zone, but shows a favorable trend. Schedule conformity W-1 and W-5 in 2016 are in the expected operating range and improving. Scheduled work order completion is stable at slightly over 90 %.

Conclusion: Issue resolved.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

3.6(1) Issue: The plant's fire protection and prevention programme, and implementation of the programme elements related to authorization of opening fire doors, personnel behaviours, and storage of combustible materials are not effective.

During the review, the team has identified the following:

- In support of work order 14856, fire door 05.308 was authorized to be propped open by fire brigade personnel, and this resulted in the loss of train separation between the two safety class batteries and a reduction in ventilation effectiveness;
- The Operations Shift Team Leader was not part of the authorization process for determining if a door should have been propped open as directed by plant procedure A09-26-N022, and the site has no formal programme for controlling doors and hatches;
- Plant personnel do not routinely verify that fire doors have closed and latched after they transit through the doors;
- Temporary shielding is not evaluated for fire loading impact prior to being installed in areas of the plant containing safety equipment;
- The aggregate impact of all fire protection system open deficiencies is not being evaluated to ensure fire protection system response will be adequate to meet potential fires on site.

Without improvements to the site's fire protection programme, plant events may be worsened by spreading fires due to open fire doors and unintended ventilation flow paths, both of which could jeopardize safety system equipment.

Recommendation: The plant should enhance the fire protection programme, to ensure that personnel behaviours are improved, fire door authorizations are more robust, and safety system integrity is not compromised.

IAEA Bases:

SSR-2/2

5.21. The arrangements for ensuring fire safety made by the operating organisation shall cover preventing the spread of those fires that have not been extinguished; and providing protection from fire for structures, systems and components that are necessary to shut down the plant safely.

NS-G-2.1

2.9. Plant personnel engaging in activities relating to fire safety should be appropriately qualified and trained so as to have a clear understanding of their specific areas of responsibility and how these may interface with the responsibilities of other individuals, and an appreciation of the potential consequences of errors.

3.1. The operating organisation should establish a comprehensive programme for fire prevention and protection to ensure that measures for all aspects of fire safety are identified, implemented, surveyed and documented throughout the entire lifetime of the plant.

6.1. Administrative procedures should be established and implemented for effective control of combustible materials throughout the plant.

7.3. Minimum acceptable levels of availability should be established and documented for all fire protection features identified as important to safety. Interim compensatory measures should be defined for each fire protection feature identified in this way.

Plant Response/Action:

The plant's fire protection and prevention programme, and implementation of the programme elements related to authorization of opening fire doors, personnel behaviours, and storage of combustible materials were not effective.

Summary of underlying causes:

Procedure A09-26-N022 version 2 did not include instructions and measures regarding when fire doors needed to be open for activities. When providing a fire permit, Operations was not involved in the assessment of the consequences for the plant. Recording of open fire doors in the control room was inadequate and not formalized. The standard with regard to stored material in the plant had dropped over time. Personnel awareness and behaviours in fire protection could be improved, and not everybody was clearly able to recognize a fire door (the red triangle was unclear).

Summary of improvement activities:

- Procedure A09-26-N022 has been adjusted to increase the involvement of the (deputy) shift supervisor when assessing fire permits with an impact on plant (nuclear) safety. Adherence to the procedure is monitored.
- Blocking fire doors in the open position is only allowed when the fire officer has put a sign on the door after having received the permission of the control room. The control room records the open fire door on a form present at the fire alarm panel (A09-26 N022), where fire permits and disabled fire detectors are also registered.
- The amount of stored (combustible) materials in the production buildings has been reduced. A 'Housekeeping working group', led by the deputy manager operations, monitors stored materials (Suggestion 3.4.1).
- There are toolboxes, lessons learned letters and intranet messages to increase fire safety awareness. These are addressed in work meetings.
- All fire doors have been equipped with a sticker reading 'Fire Door, Keep Closed', to improve recognition of fire doors.
- A form is used to assess risks in work preparation. Two questions concerning fire prevention (fire doors and combustible materials) have been added.

Effect:

Personnel behaviours, housekeeping and fire safety awareness have improved significantly. Open fire doors are a rare occurrence in the plant.

IAEA comments:

The plant has evaluated the underlying causes and has initiated modifications and actions in the areas of work preparation and the interface to Operations to strengthen the fire protection of the plant.

The focus of these modifications and actions is the procedure for the work planning, the involvement of Operations, a improved perception of labelling on fire doors and the reduction of combustible material in production buildings.

These modifications and actions have been communicated by toolbox meetings, lessons learned letter and intranet messages and in department and section meetings to inform staff and supplementary personnel.

Two important steps have been integrated:

- Additional step in the checklist for the work preparation concerning the need for an open fire door
- Report of fire department staff, which opens the door, to the shift crew on duty and a log entry for use during operation and shift turn over.

A check in 'Classbase' database shows in general a favourable trend of open fire doors since the initiation of the actions in 2015/2016.

Areas have been marked to determine permitted areas to store material and areas where this is not accepted. The condition of these areas is checked during plant tours such as Managers in Field or regular field walk downs and traceable actions follow. Storing material in areas where storage is not designated must be accepted by operations personnel.

An initiative to reduce combustible material in the production buildings was initiated and is ongoing. The team observed during plant tours a considerably improved storage situation compared with the observations in the OSART mission in 2014.

Conclusion: Issue resolved.

4. MAINTENANCE

4.1. ORGANISATION AND FUNCTIONS

The maintenance organisation structure and functions are clearly defined at the plant. Maintenance leaders ensure that work order development and reviews by well-trained department personnel are being performed. The team also noted that personnel capacities and work loading are not always balanced, leading to less than optimum use of resources. Maintenance staff training ensures that qualified personnel are available to perform all scheduled work, but a formal training certificate for completion of training does not exist. The team encourages the plant to develop a method to track staffing availability so that enough work can be scheduled to reduce existing backlog of work orders.

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The plant has developed some equipment to be used during outages that results in lower doses received by workers. The plant has introduced a specific manipulator to perform ultrasonic testing of control rod drive tube welds on the reactor vessel head. The team identified this as a good practice.

4.3. MAINTENANCE PROGRAMMES

The plant use of KPI's for the maintenance organisation is only marginally effective due to not tracking key areas such as rework and not accurately reflecting the status of maintenance backlogs. The present support activities such as other maintenance in the preventive maintenance backlog are currently increasing. The team encourages the plant to perform analysis and categorization of the preventive maintenance backlog and the rework statistics in order to establish an action plan for the reduction of both.

4.4. PROCEDURES, RECORDS AND HISTORIES

The plant writes high quality work packages for complex jobs, but does not apply the tool pouch approach for minor maintenance activities, resulting in limited planning resources being used inefficiently. The plant does not effectively use technician feedback provided to improve work packages when work is completed, as there is no formal method for this feedback to be used and for resulting actions to be captured (for example changing spares requirements or procedure steps or further corrective maintenance requirements). The team encourages the plant to implement a work package process using a graded approach to work preparation, and develop a process to formalize and use feedback from technicians to improve the work packages and future planning.

4.5. CONDUCT OF MAINTENANCE WORK

The plant has a procedure and programme for FME, work packages identify FME risks, and FME is covered in PJB prior to work performance. However, there are some examples when high standards of FME requirements were not fully met. These examples indicate that overall principles and possible consequences are not fully understood by staff and implemented in practice. The team has made a recommendation for improvement in this area.

The team observed work in progress in the field, and on some occasions, parts and materials associated with the work package were not properly controlled, and the working area was not well marked to keep other workers out of the area. The team encourages the plant to reinforce expectations regarding control of material and work areas to protect employees and plant equipment.

4.6. MATERIAL CONDITIONS

The team performed observations and noted that the plant material condition supports safe operations. Standards and requirements related to material conditions are established in procedures, which also state how to maintain the plant and how to register and label leaks. In some cases, the team noted that high standards for material conditions were not always maintained, and examples include leaks, material corrosion, small deficiencies on equipment, and practices related to poor material selection. The team has made a suggestion in this area.

DETAILED MAINTENANCE FINDINGS

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

4.2(a) Good Practice: Manipulator used for ultrasonic testing of reactor control rod drive tubes.

The plant has introduced and developed a specific manipulator for the ultrasonic test of several welds located on reactor head control rod drive tubes.

More inspections are required on the reactor control rod drive tubes, due to the latest version of the ASME code and the enhanced requirements of the ageing management programme. An assessment of the material properties and behaviours has been made for all reactor control rods tube welds with and without the thermal sleeve with the new ultrasonic inspection tool, to ensure that the mechanisms and changes in material properties are known and there are no internal changes or degradation on the inside of the tubes.

The lower welds of the reactor vessel tubes are located under the thermal insulation and can only normally be reached by removing the insulation. This would give high radiation exposures and so welds were not inspected. Previously, the upper welds have been inspected several times with radiographic and penetrant method.

With the use of this new manipulator, ultrasonic inspections can be carried out for lower welds, as the manipulator is placed below the head and the probes can reach all welds on all the tubes. The manipulator includes two manipulators reaching both required diameters of 147.2 mm and 55 mm.

The inspection method was fully qualified using blind and open calibration blocks on basis of European Network for Inspection Qualification (ENIQ) requirements.

Using this new inspection manipulator the inspection time and radiation exposures received are significantly reduced.

4.5. CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: Foreign material exclusion (FME) principles are not fully understood and a comprehensive FME programme is not implemented. The team made the following observations:

- One section of safety barrier around the fuel pool at 24m elevation of reactor building was missing. Incomplete barriers can allow items to be kicked or to roll into the pool;
- On the refuelling machine, at the 24m level of the reactor building, there are three folders with procedures. This results in loose paper stored above the pond which could fall in;
- A sensitive pressure measurement device (perskar) and its tools, nozzles and hose ends were not covered or plugged;
- A flange on UL02S012 and UL01S019 in the Turbine hall was found open and not protected against ingress of foreign material;
- Some components in the central warehouse and maintenance 'kippenkot' have no FME protection caps;
- A four foot section of piping on the floor in the demineralization plant was found on the floor in the corner of the room and a flange of the pipe was not covered;
- Plant personnel do not always remove their equipment from working areas when work is interrupted or finished. This was observed in many rooms (including the diesel generator room). This loose equipment and tools left without appropriate controls has the potential to cause or contribute to FME events;
- FME training (Z3-EW electronic learning) is available but not used by plant staff and there is no specific authorisation for FME practices for workers.

Without effective FME programme implementation and tracking, the plant is not mitigating foreign material risks which can impact safe and reliable plant operation.

Recommendation: The plant should ensure that FME principles are understood and a comprehensive FME programme is implemented.

IAEA Bases:

SSR-2/2

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

NS-G-2.5:

3.9. The areas for the handling and storage of fresh fuel should be maintained under appropriate environmental conditions (in respect of humidity, temperature and clean air) and controlled at all times to exclude chemical contaminants and foreign materials.

3.19. Inspections should neither damage the fuel nor introduce any foreign material into it. Inspectors should identify any foreign material already present in the fuel and should remove it.

Plant Response/Action:

Foreign Material Exclusion (FME) principles were not fully understood and a comprehensive FME programme was not implemented.

Without an effectively implemented FME programme and tracking of shortfalls, the plant is not fully mitigating foreign material risks which can impact safe and reliable plant operation.

Summary of underlying causes:

There was an FME programme in place, as well as associated procedures and expectations, and FME risks were mentioned in work packages and Pre-Job Briefings, but there was a lack of situational FME awareness in the field. For instance, FME areas were not marked, tools, dirt and spare parts were close to 'open systems', and there was no proper use of FME protection tools. Equipment was stored without an FME mindset (with no FME protection against dirt or pollution). Furthermore, the effectiveness of the FME programme was not consistently monitored to indicate FME programme deviations, and there was a lack of ownership concerning FME issues.

Summary of improvement activities:

A formal programme in accordance with WANO GL 2009-01 is implemented within the EPZ organization.

An FME core team (FME committee) has been set up, and the chairman is the overall FME coordinator. To ensure full awareness of FME, FME standards have been set, training/courses and procedures have been revised, and FME KPI's have been introduced to monitor the effectiveness of the FME-programme.

A formal 'living' FME programme was embedded in our Document management System (In February 2016). It consists of:

- Procedures: N12-00-006/-007/-008, containing clear roles and responsibilities for the FME programme, the graded approach policy for FME, and the recognition and perception of FME risks;
- Organization: an FME committee with the FME coordinator as its chairman. It has held meetings since November 2015 (three in 2015, and five in 2016, up to October);
- Equipment: among other things, recognizable cabinets, barriers and caps (orange in colour, since March 2016).
- Training programme: e-learning course (developed by TQ, November 2015), and, in the near future, work practices trained on the new WPS, in order to train and sustain FME awareness.

Relevant EPZ personnel have been instructed since November 2015, and required work practices and instructions are implemented. For contractors, additions have been made to the e-learning for access to the plant. Additionally, personnel can be invited to take part in the e-learning FME on a job-specific basis.

FME KPIs have been developed in accordance with the WANO FME KPI, and incidents are reported, monitored and trended. Input is based on issues mentioned in Classbase and the OE database.

Effect:

The FME awareness of EPZ personnel has significantly increased since 2014, and the percentage of threats has declined in 2016 (FME KPI).

IAEA comments:

The plant identified the underlying causes to evaluate the weaknesses in its FME programme. As a result, improvements has been made in the scope and communication of management expectation, the application of the FME programme, monitoring and trending of KPIs and the ownership and training concerning FME issues.

The plant has made several modifications to the existing FME programme, strengthened the related organisational structures and responsibilities, communication and training.

The modifications in the structure, responsibilities and training were established in November 2015, two specific procedures were revised in March 2016 to support the following items:

- Management expectations for the application
- Application of FME based on 4 categories
- Role of involved staff in work planning, conduct of work and observation
- Management and staff field walk downs
- Monitoring and reporting of the effect of the FME programme

The programme is monitored with 3 KPIs, which are reported monthly to the Nuclear Operation Management Team and assessed by the maintenance department. Related indicators have been backfilled from 2011. The basis of the indicators comes from the 'Classbase' database (low level or near misses) and SWG (events or lessons learned, threats).

Although the number of threats has declined in 2016 the indicators show a deteriorating trend from September to November 2016. This is caused by the increasing number of reports in 'Classbase'. The team rated this as a positive contributing factor due to enhanced sensitivity of staff.

The application of FME precautions is part of the work preparation. Work planners use a checklist for risk assessment. Further integration for example in the Pre Job Briefings or last minute risk assessments (LMRA) may enhance the quality of this process.

FME covers are available in the workshops. Field observations shows FME covers in temporary and permanent use.

Information and Training is provided in the toolbox and a FME specific e-learning course for own and external staff.

Conclusion: Issue resolved

4.6. MATERIAL CONDITION

4.6(1) Issue: High standards of material condition in some plant areas are not consistently maintained.

The team made the following observations:

- EY010, 20, 30; there is oil accumulation under the diesel generators, left over from the last diesel yearly maintenance;
- All of the Turbine Bypass Steam Dump Valves have oil leaks, and some of the valves have multiple oil leaks;
- Three leaks were identified in the HP injection pump rooms (TJ44D001 – outer seal leak, TJ80S009 - leakage at drain valve plug onto floor and TJ43S020 - leakage at drain valve plug onto floor);
- In room 04/210, the safety water cooling system (VF), there is leakage on a valve flange and a pump;
- Some cables are not properly and safely terminated (one electrical cable not insulated lying on the cover of the generator and another at the hydrochloric acid tank building);
- Corrosion on components in the NaOH and HCL dosing pump area in room 09.102;
- A leak on a pipe (UA045Z001) in the Demineralization Station;
- The blind flange (RS021G003) was mounted together to the pipe stainless steel flange with very corroded carbon steel bolts and nuts;
- There were bolts missing on the cabinet covers of the electrical cabinets ER020, MD072X400 and MD072Y400 in room 72.104;
- Several examples were found where equipment or small pipe was not correctly fixed by supports (SZ20S070 in the turbine hall, pipe in the room 03/125);
- Several examples were found where stainless steel material was not correctly stored and maintained against degradation.

Degraded material conditions could lead to deterioration of safety system availability and reliability.

Suggestion: The plant should consider consistently maintaining high standards of material condition.

IAEA Bases:

SSR-2/2

Requirement 28:

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

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

NS-G-2.6

10.17. A visual examination should be made to yield information on the general condition of

the part, component or surface to be examined, including such conditions as the presence of scratches, wear, cracks, corrosion or erosion on the surface, or evidence of leaking. Any visual examination that requires a clean surface or decontamination for the proper interpretation of results should be preceded by appropriate cleaning processes.

NS-G-2.14

4.36. Factors that should typically be noted by shift personnel include:

- Deterioration in material conditions of any kind, corrosion, leakage from components;
- Accumulation of boric acid, excessive vibration, unfamiliar noise, inadequate labelling;
- Foreign bodies and deficiencies necessitating maintenance or other action.

Plant Response/Action:

High standards of material condition in some plant areas were not consistently maintained. Degraded material conditions could lead to deterioration of safety system availability and reliability.

Summary of underlying causes:

Although the plant material condition supported safe operations, there were examples of leaks, material corrosion, small deficiencies on equipment, and practices related to poor material selection. This indicated a tolerance of poor material conditions, and could, in time, impact the plant's safe operation or reliability.

Summary of improvement activities:

A variety of small projects and programmes has been and will be undertaken to update and improve the plant.

In addition, a sense of urgency has been created in the maintenance department by adopting relevant KPIs in the monthly reporting system. Management in the Field rounds with photo reports have been introduced to improve overall maintenance performance.

Refurbishment activities have been carried out to improve facilities (the 'spick & span' project, painting work). Recovery/renewal projects are mentioned and prioritized in the portfolios (122 material condition-related projects, 79 with 'active' status, 2 with 'closed' status).

Effect:

In January 2016, the maintenance reporting system began monitoring the trend in leaks to be repaired immediately on a monthly basis via a KPI. Up to May 2016 this KPI generally stood at Around 160-180 leakages. Between then and now (October 2016), this KPI has shown a significant decrease (from 200 to 118).

The reports of the half-yearly, 'WANO' -type, field inspection tours show a declining trend in material condition findings since 2015.

In the weekly Management in the Field tours, findings are reported in a photo report and discussed by the maintenance management team. Since their introduction in October 2014, improvements have been observed in material condition, among other areas. These tours are carried out by a Team leader, Engineer and Supervisor from Maintenance.

There is a decrease in the maintenance backlog (positive trend 2014-2016).

IAEA comments:

The plant has evaluated the underlying causes of the OSART findings and has initiated a number of projects and programmes to achieve and maintain high standards of material conditions and the related processes and attitudes.

Several civil structure and plant system refurbishment activities have been started and executed. These activities have made considerable progress though they are not complete due to their large scope. Funding to continue these activities has been provided.

Concerning material and system conditions a WANO TSM for 'System Health Reports' was conducted and related action started. Corresponding measures like the information of management expectations, tagging of leakages and defects supports the change in the perception of the related staff on discrepancies and deficiencies from the specified and expected condition of the plant.

To monitor, correct and improve the achieved level several techniques are being used with the following results:

- Weekly Manager in the Field rounds with photo documentation shows the deviation and achievement to the management expectations. They are communicated to staff and followed in execution. The rounds show a decreasing number of deviations.
- The 1/2 year MT- EPZ held WANO shop floor visit in 2015 and 2016 shows a declining number of identified facts since 2015.
- The performance indicator for the number of leaks reported during 2016 from improved 160 to 96.
- Backlog on work on critical components has a low and favourable trend
- Scheduled investment is monitored and is on time and on budget.

Observation of the team during plant tours confirmed the progress on the work and that the plant is moving from a reactive to a proactive process.

Conclusion: Issue resolved

5. TECHNICAL SUPPORT

5.6 ORGANISATION AND FUNCTIONS

The team found that there are only 3 performance indicators in use within the Technical Support department. There are no performance indicators on the number of open modifications, or the length of time between implementing a modification and updating all documentation. The team encourages the plant to review where performance indicators may be beneficial to maintaining a strong focus.

The team found that there is no directed reading programme in place in either the Technical Support department or the Monitoring department. Therefore the team encourages the plant to implement a directed reading programme to ensure that workers are made aware of new or revised procedures.

5.7 PERIODIC SAFETY REVIEW

The recent Periodic Safety Review (PSR) (10EVA13) performed a thorough evaluation of safety systems and procedures against multiple international standards and guidelines, beyond what was required by national regulations. Additionally the review considered current state of the art technology and methods, and lessons learned from previous PSRs. The team considers this to be a good performance.

5.8 PROGRAMME FOR LONG TERM OPERATION

The plant's Long Term Operation programme made a thorough assessment of all components and the associated ageing mechanisms. The use of feedback from a SALTO review, and the assessment of active components provided good performance in this area.

5.9 SURVEILLANCE PROGRAMME

The team observed that the lack of coordination of ownership and reporting for systems, structures, and components (SSC), is leading to an incomplete overview of the status of SSCs. Operations have ownership of the testing of SSCs, Maintenance have ownership of maintaining SSCs, and Engineering have ownership of in-service inspections, however these groups do not review each other's reports. Additionally the trending and analyses of the results of maintenance, surveillance, and testing activities is inadequate, and reporting is only done on failures. This means that the opportunity to perform maintenance on deteriorating equipment before it fails could be missed. The team has made a suggestion in this area.

5.10 PLANT MODIFICATION SYSTEM

The team observed that the process for temporary modifications is not providing the necessary assessments or controls. There is no categorisation system for temporary modifications to allow for a graded approach to safety, and the initial safety assessment is not performed according to an established procedure. There is no expectation on the number or time limit for temporary modifications, and there are inconstancies in the temporary modifications database. This could lead to unapproved modifications on safety related SSCs. Additionally the labelling of temporary modifications was inadequate. The team has made a recommendation in this area.

The plant employs the Portfolio Management System in order to assess the risks associated with each proposed modification and assist in their prioritisation. The system also aides in the management of resources, and shows the availability of key resources to perform each stage of the modification. This allows for the allocation of funds and resources to the modifications which are either of the highest urgency or which will provide the most value. The team considers this to be a good performance.

It was observed by the team that the level of knowledge of the modification system of some staff who are indirectly involved in plant modifications was lacking. The team therefore encourages the plant to increase the non-expert staff's level of knowledge and awareness of the modifications system requirements and procedures.

The team observed that there are some shortfalls in the plant's programme for the control and modification of computer based systems. It was observed that small changes to the Process Presentation System (PPS) were being performed out with the modifications systems and that some of these small changes do not undergo verification. Also there is not a disaster recovery procedure for the restoration of a backup. It was found that whilst error logs were kept for the PPS these error logs did not typically undergo annual review in order to assess trends or reoccurring faults or errors. There is no offline version of the PPS on site to allow for testing of changes before they are applied to the main system, and access to the engineering terminal for the PPS was not adequately controlled. Therefore the team encourages the plant to improve its programme for the control and modification of computer based systems.

5.11 REACTOR CORE MANAGEMENT (REACTOR ENGINEERING)

The plant has no capability for core modelling. This limits the on-going assessment of core parameters which can be performed throughout a cycle. Additionally the plant has no facility to model a Xenon transient based on the actual reactor power history and conditions. The team encourages the plant to implement a core modelling and transient modelling system.

The plant currently has no route for the dispatch of failed fuel to a hot cell facility. This does not allow for the post irradiation examination of failed fuel, to establish of the cause of the fuel failure. The team encourages the plant to implement a route for the dispatch of failed fuel, so that root cause analyses can be performed on fuel failures.

DETAILED TECHNICAL SUPPORT FINDINGS

5.4. SURVEILLANCE PROGRAMME

5.4(1) Issue: The plant does not have a program which provides an adequate analysis of the results of Maintenance, Surveillance and Inspection (MS&I) activities.

The following observations were made:

- System ownership is fragmented between Maintenance and Operations, with input from Engineering;
- MS&I reports are not produced, and reporting is extremely fragmented. There is no integrated assessment of system MS&I providing a system overview;
- The owners of one aspect of a system don't read the reports of the owners of other aspects;
- Operations have developed a list detailing what aspects of each system should be prioritized but it is not distributed to Maintenance or Engineering;
- Battery voltage test results were not trended for use in preventative maintenance;
- An Operations Technician believed that the diligence of trending of test results varied over shifts;
- Operations system owners are only required to check test results against an acceptance criteria and previous result – no trending over time;
- There is no formal procedure for the trending of in-service inspection results (again results are compared to an acceptance criteria and previous results and not trended over time);
- System reports are reported by exception. They only focus on things that went wrong and don't review other areas to identify issues before they develop (reactive not proactive);
- Plant walk downs are performed on a type of component basis e.g. to look at pipe hangers, but there are no walk downs to look at individual systems;
- There is no formal process to assess equipment availability; it is performed as a set of separate functions which are not integrated.

Without an adequate analysis of MS&I activities the ability to assess adverse trends is compromised which could lead to the failure of safety related systems.

Suggestion: The plant should consider implementing a programme to provide a comprehensive assessment on the results of MS&I activities.

IAEA Bases:

SSR-2/2

8.1. Maintenance, testing surveillance and inspection programmes shall be established that include predictive, preventative and corrective maintenance activities. These maintenance activities shall be conducted to maintain availability during the service life of structures, systems and components by controlling degradation and preventing failures.

8.11. Coordination shall be maintained between maintenance groups and operations groups and support groups.

NS-G-2.6

4.12 The plant management should establish a group on the site to implement the MS&I programme.

5.24 Effective co-ordination should be established:

- Among different maintenance groups (mechanical, electrical, instrumentation and control, and civil engineering maintenance groups);
- Among the operations, radiological protection and MS&I groups; (c) Among the plant departments and contractors.

6.10. The results should be examined, where appropriate, for trends that may indicate the deterioration of equipment.

6.11. Histories of past MS&I should be used for supporting relevant activities, upgrading programmes, and optimizing the performance and improving the reliability of equipment.

6.12. Historical records of MS&I should be periodically reviewed and analysed in order to identify any adverse trends in the performance of equipment or persistent problems, to assess impacts on system reliability and to determine root causes.

Plant Response/Action:

The plant did not have a programme which provides an adequate overview of the results of Maintenance, Surveillance and Inspection (MS&I) activities. Without an adequate analysis of MS&I activities the ability to assess adverse trends is compromised, which could lead to the failure of safety-related systems.

Summary of underlying causes:

At EPZ, different departments had their own reporting systems for surveillance and inspection activities. There was no structured interdepartmental coordination or mutual performance review. Only when failures occurred did departments come together. There was no coordinated process to sustain and improve equipment reliability (ER).

Summary of improvement activities:

A working group has been formed to define what is needed to create a representative ER process. This group has made recommendations concerning organizational issues and process steps to be implemented (self-assessment).

Based on this self-assessment, a pilot project has been started.

To understand the organizational impact and requirements, a pilot has been carried out, generating an overview of the 'system health' of Emergency Grid 1. The reporting scope as well as formal roles and responsibilities are to be addressed in order to adapt the pilot concept.

Additionally, a WANO Technical Support Mission has been requested to review the pilot project and advise EPZ on further implementation, including necessary roles and responsibilities.

