NEXTera ENERGY SEABROOK

March 16, 2012

Docket No. 50-443

SBK-L-12059

U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406-1415

Attn: Art Burritt, Branch Chief

Seabrook Station
OSART Evaluation

NextEra Energy Seabrook, LLC is pleased to enclose for your information a copy of the International Atomic Energy Agency Operational Safety Review Team (OSART) evaluation conducted at Seabrook Station in June 2011. Seabrook Station volunteered for this evaluation with our colleagues from around the world in the interest of sharing knowledge and good practices. As you know, the principal purpose of OSART evaluations is to foster continuous improvement in the operational safety practices of the global nuclear power plant community through the sharing of good practices. OSART reviews have been conducted since 1982 with participation triennially by a U.S. nuclear plant. The OSART review is intended to be highly critical and in some cases compares the station to standards which exceed U.S. regulatory requirements.

We are very proud that the OSART team recognized Seabrook Station for its outstanding commitment to nuclear safety as well as our good practices to be shared among the global nuclear community. The OSART team had many positive comments relative to our nuclear safety behaviors with their overall conclusion relative to our safety culture being "*Overall the safety culture standards at Seabrook were considered by the team to be very positive. The staff ownership and the willingness to live and share very high safety behavior standards were considered as outstanding.*" This means that Seabrook Station personnel always maintain nuclear safety as the overriding priority when it comes to plant operations. The OSART team also noted that Seabrook Station has a culture that embraces continuous improvement and the identification and correction of low level issues.

NextEra Energy Seabrook, LLC, P.O. Box 300, Lafayette Road, Seabrook, NH 03874

The learning opportunities identified by the OSART team have already been incorporated in our Corrective Action Program and are being addressed proactively. Many of the OSART team's observations relating to the physical condition of the facility were previously recognized by the Seabrook Station team and are progressing with significant capital resources being expended on improvements.

We would be pleased to discuss any aspects of the OSART evaluation with you and share information on our progress. Should you have any questions regarding this matter, please contact Mr. Michael O'Keefe, Licensing Manager, at (603) 773-7745.

Sincerely,

NextEra Energy Seabrook, LLC

Paul Freeman
Site Vice President

cc with enclosure:

W. Dean, Regional Administrator, Region I
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Division of Nuclear Safety and Security
International Atomic Energy Agency
P.O. Box 100
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IAEA
International Atomic Energy Agency

FINAL REPORT

OPERATIONAL SAFETY REVIEW TEAM

(OSART) MISSION

To

SEABROOK

NUCLEAR POWER PLANT

USA

6-23 June 2011

PREAMBLE

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

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

FOREWORD

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 nine operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; operating experience feedback; radiation protection; chemistry; and emergency planning and preparedness. Depending on individual needs, the OSART review can be directed to a few areas of special interest or cover the full range of review topics.

Essential features of the work of the OSART team members and their plant counterparts are the comparison of a plant's operational practices with best international practices and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Series documents, including the Safety Standards and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organization for achieving its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power plants.

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

An OSART mission is not a regulatory inspection to determine compliance with national safety requirements nor is it a substitute for an exhaustive assessment of a plant's overall safety status, a requirement normally placed on the respective power plant or utility by the regulatory body. Each review starts with the expectation that the plant meets the safety requirements of the country concerned. An OSART mission attempts neither to evaluate the overall safety of the plant nor to rank its safety performance against that of other plants reviewed. The review represents a `snapshot in time'; at any time after the completion of the mission care must be exercised when considering the conclusions drawn since programs at nuclear power plants are constantly evolving and being enhanced. To infer judgments 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 government of the United States of America, an IAEA Operational Safety Review Team (OSART) of international experts visited Seabrook Nuclear Power Plant from 6 to 23 June 2011. The purpose of the mission was to review operating practices in the areas of Management Organization and Administration; Training and Qualification, Operations; Maintenance; Technical support; Radiation protection; Operating Experience and Emergency Planning and Preparedness. The area of Chemistry was not reviewed due to the late unavailability of the expert. 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 Seabrook OSART mission was the 163rd in the programme, which began in 1982. The team was composed of experts from Brazil, Canada, China, France, Slovakia, Slovenia, Spain, Sweden, the United Kingdom, and together with the IAEA staff members and an observer from Czech Republic. The collective nuclear power experience of the team was approximately 290 years.