A project is under way (from 2015 to quarter 1 of 2017) to redesign/improve the Preventive Maintenance basis justification (FMECA), based on interdepartmental facts and figures. This is an important element in the Equipment Reliability process.

Effect:

The System Health report (December 2016) for Emergency Grid 1 has been produced as the output of the pilot project. The Preventive Maintenance programme has been updated. This project started in January 2015, and will be finished in Q1 of 2017. The outcome is a robust maintenance programme which leads to improvements in the system health and thus increased reliability of SSCs.

Advice from external experts is being used for further implementation of the Equipment Reliability project (WANO TSM 31 October - 4 November 2016).

Deterioration and degradation of SSCs are retrospectively monitored via work management KPIs in the monthly Maintenance department reports. These KPIs address the Nuclear Safety and Operational Focus. The KPI trends show slight performance improvements, and also that attention is still needed.

In addition, dedicated working groups are focusing on thematic issues (TJ, YB).

IAEA comments:

The plant identified the underlying cause of the problem as being the lack of a process and of an organisation to sustain and improve safety by managing equipment reliability.The action plan was proposed to develop an equipment reliability programme based on AP 913. A US Plant was benchmarked to better know and understand the methodology and adapt it to EPZ needs.

The decision was made to lead a pilot project on Emergency Power Grid which was completed in December 2015 with the issue of a comprehensive report. The preventive maintenance programme was subsequently updated. A second report is planned to be issued in December 2016 on that system.

In parallel a comprehensive set of KPIs was developed for critical components. A classification matrix was established with potential impact on safety, environment, occupational safety, production and costs.

A Technical support mission from WANO confirmed the chosen direction and advised to give priority to organization and management of the process.

The programme is defined and its implementation to all systems will continue in 2017.

A key success factor for this programme is the senior management focus and oversight of indicators, trends and recommendations identified in the system reports that can be done through a process and/or management system's reviews.

The team considers that what has already been achieved gives full confidence in the resolution of the issue.

Conclusion: Issue resolved.

5.6. PLANT MODIFICATION SYSTEM

5.6(1) Issue: The process for handling of temporary modifications does not provide adequate arrangements for their review, approval or control, to ensure that temporary modifications do not adversely affect safety.

The following observations were made:

- There is no categorisation system for temporary modifications;
- There is no plant limit or expectation on the number of temporary modifications;
- The review of temporary modifications by Technical Support is at their discretion, and no process exists to alert Technical Support to new temporary modifications before implementation;
- There are inconsistencies in the temporary modifications database;
- There is no limit on the number of extensions a temporary modification can receive;
- The Operations Manager decides whether a temporary modification is extended with no further technical review;
- The Technical Support department is not on the review list for any procedure change regarding temporary modifications;
- Maintenance technicians are the typical initiators of temporary modifications and a maintenance technician had never read the procedure for temporary modifications, and there has never been any training or directed reading on the procedure;
- Some temporary modification labels were not filled out correctly;
- A temporary modification was in the database but there was insufficient information to find the temporary modification on the plant.

Without an adequate process for the review, approval, and control of temporary modifications a modification could be implemented with an unintended negative effect on nuclear safety.

Recommendation: The plant should implement a process which provides for adequate review, approval, and control of temporary modifications, to ensure that temporary modifications are handled in a safe manner.

IAEA Bases:

SSR-2/2

4.39. A modification programme shall be established and implemented to ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded.

4.40. Modification control shall ensure the proper design, safety assessment and review, control, implementation and testing of all permanent and temporary modifications.

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

NS-G-2.3

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

6.4. The procedure for obtaining approval to implement a temporary modification should be the same as that for a permanent modification. In the procedure for authorization of proposed temporary modifications, it should be ensured that they do not result in an unreview safety issue. In the review of proposed temporary modifications and planned permanent modifications, any existing temporary modifications and the effects of the proposed change should also be considered.

6.7. The process for temporary modifications should allow for rapid review and assessment of any proposed modifications that have to be undertaken urgently. Such urgent actions, however, should neither reduce levels of safety nor bypass the obtaining of regulatory approval as necessary.

6.9. An appropriate procedure should be established to control temporary modifications on the plant. The following areas should be covered in this procedure:

- Requirements for technical reviews, in particular safety reviews to be performed before temporary modifications are made. Temporary modifications to structures, systems and components and process software important to safety should be independently reviewed by personnel not involved in the design or implementation of the temporary modification and should be submitted for regulatory approval, as required, before implementation;
- Control of documentation, to ensure that all documentation — such as operating flow sheets, operating manuals, maintenance manuals, emergency procedures — reflects temporary modifications, to ensure that the plant continues to be operated and maintained safely while the modification is in place.

Plant Response/Action:

Temporary modifications can be implemented in the plant without a thorough review and approval of the technical support department

Summary of underlying causes:

The main underlying cause is that both plant status deviations and temporary modifications were treated as deviations from an operations point of view according to procedure PU-N07 03, 'How to respond to deviations'. Therefore, plant status deviations and temporary modifications were treated in the same way, and recorded in the same database according to PO-N07-53, 'Registration of Temporary Modifications'. This database is owned by the Operations department. The difference between plant status deviations (operations process) and temporary modifications (configuration management process) was therefore not recognised. Temporary modifications were therefore treated as an operations issue instead of a configuration management issue.

Furthermore, procedural guidance and adherence to existing procedures for temporary modifications were not adequate, and expectations were not clearly set.

Summary of improvement activities:

The procedure dealing with deviations (PU-N07-03) has been revised, and a clear distinction is now made between plant status issues and configuration issues. The procedures for regular plant status issues (PO-N07-53) and for dealing with temporary modifications (PU-N13-05, 'Modifications procedure', and PO-N13-26 'Procedure with guideline for writing modification plan for small non-safety related modifications') have been adapted to clearly distinguish between plant status issues and temporary modifications.

Temporary modifications are now covered by PU-N13-05, which ensures the same categorization as normal modifications, and an adequate review before implementation in the plant. Procedure PU-N13-05 also describes the review of urgent modifications by the technical support department. To make sure that, even in urgent situations, the correct review is performed before implementation in the plant, a representative of the Technical Support department is on call for small non-safety relevant modifications (category 3 according to PU-N13-05).

Criteria for assigning to category 3 as well as regarding urgency of implementation are described in PU-N07-03, so the shift team leader can decide whether or not to call in the representative of the Technical Support department. The necessary change in the on-call procedure for the representatives of the Technical Support department has been implemented and communicated to the employees concerned. The personnel concerned from Operations, Maintenance and the Technical Support department have been instructed in the updated procedures.

Decision-making on urgent modifications in higher categories (2b or 2a according to PU-N13-05) requires an ODM (operational decision making process) in accordance with A01-25 N004. The modification plan database has been adjusted to the new procedures.

To control and reduce the amount of open temporary modifications and plant status issues, a clear time limit has been set in PO-N07-53. Open plant status issues are discussed monthly by Maintenance, Operations and the Technical Support department. These issues are additionally discussed once a month at the daily plant meeting. The supervisor of KTC (the section within the Technical Support department that is in charge of writing modification plans) reviews all plant status issues registered in the Temporary Modification database (PO-N07-53) during normal working hours. He independently checks whether the recorded plant status issues should have been treated as modifications according to PU-N13-05. Once a week, the KTC supervisor reviews whether multiple plant status deviations taken together degrade the safety of the plant.

Effect:

A clear distinction is made between plant status issues and temporary modifications. The adjusted operations, maintenance and configuration management procedures ensure that temporary modifications are treated in the same way as modifications. Temporary modifications undergo a thorough review and approval before implementation.

IAEA comments:

The plant identified the underlying causes of the issue. The plant now clearly differentiates between temporary modifications related to configuration management and temporary operating deviations related to plant status e.g. alignment change.

The relevant procedures have been reviewed and updated. (PU-N07-03 'registration of temporary modification', PO-N07-53 'Plant status deviations', PU-N13-05 'modification procedure' and PO-N13-26 'guideline for writing modification plan for small non-safety related modifications').

The team observed the following improvements:

- All modifications, permanent or temporary, are assessed using the same process, and the criteria for classification are the same.
- All modification requests are reviewed systematically by technical support department before implementation,
- Technical support department is responsible for the modification process,
- For urgent category 3 (small non-safety related modifications), the shift engineer is responsible for deciding whether to request, out of office hours, a technical support assessment on the basis of classification and priority allocation criteria as per PU-N07-03.
- For higher category modifications, it is required to go through an operational decision-making meeting as per A01-25-N004.
- Appropriate criteria are used to limit the temporary modifications and plant status deviations in duration and number. This is reviewed monthly in the daily plant meeting.
- All temporary modifications and plant status deviations are recorded in the same database.
- The cumulative effect of temporary modifications and plant status deviations is reviewed weekly by the technical support department to prevent any adverse impact on safety. However, the plant does not yet formalize the conclusions of the cumulative effect review.

Conclusion: Issue resolved

6. OPERATING EXPERIENCE FEEDBACK

6.1. ORGANISATION AND FUNCTIONS

The plant's operating experience (OE) programme is not effectively identifying corrective actions needed to improve performance in a timely manner. Contributing to this performance are gaps in identifying the types of reviews required for some events, a database system that is used for trending but does not track issue owners, actions to be taken, or due dates. The team recommends that the plant should enhance its expectations and provisions in the area of OE feedback to ensure that in-house and external OE are utilized comprehensively, in a timely and effective manner.

6.5. INVESTIGATION AND ANALYSIS

The team found that analysis of some events did not always ensure that root causes are identified and consistently corrected in a timely manner. The plant procedure governing this process does not contain all needed requirements to ensure the appropriate reviews are completed. This performance gap has resulted in repeat events. The team recommends that the plant improves the quality, timeliness, and causal analysis of events.

DETAILED OPERATING EXPERIENCE FINDINGS

6.1. ORGANISATION AND FUNCTIONS

6.1(1) Issue: The plant expectations and provisions in the area of operating experience feedback do not ensure that in-house and external operating experience (OE) is utilized comprehensively, in a timely and effective manner.

- The plant safety policy lacks a statement devoted to utilization of in-house and external OE;
- The plant does not have a formal OE programme;
- Qualification criteria and training requirements for the personnel reviewing OE are not established at the plant;
- OE procedures do not always include definitions, references to international standards or other plant procedures, or responsibilities of OE personnel and managers;
- Definitions and criteria for low-level events and near misses are not specified at the plant.
- The plant uses separate data bases for internal events, external events, Low Level Events (LLE), and Near Misses (NM), making it difficult to identify common issues.
- The plant's 'Class Base' database does not track the person responsible for lessons learned associated actions, feedback, and final status of NM and LLE;
- The plant last performed a QA audit for the OE programme in 2010/2011;
- There are nine total external events in the OE backlog from 2007, 2011, 2013 and 2014, including 1 WANO SOER, several SERs and other events. These events have not been reviewed to identify if actions are required at the plant.

Without a robust OE programme, the plant may miss opportunities to learn from in-house and external experience, which could result in diminished plant safety.

Recommendation: The plant should enhance its expectations and provisions in the area of OE feedback to ensure that in-house and external OE are utilized comprehensively, in a timely and effective manner.

IAEA Bases:

SSR-2/2

5.33. The operating experience programme shall be periodically evaluated to determine its effectiveness and to identify any necessary improvements.

NS-G-2.11

2.9. There should be a commitment from the management in the various participating organisations involved in the national operational experience feedback programme to ensure that it is efficient and effective.

2.12. A detailed procedure should be developed by the operating organisation on the basis of the requirements for a national system established by the regulatory body. This procedure should define the process for dealing with all internal and external information on events at nuclear installations. The procedure should precisely define the structure of the system for the feedback of operational experience, the types of information, the channels of communication, the responsibilities of the groups and organisations involved, and the purpose of the documentation produced. Organisations that have various roles within the national process for the feedback of operational experience usually include operating organisations, the regulatory body, plant designers and research organisations. The procedure should be made available for review or approval by the regulatory body, if so required.

10.12. Reports in the system for the feedback of operational experience should be stored in such a manner that the information they contain can be easily sorted and retrieved by both the operating organisation of the nuclear installation and the regulatory body, as appropriate. The information should be organized to facilitate frequently needed searches for, for example:

- Events at similar units;
- Systems or components that failed or that were affected;
- Identification of the causes of events;
- Identification of lessons learned;
- Identification of trends or patterns;
- Events with similar consequences for personnel or for the environment;
- Identification of failure types or human factor issues;
- Identification of recovery actions and corrective actions.

NS-G-2.4

6.67. The responsibilities, qualification criteria and training requirements of personnel performing activities to review operating experience should be clearly defined. Personnel who conduct investigations of abnormal events should be provided with training in investigative root cause analysis techniques such as accident investigation, human factor analysis (including organisational factors), management oversight and risk tree analysis, change analysis and barrier analysis. Event investigators should be...

6.64. The operating experience at the plant should be evaluated in a systematic way, primarily to make certain that no safety relevant event goes undetected. Low level events and near misses should be reported and reviewed thoroughly as potential precursors to degraded safety performance. Abnormal events important to safety should be investigated in depth to establish their direct and root causes. Methods of human performance analysis should be used to investigate human performance related events. The investigation should result in clear recommendations to plant management, which should take appropriate corrective action without undue delay to prevent recurrence.

Plant Response/Action:

The plant expectations and provisions in the area of operating experience feedback did not ensure that in-house and external operating experience (OE) is utilized comprehensively, in a timely and effective manner.

Summary of underlying causes:

- Lack of promotion by senior management of the importance of OE
- Procedures and expectations for OE were unclear and not up to date

- OE coordinators did not have sufficient mandate
- Lack of employee engagement in OE

Summary of improvement activities:

- Increased senior management focus on OE
- Nuclear Safety policy declaration NV 2001-0914 has a statement on the use of OE: "We learn from experiences, we evaluate internal and external incidents, and implement corrective actions".
- Quarterly reports on operating experience are made to the senior management team
- New SOER programme developed and assessed during WANO Peer Review as state of the art
- Managers discuss most important events in canteen sessions with all staff – Managers act as sponsors for root cause analyses Procedures, expectations and mandate
- In 2015, a new position of OE coordinator was created within the QA department. The QA Manager has become a member of the senior management team.
- Meeting of OE analysis group members every two weeks.
- All LLEs (low-level events) now discussed during morning meeting. Important events followed up.
- OE procedures updated, including in relation to LLEs. Criteria determined.
- QA audit completed.
- Formally trained OE staff.
- Improved SMART criteria for corrective actions.

Engagement:

- Use of OE in refresher training (OPS, Maintenance) increased
- JITs during outages
- OE briefs integrated into management system, and used on an intensified basis (PU-A27-02-009). Since beginning of 2015, 8 lessons learned (6 internal, 2 external) and 4 incident info flyers have been published.
- Preventive maintenance tasks flagged with OE.
- 2000 - 3000 LLEs reported annually.
- >10% of population involved in SOERs

Effect:

Expectations and provisions in the area of operating experience feedback have been improved. Procedures have been improved. There are clear commitments and there is support from senior management for OE. The use of OE in the organization has increased. Timeliness of analyses has improved. The percentage of repeat events shows a positive trend.

A Human Performance coordinator is being recruited. He/she will manage the HP improvement cycle in close cooperation with the OE coordinator. This will lead to better use of internal and external OE before, during and after work.

IAEA comments:

The plant has identified the causes and taken appropriate actions to resolve the issue. Relevant plant programmes, procedures and databases were amended to take account of programmatic deficiencies identified during the OSART mission. The importance for continuous safety improvement of effective plant operational experience programme was underlined in the new Nuclear Safety Policy declaration NV 2001-0914 and management expectations were reinforced. Plant procedure PU-A27-02 'Analyses and evaluation of internal and external events and deviations' was updated in 2015 and 2016, and qualification and training requirements for Operating Experience (OE) staff were clearly defined. An OE coordinator was appointed and 12 persons were selected to conduct event analyses on the site. Basic training and refresher training is conducted to ensure requested competence. Reporting and assessment of Low Level Events (LLE) was reinforced, too and the plant prepared in 2016 a document PU-A27-04-001 'Manual for plant work force on how to handle low level events'. LLE are considered on a daily, monthly and quarterly basis. Criteria for trending of LLE are specified.

In November 2016, the plant performed an internal audit of its internal OE programme which found no major deficiencies in event reporting and analysis. The plant has increased the use of OE for continuous safety improvement, for example by preparation of Just-In-Time (JIT) training. Currently 25 JIT material packages are available at the plant, 3 of them were updated in 2016 and 2 more updates are underway. During the first stage Follow-up, the plant demonstrated the effective use of OE for Pre-Job-Brief (PJB) in maintenance department. This practice is being extended to other departments. Use of OE for JIT and PJB has been significantly improved and although not all of the processes have been yet formalised there is plant commitment to complete these processes in due time.

As concerns the utilisation of external operating experience, the plant has placed priority on completing the assessment of WANO SOERs. The work is not yet completed for the other external sources of OE but significant progress toward completion of the work is evident.

The plant has taken systematic and effective approach to resolve the issue.

Conclusion: Issue resolved

6.5. INVESTIGATION AND ANALYSIS

6.5(1) Issue: Analysis of some events did not always ensure that the root cause is identified and are not consistently corrected in a timely manner.

- Authorized procedures, containing instructions and guidelines, for performing a full root cause analysis (RCA), an apparent cause analysis (ACA), and a trend analysis do not exist;
- The plant has a large long-standing backlog of analyses of internal and external events. The backlog of unfinished analyses decreased from 77 in 2011 to 68 in 2013, and 50 in 2014;
- A procedure for performing RCA and ACA exist in a draft version at the plant;
- The plant has a backlog of category 3 and 4 reviews, which require ACA, that have not been completed within the three-month plant target. The unfinished analyses include 3 from 2012, 10 from 2013, and 28 from 2014;
- Plant procedure PU-N01-07, 'Analysing Internal and External Events', does not consider all the necessary factors or criteria to determine the correct type of investigation to perform;
- The plant has experienced many repeat events, including 18 in 2011, 17 in 2012, 25 in 2013, and 6 events as of September 2014. This indicates that OE reviews are not resulting in lesson learned to prevent recurrence of events;
- The plant is not performing the required number of RCA due to missing requirements in the plant procedure for classifying the level of review that is needed. Examples include repeat plant events, complex plant events, and INES category 1 events;
- Between 2009 and 2011 no plant events were analysed with RCA, although 3 events were classified as meeting the INES 1 criteria;
- Analyses performed between 2009 and 2012 were not performed in a systematic manner, and the documentation for these reviews cannot be extracted from the plant database;

Plant KPI's indicate poor performance in the following areas:

- Approval of recommended actions from the OE department by the responsible departments. The target for satisfactory performance is 20 days, but the site average performance is 50 days for 2014;
- Time from receipt of OE to when recommended actions are submitted for approval. The target for satisfactory performance is 150 days, but the average for 2013 was 239 days, and 312 days for 2014.

Without timely and adequate reviews and analysis of OE, the potential exists for repeating plant events or having events that challenge plant safety.

Recommendation: The plant should improve the quality, timeliness, and causal analysis of events.

IAEA Bases:

SSR-2/2

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

NS-G-2.4

6.64. The operating experience at the plant should be evaluated in a systematic way, primarily to make certain that no safety relevant event goes undetected. Low level events and near misses should be reported and reviewed thoroughly as potential precursors to degraded safety performance. Abnormal events important to safety should be investigated in depth to establish their direct and root causes. Methods of human performance analysis should be used to investigate human performance related events. The investigation should result in clear recommendations to plant management, which should take appropriate corrective action without undue delay to prevent recurrence.

NS-G-2.11

4.2. Accordingly, the operating organisation or licensee, as appropriate, should have procedures in place specifying the type of investigation that is appropriate for an event of any particular type. Such procedures typically outline the conduct of an investigation in terms of means of initiation, duration, composition of the investigation team, terms of reference for the investigation team and format of the final report. A typical outline of an investigation process is given in Appendix III.

4.3. The level of the investigation carried out should be commensurate with the consequences of an event and the frequency of recurring events. Significant factors that would influence the magnitude of an investigation may include the following:

- The consequences of the event and the extent of damage to systems, structures and components;
- Any injury to on-site personnel;
- Whether a similar occurrence has taken place earlier at the same installation or at an installation of a similar type;
- Whether a significant radiological release or an overexposure of personnel has occurred;
- Whether plant operation exceeded the operational limits and conditions or was beyond the design basis of the plant;
- Whether there is a pattern that is complex, unique or not well enough understood.

4.4. The scope of investigations of events should vary appropriately:

- In the case of a single serious event there should be a Panel or a Board of Inquiry chaired by a senior officer, involving many people and making extensive use of root cause analysis techniques;
- For an event with no consequences or a minor event, or for adverse trends, a relatively quick and simple investigation should be conducted by an individual trained in event investigation techniques; this latter type of investigation may result in the identification of an apparent cause only (rather than a true root cause).

4.10. The analysis of any event should be performed by an appropriate method.

It is common practice that organisations regularly involved in the evaluation process use standard methods to achieve a consistent approach for the assessment of all events. These standard methods usually involve different techniques. Each technique may have its particular advantages for cause analysis, depending on the type of failure or error. It is not possible to recommend any one single technique. Either one technique or a combination of techniques should be used in event analysis to ensure that the relevant

Plant Response/Action:

Analysis of some events did not always ensure that the root cause is identified and are not consistently corrected in a timely manner.

Summary of underlying causes:

- There was no formal written OE procedure with expectations regarding in-depth analysis
- There was a large backlog of outstanding analyses
- Lack of promotion by senior management of the importance of OE
- Analysis had a low priority compared to regular work for analysis group (SWG) members and their supervisors
- Insufficient training of analysis group (SWG) members
- Too much individual work

Summary of improvement activities:

- OE procedures, instructions and expectations were improved and formalized
- Meeting of OE team members every two weeks
- Increased working time on OE analysis agreed with analysis group members and their supervisors
- Improvement sessions to identify improvements have been held - PIs in monthly Operation and Maintenance reports
- Managers act as sponsors for root cause analyses

Effect:

Expectations and provisions in the area of operating experience feedback have been improved. Quality, timeliness and cause analysis have been improved. Since the beginning of 2015, seven in-depth root cause analyses have been performed, six in analysis category 3 and one in category 2 (concerning degradation of batteries, also reported to IAEA by Regulatory body). In addition, 62 apparent cause analyses (category 4) have been performed. Decreasing trends can be seen in outstanding analyses and repeat events.

IAEA comments:

The plant has analysed the causes and defined an action plan to resolve the issue. The plant has updated the plant procedure for event analyses PU-A27-02 and defined better the criteria for performance of RCA, ACA and trend analyses. During the first stage of the OSART Follow-up in December 2016 the team noted that further work is needed to specify the type and methods used for trend analyses. The plant criteria for performing RCA need to be further evaluated and modified, as necessary to ensure that all safety significant events are subject to RCA (for example: currently the formal criteria applied may theoretically allow that INES level 1 or even 2 events be excluded from RCAs). In 2015 the plant issued a manual for RCA: PU-A27-02-006, which provides detailed instructions on the way to perform RCA however, 'extent of conditions' and 'contributing causes' attributes are not yet addressed in the RCA manual.

In 2015 the plant performed seven RCAs and 62 ACAs. One RCA for INES level 1 event concerning the insufficient capacity of 24V batteries EK112, EK 114, EK 124 was reviewed during the first stage of the OSART Follow-up in December 2016. The analyses were found well performed, however, not all of corrective actions have been implemented in accordance with the established deadlines. The plant has reduced the number of repeat events in 2015&2016, however, the plant long term target for having systematically less than 10% of repeat events is not yet achieved. Furthermore, in some cases completion of analyses took longer than specified in the plant procedure and the assignment of corrective actions was not done on time.

The period needed for approval of recommended actions from the OE group by the responsible departments was reduced in comparison with 2014, however, the current average period is 41 days. This is double the plant target of 20 days for this indicator.

Although the plant has taken a systematic approach to resolve the issue further actions are needed to complete some of the actions and demonstrate sustainable results.

Conclusion: Satisfactory progress to date

IAEA comments during OSART follow-up 2nd Stage:

The plant continued its efforts to improve the quality of its root cause analyses and ensure that corrective actions are taken systematically and in a timely manner to avoid repeat events. In the beginning of 2017 the plant revised the criteria and procedure for performing of RCA to ensure the gaps identified during the OSART mission are fully resolved. The 'extent of conditions' and 'contributing causes' attributes are now addressed in the RCA manual, too. The plant further reduced the number of repeat events (25% in 2014, 18% in 2016, and 12% in 2017) and ensured that OE group's recommendations for corrective actions are adequately and timely considered and approved by the other respective departments. The plant KPI demonstrate that 11 of the 14 root cause analyses performed in 2017 were completed on time and timely corrective action implementation is now at 90 % in the CAP.

Conclusion: Issue resolved

7. RADIATION PROTECTION

7.1 ORGANISATION AND FUNCTIONS

The Radiation Protection Programme is making progress to improve their standards and procedures. The RP department proactively seeks to support other departments in the development of procedures of work plans to improve the safety of the workers. However most of the remainder of the organisation is not currently actively contributing to efforts to reduce radiation exposure or prevent the spread of contamination. The team made a recommendation that individuals and the other departments take greater ownership and accountability for ensuring radiological risks and exposure are maintained ALARA.

The QA programme (Radiation protection Programme) contains goals, objectives, legislative, and international references, supporting documentation references. There is no site wide approved dose reduction programme or RP improvement programme. There is an internal draft document for the RP department, but the plant is encouraged to make this a site owned programme.

Dose constraints or KPI target settings for tasks and outages are not currently independently reviewed or challenged. Authorisations for RP roles are only given in-line by one person and there are no prescribed standards for plant knowledge, attitudes or behaviours which need to be attained for the various authorisations. The plant is encouraged to review its independent oversight of these key RP activities.

Within the RP department, there are dedicated persons, who have a very high regard for personal and worker safety. They actively manage and support workers in the RCA to ensure that radiological controls are applied. They maintain a very good knowledge and overview individually and within the team about what work is going on, through the RP weekly lead, attendance at the relevant meetings and very proactive information sharing. The team has considered this as a good performance.

For RP staff, there are no practical linking training materials, courses or OJT guides which relate the learning of radiation protection to its application on a nuclear power station. The plant has started to bridge this gap and the team encourages this to continue. There is no specific radiation worker training programme to enable workers to know and understand the local rules and practical behaviours and practices which would enable them to apply better prevention techniques in the RCA for contamination control. The team encourages the plant to develop a radiation worker training programme.

7.2 RADIATION WORK CONTROL

The plant's standards & expectations for behaviours and work practices for work in the RCA are not always set nor visible enough and are not adhered to by all workers, nor reinforced by coaching or observation in the RCA. There is a recommendation in the MOA area which reflects the team's recommendations in this area.

The plant's routine work in the RCA is controlled largely by a basic requirement for persons to 'check-in' at the RCA entrance with a lead RP technician. This allows good conversations and face-to-face acknowledgement of the controls being imposed on the work. Nevertheless, experience at the plant and elsewhere shows that front-end planning and discussion with the radiation workers and RP together, allows better deployment of ALARA PRACTICES as is seen in the current arrangements for higher risk work. The team encourages the plant to review the arrangements for the lower risk work (e.g. RWP for routine work to contain appropriate precautions).

There are currently problems with using the work management software (asset suite 7) effectively to create the kind of Radiological Work Permits (RWPs) and instructions required. The plant is encouraged to deliver the next version of the software in collaboration with RP to ensure that it meets the needs of a functional radiological work permit system (including interaction with the EPDs).

Generally, there are increasing controls applied as the radiological risk increases. The methodology of the zoning can result in a lack of appreciation of high risk areas (>2mSv/h) as they are not clearly delineated from medium risk areas (>50uSv/h) as the red zone doserate boundary is very low. The ISO standard required radiological risk signage is not currently used on all doors into the RCA and some doors can be opened to exit the RCA from the inside inadvertently by unauthorised persons without detection. The plant is encouraged to review these arrangements for protecting against spread of contamination and inadvertent entry of persons to controlled or higher risk areas.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

Routine monitoring of the plant rooms and the associated trending allows very simple and quick identification of changes in dose rates and zoning. These are well communicated through a variety of means to the whole organisation and are identified as a good performance. The availability of the 3D photographic model of the plant to ensure that workers can visualise, measure and check their work planning prior to entering high radiation zones is also a recognised good performance.

Worker practices show a disregard for the importance of radiological exposure and contamination control. Recent plant events (person entering a high neutron area and personal contamination events) demonstrate that there are deficiencies in this area. The team has made a recommendation in this area.

The current KPIs for RP assess significant events, but the plant is encouraged to trend lower level events and near misses in RP, such as contaminated items and equipment, plant contamination above action levels and capturing more detail on personal contamination events to enable detailed trending, analysis and cause identification.

7.4 RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

The frequency of routine function checks (simple testing against a source) does not meet current industry standards as it is not high enough. Also, there is no complete QA system supporting the tracking of equipment use and checks carried out. The team encourages the plant to review this area for improvements.

7.5. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

There is a build-up of historical equipment (which may be contaminated) in a room in the RCA. This equipment is not labelled with any radiological or owner information nor wrapped. Active waste is segregated from 'potentially clean' wastes. However, there is a lack of segregation of wastes at the source in the RCA, which results in increased amounts of sorting required later, using resources and incurring dose.

The team encourages the plant to consider improving the management of active waste.

Although the plant's discharges are well within authorized levels, the plant has voluntarily set themselves lower internal targets. Performance is monitored and improved within this target, even though not required by the regulator. This is a good performance.

7.6. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

There is a lack of instrumentation available for intervention teams departing from the 'bunker' facility (only one teletector, meaning that only one team can deploy and only one very small contamination instrument for checking of all persons at a control point). The plant is encouraged to review (in line with the EP issues) the adequacy of monitoring instrumentation.

The fence monitoring system owned and monitored by the site is mainly passive and only contains one on-line gamma detector. Plans and funding are in place to replace this system in the next two years and the plant is encouraged to pursue this project with benefits for environmental, operational and emergency radiation protection.

DETAILED RADIATION PROTECTION FINDINGS

7.1 ORGANISATION AND FUNCTION

7.1(1) Issue: The plant workers and line management do not always take responsibility for ensuring their own or their team's radiation protection and are not held accountable when the required radiation protection behaviours and work practices are not achieved.

The team made the following observations:

- Some radiation workers do not understand the differences between radiation and contamination, nor the ways to prevent contamination spread;
- Recent events show that workers have not taken basic, simple measures to prevent personal contamination spread;
- There are very few supervisor observations of radiation workers in the RCA and no clear expectations that this should be undertaken. There is also no training given to enable them to undertake this effectively;
- A large quantity of equipment is regularly abandoned at the entrance to the hot workshop over night or over the weekend, without identification of owners, contravening management expectations for notification;
- There are only few dose reduction methods being undertaken by departments without RP initiation;
- Radiation workers did not undertake actions to reduce their dose without being prompted by RP staff (e.g. moving away from areas of elevated doserate);
- A recent significant event (entry into a room with high neutron doserate) demonstrates a lack of consideration of the importance of dose by an individual when entering a room;
- There is no requirement for departments to undertake investigations for their own staff when site dose constraints are exceeded or persons are contaminated;
- There are only department levels KPIs for dose in maintenance, not for contractors. Operations, projects or chemistry.

When workers and line management are not taking responsibility for their own radiological safety, dose is not controlled or reduced and contamination events will continue to occur.

Recommendation: The plant should take measures to ensure that all workers and line management take responsibility for ensuring their own and their team's radiation protection and should be held accountable when the required behaviours and practices are not achieved.

IAEA Bases:

SSR-2/2

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. Consequently, particular emphasis shall be given to the training of all site personnel so that they are aware of radiological hazards and of the necessary protective measures.

GSR Part 3

3.79 Employers, registrants and licensees shall take such administrative actions as are necessary to ensure that workers are informed that ensuring protection and safety is an integral part of a general occupational health and safety programme in which they have specific obligations and responsibilities for their own protection and the protection of others against radiation exposure and for the safety of sources.

Requirement 22;

Compliance by workers;

Workers shall fulfil their obligations and carry out their duties for protection and safety.
NS-G-2.7

2.41. All site personnel are responsible for practicing measures to control radiation exposure.

Plant Response/Action:

The plant workers and line management did not always take responsibility for ensuring their own or their team's radiation protection and were not held accountable when the required radiation protection behaviours and work practices are not achieved.

Summary of underlying causes:

1. A shortage of knowledge.
2. Lack of clear expectations and reinforcement.
3. Lack of reports to create overview of and insight into RP dose and contamination.
4. Insufficient attention to preventive measures in work preparation.

Summary of improvement activities:

To improve knowledge of radiation safety, a training plan including OJT for radiation workers, RP monitors and RP technicians has been established, and a refresher training programme is performed. A work practice simulator including dose simulation for training in radiological circumstances is under construction.

Expectations on the minimum amount of time that should be spent in the RCA by managers and supervisors are set. In addition, the instruction regarding behaviour in the RCA has been updated. The CEO is clear in his expectation that cases in which the day dose limit is exceeded can and must be prevented.

An improvement project involving all departments, with the Maintenance manager as sponsor, is under way, aimed at reducing the number of occasions on which the day dose is exceeded.

Reports on dose and contamination events are provided by the RP department. These reports are discussed at team meetings in the operational departments. A radiation safety dashboard has been created and will be made available to team leaders of the operational departments in short term. This information will be used in work preparation.

Radiological risk assessment in the work management process has been improved by introducing a formal integral risk assessment document into the process, which includes radiological risks. The radiation work permit, based on N-SG-2.7, has also been improved.

Effect:

The effect of the actions taken is that awareness of radiation safety among radiation workers has improved. Workers have more knowledge and are better trained. Every worker entering the RCA has a short briefing with the RP department at the entrance to the RCA before starting the job. Leaders take more responsibility for the radiation safety of their team members. This results in a decrease of collective dose during normal operations, and improved contamination control.

IAEA comments:

The team acknowledged the identification of underlying causes of the issue.

The procedure N17-22-230, 'Behaviours in RCA' has been updated. For example, it gives clear instruction that Operators use radiation detectors before entering high radiation rooms. The training plan set up for RP monitors and technicians as well as for other categories of personnel e.g. Operators, nuclear workers and contractors, has been implemented.

In Maintenance/projects and work management, 94 workers have been trained about the new radiation work permit and situation awareness.

In Operations, 17 shift leaders and assistant shift leaders have been trained and qualified on radiation safety level 4 and 70 field operators qualified level 5. In 2015, 76 workers from Operations attended the refresher course.

Concerning On-the-Job Training, workers from Operations and Maintenance have to go through the 4 topics of OJT (waste, contamination, dose and skills (use of RP equipment)) over a period of 4 years.

Contractors also attend specific training in connection with their activity. 286 employees attended a RP training session in 2015 and 2016.

The training programme includes evaluation, a refresher course and in the field coaching. On the Job Training is done in the RCA. The team attended an On the Job Training session of Operations staff. The team observed how such training develops a questioning attitude concerning radiation and contamination risks, as well as skills to use the detection devices.

In the near future, the Work Practice Simulator will help to enhance the competence and risks' awareness of employees and contractors in terms of radiation safety.

In order to improve prevention, the plant has revised the radiation work-permit format based on a risk analysis combining radiation and contamination risks. The plant has also introduced a practice of a short interactive briefing between RP and maintenance staff at the entrance of RCA before starting a work.

Conclusion: Issue resolved

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

7.3(1) Issue: The plant's dose reduction and contamination control techniques and practices are not effective in ensuring doses and contamination spreads are as low as reasonably achievable (ALARA).

The team made the following observations:

- EPD dose rate alarm is not set or used to allow individuals to be alerted to areas of higher dose rates and hence reduce their doses;
- The definition of a hot spot is very high (>2.5mSv/h) which in a green zone (<10mSv/h) could represent a significant unexpected exposure;
- There is a high number of personal contamination events being recorded at the final exit of the RCA (More than 400 in the period Jan – Aug 2014);
- There is no plant wide dose reduction programme;
- Waste is sorted, handled and moved without adequate checks or labelling for dose rate and contamination levels, additionally, there is a lack of use of long handled tools and no use of extremity dosimetry where high dose rates exist;
- No benchmarking is performed with other plants for outage dose reduction techniques;
- Only one camera was deployed during the 2014 outage and no remote communications were used;
- Remote monitoring of the primary circuit was undertaken in the last outage, but only one detector was deployed;
- Practical dose reduction techniques for RP staff are not used e.g. remote monitoring, cameras & communications devices;
- Limited and inconsistent production of post-job radiological survey reports;
- Loose contamination above expected levels is routinely found during surveys and when carrying out RCA clearance monitoring of tools and equipment;
- Observed behaviours during CVCS pump overhaul demonstrated a lack of good contamination control practices e.g. the following where not used: wiping, monitoring, glove changes, restriction of potential spread during search for tools;
- Room signage (zoning) is small and hard to read and is not routinely used by workers prior to room entry. It is often placed out of the line-of sight of persons entering high dose rate rooms;
- Inconsistent labelling of hot-spots does not allow individuals to understand easily where the risk and hazard is and where low dose rate areas are;
- The layout of the laundry does not allow a flow from a contaminated sorting table through to a clean area and contamination is often found in this area during routine surveys;
- The hot workshop & decontamination facility has no air sampling routinely undertaken.

Without utilising adequate dose reduction and contamination control methods, tools & techniques, additional unnecessary dose is accrued, workers are contaminated and contamination can spread around the plant and into the environment.

Recommendation: The plant should utilize a diversity of tools and techniques to reduce doses and control contamination more effectively in normal operations, during projects and in outages.

IAEA Bases:

SSR-2/2

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

NS-G-2.7

3.67. For the control of radiation exposure of personnel, consideration of the optimization of radiation protection is required in the design and operation of a nuclear power plant in order to keep doses as low as reasonably achievable, economic and social factors being taken into account. In line with this requirement, in examining working procedures and activities, the reduction of doses should be given the highest priority. A hierarchy of control measures should be taken into account in optimization. Firstly, removal or reduction in intensity of the source of radiation should be considered. Only after this has been done should the use of engineering means to reduce doses be considered. The use of systems of work should then be considered and, lastly, the use of personal protective equipment.

Methods of dose reduction that should be considered include:

- Reducing radiation levels in work areas, for example, by the use of temporary shielding;
- Reducing surface and airborne contamination;
- Reducing working time in controlled areas;
- Optimizing the number of workers in the work team;
- Increasing the distance from the dominant radiation source;
- Identifying low dose areas where workers can go without leaving the controlled area if their work is interrupted for a short time.

Plant Response/Action:

The plant's dose reduction and contamination control techniques and practices were not effective in ensuring doses and contamination spreads are as low as reasonably achievable (ALARA).

Summary of underlying causes:

1. The plant did not have a formal dose reduction programme.
2. Radiological risk assessment in the work management process was not optimized.
3. Some radiological workers suffered a lack of knowledge in the area of radiological safety.

4. Insufficient use was made of options for dose reduction using equipment.

Summary of improvement activities:

A dose reduction programme has been written and implemented. A study of reduction of the source term has been conducted. Some measures for dose reduction and source term reduction, such as increasing the pH value, have been implemented.

Radiological risk assessment in the work management process has been improved by introducing a formal integral risk assessment document into the process, which includes radiological risks. The radiation work permit, based on N-SG-2.7, has also been improved.

To improve knowledge of radiation safety, a training plan including OJT for radiation workers, RP monitors and RP technicians has been established, and a refresher training programme is performed. A work practice simulator including dose simulation for training in radiological circumstances is being built.

Cameras, tele-dosimetry and online dose rate measurements are used (for instance during outages). The introduction of extra equipment (such as headsets to improve communication) is under investigation. The overall contamination monitors at the exit of the controlled area will be replaced, and operations software including a system for analysis of contamination data will be implemented in the first quarter of 2017.

Effect:

The effect of the actions taken is that dose rates in the RCA are decreasing. Awareness of radiation safety among radiation workers has improved. Workers have more knowledge and are better trained. Every worker entering the RCA has a short briefing with the RP department at the entrance to the RCA before starting the job. This results in a decrease of collective dose during normal operations, and improved contamination control.

IAEA comments:

The root-cause analysis identified multiple causes of the issue. Several improvements have been made on that basis. A comprehensive dose reduction programme has been formalized including KPIs. Some actions in that framework are as follows:

- Relocation of a shoe cleaning machine at the exit of the RCA,
- Reduction of thresholds at overall contamination monitoring,
- Increase in the monitoring of contamination in buildings,
- Monitoring of hotspots,
- Reduction of alarm threshold on EPD (0.5 mSv/h)
- Source term reduction (pH increase, cleaning of primary coolant through demineralizers)
- Improvement of the work control through a more comprehensive Radiation work permit taking into account radiation and contamination risks assessment.
- Recording of all contamination detected at the exit of the radiation controlled area,
- Production of an ALARA report and evaluation.
- Evacuation of irradiated materials stored in the fuel pool.
- Use of tele-dosimetry for high dose activities e.g. steam generators.

These measures have led to significant improvements in collective doses even with the SAC project (evacuation of irradiated materials from the spent fuel pool), individual contamination events have deceased from about 1400 in 2014 to less than 400 in 2016 despite additional work on steam generators during the outage.

The number of green rooms has increased significantly. The team observed significant improvements in the radiation controlled area in terms of cleanliness, housekeeping, graffiti and material conditions. The team also identified that further progress is required:

The plant is taking every opportunity to reduce doses and improve contamination control.

Conclusion: Issue resolved

8. CHEMISTRY

8.3 CHEMISTRY SURVEILLANCE PROGRAMME

The chemistry programme for radiochemical and chemical parameters to be analysed is well developed and used effectively, however the pH of feed water is not in the parameter list. The conductivity of steam generator blow-down has only one action level and no corrective actions in the parameters' list to be taken in the event of a deviance. The team encourages the plant to improve the quality control programme in the Chemistry Department.

The team identified as a good performance the development of a software tool which will give advice to the technicians how to change the hydrazine dosage for control of secondary water quality.

8.5 LABORATORIES, EQUIPMENT AND INSTRUMENTS

The team identified as a good practice the environmentally controlled room in the nuclear laboratory. The accuracy of the chemistry instruments used for the analysis of samples related to plant safety is improved by their use in the environmentally controlled room.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

The team identified as a good performance that the plant has access to an international database maintained by the plant designer which contains information about approved materials. The plant also has a software module for Asset Suite, the Material Safety Data Sheet, which is used to manage the receipt of goods that have possible chemical impact on the plant. The data contained in the Material Safety Data Sheet is accessible to all staff and provides easy access to chemical data for inclusion into work order packages.

The team found examples of insufficient labelling, storing, handling chemicals and hazardous materials. The plant work practices used when handling chemicals and other hazardous materials are not always effective in ensuring that risks of personnel injury and equipment damage are minimized. The team made a suggestion in this respect.

DETAILED CHEMISTRY FINDINGS

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

8.5 (a) Good practice: Environmentally controlled room in the nuclear laboratory

Chemistry instruments used for analysis of samples related to plant safety are located in an environmentally controlled room. This produces more accurate and consistent results for analysed parameters on the RCS and boron storage tanks.

This room also functions as a cleanroom, because there is a continuous ventilation exhaust system, which reduces the likelihood of contaminating the samples and equipment. Better working conditions are also guaranteed, because temperature and humidity are stable and comfortable. Heat produced by the equipment in the room is removed efficiently.

The plant implemented this room in 2013 as a part of laboratory renovation. In this room the measurements that are the most sensitive to variations in temperature and humidity are undertaken. The most important measurement is for B-10 in nuclear systems, which is performed on the Inductive Coupled Plasma- Mass Spectrometer (ICP-MS). The ICP-MS is also used to measure metals in both nuclear and conventional systems. Another device in this room is the Milli-Q, which produces pure water from tap water, and is used for preparation of standard solutions used for QA checks of the ICP-MS and other equipment. Ever since operation with the ICP-MS in this room, all of the standard and background checks have been within specification.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

8.6(1) Issue: The plant work practices used when handling chemicals and other hazardous materials are not always effective in ensuring that risks of personnel injury and equipment damage are minimized.

The team made the following observations:

- Face shields and gloves in building 09 were noted to be stored in a manner that would allow contamination and potential exposure to personnel when wearing the equipment;
- The plant's labelling requirements for chemicals and other hazardous materials are not met in all instances. Examples include resin samples in the building 09, hazardous materials being stored in building 70, cleaning tanks for plant security cameras, chemicals used for training and a plastic can containing petrol in building 15;
- The plant is not effectively controlling hazardous materials in all cases;
- Storing painting supplies in an unlocked container (11-283);
- Storing open iron-sulphate bags in the turbine hall;
- There is a barrel containing solid waste chemicals in the laboratory chemical store room. There is no listing of current contents of the barrel;
- The plant procedure for receipt of hydrazine allows the new chemical to be received prior to completing analysis for all contaminants. The quality certificate of the incoming hydrazine did not contain the sodium and fluoride parameters. Currently, the plant analyses for sodium and fluoride after receipt, which could lead to contamination of the entire tank;
- The plant does not consistently take pre-emptive actions to preclude the spread of hazardous chemicals to plant drainage systems during chemical offloads. There were two uncovered surface water drains near a hydrazine truck while it was being offloaded into the storage tank;
- The current method for obtaining iron-sulphate tank samples does not provide convenient access to make sure samples are taken in safe conditions.

Without following appropriate work practices with chemicals and other hazardous materials, there is a risk of personnel injury and equipment damage.

Suggestion: The plant should consider improving the work practices used when handling chemicals and other hazardous materials to reduce the risks of personnel injury, releases to the environment, and equipment damage.

IAEA Bases:

SSR-2/2

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

9.3. The use of chemicals and other materials at the plant, including those brought to the plant by contractors, should be controlled in accordance with clearly established procedures. The intrusion of non-conforming chemicals or other substances into plant systems can result in deviations in the chemistry regime, leading to component and system damage or increase of dose rates. The use of uncontrolled materials on the surfaces of the components may also induce damage.

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

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

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

ILO - SAFETY IN THE USE OF CHEMICALS AT WORK.

6.9.3. (b) The handling of contaminated containers. Empty containers which have not been cleansed of hazardous chemicals should be closed and stored to await disposal or reuse, and treated as if they contained those hazardous chemicals. Empty containers should retain the identification, marking and labelling of their previous contents.

Plant Response/Action:

Summary of improvement activities:

- Improvement actions are focused on three areas:
- Creating awareness among personnel through communication
- Reducing the use of hazardous chemicals (source approach)
- Improving equipment for dosing chemicals in order to reduce contact.

Awareness:

- Information materials on handling dangerous materials have been prepared and distributed to all department team leaders and discussed within all teams. Mandatory toolboxes are delivered, and a monthly safety theme is communicated via posters and an article in the company magazine.
- The plant's labelling requirements for chemicals and other hazardous materials have been reinforced, resulting in higher standards.
- The container for storing painting supplies is regularly locked.
- The standard for taking pre-emptive action to preclude the spread of hazardous chemicals to plant drainage systems during chemical offloads has been reinforced, resulting in the use of drain blocks when necessary.

Source approach:

- A project to reduce hydrazine use, and eliminate its use during outages is well under way. The feasibility of film-forming amines as an alternative to hydrazine has been assessed, with a positive outcome.
- Furthermore, the plant procedure for receipt of hydrazine has been adapted, so that the new chemical cannot be received prior to completing analysis for all contaminants.

Equipment:

- Improvement projects for the chemical dosing station and iron sulphate dosing equipment have been executed and are almost complete.

IAEA comments:

The plant has thoroughly reviewed the issue made by the OSART team and respectively introduced an action plan to remedy the status in the area of the plant work practices for handling of chemicals. Causes, identified by the plant, include programmatic and performance based aspects of the activity for handling of chemicals.

Several procedures related to the handling of chemicals have been reviewed and amended to ensure clear description of the process and correct procedural actions made by the plant staff. These changes involve several such as assessments of chemical hazardous substances, procedure for unloading of hydrazine from tanks and the plant provisions for blocking of drainages.

The next important action made by the plant was to increase the plant personnel awareness on the nature of chemicals used at the plant and associated with that harmful industrial factors. The plant has conducted several training sessions and reinforced the plant management expectations and personnel awareness on the matter of the use and handling of chemicals. The plant and chemical department management conduct regular field tours to observe the status on the use and handling of chemicals and take an opportunity to stress the personnel attention on the correct and safe application of chemicals and coach the personnel in place as necessary. The plant data on low level events shows decrease in number of events related to handling of chemicals.

Conclusion: Issue resolved

9. EMERGENCY PLANNING AND PREPAREDNESS

9.1. GENERAL

The plant has created basis planning documents that identify the emergency response requirements for different scenarios. These documents cover a large spectrum of internal and external events, including security threats. However, they do not provide a justification for the timing of the activation of the Alarm Organisation or the timing of the protective actions on-site and off-site. The team encourages the plant to review the timing requirements for emergency response.

9.2. RESPONSE FUNCTIONS

There are over sixty members of staff that are trained fire-fighters. In addition, professional fire-fighters from the town Borssele, and voluntary fire-fighters from the region are mobilized quickly in the event of a fire. The team has recognized these arrangements as a good performance that gives depth to the fire-fighting organisation.

Several of the plant procedures describe arrangements that may introduce significant delays in the implementation of protective actions for on-site workers. The team recommended a review of these arrangements to ensure that on-site workers are protected in a timely manner.

9.3 INFRASTRUCTURAL ELEMENTS

Although the plant exercises regularly, there is no systematic process to ensure that all response functions are tested in exercises within a reasonable time period. In addition, some of the emergency arrangements have not been validated during an exercise and may not be effective during an emergency. The plant does not take full advantage of key performance indicators and operating experience to improve emergency preparedness. The team made a recommendation relative to the use of tools to validate all emergency functions and response capabilities.

The training arrangements for on-site personnel and external fire-fighters, ambulance, and security services are good, however the plant is encouraged to analyse the training needs for contractors potentially required to restore essential services on site or off site.

The Plant organizes six full scale drills each year to ensure that all personnel with assigned duties exercise each year. The drills include the participation of one of the shift crew at the simulator, a complete on-site response organisation and full deployment of beyond design basis emergency mitigation equipment (diesel generators or pumps). The team recognized this as a good practice.

The Plant invites a professional trainer from the local fire training centre and a trainer from the local hospital for some of the on-site drills. The team recognizes this as a good performance.

The plant organizes an annual field exercise with a brigade of the Army of the Netherlands. These exercises provide training, test and validate the arrangements for support from the Army during a severe accident. The team recognized this as a good practice.

DETAILED EMERGENCY PLANNING AND PREPAREDNESS FINDINGS

9.2. RESPONSE FUNCTIONS

9.2(1) Issue: The on-site emergency arrangements are not sufficient to ensure the timely protection of on-site workers in the event of an emergency.

The following observations were made:

- The plant's fire-fighters do not have electronic dosimeters or gamma dose rate meters at the fire-station or in their vehicles. The electronic dosimeters are only available at the entrance of the radiation controlled area;
- There are no visible numbers on buildings or doors outside the production facility. This may delay the response of emergency services such as the fire-fighters from the town of Borssele who come to assist the plant;
- There are no emergency muster points for non-essential personnel inside the perimeter fence. In an emergency, non-essential personnel must exit through the access control system at the main gate, up to three at a time, and assemble at the canteen. When all exit gates are available, it takes 20 min to evacuate 250 people. With two gates available (a common issue) and more people on-site (during an outage), it could take 45-60 min to evacuate non-essential personnel. During that time, they would be lining up outside, unsheltered;
- The procedures of the Shift Team Leader in the main control room include criteria for an orderly evacuation of the personnel in each building. However, his procedures do not allow for the urgent escape from the radiation controlled area, bypassing the inter-zone monitors. The procedure of the Site Emergency Director is the only one that contains instructions for such an escape;
- There are no habitability criteria for the main control room after the ventilation has been placed in recirculation. If the measured dose rate in the main control room > 10 μSv/h, the operators put the ventilation into recirculation to protect from ingress of contamination to the control room. However, the dose rate could remain high because the large windows in the main control room provide little shielding to exposure from the outside.

Without on-site emergency arrangements that allow timely interventions, the protection of on-site workers in the event of an emergency may be jeopardized.

Recommendation: The plant should revise its on-site emergency arrangements to ensure that the on-site workers can be protected in a timely manner.

IAEA Bases:

GS-R-2

3.14. In designing a threat category I, II or III facility "[a] comprehensive safety analysis is carried out to identify all sources of exposure and to evaluate radiation doses that could be received by workers at the [facility] and the public, as well as potential effects on the environment...The safety analysis examines... event sequences that may lead to [an emergency]. On the basis of this analysis... requirements for emergency [preparedness and] response can be established.

3.15. [...] The threat assessment shall be so conducted as to provide a basis for establishing detailed requirements for arrangements for preparedness and response by categorizing facilities and practices consistent with the five threat categories shown in Table I.

4.12. When circumstances necessitate an emergency response, operators shall promptly determine the appropriate emergency class (see para. 4.19) or the level of emergency response and shall initiate the appropriate on-site actions. The operator shall notify and provide updated information, as appropriate, to the off-site notification point.

4.20. [...] The criteria for classification shall be predefined emergency action levels (EALs) that relate to abnormal conditions for the facility or practice concerned, security related concerns, releases of radioactive material, environmental measurements, and other observable indications (see para. 4.70). The classification system shall be established with the aim of initiating a response prompt enough to allow for effective management and the implementation of emergency operations, including mitigation by the operator, urgent protective action and the emergency protection of workers.

4.62. Arrangements shall be made for taking all practicable measures to provide protection for emergency workers for the range of anticipated hazardous conditions (see para 4.61) in which they may have to perform response functions on or off the site.

Plant Response/Action:

The team's observations have made clear that the adequacy of several arrangements to protect on-site personnel in a timely manner could not be demonstrated.

Summary of underlying causes:

In response to the OSART recommendation the issue has been analysed to identify the full scope of the issue and its underlying causes:

- There was no clear strategy to set a protection basis, to implement protective arrangements, and to continuously update/improve these arrangements.
- Without a clear strategy, the plant did not define a structured approach to risk inventory and evaluation as a formal basis for the emergency arrangements to protect the on-site workers.
- Without a formal basis, the emergency arrangements have evolved over the years, often as a reaction to industry incidents and internal (exercise) findings. Isolated improvements could be implemented without validation of the improvement as part of a coherent and state-of-the-art protection concept.