The plant is operated by Next Era Energy Seabrook, a subsidiary of Next Era Energy Resources. The plant is a Westinghouse four-loop Pressurized Water Reactor, with a net electrical output of 1244 MWe. It was put into commercial operation in August 1990. Seabrook submitted a License Renewal Application in June 2010. There are approximately 1100 permanent workers, plant staff and permanent contractors, on the site including external services (Security, cleaning, etc).

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

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

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

MAIN CONCLUSIONS

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

- The station use of the Learning Management System (LMS) for the daily qualification verification. This is a useful tool to check personnel qualification, provide information for future training and supply automatic notifications of upcoming training.
- A Healthy Reporting Culture based on a Low-threshold and a High-volume reporting system.
- Risk ranked activities evaluations are used to monitor contractors in the field.

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

- Operations staff's and management's ownership of the plant is not being undertaken at a sufficiently high standard in the following activities:
    - The reporting of some perceived minor anomalies;
    - The housekeeping;
    - The system for controlling operator aids and procedures.
    - The control of access to systems and equipment ; and
    - The administrative burden of the Shift Manager.
- In some cases the plant demonstrates a lack of aggressive and proactive resolution on long term issues.
- The plant is experiencing material condition deterioration and degraded equipment conditions.

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

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1.1 ORGANIZATION AND ADMINISTRATION

The plant is a part of the eight-unit Next Era Energy nuclear fleet.

One of the major challenges the plant will have to deal with in the near future is the workforce demographic distribution and the increasing ratio of staff eligible for retirement. The growing demographic challenge is not specific to the plant but affects all of the US nuclear industry making the nuclear industry job market all the more stressed. As far as the plant is concerned 37% of the plant staff will be eligible for retirement by 2015. The team encourages the plant to monitor and continue to implement a robust knowledge transfer and retention plan to address this challenge.

The plant uses many tools to achieve an effective contractor monitoring program. A detailed Contractor Field Activity Monitoring Plan uses a graded approach for identifying where focused monitoring and oversight must be performed. The contractors' field activities are evaluated and risk ranked. The monitoring plan is adjusted subsequent to this evaluation. The team has identified this as a good practice.

1.2 MANAGEMENT ACTIVITIES

The plant has developed a set of day-to-day communication tools for internal communication purposes. One such tool consists of the use of video communication to ensure operational focus on topics such as decision-making and safety. Feedback from plant staff has been very positive regarding this initiative. The team has identified this tool as a good practice.

While the plant has reached a mature age, it is still relatively young compared to the US nuclear industry and even more so with respect to a potential 20 year license extension. There are some technical issues that could affect operational results, and long term oriented indicators. The team recommends the plant adopt a more aggressive and proactive resolution to tackle long term issues that could impact its reliability.

1.3 MANAGEMENT OF SAFETY

In terms of safety culture the team observed behaviours of plant staff and compared these to the safety culture attributes promoted in the IAEA Safety Standards. A number of facts related to strengths and weaknesses that could assist the management efforts regarding safety culture at Seabrook have been identified.

With respect to the strengths:

- the team recognized that there was a consistent, strong, and clear reinforcement of values (i.e. self-critical, learning organisation, openness to input) from the Chief Nuclear Officer, Site Vice President (VP) and the Plant Manager. The Site VP in particular stressed the importance of seeking excellence in accordance with the Nuclear Excellence Model Values to deliver high standards of nuclear safety. This message was not diluted with references to specific short term operational targets.
- The team found that the staff at the plant are very aware that safety comes first and are proud of it. There was clear evidence that there is no emphasis on production over safety. Numerous examples of these high safety standards were found during pre-job briefs and reinforcement of safety behaviours during plant tours were identified by the team.
- The team also found that the staff at the plant were very open to facilitating the team's activities and learning from the team's inputs. The team did not identify any defensiveness at any level and the plant staff genuinely sought any potential improvement opportunities that could enhance safety at the plant.

The team also identified areas that could be further strengthened to improve the safety culture.