Summary of improvement activities:

A specific action plan has been drawn up to address these underlying causes. The action plan has been challenged by managers from different levels, and accepted. The measures to solve the underlying causes are:

- Select a strategy.

  The EPZ policy statement on worker safety does not differentiate between normal operation and emergency conditions. The principles applied for protection of workers in normal operating conditions are the same as the principles for protection in emergency conditions. Therefore, the strategy to protect workers in normal operation conditions is the strategy selected for emergency conditions as well.

– Select a structured approach to implement the selected strategy.

– The process for a formal Risk Inventory and Evaluation (RIE) is described in procedure PO-A09-27:

  (a) Identification of hazards and their risk (potential effect times probability of occurrence) to workers.

  (b) Selection of protective arrangements to reduce that risk to an acceptable level. Measures to reduce the hazard are preferred, followed by general protective arrangements, specific protective arrangements, and as a last resort personnel protective equipment.

  (c) Implementation of the selected protective arrangements

  (d) Evaluation and updating (use of OE, periodic reviews).

1. Execute the selected approach: prepare the Risk Inventarisation & Evaluation.

Based on the scope of the existing RIEs (for normal conditions), the distinction between 'normal operation' and 'emergency conditions' is defined as 'evacuation is ordered'.

In addition, two 'categories' of on-site personnel are distinguished: the emergency response organisation, and others. A separate Risk Inventory and Evaluation has been prepared for each category:

  1) Risk Inventory and Evaluation (RIE) for personnel in the emergency response organisation.

  2) Risk Inventory and Evaluation (RIE) for on-site personnel, when building/plant/site evacuation is necessary.

2. Implement the protective arrangements as defined in the RIE. Implementation can involve new, expanded or existing arrangements that have to be validated to confirm effectiveness.

3. Add evaluation of protective arrangements as a specific goal for field exercises.

Effect:

Already identified shortcomings in protection of on-site workers in the event of an emergency have been aligned to the protective arrangements defined in the RIE, and improved and/or validated where needed to ensure their timeliness and effectiveness.

Periodic review and operating experience is used to continuously improve worker safety in emergency conditions. Protective arrangements that have been identified are implemented or modified, and validated to the extent practical, to confirm their effectiveness. Evaluation of protective arrangements is added as a specific goal for the annual series of six integrated exercises.

IAEA comments:

The plant has taken comprehensive action to identify the root causes, select a strategy and ensure on-site emergency arrangements are adequate to ensure timely protection of workers in the event of an emergency. The plant has systematically identified risks in case of emergencies and performed Risk Inventory and Evaluation (RIE) using plant procedure PO-A09-27. The identified risks and actions to mitigate them to a tolerable level were documented in 2016 in A09-27-N015 and A09-27-N16 for emergency response workers and other on-site workers respectively.

The plant has demonstrated that several deficiencies identified during the OSART missions were resolved. Dosimeters to fire fighters were provided, all buildings were appropriately

identified with visible numbers being posted on each one, emergency muster points were arranged for all personnel and procedure for exit through the access control system at the main gate was amended to allow for effective evacuation. The instructions for the MCR staff to arrange urgent escape from the RCA in case of emergency were made clear and the plant has specified the muster points and associated arrangements to handle such cases. The plant is planning to implement automatic announcements to initiate urgent escape from the MCR. The habitability of the MCR was evaluated and improvements were proposed concerning the automatic transfer of ventilation to filtered mode to prevent ingress of contamination. In addition, in 2016 clear instructions were included in emergency procedure N14-23-001 to request the staff to move to the back-up control room when the MCR radiation dose rate exceeds 10 μSv/h. The actions of operational staff to handle accidents from the back-up control room are addressed in the EOPs and SAMG.

At the time of the first stage of the OSART follow-up mission in December 2016 the plant considered that the most significant actions needed to improve worker protection in an emergency were implemented in 2015&2016. Other actions included in the plant improvement action plan, considered as less important or being part of plant continuous safety improvement, are scheduled for implementation in the next two years. This concerns for example policies and practices for pre-distribution of iodine thyroid blocking tablets, procedure for accelerated purging of hydrogen from the generator, which is close to the MCR, to avoid potential explosions, establishment of an alternative Emergency Response Centre, enhancing the habitability of the back-up control room, improving the audibility of announcements and communications during emergencies, etc. Some of these actions are part of the plant project for implementation of the Periodic Safety Review and EU 'NPP stress tests' improvements, scheduled for second quarter of 2017.

It was noted that approximately 50% of actions concerning emergency response worker protection and 20% of actions concerning other workers' protection were completed by December 2016. The rest of the actions, as mentioned above, are progressing according to the established time schedule and are planned for completion in 2017 or 2018.

Conclusion: Issue resolved

9.3 INFRASTRUCTURAL ELEMENTS

9.3(a) Good practice: The plant organizes six site-wide integrated exercises each year to ensure that all personnel with assigned duties during an emergency participate in an exercise each year.

Each exercise includes the participation of one of the shift crews at the simulator, a complete roster of personnel at the Alarm Coordination Centre, the security organisation, the maintenance organisation, the deployment of emergency mitigation equipment (diesel generators or pumps) which may involve the assistance of off-site contractors or the Army. In addition, the exercises are coordinated and conducted in collaboration with the external Emergency Response Organisations, which include: the Regional Centre of the Safety Region of Zeeland (VRZ), the nuclear regulatory body (KFD), the National Institute for Public Health and the Environment (RIVM), the National Nuclear Assessment Team (EPAn), and the crisis centre of the plant designer (Krisenstag Areva). These organisations appreciate the opportunity for all their personnel to participate to an exercise.

Once every five years, a national large-scale exercise includes the participation of all ministries involved in the response to a large scale emergency, in addition to the participants to the annual exercises.

9.3(b) Good practice: The plant organizes annual exercises with the 13 Armoured Brigade of the Netherlands Armed Forces. The tests involve support by the Army for the deployment of beyond design basis emergency mitigation equipment, security, and decontamination.

After the Fukushima accident, the plant made arrangements with the 13 Armoured Brigade to provide support in crisis situations. The 13 Armoured Brigade possesses a wide range of mobile equipment and means of transport to deliver resources anywhere. Its personnel is equipped and trained to operate under harsh conditions such as those encountered during a nuclear emergency.

The agreement between the plant and the 13 Armoured Brigade includes participation in a yearly exercise where these arrangements are tested in the field. In 2012, the exercise involved the delivery of diesel fuel, a large mobile diesel generator, and operating crews during a simulated flood. During the 2013 exercise, the 13 Armoured Brigade performed monitoring and decontamination for 60 employees. It also arranged an emergency communication network. In November 2014, a third exercise is planned, which will involve radiation protection support on-site, and the off-site decontamination of vehicles that evacuated from the plant. The annual exercises also integrate a security component.

These arrangements increase the robustness of the mitigation measures that were put in place by the plant as part of the Complementary Safety-margin Assessment – the European Union stress-test.

9.3(1) Issue: The plant does not use all available tools to comprehensively validate the adequacy of the emergency functions and response capabilities.

The following observations were made:

- There is no multi-year exercise plan to ensure that all response functions are tested within a given time period;
- When workers are found to be contaminated at the outer gate, or when the gates go into dose rate alarm, workers have to be checked manually for contamination. These arrangements have not been tested recently during an exercise;
- The plant has not validated the current arrangements for radiation protection personnel during an exercise that involves contamination throughout the site;
- The iodine thyroid blocking tablets (ITB) are stored at the security office, near the main gate. According to the procedure of the Manager Support Services (MOD), the security personnel will distribute the ITB to emergency workers that remain on-site and to non-essential personnel at the canteen, which may introduce significant delays. The plant has not validated these arrangements during an exercise;
- The plant identified a pond near the coal fired station that could be used to provide cooling water; however, it has never tried to draw water from it using the fire pump truck from the on-site fire station. Experience shows that strainers at the water intake point can become clogged when such alternate sources of water supply are used;
- Performance indicators for EPP are focused on exercises and training. There is a need to develop improved performance indicators that measure the effectiveness of the emergency preparedness programme;
- There is no formal review of the operating experience database during revisions of the emergency management programme. The emergency preparedness group relies on the operating experience group for issues that may require actions.

Without using all available tools to comprehensively validate the adequacy of all emergency functions and response capabilities, the plant may miss opportunities for improving the safety during emergencies.

Recommendation: The plant should comprehensively validate the adequacy of all emergency functions and response capabilities considering exercises, effectiveness reviews, performance indicators, and operating experience.

IAEA Bases:

GS-R-2

3.16. Operators, the national co-ordinating authority (see para. 3.4) and other appropriate organisations shall periodically conduct a review in order to ensure that all practices or situations that could necessitate an emergency intervention are identified, and shall ensure that an assessment of the threat is conducted for such practices or situations. This review shall be undertaken periodically to take into account any changes to the threats within the State and beyond its borders, and the experience and lessons from research, operating experience and emergency exercises (see paras 5.33, 5.37 and 5.39).

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

Plant Response/Action:

1. The issue covers several categories of shortcomings:
2. The adequacy of emergency functions and capabilities could not always be demonstrated.
3. Drills and exercises are not used extensively to determine adequacy and preparedness of these functions and capabilities. Although many functions and capabilities have been validated (to some extent), other functions/capabilities, especially those in existence for a long period, may only have been part of integrated exercises, instead of being explicitly validated or formally assessed.
4. Internal and external operating experience is not used consistently.
5. Key Performance Indicators to measure the emergency response organisation's readiness are not used.

Summary of underlying causes:

The emergency functions and response capabilities have evolved over the years to their current extent and detail. Lessons learned from (international) standards and examples, knowledge and experience have resulted in the current emergency functions and response capabilities. However, it was not unusual for emergency functions to be allocated to personnel with an implicit assumption that the required knowledge and skills to perform these functions are not too different from their normal job, and a drill or an exercise should be able to bridge the gap. Often, an explicit validation or assessment was not executed to verify that assumption, or such validation has become outdated due to changes in organisation, procedures, plant or equipment.

The development, execution and assessment of drills were often at the discretion of line management, and EPP did not receive the attention warranted by its importance to ensure nuclear safety. Integrated exercises with a full-scale emergency response organisation have been held for many years, typically six each spring. Line managers did not ensure that all emergency response personnel participated, and did not use these exercises to assess their performance.

Use of Operating Experience was not formalised and tracked.

Performance indicators and metrics were limited, and were used to measure effort (hours of refreshment training, number of drills) instead of capability, effectiveness or preparedness.

Summary of defined actions:

1. Define multi-year training, drill, and exercises programme:
   1.1. Define qualifications (training, drills) for emergency response roles.
   1.2. Define drill and exercise programme to ensure initial qualifications and proficiency., A five-year cycle has been chosen for the programme, to be

   consistent with the multi-year EOP (Emergency Operating Procedures) programme for control room personnel.

2. Describe the EPP process, make it explicit in the integrated management system as a nuclear safety relevant process, and reinforce the assignment of EPP tasks to personnel in the line organisation.
3. Formalise, use and validate internal and external OE to improve emergency functions and capabilities.
4. Define and implement key performance indicators for ERO effectiveness.
5. Solve identified urgent shortcomings.

Effect:

An initial set of qualifications for emergency response roles was defined (NO/JvC/JvC/N152081) in 2015. In 2015-2016, the defined qualifications were documented in EPP instructions, and hands-on training has resulted in so-called On-the-Job-Training (OJT) modules. The OJT programmes ensure initial qualification and proficiency through periodic drills. A multi-year integrated exercise programme has been drafted.

The EPP process has been described explicitly (HB-N14), distinguishing Emergency Planning and Preparedness (EPP) from Emergency Response (ER). The EPP organisation has been elaborated with a task description (containing tasks, responsibilities and authorisations) for each member (N14-23-600). This task description is included in each member's task description for his/her normal line position.

A selection of members of the EPP organisation took part in a so-called 'Improvement Session', a special session to define short term actions to ensure that (in this case) EPP members take and are allowed to take responsibility for their EPP task. This has resulted in one member giving his task to a subordinate, and a clear statement of the others that they will take their responsibility with respect to their EPP tasks. Line managers confirmed the importance of EPP and accepted personnel availability for EPP tasks. It was also concluded that a shared vision and clear common goals were lacking in the EPP organisation. In 2017, teambuilding sessions will be used to increase engagement throughout the EPP organisation, including a shared vision and common goals for the EPP organisation.

The use of OE, tracking and documentation of changes, and the validation of (changed) emergency arrangements have been formalised in the EPP process, and responsible personnel has been instructed accordingly.

Existing performance indicators are gradually being expanded to include indicators for effectiveness and preparedness of the emergency response organisation and of individual emergency functions/capabilities. Historic data will be used where practical and available.

IAEA comments:

Following the OSART mission the plant has evaluated the adequacy of its emergency functions and response capabilities. The qualification, competence and responsibilities of the emergency planning and preparedness teams have been defined and documented in N14-22 600, which was last revised in September 2016. The plant has paid special attention on the team working and special team building activities are planned for 2017.

The plant has prepared a 5-year emergency exercise plan to ensure all response functions are tested within a given period. Since the original OSART mission no integrated emergency

exercise was performed to address severe accident scenarios, however such exercises are planned for 2017 & 2018.

The plant performed a table-top evaluation of its arrangements for radiation protection personnel in an emergency that involves contamination throughout the site, however this evaluation was not confirmed by an exercise in the field. Such a validation is planned for 2017.

The deficiencies concerning administration of iodine thyroid tablets have not yet been fully resolved as the plant needs to ensure compliance with relevant national standards for use of medicines.

The plant conducted an initial test to confirm the feasibility of using fire pump truck to deliver water from the nearby pond, however this was not exercised as part of the emergency drills as the formal introduction of such equipment in the plant accident management programme is not yet completed.

The plant has improved its processes to include the systematic use of OE in the review of the effectiveness of emergency management programme. The plant developed also a new set of 13 performance indicators that are used to measure the effectiveness of the emergency preparedness programme and made a pilot application of their use in 2016. The use of the performance indicators is to be revised in order to confirm appropriate target values are used.

The plant has taken systematic approach to resolve the issue, however further work is needed to complete some of the actions and demonstrate sustainable positive results.

Conclusion: Satisfactory progress to date

IAEA comments during OSART follow-up 2nd Stage:

The qualification, competence and responsibilities of the emergency planning and preparedness teams have been defined and documented in N14-22-600 and their adequacy was regularly revised and documented in 2017. Several team building activities took place in 2017 that strengthened plant emergency response capabilities.

The plant has prepared a comprehensive set of performance indicators to assess plant emergency preparedness and response functions. In 2017 18 performance indicators have been regularly tracked and evaluated. In several cases iterative process was used to establish meaningful performance indicator target values and ensure that they serve as a driver for continuous improvement.

The plant has established the scope and frequency of emergency exercises to ensure all important scenarios are covered in the plant 10-year emergency exercise planning. In 3 Q of 2017 the plant performed an integrated emergency exercise for a severe accident scenario: severe damage of fuel in the spent fuel pool which resulted in significant radioactive releases. The exercise was completed for all shifts and results are to be evaluated by the end of 2017. It was noted that the plant can benefit from better preparation of the exercises evaluation criteria and more systematic recording of the evaluator observations.

Conclusion: Issue resolved

13. SAFETY CULTURE

13.1 GENERAL

13.1.1 Descriptive analysis

As result of the safety culture assessment at EPZ Borssele NPP for the descriptive analysis of the team identify the following:

Artefacts

A theme of inconsistencies was observed across several parts of the organization. Specific examples are presented in the technical areas of the report.

– Shared values

Some examples of the organizations shared values include 'Get it done', 'We need to be better to survive', 'We are very knowledgeable' and 'My opinion is important'.

– Basic assumptions

Some examples of the organization include 'We are safe', 'We are not very different from other power production companies' and 'We have control'.

– Self-Image

These three elements of artefacts, shared values and basic assumptions create a 'self-image' that drives the organizations performance and operate in a self-perpetuating mechanism that condemns the organization to repeat and to maintain the same inconsistencies, values and basic assumptions that provide a barrier for improvement. The non-challenging environment within the organization creates a further barrier that prevents the organization from effective and sustainable change.

The self-image in believing that we are safe regardless of what we do, contributes to an environment of acceptance. Combined with the non-challenging aspect of the culture the inconsistencies are sustained without questioning safety. 'Are we safe?' should be the challenge.

This self-perpetuating mechanism challenges the organization by not considering all possible impacts on safety. The basic assumption of being safe is not challenged enough. Basic assumptions are by nature not conscious in an organization; the team believes this is the case for this organization as well.

13.1.2 Normative analysis

Once the descriptive analysis was completed the team compared the overarching themes with the IAEA Safety Culture Normative Framework and identified four themes.

– Communication

– Learning organization

– Organizational Change

– Leadership

These themes reinforce the self-perpetuating mechanism. In this way the four areas are prevented by the organizational culture to effectively contribute to continuously improve safety by not challenging the self-image.

13.2 COMMUNICATION

The Young EPZ Professionals (YEP) was established as a response to rapidly changing employee demographics, this is recognized as a good practice.

Examples of good performance in communication, identified by the team, include the Lencioni team building initiative, effective communication at the working level between different groups, a shared value that everyone's opinion is important and experienced employees openly share their views with others.

However, the team also identified that the organization's communication practices do not ensure that the importance of nuclear safety is understood in all parts of the organization. The team made a recommendation in this area.

13.3 LEARNING ORGANIZATION

Examples of good performance of a learning organization, as identified by the team, included the use of operating experience in several instances, reporting mistakes is encouraged, that the threshold for reporting is perceived to be lower than in the past and safety culture activities have been initiated.

The team also identified that the organization does not realize and reinforce the importance of learning from experience. The team has made a recommendation in this area.

13.4 ORGANIZATIONAL CHANGE

A positive aspect, identified by the team, was that formal documentation on organizational change reflects an appropriate understanding of risk implication.

The team identified that changes in organizational structure, function, leadership, policies, programmes, procedures and resources do not always consider safety implications and are not effectively communicated and implemented.

The team made a recommendation in this area.

13.5 LEADERSHIP

Good performance was identified by the team in the positive relationship between supervisors and their immediate workers, and by employees expressing satisfaction and pride in working for the organization.

The team also identified that leadership for safety is not recognized throughout the organization to ensure sustainable safety performance and made a recommendation in this area.

The team recognizes that the organization has initiated several improvement activities related to human and organizational factors. These initiatives related to management, leadership and culture for safety have been formulated in a compartmentalized manner and demonstrate a lack of understanding of the necessity to consider the interaction between human, technical and organizational factors in a systemic approach to safety. Subsequently the team

encourages the organization to consider the self-perpetuating mechanism that has been identified and described in its improvement process.

DETAILED SAFETY CULTURE FINDINGS

13.2 COMMUNICATION

13.2(a) Good practice: The Young EPZ Professionals (YEP) was established as a response to rapidly changing employee demographics. YEP provides young employees with an opportunity to discuss, comment, exchange knowledge and contribute to the development of EPZ.

The arrival of many new colleagues at EPZ the past years considerably reduced the average age of employees. The particular processes and the department-oriented thinking at EPZ, however, makes it rather difficult to meet with other colleagues with whom one is not working together on a daily basis. In response to this, Young EPZ Professionals (YEP) was established by a group of motivated colleagues to help increase the communication and interaction in the organization. A kick-off meeting was held in December 2012. The target audience consists of all EPZ employees under the age of 35 which currently consists of 102 people. Fifty-five of these individuals currently belong to YEP.

YEP provides young EPZ colleagues the opportunity to exchange knowledge and experience as they often face similar challenges in their daily work. By meeting regularly and facilitating discussions on current issues and developments within EPZ, YEP works to contribute positively to achieving the organization's goals to enhance personal development on the other. Discussions, think tanks and workshops are facilitated on issues such as 'how to improve FME policy', 'how to apply and communicate EPZ' rules of conduct' and 'how to improve EPZ if you were a manager'. The results of such activities are documented and formally presented to the relevant EPZ employee for his or her consideration. YEP further contributes to strengthening EPZ communication by arranging regular informal meetings with members of the EPZ management, communication with professional and functional levels within EPZ as well as various teambuilding events for EPZ members. YEP also facilitates communication and cooperation with young professional peers outside of EPZ.

Examples of results in relation to nuclear safety:

- YEP discussed the FOCUS 2 with the Senior Management team. Based on this discussion, the action plan was modified.
- YEP had a presentation on Lean Six Sigma, and after that, YEP asked for a more structured approach to implement Lean Six Sigma at EPZ. Due to this request, 4 lean six sigma projects started in 2014, and these projects are anticipated to help make significant improvements in 4 processes.
- YEP discusses with managers and workers all over the company about organizational and cultural issues. They try to break organizational barriers.

13.2(1) Issue: The organization's communication practices do not ensure that nuclear safety is understood in all parts of the organization.

The following observations were made:

- The lack of direct and open communication within and between the various management levels (corporate organization and the plant) can jeopardize nuclear safety. There are essential problems of:
  - Lack of trust;
  - Power dynamics;
  - One-way communication;
  - Top-down communication;
  - Discussions rather than dialogues.
- The lack of direct and open communication vertically throughout the organization is a critical problem due to the similar aspects mentioned above.
- The working level of the organization is not sufficiently kept formally informed, which creates a window for rumours and lack of trust. Some examples of lack of information are:
  - The vision of the future;
  - The organizational changes;
  - The departure of some managers;
  - The conditioned licence to operate, i.e. to be in the first quartile; and
  - What is going on in other departments?
- The organizations approach to communication does not close the loop to ensure that people have a shared understanding. There is:
  - Lack of three-way communication;
  - Lack of requesting and providing feed-back;
  - Overreliance on email, intranet, posters, and booklets.
- The organization needs to revise the communication provided to contractors about radiological risks as there is evidence of people being concerned about working in a nuclear power plant.
- There is an attitude that problems should not be raised without solutions. This has to be attended to as it can create a 'good news' culture, which filters out important safety related information.
- Many individuals, both workers and managers perceive that too much time is spent in meetings which take time away from doing work in the field.

Without clear, open and interactive communication through all parts of the organization, nuclear safety might not be fully understood.

Recommendation: The organization should improve its communication practices to ensure that the importance of nuclear safety is understood by all organization staff.

IAEA Bases:

GS-R-3

2.5. The management system shall be used to promote and support a strong safety culture by:

Ensuring a common understanding of the key aspects of safety culture within the organization;

Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organization;

- Reinforcing a learning and questioning attitude at all levels of the organization;
- Providing the means by which the organization continually seeks to develop and improve its safety culture.

GS-G-3.5

2.10. Senior management should establish and promote a set of principles to be used in decision making and promoting safety conscious behaviour. Examples of such principles used in some organizations are as follows:

(a) Everyone has an impact on safety.

(b) Managers and leaders must demonstrate their commitment to safety. (c)Trust and open communication permeate the organization.

(d) Decision making reflects putting safety first.

....

.....

(i) A proactive approach to safety is taken. ü)Safety is constantly under review.

Appendix I

I SAFETY IS A CLEARLY RECOGNIZED VALUE

(a) The high priority given to safety is shown in documentation, communications and decision making

II LEADERSHIP FOR SAFETY IS CLEAR

(c) There is visible leadership showing the involvement of management in safety related activities

(h) Management shows a continual effort to strive for openness and good communication throughout the organization

(i) Relationships between managers and individuals are built on trust

III ACCOUNTABILITY FOR SAFETY IS CLEAR

(b) Roles and responsibilities are clearly defined and understood

IV SAFETY IS INTEGRATED INTO ALL ACTIVITIES

(a) Trust permeates the organization

(f) Factors affecting work motivation and job satisfaction are considered
(h)There is cross-functional and interdisciplinary cooperation and teamwork

V SAFETY IS LEARNING DRIVEN

(a) A questioning attitude prevails at all organizational levels

(b) Open reporting of deviations and errors is encouraged

Plant Response/Action:

Summary of underlying causes:

A lack of trust and openness, the communication skills of leaders, and their lack of presence in the field were identified as the main causes for the poor communication.

Summary of improvement activities:

EPZ has integrated the approach on solving both issues "communications practises 13.2(1)" and "leadership for safety 13.5(1)" in the leadership development programme (see issue 13.5(1)).

The plant launched an improvement programme in 2016, predominately focusing on co-operation between departments, and with a high involvement of the workforce. This resulted in many positive results from the problem-solving teams due to the focus on cross-functional and cross-departmental co-operation.

The role of all leaders in restoring trust was identified as a crucial improvement, as well as improving their skills and attitude towards the workforce. Leaders must focus on creating a culture of trust and openness. Therefore, setting clear expectations for leaders, and developing them in accordance with these new expectations, has been made a priority in 2016 and 2017.

In that respect, all leaders are required to spend more time in the field. The Management in the Field programme (see issue 1.3(2)) is an important tool in achieving this goal.

Next "facilitative leadership" (also known as humble leadership) was introduced as a framework to define the desired behaviour of leaders. This leadership vision focusses on:

- Authenticity
- Giving responsibility
- Appreciation
- Empowerment
- Cooperation
- Courage

All leaders will/are be/being assessed, developed, and trained in accordance to this leadership style. Leaders had coaching from external advisors.

The separate Corporate and Plant Management team were merged into one Site Management Team. Assessment of the senior managers to assess fitness for the new requirements resulted in several position changes.

Team leader lunches are being organised to exchange information, thus to improve communication.

Effect:

The improvement programme did/does contribute to a better communication between cross functional and cross-departmental workers, supervisors and managers.

Leaders spend more time in the field, and by using the "facilitative leadership" style, trust and openness are being improved. This effectively enforces the culture for safety within their departments and by the workforce.

IAEA comments:

Since 2014 there has been a fundamental review and revision of communication practices set out in a communication strategy.

This issue has been linked with actions taken in response to Issues "communications Practices 13.2(1)" and "leadership for safety 13.5(1)".

The plant launched an improvement programme in 2016, predominantly focusing on co-operation and collaboration between departments, and with a high involvement of the workforce. This included the development of cross departmental problem-solving teams. The engagement level in these teams resulted in many positive developments in both communication and enhancement of understanding of safety, including nuclear safety. This was confirmed during the FU mission as feedback showed that personal contribution to nuclear safety has been clarified and is better understood (eg HR understanding their contribution for selection of nuclear plant personnel).

As mentioned in issue 13.5(1) the site management team adopted a humble management style. The intent was to create a climate of openness and trust between management, supervisors and the work force where all aspects of safety could be discussed and feedback is freely given and received. This has resulted in improved 'closed loop' rather than 'top down' communications, more effective feedback to management and enhanced understanding of the nature and importance of nuclear safety. Leaders now spend more time in the field, and by using the "humble leadership" style, trust and openness are being improved. This effectively enforces the culture for safety within their departments and by the workforce and has particularly improved the communication and understanding of nuclear safety

Merging the separate Corporate and Plant management organizations into a single Site Management Team has resulted in shorter lines of communication. The new organization has also developed more consistent and easily understood expectations regarding nuclear safety.