- The team found that the mechanisms to identify and report material condition and housekeeping concerns could be improved.
- In addition, a more aggressive approach to addressing longer term issues such as long standing defects and more significant issues such as ground water intrusion would benefit from further attention. This focus would reduce any potential for 'normalisation' of staff to less than excellent conditions.

Overall the safety culture standards at Seabrook NPP were considered by the team to be very positive. The staff ownership and the willingness to live and share very high safety behaviour standards were considered as outstanding.

1.5 INDUSTRIAL SAFETY PROGRAMME

The plant uses a Safety Booth to encourage participation from the workforce by providing valuable safety information. Throughout the year, different departments are responsible for developing media material to run the booth. The Safety Booth topic is related to personnel safety and is intended to remind workers of hazards encountered in everyday life. Prizes are randomly awarded to participants at the end of each month based on quiz participation. This is a powerful incentive tool to promote industrial safety at the plant. The team has identified this as a good performance.

The plant attaches high importance to industrial safety and has achieved a "Total Industrial Accident Rate" of 0 at the end of 2010. Although the plant has had recent good records, the team identified weaknesses in hazard identification, risk prevention practices and existing hazardous situations in the field. The team recommends that the plant reinforce its industrial safety mitigation and prevention practices to meet International Labour Organization standards.

1.6 DOCUMENT AND RECORDS MANAGEMENT

The plant's archives (regular set + backup) are stored on site in the same room. IAEA requirements state that they should be separately stored. The plant has short term plans to send the archives' backup to a separate repository location in New York State. The team encourages the plant to store its backup records separately.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.1 ORGANIZATION AND ADMINISTRATION

1.1(a) Good Practice: Risk ranked activities evaluations are used to monitor contractors in the field.

The Nuclear Project Group is responsible for many of the capital improvement projects undertaken at plant and it relies heavily on contracted work forces to implement these projects. As a result, an important focus area for staying in the preventive mode is contractor control. Nuclear Project Group uses many tools to achieve an effective contractor control program. One of the more comprehensive tools is a detailed Contractor Field Activity Monitoring Plan (FAMP).

The Nuclear Project Group develops the FAMP to ensure contractors' activities are performed safely and completed with first time quality. Focus areas of the FAMP include the contractor's organization, supervisor to worker ratios, training/qualifications and work package preparation. The plan uses a graded approach for identifying where focused monitoring and oversight will be performed. The contractor's field activities are evaluated and risk ranked. The risk ranking considers both industrial safety and equipment/nuclear safety. Activities identified as high risk are flagged in the outage schedule as a High Risk FAMP Hold Points.

The use of FAMP has become an important and effective tool to strive for improvement in the area of contractor control. The plant has been using FAMP the last 5 years. The plant has had several plants come and benchmark the process and have FAMP as one of their transferable good practices.

The efficiency of the Nuclear Project Group's control is evidenced by:

- Back to back breaker to breaker runs for the last two operation cycles with no challenges due to contractor performance in the field; and
- Contractor performance during the last refuelling outage where there was one first aid, no Occupational Health and Safety recordable injuries.

1.2 MANAGEMENT ACTIVITIES

1.2(a) **Good Practice**: Use of video communication tool to ensure operational focus on topics such as decision-making and safety.

Communication tools at the plant are used to ensure an operational focus on topics such as decision-making and safety. This ensures that members of the team at all levels of the organization understand why decisions on plant operations have been made, and that safety is always the #1 priority in all operational decision-making at the plant.

Frequent video messages are produced and posted to the eWeb page in order to be available to plant staff. This method was initiated by plant management to communicate important information on a variety of subjects in a formal manner. Typically, the messages are a few minutes long, conducted as interviews and cover one or more recent events or topics of interest. No teleprompter is used and the host and the person being interviewed simply use small note cards if necessary.

Feedback from members of the plant staff has been very positive. Viewers like the informal tone and the ability to watch the messages at the computer on their desk when it is convenient for them. This video format has been used by the Site VP, Plant General Manager, Health and Safety Manager, Engineering Manager, Outage Manager and others.

Recent examples of the use of the tool at the plant:

- Plant General Manager provides the team with an update on valve SI-V-82 safety case, OSART mission and the INPO Maintenance and Technical training accreditation.
- Plant General Manager interview about the decision making process to take the plant off line over the weekend of June 4, 2011 to conduct repairs on the secondary side of the plant.
- Design Engineering Manager provides details of the condition called Alkali-Silica Reaction discovered on the wall section of the B electrical tunnel.
- Plant General Manager talks about closing the breaker on outage 14 and getting the plant back online.

1.2(1) **Issue:** In some cases the plant demonstrates a lack of aggressive and proactive resolution on long term issues.

The following facts were identified by the team:

- Ground water seepage issues affecting different areas of the plant have occurred since shortly after construction of the plant and have been present ever since. The selection of low susceptibility cement and aggregate was meant to eliminate the possibility of an Alkali Silica Reaction (ASR). The ASR phenomenon was known at the time of construction and assessed but no ASR was found. The ASR risk was not reassessed before the re-licensing process and this resulted in core bores being taken to validate the condition of the concrete in contact with water seepage. Core bores performed in 2010 identified the presence of ASR in some locations due to ground water. Earlier concrete boring activities could have led to the discovery of this phenomenon sooner.
- The Safety Injection SI-V-82 check valve has had indication of leakage since 2005. The valve was cleaned and boron removed 3 times: in 2005, 2006 and 2009. 4 outages have taken place since 2005 and the check valve is still not repaired. A temporary clamp was installed in May 2011. Leakage has reappeared just a month after start up from the last outage. This leak could lead the plant to shut down for repair knowing that 15 months remain in the fuel cycle.
- The Nuclear Oversight Group identified a lack of management oversight of the industry recommendation issued in 2009 with respect to in-depth questioning attitude and challenge.
- Significant backlogs exist at the plant:
  - Corrective Action backlog: 921
  - Work order backlog after the outage:

    - Corrective Critical (CC): 1
    - Corrective Non-critical (CN): 2
    - Corrective Low (CL): 11
    - Deficient Critical (DC): 109
    - Deficient Non-critical (DN): 316
    - Deficient Low (DL): 829
    - Other: 1643
  - Procedure Change Request backlog: 1165

The average age of the items in the backlogs is high:

- 177 days for Corrective Actions
- 308 days for PCR priority 2 compared to 180 days expected

- Plant performance is below industry top quartile performance in some areas:
  - The last outage performance did not meet the schedule (24 days overdue for an outage initial duration of 28 days) due to 4 issues (including one related to unforeseen repairs on the Essential Service Water piping; another requiring repeated work on RHR pump and another related to SI-V-82 valve leakage).
  - 3 major safety systems' unavailability rates are consistently above industry best quartile (Emergency Diesel Generator -3rd quartile, Emergency Feed water System - 2nd quartile, and High Pressure Injection system -2nd quartile).

- There is no Human Resources committee at the plant level although the plant has challenging demographic issues to face in the near future. It is a missed opportunity to share practices and to find common solution between the different departments.
- Lack of long term roll up and trending with respect to Nuclear Oversight findings.

The lack of aggressiveness and proactive resolution regarding some long term issues could lead the plant to inadequately address major challenges with respect to: prioritization, labour force skills availability, timeliness and quality of resolution. This lack of aggressiveness could negatively impact plant safety and performance.

Recommendation: The plant should aggressively implement proactive strategies to resolve long term issues which have the potential to impact future reliability.

IAEA Basis:

GS-R-3 6.1

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

GS-R-3 6.9

Weaknesses and obstacles shall be identified, evaluated and remedied in a timely manner.

GS-R-3 6.10

The review shall identify whether there is a need to make changes to or improvements in policies, goals, strategies, plans, objectives and processes.

GS-R-3 6.18

...Actions for improvement shall be monitored through to their completion and the effectiveness of the improvement shall be checked.

1.5 INDUSTRIAL SAFETY PROGRAMME

1.5(1) Issue: Industrial safety mitigation and prevention practices do not meet international standards.