The quarterly communication meetings held by the CEO have enhanced the exchange of information between management and the workforce and were identified by the focus groups as a good communication activity. Other activities that contribute to the improved understanding of nuclear safety include:

- Nuclear safety is discussed as opportunities arise during normal tasks.
- Nuclear safety card exercise – feedback during the FU mission showed that this exercise was well thought of and encouraged reflective learning.

- Pre-job briefs were described as being more helpful, less ‘top down’, more practical and focus on hazards of the job including nuclear safety.
- Messages on nuclear safety are displayed on TV screens and posters at the entrances to the site – this was described as a reminder that you were entering a nuclear facility.
- Nuclear safety is included in contracts and negotiations processes with suppliers

The improvement programme implemented by the organization has created an environment where communication between workers, supervisors and managers across functions and departments has significantly improved.

Conclusion: Issue resolved

13.3 LEARNING ORGANIZATION

13.3(1) Issue: The organization does not realize and reinforce the importance of learning from experience on the basis of an effective process.

While there are some examples that operating experience is identified, the organization is missing opportunities to use this information as part of a learning process.

The following observations were made:

- There is a perception among some employees that not enough use of operating experience from other industries is used at the plant;
- There is no human factors expertise in the organization, e.g. in the OE team;
- Use of internal and external OE is not systematically integrated into routine activities, e.g. PJB, turnovers, revision of plant's documents;
- The value of a comprehensive and effective Corrective Action Programme (CAP) for plant performance improvement is not being realized;
- Managers are required to report at least 10 near misses (NM) and low-level events (LLE) per year. Other personnel must report at least 2 near miss (NM) and low-level events (LLE) per year. This information is not being tracked or trended and in several departments the managers are not meeting the requirements;
- There is reluctance on the part of supervisors to report any issue regarding organisational or behavioural aspects observed in the field;
- Corrective actions from repeat events are not always identified and Common Cause Analysis is not conducted;
- System health reports are not produced and the reporting of different aspects of systems is fragmented. There is no integrated assessment of system health provided for use in learning and understanding the status of the overall plant;
- Some of the plant's important processes do not have appropriate KPIs (EPP, risk management, and portfolio management). The use of KPIs by themselves does not ensure quality of work and this needs to be better understood and evaluated;
- There is a perception among some employees that the historical and organizational knowledge in the organization is rapidly diminishing. The implications for learning and maintaining a good knowledge base in nuclear safety is troublesome. Examples identified include:
  - Many senior people with most of the plant experience and knowledge are leaving;
  - The Engineering Department is concerned about lack of experienced engineers and knowledge with respect to the design basis of the plant;
  - There is lack of experience in core design at the plant;
  - Some skills rest with only one or two people.

An individual's annual dose report is sent to their home but many individuals have identified that they don't know how to interpret the information.

Without realizing and reinforcing the importance of learning from experience on the basis of an effective process the organization is missing the opportunity to learn and continuously improve safety.

Recommendation: The organization should realize and reinforce the importance of learning from experience on the basis of an effective process

IAEA Bases:

GS-R-3

2.5. The management system shall be used to promote and support a strong safety culture by:

- Ensuring a common understanding of the key aspects of safety culture within the organization;
- Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organization;
- Reinforcing a learning and questioning attitude at all levels of the organization;
- Providing the means by which the organization continually seeks to develop and improve its safety culture.

GS-G-3.1

Safety is learning driven:

- A questioning attitude prevails at all organizational levels.
- Open reporting of deviations and errors is encouraged.
- Internal and external assessments, including self-assessments, are used.
- Organizational experience and operating experience (both internal and external to the facility) are used.
- Learning is facilitated through the ability to recognize and diagnose deviations, to formulate and implement solutions and to monitor the effects of corrective actions.
- Safety performance indicators are tracked, trended, evaluated and acted upon.
- There is systematic development of individual competences.

GS-G-3.5

Appendix I

II LEADERSHIP FOR SAFETY IS CLEAR

(c) There is visible leadership showing the involvement of management in safety related activities.

(e) Management ensures that there are sufficient competent individuals.

IV SAFETY IS INTEGRATED INTO ALL ACTIVITIES

(d) The quality of processes, from planning to implementation and review, is good.

(e) Individuals have the necessary knowledge and understanding of the work processes.

V SAFETY IS LEARNING DRIVEN

(b) Open reporting of deviations and errors is encouraged.

(c) Internal and external assessments, including self-assessments, are used.

(d) Organizational experience and operating experience (both internal and external to the installation) are used.

(e) Learning is facilitated through the ability to recognize and diagnose deviations, to formulate and implement solutions and to monitor the effects of corrective actions.

Plant Response/Action:

Summary of underlying causes:

- Lack of management involvement in key processes that support learning and improving.
- Not engaging staff in learning and improvement activities.
- Internal and external experiences not used in routine activities.
- Basic assumption that learning and improving was not part of daily work.
- Leadership not valuing the importance of learning and improving.

Summary of improvement activities:

In 2015, a team within the QA department was formed to improve the key processes for learning and improving (i.e. CAP, OE, self-evaluation).

A human performance owner (coordinator) was appointed, and a HP-programme was established and implemented. The HP-owner is also part of the OE (Operating Experience) team to provide human factors expertise.

The culture for safety programme was launched in 2016. 'Learning organization' is one of three main focus areas. All teams and managers were engaged in learning and improvement activities (such as reducing the number of daily radiation dose limits were exceeded from 28 in 2016 to 2 during the 2017 outage). Also, the culture for safety programme was used to learn about, and correct underlying weaknesses within the company (e.g. in the area of team meetings, the CAP, the senior management).

Multidisciplinary improvement teams were used to increase exchange of experience, strengthen cooperation, and to establish a sound basis for continuous learning and problem solving.

Management expectations have been updated and five basic expectations have been established and implemented. One of the basic expectations is "We cooperate, share our knowledge and experience, and stimulate improvement".

SOER-implementation was strengthened to stress the importance of learning from external events to improve nuclear safety. Over 100 staff members have been involved in implementing SOER recommendations.

Participation in international exchanges to learn from other plants (workshops, seminars, WANO, TSM's, etc.) was increased. E.g. EPZ managed to perform containment pressure tests, and to implement the new Reactor Control and Limitation System successfully by making use of international experiences.

Several improvements on the OE programme were realized with both internal and external help, and put into the management system (procedure PU-A27-02). The improvements relate to increased rigorousness, human performance expertise, timeliness, management support for root causes, better trending and dissemination of OE.

Numerous efforts to further integrate Operating Experience in routine activities (JIT's in work/project preparation, OE briefs, discuss/report low level events in daily meetings, process performance reviews, etc.) and training have been undertaken.

A comprehensive CAP (Corrective Action Process) has now been established, and is used for performance improvement throughout the company. All different action lists have been combined into one. Process owners use the CAP to improve their processes. Senior management uses the CAP to steer improvements of safety performance. The CAP is used as input for the two-yearly evaluation.

For all important processes, performance indicators have been developed, and performance reviews have been implemented. Performance indicators, and also CAP information (low level events, pending actions), are used to learn about and to improve process performance.

Team meetings have been improved. Learning and improving is discussed in every meeting.

The improvement processes employed at the station are now all part of the integral management system.

Effect:

EPZ went from a declining performance to a situation in which learning and improvement is demonstrated in all layers of the organization. All staff members routinely engage in learning and improving activities. A comprehensive CAP was established and used throughout the organization. OE is used in routine activities. All training activities now include OE.

SOER implementation went from 50% to 80% SAT. Repeat events show a positive trend since 2014, and are moving towards the long term strategic target (<10%).

IAEA comments:

The organization chose to improve this situation on a number of levels and incorporated the improvements into the actions associated with leadership and the integrated management systems improvement activities.

In 2015, a team within the QA department was formed to improve the key processes for learning and improving (i.e. corrective action program, operational experience, self-evaluation).

A human performance owner (Hu coordinator) was appointed, and a Hu-programme was established and implemented (see issue 1.2(1). The Hu-owner is also part of the Operating Experience (OE) team to provide human factors expertise.

The culture for safety programme was launched in 2016 and 'learning organization' became one of three main focus areas. An example activity was the establishment of teams that included cross disciplinary members from all levels and areas of the organizations, engaging in learning and developing and implementing improvement activities (such as reducing the occurrences of exceeding the daily individual radiation exposure limit from 28 in 2016 to 2 during the 2017 outage). Also, the culture for safety programme was used to learn about, and correct, underlying weaknesses within the company (e.g. in the area of team meetings, the CAP, the senior management).

Multidisciplinary improvement teams were also used to increase exchange of experience, strengthen cooperation, and to establish a sound basis for continuous learning and problem solving.

Management expectations have also been updated and five basic expectations have been established and implemented. One of the basic expectations is “We cooperate, share our knowledge and experience, and stimulate improvement”.

Significant operating event report (SOER) evaluation was also strengthened to stress the importance of learning from external events to improve nuclear safety. Over 100 staff members have been engaged in implementing SOER recommendations.

Participation in international exchanges to learn from other plants (IAEA workshops, seminars, WANO TSMs, etc.) was increased, for example the organization managed to learn from international experience and successfully implemented the new Reactor Control and Limitation System during the 2017 outage.

Several improvements to the OE programme, and improved trending has made information available for use by leaders in work/task preparation activities. Focus groups mentioned the improved use of OE inside work package files as part of the pre-job-brief (PJB and observations on the plant also confirmed the use of OE during PJB. The work packages and PJB also has recorded information of task experience gathered by the post job review process. This is specific OE for the task and is perceived by the workforce to be extremely useful. The integration of operating experience in routine activities (just–in-time briefs in work/project preparation, OE flyers, discuss/report low level events in daily meetings, process performance reviews, etc.) and training were put in place and were observed and seen to be effectively used during the FU2 mission. One of the focus groups discussed the use of OE information in toolbox talks and included the communication of “tips and tricks” and good practice knowledge.

Speedy communication for urgent information is also organised through plant stand downs to provide workers with information that they need to know. An example was given by the focus group of the briefing following the recent reactor scram. The focus groups showed great interest in the ongoing investigation.

Key performance indicators identified that satisfactory implementation of SOERs went from 50% to 80%. Repeat events also show a positive trend of reduction since 2014, and are moving towards the organization’s long term strategic target (<10%). The number of reportable events also decreased.

Through the above actions the organization has demonstrated that they have developed processes in which OE is used in a practical way that contributes to continuous improvement within the organization. All staff members routinely engage in learning and improvement activities and this contributes to the development of a ‘learning organization’.

Conclusion: Issue resolved

13.4 ORGANIZATIONAL CHANGES

13.4(1) Issue: Changes in organizational structure, function, leadership, policies, programmes, procedures, and resources do not always consider safety implications and are not effectively communicated and implemented.

The following observations were made:

- The reason for change, whether it be organizational, process, personnel or technical are not clearly communicated or understood;
- Transition of the coal plant personnel into the nuclear plant is perceived to be lacking a clear strategy. Management has not yet told the staff when it will present the plan;
- The reorganization (FOCUS 2) is perceived to be necessary because of the pressure of cutting costs to be able to operate until 2034. Concern about how to manage the pressure has resulted in rumours that management will shut down the nuclear plant earlier;
- The work management system is still not understood. Small jobs are described as difficult to perform since they have to be done in the same way as large jobs;
- There are a lot of ongoing changes such as technical modifications and organizational changes that are still not finished and it is not clear why;
- Since 2010 a considerable number of managers have changed, including 4 different plant managers, and it was not understood by plant personnel how it would improve the organization;
- The Change Management Procedure has not been applied to key organizational projects.
- Even though several information meetings with the personnel have taken place, many of the personnel believe that the organization has already implemented

FOCUS 2 but in fact that change has not yet been officially conducted;

- The process of change in the organization does not consider the impact of the change on the personnel that are involved;
- Personnel describe that they are generally not involved in the organizational change process;
- Operators in the control room are getting many questions about how to do work within the new software system and work management system because of incomplete implementation and inadequate training for the personnel who must do their jobs with these systems;
- The root causes identified in the significant event related to valve in TJ031 were linked to the implementation of the work management system. Standards were insufficiently communicated, jobs were understaffed, there was insufficient management involvement, and delays in implementation;
- Decisions to implement change are originating from the upper level in the organization without the input from those who will be impacted by the change. After implementation it becomes too resource intensive to formally change the process;
- Change is often made more complex and complicated than it should be because of the informality and lack of clarity in implementation;

- AP928 originally had 35 steps when it was first implemented. After all departments provided their input (RP, CH, OPS, MA) it ended up with 75 steps. The original system had more flexibility but by adding more detail and moving away from the formal system it became more complicated;
- When people say 'there has been a reorganization', people first ask – 'which one?'
- The change to the work permit system has worked well in other companies but not in this organization. The personnel that knew the system the best left the company and there are a lot of things still required to complete the system. Many personnel have made their own informal modifications to make the system work for them.
- The value that everyone's opinion is important is perceived not to be in balance. It is expressed that peoples involvement in the decision-making process sometimes is hindering from moving forward. There is a difference between the less experienced personnel who want to make decisions and changes quickly with the more experienced personnel who would like to take more time.
- The plant has implemented organisational changes that impact on safety. Implementation of the Nuclear Safety section was not analysed.

Focus 3 is currently in implementation and concerns safety culture and the basis for improvement in the organization. Personnel are not aware that FOCUS 3 is ongoing and some management indicates that the new organizational structure and processes are required to start this programme. The confusion around the status of FOCUS 2 and FOCUS 3 is symptomatic of the problems in change management in the organization. Organizational changes need to be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.

Recommendation: The organization should incorporate safety consideration in changes in organizational structure, function, leadership, policies, programmes, procedures and resources and effectively communicate and implement these changes.

IAEA Bases:

GS-R-3

5.28. Organizational changes shall be evaluated and classified according to their importance to safety and each change shall be justified.

5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.

GS-G-3.1

5.56. When organizational change is necessary, no reduction in the level of safety achieved should be acceptable, even for short periods of time, without appropriate justification and approval.

5.57. The drive to improve efficiency and reduce costs can result in organizational changes that can have significant safety implications. Examples of such changes are:

- Mergers of organizations, leading to a drive for harmonized standards and procedures;
- Changes in the arrangements for providing central support services;
- Reassignment of work activities, thereby increasing the likelihood that expertise in critical areas will be lost;

– Changes in the policies for recruitment, selection, induction and training of individuals;

– Reductions in the number of management levels and in the grades of individuals carrying out activities in the organization.

5.58. When major organizational changes are planned, they should be rigorously and independently scrutinized. Senior management should remain aware that it has the ultimate responsibility for safety and should ensure that safety considerations are given a priority commensurate with their significance during any process of major change.

5.60. For changes for which it is judged that potentially significant effects on safety could arise, assessments should be carried out to ensure that the following factors are considered:

– The final organizational structure should be fully adequate in terms of safety. In particular, it should be ensured that adequate provision has been made to maintain a sufficient number of trained, competent individuals in all areas critical to safety. It should also be ensured that any new processes introduced are documented with clear and well understood roles, responsibilities and interfaces. All retraining needs should be identified by carrying out a training needs analysis of each of the new roles. The retraining of key individuals should be planned. These issues are especially important if individuals from outside the organization are to be used for work that was previously carried out internally, or if their roles are to be otherwise substantially extended;

– The transitional arrangements should be fully adequate in terms of safety. Sufficient personnel with knowledge and expertise that are critical to safety should be maintained until training programmes are complete;

– Organizational changes should be made in such a way as to maintain clarity about roles, responsibilities and interfaces. Any significant departures from pre-planned transitional arrangements should be subject to further review.

5.61. Senior management should develop a specific process to manage and review organizational changes. The process should ensure that there is no degradation in the safety culture of the organization.

5.62. A safety assessment should be developed for any changes that have the potential to affect safety. For more significant changes, advice should be sought from internal and external experts.

5.64. Communication with interested parties, including individuals, should be carried out honestly and openly, addressing the safety implications and other implications of the changes and explaining the steps being taken. The appropriate mechanisms for the feedback of information to monitor the effects of the changes that are implemented should be set up.

5.65. For each change, the project leader should apply a systematic and transparent project management process, the rigour of which should be commensurate with the significance of the change. In parallel, senior management should consider the overall integration of all changes, and should oversee very significant changes that are imposed and the cumulative effects of smaller changes that may interact with each other. Effects on ongoing activities during the implementation of changes should be studied well and given careful consideration.

5.66. For each project for change proposed, the risks to the objectives of the organization, including safety, health, environmental, security, quality and economic risks, should be identified and evaluated.

5.67. The interactions between different changes should be given careful consideration. Changes that on their own may have only a limited effect on safety may combine and interact to produce much more significant effects. Where possible, different initiatives for changes that are pursued at any one time and that may affect safety should be minimized. In addition, the total workload imposed on the organization to implement the changes in parallel with continued operational activities should be given careful consideration.

5.68. The individual who has the authority to approve changes to be implemented should be clearly designated. For each change, and on the basis of the significance of the change, controls should be applied to ensure that it is possible to identify the individual in the organization who is authorized to approve the change.

GS-G-3.5

2.25. Major initiatives for changes that affect the safety culture should not be launched prematurely. A careful approach should be taken initially to ensure that everyone understands the new way of thinking and working, and to consider how the existing culture could help or hinder the new culture. The desired changes should build on the existing culture. It should be considered how the individuals who are the targets for change could be motivated to want to change, but such individuals should not become so anxious about learning new things as to resist change. Consideration should be given to how the existing culture can help the learning process and make individuals feel secure.

2.26. A major challenge in changing the safety culture is to develop a learning organization that will continually be able to make its own diagnosis, and to self-manage whatever transformations are necessary as the environment changes. An organization of this type is likely to be far more resilient and successful in dynamic, fast changing economic conditions. Ideally, all individuals should be involved in proactively contributing ideas for improvements. More sustainable approaches would involve encouraging individuals to work in teams and continually seek improvements by identifying and prioritizing actions to enhance safety in their own work areas. To facilitate this, individuals should be given the opportunity to compare their way of working with that of others, so that they are aware of what constitutes excellence in their area of work

3.23. Organizations should promulgate a policy for promoting and managing change that encompasses their vision and values. This policy for change management:

(a) Should give priority to safety;

(b) Should address all types of change;

(c) Should introduce the process for change management;

(d) Should state that only approved changes will be implemented;

(e) Should promote effective communication.

GS-G-3.5

Appendix

II LEADERSHIP FOR SAFETY IS CLEAR

(a) Safety implications are considered in change management processes.

III ACCOUNTABILITY FOR SAFETY IS CLEAR

(a) An appropriate relationship with the regulatory body exists that ensures that the accountability for safety remains with the licensee.

IV SAFETY IS INTEGRATED INTO ALL ACTIVITIES

(d) The quality of processes, from planning to implementation and review, is good. (f) Factors affecting work motivation and job satisfaction are considered.

Plant Response/Action:

Summary of underlying causes:

- Procedures for management of non-technical changes were incomplete and not followed by management.
- Lack of leaders communicating with, and engaging staff in non-technical changes.
- Management underestimated the complexity and impact of non-technical changes.
- Lack of alignment in the organizations management.

Summary of improvement activities:

The organizational change procedure (PU-A11-05) was improved and implemented. All organizational changes are now risk assessed on (nuclear) safety. The change management is performed by change coordinators, and changes are evaluated.

For all other non-technical changes (other than organizational), a standard was developed to complete the management of change framework in the management system. The standard (PU-A27-05) was based on the experiences of the culture for safety program, and examples from industry.

New aligned site management team.

The culture for safety programme was launched in 2016. The programme focusses on shop floor needs, and open communication. Proposed changes are challenged by a committee with representatives from the shop floor. The changes are subjected to a risk assessment, and always performed in close collaboration with the people involved as to maximize engagement and minimize negative change impact.

Communication about changes was improved substantially. Quarterly meetings are being organized in which changes (in function, leadership, management, etc.) are discussed openly with the organization by the CEO. Team leaders discuss changes in team leader lunches, and managers go in the field each day to talk to staff about the direction of EPZ and ongoing (or new) changes.

Effect:

Changes in organizational structure, functions, leadership, policies, programmes, procedures, and resources are standardized in the IMS. The changes are subjected to risk assessment, and special attention is being paid to careful implementation, communication and follow up. Many changes have been successfully conducted without adverse effects on safety.

IAEA comments:

From 2015 the site revised the management of change processes to improve the communication of the reasons for each change and explain and how change would be implemented. This included discussions with those directly affected by the proposed changes.

The culture for safety programme was launched in 2016 and included the workforce and open communication. Senior management endeavour to create a safe environment where proposed changes can be openly discussed and challenged by a committee with representatives from all levels. Changes are now subject to risk assessment, and always performed in close collaboration with the people involved, to maximize engagement and minimize any negative effect.

Communication about change has been improved substantially. Quarterly meetings are held in which changes (in function, leadership, management, etc.) are discussed openly with the workforce by the CEO. Team leaders discuss changes in team leader lunches, and managers go in the field each day to talk to staff. Some of this communication concerns the direction of the company and ongoing (or new) changes.

In discussion, several focus groups confirmed that communication had improved to the point where all were confident they knew what changes were proposed and that they could ask questions and challenge where necessary. The recent change of key senior posts was quoted as an example and the assessment process used in candidate selection was also known.

The CEO also communicates regularly with the shareholder supervisory board to align them with the organization's proposals with respect to safety.

Changes in organizational structure, functions, leadership, policies, programmes, procedures, and resources are standardized in the IMS. The changes are subjected to risk assessment, and special attention is being paid to careful implementation, communication and follows up.

Conclusion: Issue resolved

13.5 LEADERSHIP

13.5(1) Issue: Leadership for safety is not recognized throughout the organization to ensure sustainable safety performance.

The following observations were made:

- The organization has a culture of allowing people opinions after decisions are made. This is expressed to be adding complexity as layers of details are added. This often creates delays in the implementing process, which can have a negative impact on safety;
- Personnel coming from other industries are puzzled that people at the nuclear power plant are not expected to take accountability for their actions. For example:
  - Many managers do not take their role as leaders to follow up that agreed upon actions have been fulfilled;
  - Several employees have stressed the fact that it is accepted that people avoid taking ownership;
  - There is a general acceptance of not meeting timelines (delays in the inputs to the work management process, crane in the reactor building);
  - In the survey 19% of the respondents answered that they don't think management communicates effectively about safety.
- The communication and enforcement of consequences when personnel are not fulfilling expectations or adhering to rules not being done, e.g. when a new procedure was going to be implemented an additional procedure was written on how to handle the situation when the new procedure was not followed. While there are a few examples of good leadership for safety it must be stressed that most of the managers do not spend sufficient time in the field or with the personnel. The following have been expressed by working level personnel:
  - Personnel seldom or never see managers in the field, even their own department managers;
  - The perception that managers prefer to be in meetings or hiding behind their desk;
  - Plant KPIs for managers in the field shows a decrease in the participation in several departments;
  - There is also evidence for this in the survey results as in the area within 'leadership for safety is clear' the most negatively answered question is about management visibly present in the field (negative 46%).
- Most of the interviewees and participants in the focus groups would like to see a change in the management and leadership to become better in :
  - giving clear direction and taking the lead in decisions;
  - providing personal feed-back;
  - talking to people;
  - be better in listening;
  - utilize people's knowledge before implementing new systems;

  - be more transparent (referring to rationale behind decisions and terminations of some managers);
  - resolving the collaboration problems in the senior management team;
  - understanding how to manage a power plant with reference to nuclear knowledge;
  - explain the rationale behind crucial decisions; – focusing on the nuclear power operations
- In general, there is an underestimation of the value and importance of leadership for safety. This is described above and in the lack of programme for leadership development.
- Confidence concerning operational safety in some of the senior management team despite of lack of experience.
- All levels of personnel aggressively question the management structure and its functionality. It is referred to as an upside-down triangle or rowing a boat with one man rowing and seven men giving directions. A tension exists between the corporate management and the nuclear plant management, which is creating a lack of trust.

Without an effective leadership clearly expressing the value of safety in the organization there is a risk that safety does not have an overriding priority.

Recommendation: The senior management should establish an effective leadership that clearly express the value of safety to ensure sustainable safety performance.

IAEA Bases:

SSR-2/2

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 leadership, protection of health, human performance, protection of the environment, security and quality, and so that safety is not compromised by other requirements or demands.

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

GS-G3.5

Appendix I

SAFETY IS A CLEARLYRECOGNIZED VALUE

(f) The high priority given to safety is shown in documentation, communications and decision making.

(g) Safety is a primary consideration in the allocation of resources

(d) Individuals are convinced that safety and production go hand in hand.

(e) A proactive and long term approach to safety issues is shown in decision making.

(f) Safety conscious behaviour is socially accepted and supported (both formally and informally).

II LEADERSHIP FOR SAFETY IS CLEAR

(h) Senior management is clearly committed to safety:

(i) Commitment to safety is evident at all levels of management:

(j) There is visible leadership showing the involvement of management in safety related activities:

(k) Leadership skills are systematically developed:

(l) Management ensures that there are sufficient competent individuals:

III ACCOUNTABILITY FOR SAFETY IS CLEAR

(d) Management delegates responsibility with appropriate authority to enable clear accountabilities to be established:

(e) 'Ownership' for safety is evident at all organizational levels and for all personnel.

IV SAFETY IS INTEGRATED INTO ALL ACTIVITIES

(a) Trust permeates the organization.

(f) Factors affecting work motivation and job satisfaction are considered.

(g) Good working conditions exist with regard to time pressures, workload and stress.

(h) There is cross-functional and interdisciplinary cooperation and teamwork.

(i) Housekeeping and material conditions reflect commitment to excellence.

V SAFETY IS LEARNING DRIVEN

(a) A questioning attitude prevails at all organizational levels.

(b) Open reporting of deviations and errors is encouraged.

(f) Safety performance indicators are tracked, trended and evaluated, and acted upon.

(g) There is systematic development of individual competences.

Plant Response/Action:

Summary of underlying causes:

- Difficult management structure.
- Communication loop management-staff not closed.

Summary of improvement activities:

A new management structure: clear focus on nuclear safety and clear responsibility for Nuclear Safety. The focus is on operating a nuclear power plant only (the coal fired plant on the site has been permanently shut down). There is one CEO, and the responsibility for Nuclear Safety is no longer divided between two persons. Furthermore, EPZ merged the separate Corporate and Plant Management team into one Management team (called Site Management Team or SMT). In this SMT, all main process responsible are represented.

Actions in this area also included the CEO moving into the onsite office building to be closer to Operations.

Desired behaviours and attitudes of leaders were defined, and a framework was chosen accordingly. This framework called "facilitative leadership" (also known as Humble leadership) will also help to resolve the issue of communication practices 13.2(1), because this style of leadership will create a culture of openness and trust.

Additional specific requirements for Senior Nuclear leaders were defined and incorporated in the recruitment of new senior nuclear leaders. These are both specific requirements on competences and (communication) skills for senior leaders, and requirements as defined in IAEA GSR-part 2 ('REQUIREMENTS SENIOR MANAGEMENT concerning integrated nuclear safety'). The requirements were integrated in the new 'EPZ Site Management Team guideline'.

Assessment of all senior managers in the new Site Management Team, using the new framework (humble leadership) as well as the additional requirements for senior leaders, has led to a significant change in the management team with four new senior managers out of nine).