The following facts were identified by the team:

- Examples of inadequate hazard identification and industrial safety signage throughout the plant were noticed:
  - Some hazard and Personal Prevention Equipment's tags are not posted at worksites.
  - Protruding metalwork hazard signage is regularly missing throughout the plant.
  - PPE signage is not consistent and systematic while entering the turbine hall.
  - Risk signage requesting the wearing of antistatic clothing and forbidding vehicle entrance is missing in the warehouse although a significant amount of flammable materials is present. A car without spark arrest equipment was observed in the same building.
  - Poor risk signage and attachment were noticed in the plant: hand written, fallen on the floor, fixed with duct tape.
- Some examples of poor risk prevention practices were identified:
  - Access to the plant through the switchyard represents a potential risk.
  - Electrical power cabinets not locked were found by the team.
  - Assessment of the load bearing limits of scaffold is not posted at the plant. In addition, there is no load check by the user of the scaffold before use.
  - Although inspected prior to use, maintenance machinery tools and hand tools are not regularly inspected at the plant on a fixed schedule.
  - Although inspected prior to use, harnesses are not regularly inspected on a fixed schedule.
  - Flammable cabinets not grounded were found in maintenance facilities.
  - There are no safety coveralls requirements for regular worksites.
  - Absence of systematic analysis of cross discipline industrial safety risks to take into account overlapping worksites and activities during the outage was identified during the review.
- Industrial safety risks that require attention and improvement remain in the plant:
  - Protruding metalwork padding are missing throughout the plant and represent a potential for body injury.

- High vertical ladders (up to 20 Foot) with no cages were noticed throughout the plant which increases the risk of fall accidents. This practice does not meet International Labour Organization standards.
- The plant recognizes that fall arrest protection system user friendliness is challenging and could be improved (AR# 1659460).

The lack of risk hazard identification in the field combined with industrial safety prevention measure deficiencies on equipment and facilities and some examples of poor risk prevention practices increases the likelihood of personnel injuries.

Recommendation: The plant should reinforce its industrial safety mitigation and prevention practices to meet international standards.

IAEA Basis:

ILO-OSH 2001 3.10.1.1.

Hazards and risks to workers' safety and health should be identified and assessed on an on-going basis. Preventive and protective measures should be implemented in the following order of priority:

(a) eliminate the hazard/risk;

(b) control the hazard/risk at source, through the use of engineering controls or organizational measures;

(c) minimize the hazard/risk by the design of safe work systems, which include administrative control measures; and

(d) where residual hazards/risks cannot be controlled by collective measures, the employer should provide for appropriate personal protective equipment, including clothing, at no cost, and should implement measures to ensure its use and maintenance.

2. TRAINING AND QUALIFICATIONS

2.1 TRAINING POLICY AND ORGANIZATION

The ease of use of the Qualification Health Method to identify all skills required in the plant, and the number of staff required, is recognized by the team as good practice.

The use of the learning management system (LMS) to check personnel qualifications and that training is carried out by staff and managers as well as contractors, on a daily basis, and is considered by the team as a good practice.

Prior to outages there was observed a reduction in the number of management observations of training activities. The team encourages the plant to ensure that production requirements do not interfere with the oversight of training process.

Even though the plant has a plan in progress to recruit more training staff, it should consider providing additional attention on training department staffing to ensure effective support for future training activities. The team has made a suggestion on this point.

2.2 TRAINING FACILITIES, EQUIPMENT AND MATERIAL

The learning environment is supported by different types of training facilities including simulators and mock-ups. In particular the team noted the effective use of the human performance simulator and its contribution to reducing the number of human performance errors and the quarterly error rate. This is recognized by the team as a good performance.

However the plant has not implemented a replica of the remote safe shutdown panel, so the crews cannot train on that panel to reinforce their skills in all accident situations. The training scenarios in the simulator and the emergency plan drills do not contain the use of self-contained breathing apparatus (SCBA) for the control room crews. The plant should consider the introduction of this type of scenario to train the crews in all situations to achieve the skills and psychological preparedness to act under conditions within the design basis, beyond the design basis and extreme situations. The team has made a recommendation on this point.

Although the training facilities are well equipped in term of size and material, the team encourages the plant to verify that all of the training staff have appropriate space to effectively perform their duties, for the current staff and for the future recruitment.

2.3 QUALITY OF TRAINING PROGRAMMES

The annual training arrangements in the Technical Training Program and the Maintenance Program do not require systematic and periodic review of plant systems knowledge. The team encourages the plant to consider the introduction of this training on a regular basis.