A leadership development programme, based on fundamental nuclear leadership skills/knowledge and on the humble leadership framework, was developed, and is being implemented. Several leaders have started the programme.

Assessment of all team leaders/supervisors at the beginning of this development programme. This will help the leaders with their personal development in identifying the actions needed to become a facilitative leader. It will also create awareness within the group of leaders as to establish their personal match with humble leadership.

The survey regarding safety culture is being epeated.

Effect:

EPZ has a more clear and simple management structure with a clear focus on safety. New clear expectations for leaders and senior leaders were defined, which resulted in a change of senior managers. Ongoing assessments and the leadership development programme enforce the humble leadership style and the value of safety as overriding priority.

IAEA comments:

The organization developed a new simpler management structure with a clear focus on nuclear safety and clear responsibility for nuclear safety. There is now one CEO, and the responsibility for nuclear safety is no longer divided between two persons. Furthermore, the organization merged the separate Corporate and Plant Management teams into one Management team (called Site Management Team or SMT). In this SMT, all main process responsibilities are represented. Actions in this area also included the CEO moving into the onsite office building to be closer to operations.

In discussion with several focus groups, improved and faster communication with the leadership team were mentioned along with the perception of good responsiveness to improvement suggestions and worker concerns. The slogan "we do it safely or not at all" was mentioned in all the focus groups as an illustration of the leadership commitment to safety which they have seen in practice.

The role of all leaders in restoring trust was identified as a crucial improvement for ensuring and improving safety performance. Setting clear expectations for leaders, and developing them in accordance with these new expectations, was made a priority in 2016 and 2017.

The organization identified the desired behaviours and attitudes of leaders, and a framework was chosen accordingly. This framework called "facilitative leadership" (also known as 'humble leadership') was chosen to fit with the organization's culture and improve the issues around communication of safety (see also 13.2(1)).

As well as improving their skills of leadership and their relationship with the workforce, they focused on creating a culture of trust and openness. All of these aspects were described in the focus groups as improving the engagement of personnel, promoting personal responsibility of individuals and their understanding of safety (in particular nuclear safety), encouraging a questioning attitude', expression of feelings and difficulties, and improving feedback for use in continuous improvement.

Additional specific role requirements for "Senior Nuclear leaders" were also defined and incorporated in the recruitment of new senior nuclear leaders. These include both specific requirements on competences and (communication) skills for senior leaders, and requirements as defined in IAEA GSR-part 2. The requirements were integrated in the new organisation's 'Site Management Team guideline'.

Assessment of all senior managers in the new Site Management Team, using the new framework (humble leadership) as well as the additional requirements for senior leaders, has led to the. appointment of new senior managers in key roles. Assessment of all team leaders/supervisors in the organization at the beginning of the development programme is planned. This will allow leaders to be identified and developed to become 'facilitative' leaders.

Specific leadership activities have been put in place to ensure leaders have the opportunity to engage with the workforce and provide coaching on safety performance. The leaders in the field conduct observations and encourage feedback, demonstrate the leadership principles, and communicate the 5 expectations developed by the senior leadership. During focus group discussions, these activities were viewed positively and perceived to achieve improved team behaviour and greater personal responsibility.

In discussion within several focus groups a consistent message was given that leadership for safety has improved by application of the 'humble leadership' principles.

The organization has developed a simpler management structure with a clear focus on safety. The new leadership team has adopted and promoted the 'humble leadership style' which requires all leaders to engage with the workforce, enhance their skills for communication and communicate the value of safety as an overriding priority. Focus group discussions identified a clear perception of improvement in leadership for safety and the understanding of safety as the organization's overriding priority.

Conclusion: Issue resoled

14. SEVERE ACCIDENT MANAGEMENT

14.1 OVERVIEW OF SEVERE ACCIDENT MANAGEMENT

The development of the plant SAM Programme uses experience and results from the Pressurised Water Reactor Owners Group (PWROG). This can be considered as an optimum decision, since the PWROG approach is internationally recognized as a comprehensive and consistent set of strategies for addressing all challenges associated with severe accident. Implementation of PWROG generic guidelines to original SIEMENS KWU design required some plant modifications and support from the original plant designer (AREVA). The team encourages the plant to continue its cooperation with the supplier of original Emergency Operating Procedure (EOPs) and Severe Accident Management Guidelines (SAMG) to implement new experience and results from PWROG.

14.2 ANALYTICAL SUPPORT FOR SEVERE ACCIDENT MANAGEMENT

The original strategies are based on analyses performed during the development of the generic strategies and modified (when necessary) on a plant specific basis. The plant specific analyses used for strategy development are (a) deterministic analyses performed by AREVA during design modification, (b) PSA insights and supporting analyses performed by NRG, SCIENTECH etc. and (c) analyses for licence purpose performed by AREVA. The supporting analyses cover the progression towards severe accidents in the reactor core (both at power conditions and shutdown reactor) as well as in the spent fuel pool.

Major upgrades that are foreseen based on identified measures in the Complementary Safety Margin Assessment (CSA) will significantly influence the selection of severe accident management strategies, their timing, prioritization and effectiveness. The team encourages the plant to update the relevant analyses to address all possible influences from the proposed measures in CSA.

14.3 DEVELOPMENT OF PROCEDURES AND GUIDELINES

Accident management extends from the preventative part in the EOPs domain to the mitigating part, known as the SAMG domain. The plant specific Westinghouse based EOPs and functional restoration procedures have been implemented for preventing core damage. When working in the EOP-domain, there is a person (Deputy Shift Leader) in the main control room who monitors critical safety functions and triggers the transfer to function restoration, when exceeding a set of critical safety function criteria. The criteria for entering the SAMG domain are precisely specified for both the reactor core and the spent fuel pool. As long as the Technical Analysing Group (TAG) is not staffed or not ready to respond, the control room operators follow the severe accident control room procedures (two procedures for at-power plant initial state). The third procedure specifically for plant shutdown states is not developed yet.

Not all abnormal operation procedures and EOPs are implemented and hence the abnormal operation procedures and EOPs do not address all possible plant states. Also no formal procedure for SAM procedures and guidelines development exists. A suggestion was made by the team in this area.

Requirements for availability, allowed outage times, required actions and surveillance requirements of some SAM equipment are included in a separate Plant Technical Specifications (BTS). The team considers this as a good practice.

The SAMGs contain attachments with system line-ups that can be used to achieve certain flow paths (mostly the non-standard flow paths not familiar to the personnel). The plant has a complete set of up-to-date process diagrams available for every system line-up that is mentioned in the SAMG and a software tool to maintain them. The team considers this also as a good practice.

14.4 PLANT EMERGENCY ARRANGEMENTS WITH RESPECT TO SAM

SAM functions and responsibilities are included in Emergency Response Organisation (ERO) and are clearly described. The ERO is structured to support all required SAM functions in the preventive and mitigative phases. The criteria, responsibilities and required time response for activation of the SAMG users are adequate. All SAMG users available would be involved if accident was progressed to severe accident. If the SAMG users are not mobilized when the transition from EOPs to SAMG is required, the control room operators use dedicated procedures until ERO members responsible for SAM are present and ready to assume their function.

The access and habitability of the corresponding locations of the teams of evaluators and implementers have been assessed from the points of view of security, industrial safety and radiation protection. The team has recognized as a good performance that information about dose rate predictions in locations of the teams of evaluators and implementers is described in the corresponding procedure.

The team has recognized as a good performance that all teams of the emergency response organisation are provided with on-line data from the process computer. On-line data is available in the main control room, in the TAG room in the ERC, in the KFD`s office and also in AREVA, Krisenstab. If normal communication means are lost, then alternative communication means are available (implemented in the scope of post-Fukushima measures).

14.5 VERIFICATION AND VALIDATION OF PROCEDURES AND GUIDELINES

EOPs are validated on the control room simulator (CRS) during operators training and there are no special sessions for validation. CRS capabilities are restricted and do not allow validation of the full range of EOPs.

Verification of the SAMGs was performed within the vendor`s QA process during the development of the guidelines. In addition, the guidelines were independently reviewed by the plant staff. The validation included demonstration by analysis of feasibility and effectiveness of the proposed SAMG actions. The 'table top' exercises were mainly used for a limited scope of validation.

SAM procedures and guidelines verification and validation are regularly performed, however no dedicated procedure for validation exists. The conclusions of the validation are documented in the internal database only and no systematic approach for validation process documentation exists. The plant SAMGs are not reviewed and updated on a regular basis and the plant does not use international feedback from the PWROG. When new severe accident issues occur, Westinghouse updates their generic SAMG, but this information is not systematically used at the plant. It should be emphasised that updating the SAMGs and validating them will be necessary in connection with the planned upgrading of the plant hardware features for mitigation of severe accidents. A suggestion was made by the team in this area.

14.6 TRAINING NEEDS AND TRAINING PERFORMANCE

Several kinds of training are provided to individuals and groups involved in the application of the SAMGs. The SAM personnel have adequate qualification and training to provide

Qualified support. The training is focused on all aspects of SAM including the analysing of a real accident by TAG and expectations from AREVA Krisenstab. Also new information is regularly provided during refresher training.

The team has recognized a good performance that the handbook for the alarm organisation specifies the requirements for qualification and training (both initial and refresher) for personnel involved in SAM.

The plant uses a specific severe accident simulator model that runs on a personal computer on a RELAP/SCDAP platform to train the ERO personnel in the use of the EOPs and SAMGs. The team considers this as a good practice.

14.7 SEVERE ACCIDENT MANAGEMENT UPDATING AND REVISIONS

The overall assessment of all existing plant SAM procedures and guidelines and the verification of the validity of existing analyses is a part of the PSR. The latest PSR (10EVA13) was finished in 2013.

As new information has become available and based on the Complementary Safety Margin Assessment the plant recognized that some procedures and guidelines needed improvement and hence the corresponding measures to enhance SAM programme have been included into the stress tests action plan and approved by KFD. These measures are either focussed on the overall assessment of the existing SAM procedures and guidelines and identification of possible gaps and the enhancement or the development of additional new procedures and guidelines. The survivability of some equipment that has been installed in the past for implementation of the SAM strategies has not been analysed to ensure that during all internal and external events it will remain functional. This deficiency has been recognized by the plant and the requirements for systems enhancement are included in the stress tests action plan. The team encourages the plant to follow the requirements of the action plan and to implement all required measures.

The team has recognized as a good performance that, together with the original vendor of the plant, a comprehensive matrix was developed to relate the individual stress test measures to each other and to demonstrate that all objectives are met. The matrix demonstrates that for all the defined plant states (full power, mid-loop operation, refuelling and reactor core fully unloaded) the vital safety functions are fulfilled.

DETAILED SEVERE ACCIDENT MANAGEMENT FINDING

14.3 DEVELOPMENT OF PROCEDURES AND GUIDELINES

14.3(a) Good practice: Requirements for SAM equipment in separate Plant Technical Specifications.

Plant equipment and features intended to be used for Severe Accident Management are described in the Plant Technical Specifications (BTS in Dutch). This is a set of Technical Specifications that is separate from the formal set of Technical Specifications of requirements for the safety systems of the plant (based on NUREG 1431), but they use the same structure and layout. Availability requirements, allowed outage times, required actions and surveillance requirements are prescribed by this BTS in the same way as it is done by the formal Technical Specifications (TS). The authorisation of the BTS is carried out by the plant's Nuclear Safety Manager. Deviations from these self-imposed requirements are primarily reported to the Nuclear Safety Manager who is also authorized to grant exemption requests. The management expectation is that staff makes no distinction between the use of the TS requirements and the BTS requirements.

Benefits associated with the use of Plant Technical Specifications.

The availability of SAM equipment is controlled in a similar way to the plant's safety equipment. The management expectation that the BTS requirements must be considered as important as the Technical Specifications requirements guarantees that the SAM equipment is not neglected but well maintained. The BTS also ensures clear requirements and SMART actions to maintain or restore AM availability.

14.3(b) Good practice: Management of Severe Accident Management Guidelines (SAMG) process diagrams (PIDs) with coloured flow paths

The SAMGs contain attachments with system line-ups that can be used to achieve certain flow paths (e.g. the non-standard flow path to inject water from the containment sump into the spent fuel pool by use of a residual heat removal pump). In order to assess and to configure these possibilities during an emergency, staff will mark the flow paths on process diagrams. This work is time consuming when several flow paths are to be assessed. Therefore, EPZ has a complete set of up-to-date process diagrams available for every system line-up that is mentioned in the SAMG with the intended flow path marked by a coloured line.

To consistently maintain a second set of PIDs and to keep them in accordance with the as built PIDs that are normally used is challenging. Deviations between almost identical sets of documents can easily occur. EPZ uses a CAD programme to draw and alter all drawings including PIDs. The process diagrams are multi layered drawings. The coloured SAMG process diagrams are produced by using the existing digital PID layers of the according process diagrams and adding one additional coloured layer representing the intended flow path of the SAM guideline. Every time a process diagram is changed this is recorded in a database which directly informs the engineer which SAMG PIDs must be changed. Because almost all modifications to the process diagrams are minor changes, the SAMG PID can be changed by simply printing new copies of it based on the modified underlying PID and the existing coloured layer. Occasionally the coloured flow path has to be altered when a major change is made to a system. The use of the database ensures that every SAMG PID is revised when the underlying process diagram is changed. The revision number and date of the original PID are also printed on the SAMG PID this enables an easy check whether the drawing matches its source.

Benefits associated with the management of SAMG process diagrams.

The use of coloured SAMG PIDs guarantees easier and quicker assessment and configuration of possible flow paths and error reduction in the interpretation of possible system line-ups described by the SAMG attachments. The QA process for the management of the SAMG PIDs guarantees that the information in these drawings is also up to date after a plant modification and in compliance with the as built PIDs.

14.3(1) Issue: The plant abnormal operation procedures and EOPs are incomplete and do not address the scope of all possible plant states.

The team made the following observations:

- External event procedures are event oriented and do not address the impact of external events on safety functions;
- No transitions from external event procedures to SAMG are identified and implemented;
- The procedure for transition from the main control room to the emergency control room is very general and does not provide criteria and other necessary information for making the transition;

Not all sets of SAM procedures and guidelines are implemented. The following deficiencies were identified:

- EOP for spent fuel pool does not exist, only an alarm card for low spent fuel pool level is included in alarm response procedure;
- Manuals for TAG to support CR personnel if 'consult plant engineering staff' in EOPs is required, do not exist.
- The plant specific procedures and guidelines have been developed based on the generic documentation and experience of staff. There is no formal procedure for their development (like plant specific author guides).

Without a full set of SAM procedures and guidelines addressing all internal and external events SAM could be ineffective.

Suggestion: The plant should consider enhancing abnormal operation procedures and EOPs to ensure that procedures are complete and address all plant states.

IAEA Bases:

Requirement 19: Accident management programme

5.8. An accident management programme shall be established that covers the preparatory measures and guidelines that are necessary for dealing with beyond design basis accidents. The accident management programme shall be documented and periodically reviewed and revised as necessary. It shall include instructions for utilization of the available equipment — safety related equipment as far as possible, but also conventional equipment — and the technical and administrative measures to mitigate the consequences of an accident. The accident management programme shall also include organizational arrangements for accident management, communication networks and training necessary for the implementation of the programme.

5.9. Arrangements for accident management shall provide the operating staff with appropriate systems and technical support in relation to beyond design basis accidents. These arrangements and guidance shall be available before the commencement of fuel loading and they shall address the actions necessary following beyond design basis accidents, including severe accidents. In addition, arrangements shall be made, as part of the emergency plan, to expand the emergency response arrangements, where necessary, to include the responsibility for long term actions.

2.14. The approach in accident management should be based on directly measurable plant parameters or parameters derived from these by simple calculations.

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.

3.27. Priorities should be set between strategies, because possible strategies can have a different weight and/or effect on safety, and because not all strategies can be carried out at the same time. In the preventive domain, the priority of the strategies should be reflected in the priority established for the critical safety functions. In the mitigatory domain, priority should be given to measures that mitigate large ongoing releases or challenges to important fission product barriers (where 'large' means releases with levels of radioactivity that are above the general emergency levels, as defined in the plant emergency plan). The basis for the selection of priorities should be recorded in the background documentation. An example is a set of priorities that follows the evolution of many severe accidents; that is, the first priority is to the first fission product barrier to fail if no mitigatory measures are taken. The setting of priorities should include the consideration of support functions (vital auxiliaries such as AC and DC power and cooling water).

3.40. Interfaces between the EOPs and the SAMGs should be addressed, and proper transition from EOPs into SAMGs should be provided for, where appropriate. Functions and actions from strategies in the EOPs that have been identified as relevant in the mitigatory domain should be identified and retained in the SAMGs. Preferably, there should be no formal transition back from the mitigatory domain (SAMGs) to the preventive domain (EOPs), once the EOPs have been exited, although EOPs may still be used as judgement dictates. Where this is nevertheless applied, it should be ensured that the EOPs considered are applicable and valid in the core damage domain, and that the decision-making process includes all features necessary in the core damage or mitigatory domain. As EOPs have been designed for a reactor with an intact core, they lose, in principle, their design basis in the mitigatory domain and, hence, should be exited.

3.43. The transition point from the preventive domain to the mitigatory domain should be set at some time prior to 'imminent core damage' or at the 'beginning of core damage', or at some other well-defined point (e.g. the execution of preventive measures has become ineffective or impossible). The selection of the transition point may influence the magnitude and/or sequence of subsequent challenges to fission product barriers. In such cases, this should be taken into account in the selection of the transition point which, therefore, should be placed at a point that is optimal for accident management. Where the transition point is specified on the basis of conditional criteria (i.e. the transition is made if certain planned actions in the EOPs are unsuccessful), the time necessary to identify the transition point and the possible consequences thereof should be taken into account. For example, the rise in core temperature and the associated core damage that will occur during the attempts to prevent core damage should be considered.

3.45. Procedures and guidelines should be based on directly measurable plant parameters. Where measurements are not available, parameters should be estimated by means of simple computations and/or pre-calculated graphs. Parameters that can be obtained only after carrying out complex calculations during the accident should not be used as the basis for decisions.

3.46. Procedures and guidelines should be written in a user-friendly way and such that they can be readily executed under high stress conditions, and should contain sufficient detail so as to ensure that the focus is on the necessary actions. The procedures and guidelines should be written in a predefined format. Instructions to operators should be clear and unambiguous.

3.69. For dedicated or upgraded equipment, there should be sufficient confidence in the equipment and, where possible, demonstration of its capability to perform the required actions in beyond design basis and severe accident conditions should be provided. Demonstration of the capability of equipment should be provided where other assessment methods cannot provide sufficient confidence. However, the level of qualification applied to such equipment need not necessarily be the same as that typically required for components and systems that cope with design basis conditions. Similarly, requirements on the redundancy of such systems may also be relaxed compared to the requirements applied in the design basis domain.

3.71. Since the SAMGs depend on the ability to estimate the magnitude of several key plant parameters, the plant parameters needed for both preventive accident management measures and mitigatory accident management measures should be identified. It should be checked that all these parameters are available from the instrumentation in the plant. Where instruments can give information on the accident progression in a non-dedicated way, such possibilities should be investigated and included in the guidance.

Plant Response/Action:

The issue has been addressed within issue 14.5 (1).

IAEA comments:

The plant has taken a systematic approach to resolve the issue. The plant contacted Westinghouse for support to revise, update and validate plant Emergency Operating Procedures. In 2016 EPZ became a member of PWROG and received access to Westinghouse state-of-the-art generic EOPs and SAMGs.

The plant has revised the shutdown EOPs and implemented the work for spent fuel pool EOPs. The plant simulator was upgraded and used for validation of shutdown EOPs and operation at mid-loop. Detailed instructions for operational staff transition from main control room to back-up control room were specified in N14-23-001.

The revision of all EOPs was initiated in 2016. The work is being implemented within a common project with Westinghouse. The revision process takes into consideration the Westinghouse generic approach, results of the plant specific Periodic Safety Review and designer's advice provided by AREVA. Plant specific procedure P0-N07-40 using Westinghouse generic approach was developed for writing, verifying and validation of EOPs and SAMGs. The revision of plant procedure E0 'Diagnostic procedure' was completed in November 2016 as a pilot project. The full set of EOPs will be updated by July 2017. This date stems from the requirements in the new licence.

Conclusion: Satisfactory progress to date

IAEA comments during OSART follow-up 2nd Stage:

The plant has revised the full set of EOPs as expected by July 2017. All EOPs have been verified and validation was performed in September / October 2017 at the plant full scope simulator (30 procedures) or by table top exercises (18 procedures). The results from the validation process were well documented and the final version of the EOPs is being prepared. This process is to be completed by the end of 2017. The plant prepared also a comprehensive training plan to ensure all operational personnel is aware of the EOPs revision and trained adequately. The new EOPs are reflected in the routine operators simulator training programme, as appropriate.

Conclusion: Issue resolved

14.5 VERIFICATION AND VALIDATION OF PROCEDURES AND GUIDELINES

14.5(1) Issue: Verification and validation of the SAM procedures and guidelines are not comprehensively described in any dedicated procedure and are not systematically conducted or documented.

The team made the following observations:

- The CRS is not able to simulate all plant states (e.g. shut down states);
- There is incomplete validation of major changes of EOPs at CRS before implementation;
- Formal cooperation with SAM technical owner (WEC) was terminated in 2004 and since then the EOPs maintenance has been done by plant personnel. The alignment with PWR OG EOPs changes has been lost and hence the procedures may not be at the current industry standard;
- There were no dedicated sessions organized for EOPs validation at the full scope simulator, EOPs are validated during standard operators training;
- A process for EOPs modification is implemented and used, however no dedicated procedure for verification and validation exists;
- SAMG verification was performed only during the development phase based on vendor`s QA programme, no later independent verification was conducted;

Without systematic verification and validation, the procedures and guidelines could lose integrity and potentially will not accomplish the original goal.

Suggestion: The plant should consider implementation of the systematic verification and validation of SAM procedures and guidelines.

IAEA Bases:

NS-G-2.15

3.99. All procedures and guidelines should be verified. Verification should be carried out to confirm the correctness of a written procedure or guideline and to ensure that technical and human factors have been properly incorporated. The review of plant specific procedures and guidelines in the development phase, in accordance with the quality assurance regulations, forms part of this verification process. In addition, independent reviews should be considered, where appropriate, in order to enhance the verification process.

3.100. All procedures and guidelines should be validated. Validation should be carried out to confirm that the actions specified in the procedures and guidelines can be followed by trained staff to manage emergency events.

3.101. Possible methods for validation of the SAMGs are the use of a full scope simulator (if available), an engineering simulator or other plant analyser tool, or a table top method. The most appropriate method should be selected. Onsite tests should be performed to validate the use of equipment. Scenarios should be developed that describe a number of fairly realistic (complex) situations that would require the application of major portions of the EOPs and the SAMGs. The scenarios encompass the uncertainties in the magnitude and timing of phenomena (both phenomena that result from the accident progression and phenomena that result from recovery actions).

3.103. The findings and insights from the verification and validation processes should be documented and used for providing feedback to the developers of procedures and guidelines for any necessary updates before the documents are brought into force by the management of the operating organisation.

Plant Response/Action:

The plant's Abnormal Operation Procedures (AOPs) and Emergency Operation Procedures (EOPs) are incomplete and do not address the scope of all credible plant states. The plant's Severe Accident Management Guidelines (SAMGs) are not reviewed and updated on a regular basis. The plant was not a member of the PWROG, which provides updates in the generic EOPs and SAMGs to its members.

EOP changes are tested and validated on the control room simulator (CRS) during regular operator training but the results are not consistently documented. There are no special sessions for verification and validation of EOP modifications. Also, no formal procedure for SAMG development and validation exists.

Summary of underlying causes:

The plant's EOPs and SAMGs are based on the generic Westinghouse procedures. The plant-specific procedures and guidelines were initially bought from Westinghouse. Thereafter, the plant enhanced and maintained these without much input from evolutions in the generic procedures. As the plant is not a member of the PWROG, the plant does not have access to the so-called 'writer's rules' that are needed to maintain the procedures in a consistent manner without the risk of violating the basic principles they are based on. Also, the plant does not use Westinghouse's 'procedure verification and validation' method.

Summary of improvement activities:

The plant became a PWROG member at the beginning of 2016.

A procedure is in place that prescribes the basis and the change process for EOPs, SAMGs and FLEX guidelines. This process will refer to the Westinghouse 'writer's rules' and the Westinghouse document for verification and validation of changes. According to the new procedure, verification and validation of procedure changes can be performed via: desk-top reviews, table-top exercises, simulator exercises, or, for example, specific analyses. Two new forms will be used to bring in proposed changes and to document performed verifications and validations. This administrative procedure is ready to be implemented.

The plant started a project with Westinghouse Belgium to enhance and update the existing set of EOPs. Within these projects, the existing plant-specific EOPs will be assessed, and new EOPS and FLEX guidelines will be developed to cover all plant states. This work started in March 2015, and is planned to finish in July 2017.

In February 2016, the PWROG issued a new version of the generic SAMGs. This set of guidelines is now available to all PWROG members. The newly issued generic SAMGs will be used to update the plant-specific SAMGs. A project has been started to rewrite the plant's SAMGs to the new format. This work is planned to finish in December 2017.

IAEA comments:

The plant has taken a systematic and comprehensive approach to resolve the issue. The plant contacted Westinghouse for support to update, verify and validate plant specific SAMGs to take into consideration lessons learned from Fukushima-Daiichi accident, EU NPP stress tests and the plant specific Periodic Safety Review. In 2016 EPZ became a member of PWROG and received access to Westinghouse state-of-the-art generic EOPs and SAMGs. Plant specific procedure P0-N07-40 using the Westinghouse generic approach was developed for writing, verifying and validation of EOPs and SAMGs.

The revision of the plant specific SAMGs was initiated in 2016. NRG, a Dutch Technical Support Organization (TSO) that was involved in writing the original set of SAMGs was also consulted. The latest version of generic PWROG SAMGs issued in February 2016 is being used as a basis. The revision will take into consideration all post-Fukushima plant specific upgrades including installation of additional emergency mobile equipment and plant implementation of the 'in – vessel retention' concept. The new version of SAMGs will be completed by December 2017.

Conclusion: Satisfactory progress to date

IAEA comments during OSART follow-up 2nd Stage:

In 2017 the plant prepared or updated 17 procedures for utilisation of emergency mobile equipment in case of severe accidents and implemented plant modifications for easy connection of mobile equipment to the plant, for example to allow cooling of the reactor pressure vessel needed to ensure 'in-vessel retention' of the molten core in a severe accident. The technical content of plant SAMGs was updated to take into consideration the latest upgrades of the plant and, in particular, those associated with lessons learned from Fukushima accident. In Q3 of 2017 the plant performed an integrated emergency exercise for a severe accident scenario (severe damage of fuel in the spent fuel pool) that involved use of some parts of SAMGs, including emergency mobile equipment. The results of this exercise will be evaluated by the end of 2017 and improvements made as necessary. The plant is planning to revise the SAMGs to transfer them to the Westinghouse state-of-the-art SAMG format in the beginning of 2018 and complete the formal SAMGs validation process by mid 2018.

Conclusion: Satisfactory progress to date

14.6 TRAINING NEEDS AND TRAINING PERFORMANCE

14.6(a) Good practice: Plant specific Severe Accident Simulator

The plant has a specific severe accident simulator model that runs on a personal computer. The model runs on a RELAP/SCDAP platform with a user-friendly interface consisting of 3 separate screens. One screen is an instructor screen to control the simulator, the other two screens only present plant parameters that are also presented in the main control room. The RELAP model is copied from a RELAP model that was used to perform formal safety analysis of the plant design by the original plant designer. Necessary safety systems and a simple secondary system were added to the original model to make a working simulator for training purposes. The simulator was tested and validated against the safety analysis reports made by the vendor. Overheating, gap release, melting and relocation of the model's reactor core are simulated by the SCDAP part of the model.

Benefits associated with the Plant-specific Severe Accident Simulator

This SAM simulator is used to train the Emergency Response Organisation in the use of the EOPs and SAMGs. The simulator is also used to develop severe accident scenarios for exercises in which the CRS is used. The CRS stops before fuel damage starts so exercises with use of the CRS can only be extended into core melt region when pre-calculated data from the SAM simulator is used to 'simulate' the part of the scenario from where the simulator is stopped. Accident progression can also be studied with the SAM simulator to estimate the possible outcomes before formal analyses are requested from contractors.

15. CORPORATE FUNCTIONS

15.1 CORPORATE MANAGEMENT

The organisational structure including responsibilities and lines of authority have been defined and communicated in relevant documents of the organisation. It is divided between the organisation, the plant and the supporting organisation. Tasks and responsibilities are described in task descriptions and processes and procedures of the management system. The Management Board consists of the Chief Executive Officer (CEO), (who is also the license holder for Borssele NPP and represents the operating organisation) COO, CFO, head of support services, referred to collectively as the organization. Fuel Cycle Management, Nuclear Safety, Quality Assurance, Procurement, Regulatory compliance and legal affairs and communication report directly to the CEO. A Chief Nuclear Officer CNO is not part of the organisation. The CEO reports regularly to the Shareholders meeting on behalf of the Board of Directors.

The shareholders agreement does not contain separate rules about Nuclear Safety. The shareholder agreement enables the CEO to have the authority to work and react in respect to nuclear safety and is appropriate to his position as license holder.

Key senior management changed considerably since 2010. The position of the plant manager has changed four times during that time. In 2012 the position of the plant manager was divided between the responsibility for production and nuclear safety. This was necessary due to an interim manager having no nuclear experience. The Head of Nuclear Safety is not part of the independent oversight. A list of changes from organisation and plant managers in the last 5 years was observed. Organisations managers have less experience (2 years) in nuclear operation, while plant managers have gained experience between 7 and 10 years in nuclear operation.

A systematic approach for succession planning of corporate and line managers was implemented in August 2014 based on a set process (see Human Resources).

ESTABLISHING POLICIES, EXPECTATIONS AND INFLUENCING PRIORITIES, PRACTICES, BEHAVIOURS.

A 3-year business plan is issued yearly by the organisation. It is a result of the objectives of the shareholders and the organisation's own objectives, it is communicated to the staff of the organisation and its implementation is reviewed by the organisation quarterly. Existing and possible risks are assessed in an integrated risk management methodology, sorted into different risk classes and associated with the objectives. The team recognized a Good Practice in this respect.

The results of the 3-year business plan are transferred to middle and long term actions. Attached to the business plan is a list of the planned investments. Non-technical projects, known in the plant as programmes are not included in a summarized list. The plant's annual plan by Nuclear Operation, Financial sector and Support Services are elaborated every year. For departments, more specific objectives and indicators are listed. Low level indicators are not developed at this stage due to the on-going implementation of the Integrated Management System. The annual plans also include the rough resource planning of the department. Non-technical projects in which staff members participate are mentioned. The ratio between daily operational work and additional work for non-technical projects (programmes) and technical project is not obvious. An increased work load could lead to a reduced attention on Nuclear Safety. The team made a suggestion in this respect.

Objectives in the performance evaluation forms of the staff often use high level indicators or general tasks, which are not or not easily translated in reasonable personnel contribution to Nuclear Safety. Individual Performance Indicators (IPI) or objectives for applying IIP tools for workers and IPI's for supervisors to encourage workers to use IIP tools are not sufficiently included in task descriptions and performance evaluations. Without implementing an effective communication of objectives and goals, the contribution of individuals will not meet the expectations of the management. The team made a recommendation in this respect.

Organisations managers participate in a 'Managers in the Field Programme' (process PU-N01-03 from 31.03.2014). In 2014 for Management walk downs, 3 of 5 organisation managers and 10 of 66 managers missed the goals substantially.

MONITORING, DECISION MAKING AND CORRECTIVE ACTIONS.

A system of inspections, evaluations and assessments is implemented to ensure, that activities, processes and performance of Nuclear Operation is in compliance with existing requirements. The organisation monitors this in different steps.

The organisation is informed daily about the plant status using a form. Relating to Nuclear Safety, only one Fundamental Safety Function (Confinement of radioactive releases) is mentioned. The team encourages the organisation to address all three Fundamental Safety Functions to get a comprehensive view on Nuclear Safety.

An integrated management system is in the implementation stage. Process owners are dedicated to the processes; processes reviews are not systematically conducted by all process owners to ensure continuous improvement. Some processes do not have indicators to evaluate their effectiveness. The status of the indicators is reported monthly to the organisation. Indicators are highly aligned to the KPIs from e.g. WANO. Low level or process indicators do not exist in a structured way at this time due to the development of the Integrated Management System. The result of review and analysis of indicators is sent monthly to plants management and process owners and quarterly reviewed by the organisation. The team observed that the PIs are not always assessed in a stringent matter.

A QA programme for audits performs 10 to 15 audits / year on average. For 2014, 11 out of 12 audits have been performed to date. The number of audits in 2014 is reduced, because external assessments like WANO, OSART and Lloyd are considered in the programme. In a database the results and non-conformances are recorded. Two major non-conformances from 2011 and February 2014 are still pending. Also, some minor issues from 2009 are not resolved.

2 yearly and 10 yearly report of self-evaluation of changes and results in organisation, staff, operations and technique have been performed since 1994. The team reviewed the last 2 yearly reports from 2011/2012. The report includes a considerable number of suggestions for improvement made by the plant and is shared with the regulator. Some suggestions from the report have not been added to the corrective action list of plant management as required.

A structured form is used for decision making in the organisation. 41 decisions have been performed in 2014. The effectiveness of this has not been evaluated up to now. The team encourages the plant to review the effectiveness of the decisions and the decision-making form appropriately.

A corrective action list is maintained by the plant management (process A01-24-N201). Since 2011 remaining actions are decreasing slowly (209 – 127). The status is reported monthly to the plant management and the indicator owners and monitored by 4 indicators; three of them are not meeting their required values. The process description describes input, output, task owners and the use of success/efficiency criteria. 127 active actions are grouped in three priorities A (4), B (97), C (4), 22 are not prioritized. The list is updated on demand, the performance indicators (PI) are updated monthly. The process requires that corrective actions of the 2 yearly reports have been integrated in the related plant management list. Due to missed input data like the owner of the action and execution date, this is not done. Performance indicators are reviewed in the organisations management quarterly. No effective corrective actions were taken by the organisation related to this issue. The team has issued a recommendation in this respect.

PROVIDING RESOURCES CONSISTENT WITH RESPONSIBILITIES.

The 3-year business plan and the annual plans of the sectors provide the scope for the investment plan and the staffing plan. Since 2009 staff has greatly increased especially in those departments related to the plant.

The organisation does not include a Chief Nuclear Officer. Functions related to Nuclear Safety are the CEO as license holder, the Head of Nuclear Safety as member of Plant Management and the Nuclear Safety Officer as member of Quality Assurance in the role of independent oversight. The Head of Nuclear Safety has to review the Nuclear Safety related activities independent from costs and schedule considerations. His operational unit has no directly assigned work forces to allow him to have flexible focus on important issues additional to his daily work. This has been recognized in the FOCUS 2 project and assigned workforce is planned in this context. The organisation is encouraged to keep this and to support the Head of Nuclear Safety discharge his responsibilities.

MANAGEMENT OF CHANGE.

For organisational changes affecting Nuclear Safety the plant performs an organisational change process PU-A01-08. The objective is to assure that the organisational changes concerned will not reduce or have a negative impact on Nuclear Safety. This safety assessment is performed by the plant quality assurance (QA) department. The process has been used twice in the frame of FOCUS 2. The last resulting report is focused on the comparison of the proposed change related to national and international regulations and existing plant documentation and does not comprehensively assess the impact on Nuclear Safety. The team has made a recommendation in this respect.

15.2 INDEPENDENT OVERSIGHT

The Independent Nuclear Oversight Officer (INO) reports to the manager of the Quality Assurance department. His role as INO is not a full-time position, as he is also developing QA tasks and functions. He has formally got direct access to the CEO, although this access has never been used to discuss safety issues to date. Direct access to the CEO would only be used if escalation was needed. Safety issues are in the first instance discussed with the plant management, in some occasions, in the Plant management meetings. These options have been used several times.

There is no formal plan for the INO inspection tasks during normal operation; an 'organisation-sensitive' approach is followed instead of periodically assessing standard processes. The INO focusses on the areas providing some kind of weakness or potential issue. The process to conduct his role is described in the procedure PU-A02-31. According to this procedure, the inspection plan is based on organisational goals, risks, incidents and signals coming out from operation and the organisation. For every outage period, an INO inspection plan is issued.

The recommendations issued by the INO officer in his reports are not always incorporated into the corrective action programme and are not always traceable. INO does not track them for completion, as that is the responsibility of the individual departments.

The status or results of the Human Performance Programme, leadership and culture issues and the adequacy of human resources are assessed in the yearly safety assessment in the Internal Reactor Safety Committee in which the INO officer holds an independent position. Another person in the QA department (the Operational INO officer) focuses on plant operations, whereas the INO officer assesses the fulfilment of safety policies.

The INO officer does not perform a systematic follow-up of some of the main challenges of the station, such as the FOCUS-1 project and the implementation of the work management process. INO has reviewed some technical projects, such as the MOX-project (report 1403). No process to assess the effectiveness of the independent nuclear safety oversight activities has been defined.

The team encourages the organisation to further develop the role of the INO and to reinforce all the above-mentioned tasks in order to ensure that the INO assesses the level in which safety standards are maintained and improved.

15.3 HUMAN RESOURCES

The organisation supports the plant management by the Human Resources department in the area of strategic recruitment, management of change and organisational development (team coaching, individual coaching). Those issues are also part of the non-technical projects FOCUS 1/2/3.

Key competences are kept internalized and made accessible by a register of core functions, for which 36 have been developed. Task descriptions include a job profile with requirements for the job (including soft skills) and how they are or will be fulfilled. These documents are easily available in the document management system of the company. To ensure the availability of the appropriate number of competent staff a systematic approach is in use within the process for the succession planning PU-A11-04. The process has been implemented in August 2014, up to now 5 of 7 steps have been performed.

PROVIDING COMPETENCE, KNOWLEDGE MANAGEMENT.

The organisation sees their role in providing the register of competence. A more specific knowledge management is performed in the TQ section in 2 fields:

- Educational and work experience;
- Plant specific experience.

The organisation has implemented an individual performance assessment to evaluate annually the performance for each staff member. This is validated by an indicator, which is well in line with the required value.

The objectives in the task description observed to Nuclear Safety are not always based on the direct contribution of the employee to Nuclear Safety or easily translated into personnel objectives. The team observed that individual objectives are often issued as high level indicators like Total Core Damage Frequency, number of scrams, reports to the regulator, or unavailability. A survey from Human Resources in the task descriptions or performance evaluation forms shows that the use of Human Performance Tools, which contributes directly to Nuclear Safety, is not sufficiently included. The organisation has already started a non-technical project to provide support to the staff identifying their contribution. The team has issued a recommendation on this topic.

LABOUR RELATIONS AND UNION AFFAIRS.

A manager of the organisation is the designated spokesman to the workers' council and the unions. He communicates mainly with WENB for the collective bargaining (now a contract for two years) and the EPZ worker's council (how to reward performance assessments). Alcohol tests are randomly performed at the entrance 'loge' or 100 % on the access road. Until now, drug tests are not performed. The plant is not concerned about expected strikes of key operational personnel.

Employee surveys have been performed yearly from 2005 to 2010 and in 2013. 407 out of 550 staff members participated. No surveys were planned for 2012 and 2014 due to the scheduled SCAV and OSART missions. A large number of the results of the last survey are in known range of other employee surveys done in the Netherlands. Organisation and the plant are considered as good employers, but more than half of the employee feel affected by the reorganisation. The organisation is using this information to adjust communication and performance assessments.

15.4 COMMUNICATION

The communication department reports directly to the organisation. It was founded in 2001 and since the event in Fukushima an additional person has been employed;

It is active in the area of internal communication, external communication and crisis communication. Communication is established as process A21. Its maturity has been checked. Stakeholders' satisfaction (internal/external receivers) has been checked since 2011.

The communication staff are professionals. They are included in training courses to better understand the surroundings they report on and can attend any meeting they would like to attend.

The Intranet provides channels to encourage, monitor and address employees providing feedback on the organisations/plant initiatives e.g. on FOCUS 2. A considerable number of messages were given by the organisation via the Intranet about FOCUS 2. The management asked for response, but did not receive any;

The communication department strives for the participation of general company staff in communication to open channels to get feedback about staff opinions on plant action. The organisation is encouraged to enhance its efforts to receive feedback on its programmes and initiatives;

The communication department uses own company staff for communication and development of communication tools. This increases the acceptance of the tools and makes messages more authentic. The team has issued a good practice on that topic;

Based on the areas for improvement from WANO and SCAV reviews, the communication department is participating in the development of the tool 'My contribution to Nuclear Safety'. The objective is to translate global objectives for Nuclear Safety into the contribution of the different levels of the staff. The development of the methodology has started with a first pilot and will be rolled out for the objectives in 2015;

Communication is part of the crisis management organisation. A crisis communication plan is established and used for drills. It is available in the document management system. The document is reviewed every year. A contractor is available to support communication in the case of a crisis.

15.5 CORPORATE SUPPORT FOR INFORMATION TECHNOLOLGY (IT).

Safety related IT systems are utilized in EPZ in the Business application (BIS), Technical application (FIS) and Security application (SIS). None of these systems have a direct connection to the reactor control or the reactor protection systems.

In the CM area the BIS was observed, which is conducted by the department Information Technology. An annual plan with performance indicators (PI) is issued for incident management, problem management, configuration management, version management, change management and license management. Monthly reports about the status of the indicators in these of the areas are sent to the organisation. The indicators were checked without concerns.

The organisation has outsourced the service (servers/network, clients, infrastructure) to OGD and the Technical Application Management (TAM) of software to ATOS. These tasks are monitored by weekly or monthly meetings.

A document which includes adequate rules governing the testing and acceptance of new software is in the development phase (70 to 80% readiness of the Use Cases) at the plant. The team encourages the plant to further enhance the development of these rules.

Backup processes are performed by OGD on a daily and weekly basis. A clearly arranged procedure for back up processes exists in the QS system of CO. The tape backups are stored in fire proof safe in the CO archive and the NO archive. The CO archive is not equipped with fire detectors or fire extinguishers.

Specific training is given to the staff for new applications and how to preserve knowledge about exist applications to maintain knowledge in Borssele NPP.

15.6 CORPORATE SUPPORT IN PROJECT EXECUTION

The organisation created a department for the management of projects in 2011. The term project is understood clearly by the organisation as the execution of a technical modification or change. Changes, e.g. in the organisation, in Human Performance or continuous improvement are conducted in plant management. Those non-technical projects often are communicated as programmes.

Technical projects are recorded in common lists (e.g. Long Term investment List). Budget, milestones and risks are reassessed and communicated.

The organisation has realized that an extensive and improved reporting for technical and non-technical projects is needed. The team encourages the organisation to continue the started improvement in project management and to assess if the intended objective of creating a project department has been achieved.

For non-technical projects (programmes) the team observed a less effective approach. Not executing non-technical projects, especially in changing organisation and behaviour of staff not in an effective manner may impact Nuclear Safety in continuing operation. The team has issued a suggestion in this respect.

15.7 LICENSING AND REGULATORY INTERACTION

The organisation and the plant management has regular meetings and contacts with the regulator. This is mainly performed by the CEO, the Head of the Quality Assurance and the

Head of Nuclear Safety. Actions resulting from regulatory visit or assessments are transferred in a database, which follows the actions and reports to the organisation.

The regulator does not intervene in the daily nuclear operation, but monitors the progress of modification e.g. if the modifications on the polar crane, the portal crane outside of the reactor building and the turbine building exceed the deadline the regulator will impose a penalty.

Following the plant's process for Change Management, the regulator is informed about those changes and a decision is expected. During interviews managers stated, that the regulator or conditions in the license do not require a decision or approval of the regulator as a result of the information. The organisation should define clearly its process in relation to the expected response of participated parties or organisations. The team has issued a recommendation in this respect.

DETAILED FINDINGS IN CORPORATE FUNCTIONS

15.1 CORPORATE MANAGEMENT

15.1 (a) Good Practice: Integral risk management

EPZ has a risk management officer who is responsible for development and control of integral risk management within the organisation. Integral risk management is the umbrella for all types of risks.

The starting point for the risk management is the strategic goals in the business plan. Integral risk management has the scope nuclear safety, industrial safety, plant availability, finance, compliance and employee satisfaction and assesses strategic risks, process risks, project risk and aspect risks as security and fraud.

The objective of EPZ is to integrate risk management in the processes. Risk management is already in use in the business planning process, the management decision making process, the portfolio management process (prioritizing), project management, operational experience (prioritizing), the administrative organisation and information security.

Risks for the strategic goals are classified with the EPZ risk matrix. The impact areas in the risk matrix are linked to the strategic goals and severities of the impact areas are balanced. As a result of this the response strategy is balanced. Risks are registered in a database. Main risks are reported every 3 months and discussed in the management team and in the shareholders meeting.

15.1(1) Issue: The expected contribution to Nuclear Safety for the achievement of the organisation's objectives is not effectively determined, communicated to and understood by the staff.

Although the organisation has started to develop a related programme the team observed the following:

- Objectives in the performance evaluation forms often use high level indicators (e.g. Total Core Damage Frequency, number of scrams, number of INES reports) or general tasks (preparation of OSART mission), which are not or not easily to translate in reasonable personnel contribution to Nuclear Safety;
- Reviewed performance evaluation forms from staff members on different working levels shows vague or more global goals on the lower working levels;
- Low level process based indicators, which could be used as an objective in task descriptions, are not yet developed;
- A survey by EPZ Sector Human Resources showed that the use of Human Performance Tools, which contribute to Nuclear Safety, is not implemented and required yet in the performance evaluation forms of the staff.

Without implementing effective individual objectives and goals the contribution of individuals will not meet the expectations of the management.

Recommendation: The organisation should enhance the awareness of individuals concerning the relevance and importance of their activities and of how their activities contribute to Nuclear Safety in the achievement of the organisation's objectives.

IAEA Bases:

SSR-2/2

3.2 Promoting a strong safety culture.

Strategies and management objectives shall be developed in accordance with the policy in order to put the policy into effect.

Policy making for all areas of safety, which includes:

- Setting management objectives;
- Establishing the policy for Safety;
- Developing management and staff who value learning, have skills in creating, acquiring and transferring knowledge, and can adapt the organisation on the basis of new knowledge and insights; corrective actions and making improvements;
- Promoting a strong safety culture.

GS-R-3:

3.2. Senior management shall develop individual values, institutional values and behavioural expectations for the organisation to support the implementation of the management system and shall act as role models in the promulgation of these values and expectations.

3.3. Management at all levels shall communicate to individuals the need to adopt these individual values, institutional values and behavioural expectations as well as to comply with the requirements of the management system.

3.4. Management at all levels shall foster the involvement of all individuals in the implementation and continual improvement of the management system.

3.8. Senior management shall establish goals, strategies, plans and objectives that are consistent with the policies of the organisation.

3.9. Senior management shall develop the goals, strategies, plans and objectives of the organisation in an integrated manner so that their collective impact on safety is understood and managed.

3.10. Senior management shall ensure that measurable objectives for implementing the goals, strategies and plans are established through appropriate processes at various levels in the organisation.

4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills, knowledge and experience to ensure their competence. Training shall ensure that individuals are aware of the relevance and importance of their activities and of how their activities contribute to safety in the achievement of the organisation's objectives.

Plant Response/Action:

See also the plant response/action for issues 1.3(2), 13.2(1) and 13.5(1). *Summary of improvements activities:*

A clear definition of nuclear safety has been developed and communicated (posters, presentations, screen saver, etc.): 'Nuclear safety is protecting people and environment against the hazardous effects of radioactive releases and radiation. At EPZ, we do this by continuously improving technology, organisation and culture'.

The policy statement regarding nuclear safety is included in the IMS, and also widely communicated (e.g. posters, red booklet 'management expectations'). The first basic management expectation exclusively deals with nuclear safety as overriding priority.

A specific programme called ENBV "My contribution to nuclear safety" has been developed and implemented. In this programme, all EPZ employees discuss in small groups their contribution to nuclear safety by using questions from IAEA (INSAG 15), WANO and INPO. Every EPZ employee attends two sessions per year. The sessions are moderated by EPZ employees (>40); all are trained to perform this role. Each session is concluded by filling out a personal working paper in which at least one identified notion/contribution, and one focus point/improvement regarding nuclear safety should be addressed.

The ENBV programme started in 2015, and the methodology has been adapted/improved ever since. The methodology helps in clarifying one's contribution to nuclear safety, and to increase safety awareness. It also helps in discussing and exchanging information between departments, managers and workers, seniors and juniors, thus to improve the cross-functional and cross-departmental relations.

Effect:

A more common understanding of the meaning of nuclear safety has been established. By using tools like the ENBV programme, staff is more aware of their own role, contribution, and responsibility regarding nuclear safety.

IAEA comments:

The plant has developed a definition of Nuclear Safety to promote common understanding by all staff. This definition has been communicated in the management expectations, IMS, posters and different meetings.

To enhance staff awareness of the importance of their activities and their contribution to nuclear safety a programme and methodology 'My contribution to Nuclear Safety' was developed and implemented. The work and behaviour of individuals and their contribution to nuclear safety is discussed in sessions of 5 to 8 EPZ members, based on IAEA Standards and related WANO documents. This allows the members to develop their own picture of their contribution and discuss this within the group. The mixed groups promote mutual understanding of the tasks of each other's departments. In 2016 94 % of EPZ staff participated in at least two sessions. In 2017 up to date 85 % have been involved. Communication with staff in the field concerning their contribution shows a growing awareness of nuclear safety. Although these are long term processes the team sees this as a clear indication of a positive change.

In this context, the plant has developed indicators which are evaluated in the sessions. These indicators include: contribution to nuclear safety, insight in their own work, improvement in daily work, and acceptance of the methodology. They indicate the status of the processes and show a stable trend at acceptable levels.

The description of the task related to nuclear safety has been focused in the yearly individual evaluation plan. Tasks such as Manager in the Field, schedule adherence, reduction of backlogs and use of PPE are connected to and followed by companies, departments or individual indicators. The use of human performance tools is mandatory and stated in the management expectations. The verification is done by Managers in the Field rounds and task observations.

The plant's programme team consists of the project team and 40 EPZ members who act as moderators. The management team's sustained support of the plant programme team, either as moderators or as occasional members of the "My contribution to Nuclear Safety" sessions was noted by the team.

By these measures, reinforced by information from various sources like posters, the EPZ intranet and quarterly canteen communication sessions, nuclear safety in the different plant conditions has been successfully made more visible and understandable for EPZ staff.

Conclusion: Issue resolved

15.1(2) Issue: Corrective actions are not treated in accordance with plant procedures and not controlled effectively by the organisations management

- In plant management corrective action list is used (process A01-24-N201). The process is reviewed by four indicators; 3 of 4 indicators do not meet their threshold;
- 3 priorities (A, B, C) are defined. In priority A two non-conformances from 2011 (outage preparation) and February 2014 (EPP responsibilities) are pending, which are not fully implemented and dated;
- The CEO as license holder and representative of the operating organisation uses the indicators of the plant management list to review quarterly the corrective actions. Although 3 of 4 indicators for the plant management corrective action list did not meet their objectives no action was taken by the organisation;
- The process requires that corrective actions from the 2-yearly evaluation report for the years 2011/2012 are collected in the plant management list. The report is requested by the regulator. A considerable number of deviations have been recorded in this 2-yearly report. The suggestions made by plant management have not been recorded as corrective actions in the plant management list as required by the plants process. This is due to missed input data like owner of the action, success criteria and finalization date.

Without implementing, regularly reviewing and assessing corrective actions to carry out the activities connected to nuclear safety in the organisation, the plant will miss opportunities achieving its goals and objectives and improving safety performance.

Recommendation: The operating organisation should implement, regularly review and assess an appropriate corrective action programme to monitor and review the safety performance.

IAEA Bases:

SSR-2/2

Requirement 9: Monitoring and review of safety performance

The operating organisation shall establish a system for continuous monitoring and periodic review of the safety of the plant and of the performance of the operating organisation.

4.37. The appropriate corrective actions shall be determined and implemented as a result of the monitoring and review of safety performance. Progress in taking the corrective actions shall be monitored to ensure that actions are completed within the appropriate timescales. The completed corrective actions shall be reviewed to assess whether they have adequately addressed the issues identified in audits and reviews.

GS-R-3

6.11. The causes of non-conformances shall be determined and remedial actions shall be taken to prevent their recurrence.

6.12. Products and processes that do not conform to the specified requirements shall be identified, segregated, controlled, recorded and reported to an appropriate level of management within the organisation. The impact of non-conformances shall be evaluated and non-conforming products or processes shall be either:

- Accepted;
- Reworked or corrected within a specified time period; or
- Rejected and discarded or destroyed to prevent their inadvertent use.

6.13. Concessions granted to allow acceptance of a non-conforming product or process shall be subject to authorization. When non-conforming products or processes are reworked or corrected, they shall be subject to inspection to demonstrate their conformity with requirements or expected results.

6.14. Corrective actions for eliminating non-conformances shall be determined and implemented. Preventive actions to eliminate the causes of potential non-conformances shall be determined and taken.

6.15. The status and effectiveness of all corrective and preventive actions shall be monitored and reported to management at an appropriate level in the organisation.

6.16. Potential non-conformances that could detract from the organisation's performance shall be identified. This shall be done: by using feedback from other organisations, both internal and external; through the use of technical advances and research; through the sharing of knowledge and experience; and through the use of techniques that identify best practices.

Plant Response/Action:

Summary of underlying causes:

- The procedure (A01-24-N201) was erroneous on some aspects and not up-to-date.
- Department managers used their own action lists and set their own priorities.
- No formal periodic review was performed by management of the CAP.
- The process of dealing with corrective actions was reactive, lacked positivity and a common drive.
- Lack of promotion and support of the CAP by senior management.

Summary of improvement activities:

In 2015, a team within the QA department was formed to improve the key processes for learning and improving. This included the appointment of a CAP coordinator who did set up a single comprehensive actions list by merging several lists, and who drafted a CAP procedure (PU-A27-03).

Within the culture for safety program, the CAP was improved. All non-technical actions, events analyses, non-technical improvements, etc. were merged into one comprehensive CAP.

New aligned management team.

CAP progress is now managed two-weekly as part of the management meeting, and its performance is monitored through KPI's and reported monthly and quarterly to the management team.

CAP use for improvement of safety performance was strengthened throughout the company. For example, in process performance reviews that are held periodically for all important processes, in important meetings and in the two yearly safety review.

Effect:

EPZ has gone from several unmanaged action lists in 2014 to a single comprehensive CAP list, which is regularly reviewed by the organizations management. The CAP is integral part of the management system (PU-A27-03). Process owners use the CAP to improve their processes. Senior management uses the CAP to steer improvements on safety performance.

Turnover rate and number of completed actions have risen sharply. No category A actions are overdue.

IAEA comments:

The plant has assigned a process owner to the Corrective Action Programme (CAP) and published a new procedure PU-A27-03. The "new" CAP uses more inputs, for example from improvement sessions, event analysis, performance reviews and understanding of expected results. Low level events are currently not part of the CAP, but any resulting actions are recorded and implemented. Inputs are categorized according to their significance in category A (significant), B (less significant) or C (internal inputs).

The QA function regularly reports to the site management team, process owners and process responsible persons about the status of CAP actions including a forecast for impending actions. The site management team assesses in its 2-weekly meeting the status of CAP actions, and decides about changes in execution-deadlines or status. Decisions are recorded in the CAP.

The system is also used to inform the site's regulatory representative about related actions and their status.

EPZ staff have access to the CAP system, which is maintained by 3 administrators. The system records all updates to the database, which serves as an adequate indicator for its use by the appropriate personnel.

The team followed the development of the records in 2015 – 2017. While in Q4 2015 in total 376 actions were recorded in Q3 2017 this number increased slightly to 399. In 2016 this number increased to 509. Q4 2015 120 new inputs and 104 finished actions were recorded. This changed Q3 2017 to 200 new inputs and 180 finished actions. Overall the development shows a constantly increasing number of completed actions while the range of inputs varies depending on events, assessments or improvements. The number of overdue open actions has considerably improved from 50 % in 2014 to 10 % in 2017.

The status of actions within the categories shows a small number of overdue actions. In category A 21 action are not finished, 1 action is overdue. In category B 306 action are not finished, 33 actions (10 %) are overdue. No actions concerning regulatory requirements or responses are overdue. The decision to delay the deadlines is recorded in the CAP. Category C was not followed due to the internal character of the inputs.

The team found that the considerable support of the management team, which now sees the CAP as an effective management tool, and the engagement of the CAP coordinator has led to sustained improvement of the CAP.

Conclusion: Issue resolved

15.1(3) Issue: The change management process is not effectively used to support changes in the organisation.

Although a change management process (PU-A01-08) is part of the Integrated Management System (IMS) of the station the team observed the following:

- FOCUS 2 is processed as a non-technical project (operational programme). The resulting document for FOCUS 2 assessing the impact on Nuclear Safety does not address for example the total workload imposed on the organisation to implement the changes in parallel with continued operational activities;
- Steps in the process are not defined appropriately (e.g. classification of importance of changes, integration of and expectation to the regulator, feedback cycle for given comments) and could be misinterpreted;
- Task descriptions, which include functions and responsibilities of sections that had changes in 2009 (e.g. Plant Manager NO and Head of Nuclear Safety) have not been promptly updated. Some task descriptions have been reviewed with a considerable delay;
- No preliminary safety evaluation was performed prior to the implementation of the role of the Head of Nuclear Safety Section;
- The Internal Nuclear Safety Committee has given comments on the proposed changes. The feedback about resolving their comments is rated as not satisfied.

Without conducting an appropriate change management processes the organisation cannot ensure a safe and effective transition.

Recommendation: The organisation should use and implement the process for managing complex organisational changes.

IAEA Bases:

SSR-2/2

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

(b) Allocation of responsibilities with corresponding lines of authority and communication, for:

- Allocating resources;
- Providing human resources with the appropriate level of education and;
- training and material resources;
- Retaining the necessary competences;
- Approving the contents of management programmes;
- Developing procedures and instructions, and having a strict policy to;
- Adhere to these procedures and instructions;
- Setting policies on fitness for duty;
- Establishing a programme to make the necessary changes to any of these
- Functions on the basis of the performance in achieving objectives.

GS-R-3

5.28. Organisational changes shall be evaluated and classified according to their importance to safety and each change shall be justified.

5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.

GS-G-3.1

5.60. For changes for which it is judged that potentially significant effects on safety could arise, assessments should be carried out to ensure that the following factors are considered....

5.61. Senior management should develop a specific process to manage and review organisational changes. The process should ensure that there is no degradation in the safety culture of the organisation.

5.67. The total workload imposed on the organisation to implement the changes in parallel with continued operational activities should be given careful consideration.

Plant Response/Action:

Summary of underlying causes:

An incomplete and unclear process for managing organizational changes. Insufficient adherence to this procedure.

Lack of awareness that there needs to be a focus on nuclear safety when conducting changes in the organization.

Summary of improvement activities:

The organization has incorporated safety consideration in organizational changes (in the process as well as in the actual implementation) to ensure a safe and effective transition when designing and implementing changes in the organization. For this, a new organizational change procedure (PU-A11-05) was developed, tested, implemented and authorized. Professional change leads were trained or assigned.

The organizational change process follows a new approach based on OSART findings. New steps included in the process:

1. Management team sessions to create a blueprint and commitment;
2. Risk evaluation of the proposed changes;
3. Early evaluation by Independent oversight;
4. Consulting 4 committees (Internal and External Reactor committee, Works council, Regulator) to ensure that proposed changes are fully understood, and feedback is implemented correctly by having a possibility to ask additional questions and to review additional documents;
5. Additional Go/No-Go decision making steps for Management team;
6. A checklist of all necessary implementation activities, including promptly update of relevant documents.

The process has successfully been used for different changes. For example:

- the organizational change with respect to one CEO and one plant manager (October 1st, 2016)
- the Site Management Team change (October 1st, 2017).

Effect:

- EPZ can now manage complex organizational changes successfully.
- Feedback of committees is incorporated in, and results in adjustment of, plans.
- Conservative decision making; several initial proposed changes were not implemented due to low support for these changes, unclear effects on improvement of safety, insufficient preparation of the changes.
- Commitment and acceptance of the organization for implemented changes.

IAEA comments:

After the OSART mission in 2014 organisational changes were stopped in order to prepare and implement a new structured management of change process and to involve staff more adequately. This new process is part of the Integrated Management System (IMS) which was implemented mid 2017 by the document PU-A11-05. The IMS manual HB-A00 provides detailed guidance on which specific procedures should be used for technical, organisational, documental, computer related and non-technical changes. For 2 of these 5 categories procedures already existed which are now superseded by the revised documents.

The specific procedures follow a clear structure with comparable content. The user can take advice from appointed change coordinators who provide guidance in the first phases of the process .

The procedure for organisational changes has 5 phases:

1. Start-initiation-decision of the change,
2. Basic design – objective

3a Detailed design – deliverables – assessment of the impact on nuclear safety and risk analysis

3b Consultation of committees and other participated parties – decision – finalisation of documents

4 Personnel migration

5 Evaluation of the effectiveness of the change – close of the process.

Within step 3a the impact on nuclear safety of the change is assessed by the Independent Nuclear Oversight Officer prior to the change. A risk analysis is performed according to a list of criteria. The team considers this an adequate and necessary involvement of plant organisational safety functions at different stages of the process.

A detailed communication plan is required to inform shareholders, management and staff initially and periodic by different channels (canteen sessions, EPZ intranet) about the change.

Depending on the significance of the change phase 3b requires consultation with internal and external safety committees, work councils and the regulator to ensure independent justification and understanding of the change. The finalization of the concerned organisational documents e.g. the revision of task descriptions and individual evaluation sheets is a subsequent step in this phase.

2 larger and 3 smaller projects have been carried out using this process in the last 2 years. The team reviewed the implementation of the change process regarding the site management team in October 2017. The process was executed consistently, in the required sequence. The significant step 'assessment of the impact on nuclear safety and the risk evaluation' led to a change to the originally defined objectives (keeping QA in the site management team). Those results were discussed, accepted and implemented. The team considered this as a significant contribution to the formation of a sustainable plant management team in accordance with the revised management of change process.

Conclusion: Issue resolved

15.4 COMMUNICATION

15.4(a) Good Practice: Engagement of own employees in the performance of internal and external communication / virtual tour on the organisations website

DEVELOPMENT OF COMMUNICATION TOOLS.

EPZ consult staff for suggestions or new tools for communication, as they know best where improvement is needed in the communication on the shop floor to develop their engagement. On safety communication a working group, which consists of representatives of several departments 'It is your safety, too!' comes up with suggestions for the communication of actual safety themes (e.g. special toolbox presentations, articles for the internal magazine, illustration for the screens). An example is the short movie about Nuclear Safety, which marked the start of the yearly outage and was highly appreciated by employees.

CONDUCTING INTERNAL & EXTERNAL COMMUNICATION.

EPZs Communications department uses only EPZ's own employees in all internal and external communication tools. In this way, the tools are recognizable for EPZ staff, the public and interested parties. The use of pictures of colleagues creates both engagement with their colleagues and pride. Employees can show their contribution to a corporate culture

THE ORGANISATIONS WEBSITE INCLUDING FACT SHEETS AND VIRTUAL TOUR.

Organisations website offers a virtual tour with plant pictures and pictures of their own employees. EPZ website is open for questions from the public, which are promptly addressed with reliable, factual information in a comprehensible way. EPZ factsheets and illustrations are often used by the media and will be used by the regional authorities for purposes of crisis communication.

15.6 CORPORATE SUPPORT IN PROJECT EXECUTION

15.6(1) Issue: The management (planning, coordination and treatment) of non-technical projects (called programmes) is not structured consistently with the treatment of technical projects.

Operational projects include technical and non-technical initiatives e.g. to enhance Human Performance or to implement organisational changes. For the coordination of technical projects a specific department was founded, it uses a structured process and professional methodology as base for its work. However, the team observed the following facts:

- In interviews managers described the different treatment, definition and information between technical and non-technical projects (called programmes);
- No integrated action plan with a complete list of non-technical projects is available at the corporate management;
- Resources required from departments for projects are assessed in depth only for several large technical projects;
- Middle management stated that they receive less periodic or comprehensive information on the status of budget, the results, risks or mile stones of the non-technical projects;
- Priorities for non-technical projects and contributions are not based on a risk assessment and not fully identified.

Not to coordinate and treat non-technical projects in accordance to appropriate standards may impact Nuclear Safety in continuing operational activities.

Suggestion: The organisation should consider reinforcing the coordination and treatment of operational non-technical projects appropriately.

IAEA Bases:

GS-R-3

5.1. The processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organisation shall be identified, and their development shall be planned, implemented, assessed and continually improved.

5.28. Organisational changes shall be evaluated and classified according to their importance to safety and each change shall be justified.

5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.

GS-G-3.1

5.60. For changes for which it is judged that potentially significant effects on safety could arise, assessments should be carried out to ensure that the following factors are considered.

5.61. Senior management should develop a specific process to manage and review organisational changes. The process should ensure that there is no degradation in the safety culture of the organisation.

5.67. The total workload imposed on the organisation to implement the changes in parallel with continued operational activities should be given careful consideration.

Plant Response/Action:

See also the plant response/action for issue 13.4(1).

Summary of underlying causes:

- Lack of a standard approach to non-technical projects (sometimes called programs).
- Lack of a portfolio of non-technical projects and a portfolio manager.
- Management underestimated the complexity and impact of non-technical projects ‘just do it’).
- Lack of alignment in the organizations management.

Summary of improvement activities:

As part of the culture for safety program, a comprehensive action plan was developed and integrated into the CAP. Resources were assessed and resource gaps were addressed.

Priorities for non-technical projects are now set based on their contribution to strategic goals. New aligned site management team.

Based on the experiences of the culture for safety program, a standard approach for non-technical projects was developed and incorporated into the IMS (PU-A27-05). The progress of non-technical projects is followed through management meetings and the CAP. Non-technical projects use a “gated process” in line with the technical projects.

A portfolio of non-technical projects is available and a portfolio manager was appointed.

The organization is routinely informed on the progress of non-technical projects through quarterly meetings and available dashboards.

Effect:

The portfolio of non-technical projects is established and integrated in the CAP. The gated approach to non-technical projects is in line with the technical projects. The portfolio is followed by the appointed portfolio manager and managed through management meetings and the CAP.

IAEA comments:

The Integrated Management System manual HB-A00 contains detailed guidance on the use of specific procedures for technical, organisational, documental, computer-related and non-technical changes.

The plant issued a new procedure PU-A27-05 for the management of non-technical projects in March 2016. Non-technical changes have been performed, for example on the communication interface with the regulator, site access procedures, treatment of OSART recommendations and WANO AFIs.

The process for non-technical changes is in line with the approved process for technical changes and includes and follows similar phases. The application of similar phases ensures that adequate risk analysis and safety assessments, planning of resources required by departments for projects and prioritization are utilized depending on the safety significance of each change.

Actions resulting from the process are embedded in and followed by the Corrective Action Programme (CAP). By this and routine meetings the site management team can monitor progress and can take corrective action if needed. A designated project portfolio has been established and a portfolio manager appointed.

The team followed the process since its implementation. During this period 69 requests for non-technical projects have been recorded. 30 of the request have been successfully finished, 9 are in progress and 13 have been rejected.

2 management meetings are conducted each year in which the non-technical projects are assessed and amended if needed. The team reviewed 2 meeting results from March 2017, where projects have been comprehensively assessed to set new priorities, combine or postpone them. The most important remaining issues were identified in these sessions, owners confirmed or appointed and priorities adjusted.

The team concluded that the established process, the integration of the results in the CAP and the appointment of a designated portfolio manager enable the plant to implement nontechnical projects adequately.

Conclusion: Issue resolved.

ANNEX 1: THE OSART SAFETY CULTURE ASSESSMENT METHODOLOGY

INTRODUCTION

Safety culture assessment differs from other types of assessment in that it requires a deeper understanding of the underlying organizational and cultural issues behind what is explicitly observed and reported. A safety culture assessment does not lead to a clear-cut and easily actionable result, but will lead to an increased understanding of why different issues related to safety appear.

Safety culture needs to be understood in the light of its complexity. No safety culture is perfect; every organization has its areas for improvements. The objective of a safety culture assessment is to identify positive practices and areas that need attention.

METHODOLOGY

The methodology used for the safety culture assessment is divided into two parts sequentially divided:

- A descriptive part to identify the cultural expressions (facts1) and themes; and
- A normative part to evaluate cultural themes (issues2) against the IAEA framework of safety culture.

The critical aspect of the methodology is to hold the descriptive and the normative analyses separate until the final part of the assessment. This ensures the identification of the vital aspects of the culture before the scope is narrowed into the fixed normative framework. It is essential to avoid a check-list-type-of-audit, where the assessors are directly comparing the findings against the normative framework in the initial part of the assessment.

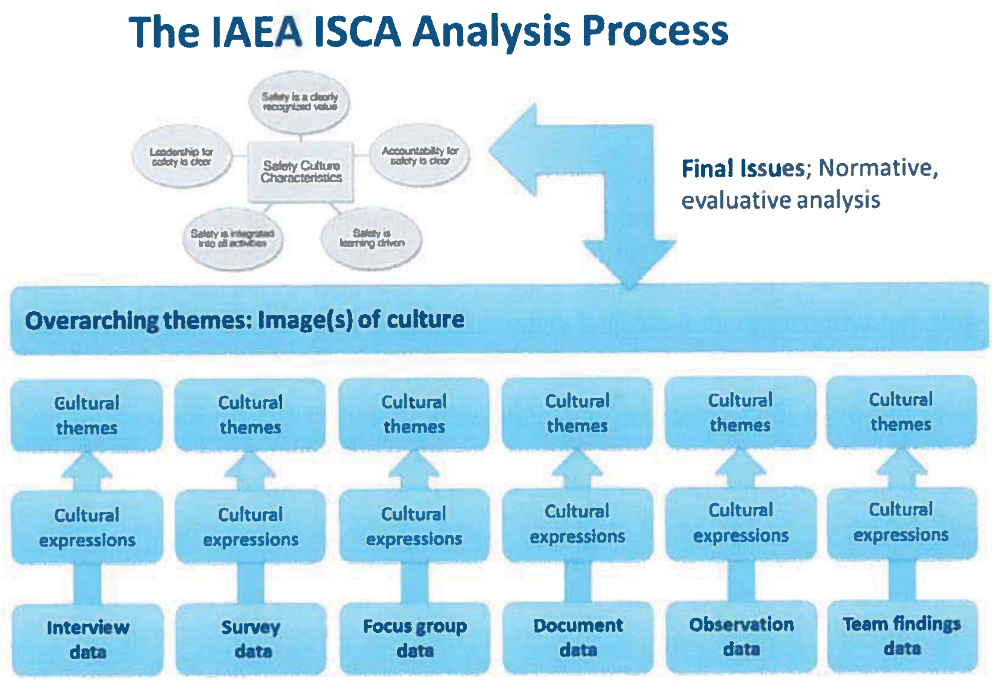
The following six methods are used to collect data:

- Document review;
- Questionnaire;
- Interviews;
- Focus groups;
- Observations;
- Team findings.

The figure below describes the methodology analysis process. Each method for collecting data is trated separately to ensure validity of the results. The normative analysis starts when the overarching issues are identified. Earlier in the process the data collection and analysis are performed in a descriptive manner.

To align with the OSART terminology cultural expressions will be named facts

To align with the OSART terminology normative cultural themes will be named **issues.**



Proper implementation of a safety culture assessment requires five critical elements:

- Theoretical basis;
- Valid methodology;
- Appropriate expertise;
- Descriptive data;
- Internationally recognized safety standards.
- Within the assessment three senior management workshops are conducted to ensure a shared understanding of the findings and results.

BASIS OF THE RESULTS

The results of the safety culture assessment are based on:

- Document review of the Advanced Information Package for the OSART as well as additional documentation requested during the on-site data collection;
- The IAEA Safety Culture Perception Questionnaire administered to all the employees associated with the organization;
- Interviews representing all different functions and organizational levels;
- Focus groups conducted across the organization representing all departments and levels;
- Observations including regularly scheduled meetings, shift turn-overs, work activities and plant tours;
- All the team findings in the daily reports of the OSART missions were included.

DESCRIPTIVE ANALYSIS

The descriptive analysis was conducted using the Schein (1992) model of culture.

According to Schein's three-level model, an organization's culture can be assessed by evaluating the organization's artefacts, values, and basic assumptions. The metaphor of an iceberg is often used to help explain the concepts. Above the level of the water, on the first level of the model the organization's artefacts are found. Artefacts are the observable signs and behaviours of the organization and represent only a small portion of the whole culture. Below the surface of the water is the second level that consists of the organization's values. Examples of values might include such things as, 'safety first' or 'maintaining an open reporting work environment.' Deep in the water and the majority of the iceberg is the third level which contains the basic assumptions of the organization. Examples of basic assumptions may include, 'safety can always be improved' or 'everyone can contribute to safety.' The organization's basic assumptions are less tangible than the artefacts and values. They are often unconscious and taken for granted within the organization sharing the culture.

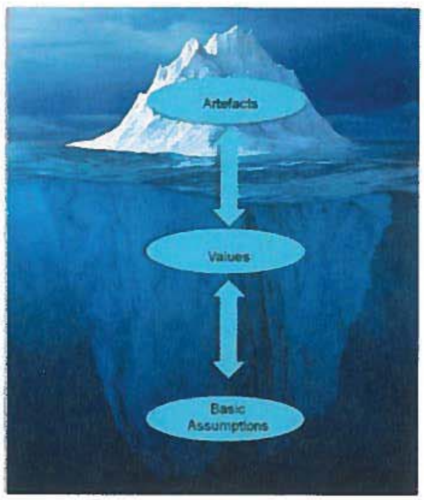


Figure 1: Schein's model of the levels of culture

NORMATIVE ANALYSIS

Once the descriptive analysis was completed the team compared the overarching themes with the IAEA Safety Culture Normative Framework describe in the Safety Standards GSR3, GS-G-3.1 and GS-G-3.5.

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

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

Good practice

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

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

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

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

DEFINITIONS - FOLLOW-UP MISSION

Issue resolved - Recommendation

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

Satisfactory progress to date - Recommendation

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

Insufficient progress to date - Recommendation

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

Withdrawn - Recommendation

The recommendation is not appropriate due, for example, to poor or incorrect definition of the original finding or it is 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 it is 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 Organisation for Nuclear Power Plants (Safety Guide);
- **NS-G-2.5;** Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide);
- **NS-G-2.6;** Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide);
- **NS-G-2.7;** Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide);
- **NS-G-2.8;** Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide);
- **NS-G-2.9;** Commissioning for Nuclear Power Plants (Safety Guide);
- **NS-G-2.11;** A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide);
- **NS-G-2.12;** Ageing Management for Nuclear Power Plants (Safety Guide);
- **NS-G-2.13;** Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide);
- **NS-G-2.14**; Conduct of Operations at Nuclear Power Plants (Safety Guide);
- **NS-G-2.15;** Severe Accident Management Programmes for Nuclear Power Plants Safety Guide (Safety Guide);
- **SSG-13;** Chemistry Programme for Water Cooled Nuclear Power Plants (Specific Safety Guide);
- **SSG-25;** Periodic Safety Review for Nuclear Power Plants (Specific Safety Guide);
- **GSR;** Part 1 Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements);

- **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 Radionuclides (Safety Guide);
- **RS-G-1.3;** Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide);
- **RS-G-1.8;** Environmental and Source Monitoring for Purpose of Radiation Protection (Safety Guide);
- **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);
- Safety and health in construction (ILO code of practice);
- Safety in the use of chemicals at work (ILO code of practice).

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

	RESOLVED	SATISFACTORY PROGRESS	INSUFFICIENT PROGRESS	TOTAL
Management, Organization &	**R** 1.2(1) **R** 1.3(1) **R** 1.3(2)			3
Training and Qualification	**R** 2.1(1) **S** 2.2(1)			2
Operations	**S** 3.2 (1) **S** 3.4 (1) **R** 3.5 (1) **R** 3.6 (1)			4
Maintenance	**R** 4.5 (1) **S** 4.6 (1)			2
Technical Support	**S** 5.4(1) **R** 5.6(1)			2
Operating Experience	**R** 6.1(1) **R** 6.5(1)			2
Radiation Protection	**R** 7.1(1) **R** 7.3(1)			2
Chemistry	**S** 8.6(1)			1
Emergency Planning and Preparedness	**R** 9.2(1) **R** 9.3(1)			2
Severe Accident Management	**S** 14.3(1)	**S** 14.5(1)		2
Safety culture	**R** 13.2(1) **R** 13.3(1) **R** 13.4(1) **R** 13.5(1)			4
Corporate Functions	**R** 15.1(1) **R** 13.2(1) **R** 13.3(1) **R** 13.3(1)			4
TOTAL R (%)	**22** (100%)	-		**22**
TOTAL S (%)	**7** **(88%)**	**1**(12%)		**8**
TOTAL Issues	**29** (97%)	**1** (3%)		**30**

TEAM COMPOSITION OF THE OSART MISSION

GEST, Pierre – IAEA
Division of Nuclear Installation Safety
Years of Nuclear Experience: 35
Review area: Team Leader

MARTYNENKO, Yury - IAEA
Division of Nuclear Installation Safety
Years of nuclear experience: 30 Review area: Deputy Team Leader

BASSING, Gerd - Germany
Years of nuclear experience: 44
Review area: Corporate functions

GALLES, Qim - Spain
ANAV (Asociación Nuclear Ascó-Vandellòs)
Years of nuclear experience: 15
Review area: Management, Organisation and Administration

BISCHOFF, Gerard - France Slovenske elektrane, a.s.
Years of nuclear experience: 32
Review area: Training and Qualification

POLYAKOV, Alex– IAEA
Division of Nuclear Installation Safety
Years of nuclear experience: 29
Review area: Operations 1

SHARRETT, Lance– United States of America
Palo Verde Nuclear Power Plant Years of nuclear experience: 31
Review area: Operations 2

BUJAN, Miroslav- Slovak Republic Slovenske Elektrarne
Years of nuclear experience: 26
Review area: Maintenance

LE GROVE, Rob – United Kingdom
EDF Energy – Hinkley Point B Power Station
Years of nuclear experience: 6
Review area: Technical Support

PAVLIN, Darko – Slovenia
Slovenian Nuclear Safety Administration
Years of nuclear experience: 9
Review area: Operating Experience

HALE, Heather– United Kingdom
EDF Energy – Nuclear New Build
Years of nuclear experience: 12

Review area: Radiation Protection

LENGYEL, Andras - Hungary
MVM Paks Nuclear Power Plant LTD.
Years of nuclear experience: 10
Review area: Chemistry

LEMAY, Francois - Canada
International Safety Research
Years of nuclear experience: 29
Review area: Emergency Planning and Preparedness

HONCARENKO, Radim – Czech Republic
CEZ, a.s.
Years of nuclear experience: 28
Review area: Severe Accident Management

HAAGE, Monica – IAEA
Years of nuclear experience: 11
Review area: Safety Culture

HABER, Sonia – United States of America
Human Performance Analysis, Corp.
Years of nuclear experience: 25
Review area: Safety Culture

BASSING, Gerd – Germany
EnBW Kernkraft AG
Years of nuclear experience: 44
Review area: Corporate Functions

TEAM COMPOSITION OF THE OSART 1ST STAGE FOLLOW UP MISSION

MARTYNENKO, Yury – IAEA
Team Leader
Review area: Training and Qualification, Chemistry
Years of nuclear experience: 32

RANGUELOVA, Vesselina - IAEA
Deputy Team Leader
Review areas: Operating Experience, Emergency Planning & Preparedness, Severe Accident Management
Years of nuclear experience: 30

GEST, Pierre – CONSULTANT
Review areas: Radiation Protection, Technical Support
Years of nuclear experience: 34

BASSING, Gerd - SEOS CONSULTING
Review area: Maintenance, Operations
Years of nuclear experience: 30

RYCRAFT, Helen – IAEA
Review Area: Progress in Management Organization and Administration, Corporate Function, Safety Culture
Years of nuclear experience: 34

TEAM COMPOSITION OF THE OSART 2ND STAGE FOLLOW UP MISSION

MARTYNENKO, Yury – IAEA
Team Leader
Review area: Training and Qualification, Operations, Maintenance, Radiation protection, Chemistry
Years of nuclear experience: 33

RANGUELOVA, Vesselina - IAEA
Deputy Team Leader
Review areas: Operating Experience, Emergency Planning & Preparedness, Severe Accident Management
Years of nuclear experience: 31

GEST, Pierre – CONSULTANT
Review areas: Management, Organisation and Administration
Years of nuclear experience: 34

BASSING, Gerd - SEOS CONSULTING
Review area: Corporate Functions
Years of nuclear experience: 30

RYCRAFT, Helen – IAEA
Review Area: Safety Culture
Years of nuclear experience: 35

Tarren, Peter – IAEA
Review Area: Safety Culture
Years of experience: 40