Regular training for Root Cause Evaluators is delayed and is not performed since 2006; the team encourages the plant to complete the training.

2.4 TRAINING PROGRAMMES FOR CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

During simulator scenarios, the session is video recorded and is used during the debriefing to reinforce good performance and identify those areas for improvement. This is considered by the team as a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1 TRAINING POLICY AND ORGANIZATION

2.1. (a) Good practice: Qualification Health Reports

The plant identified all skills required in the plant and developed an indicator to show the qualifications and the number of staff required. Each accredited training discipline is required to maintain a qualification health report. These reports are reviewed at the Plant Training Advisory Board.

- These reports are an easy to understand tool to monitor the required qualified staff for specific works.
- The qualification health reports in all of the accredited training disciplines illustrate and facilitate the strategic management of worker qualifications.
- These reports allow line departments to identify qualification areas where additional focus is needed to maintain qualification levels. The line departments can identify to station management those qualifications that require additional attention due to unique qualifications or limited candidates.

2.1.(b) Good practice: Station Use of the Learning Management System (LMS) for the daily qualification verification.

This is a useful tool to check personnel qualification, provide information for future training and supply automatic notifications of upcoming training.

The benefit of this tool is that every individual and manager can easily check if they are qualified to performing the work before they do it.

Plant personnel access the Learning Management System (LMS) to ensure that they are qualified to perform work. Using their own computer work stations, workers and supervisors in the station line organizations access the on-line database of training and qualification records. Workers perform this qualification check at least daily or prior to performing work to ensure that they are qualified to perform their assigned work. This is a view of LMS used to check qualifications (also known as "curriculum status").

In addition to checking qualifications, plant personnel can check if they are scheduled for future training sessions and can also check if they are due to complete web-based training. If web-based training is required, the worker is able to select the item in LMS and complete it.

LMS also provides automated email notifications to personnel of upcoming open training requirements or class enrolment information, which can be added to the individual's calendar.

A daily computer reminder and a culture of verifying that personnel are qualified to perform work ensure work in the station is performed to management's expectations.
Daily checks also ensure that training is attended as scheduled, and that qualifications do not lapse due to incomplete training requirements.

2.1(1) Issue: Operations Training staffing does not meet the expectation to effectively support future training activities.

Even though the plant has a plan in progress to recruit and train more instructors, the team observed the following:

- According to the "Accredited Training Health Report" Training Staffing does not meet the expectation because a shortage of training staff.
- Initial training for licensed operators has been postponed several times, initially this was planned to start in December 2010 then was postponed to June 2011 and finally is planned for September 2011, because of the staff shortages.
- The Operations Initial Training Supervisor position was vacant during the OSART mission even though the plant has an on-going plan to fulfil it.
- According to the root cause analysis of AR: 596266, it was determined that management failed to provide adequate training resources to support training activities.

Without the appropriate Operations Training staffing it is not possible to meet the expectation to effectively support training activities.

Suggestion: The plant should consider the proper implementation of Operations Training staffing to meet the expectation to effectively support future training activities.

IAEA Basis:

NS-R-2
2.4. The organizational structure shall be established and documented so as to ensure that the following responsibilities are discharged with respect to achieving safe operation of nuclear power plants:
(1) ....
(6) Adequate resources, services and facilities shall be provided.
(7) ....

NS-G-2.4
3.7. The operating organization should be responsible for providing all equipment, staff, procedures, training and management practices necessary for safe operation, including the fostering of an environment in which safety is seen as a vital factor and a matter of personal accountability for all staff. Reliability in the long term should not be served by compromising safety in the short term.

NS-G-2.8

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

—.........

—the training unit is provided with all necessary resources and facilities;

—.............

—in allocating resources, the implementation of training programmes is given high priority.

4.9. .... Managers and supervisors should ensure that production requirements do not interfere with the conduct of training programmes.

2.2 TRAINING FACILITIES, EQUIPMENT AND MATERIAL

2.2(1) Issue: The simulator facilities and programs, in some cases, do not fully reflect the status of the plant to effectively train Operations crews in some accident conditions.

- There is no full scope replica of the Remote Safe Shutdown Panel (RSS) in the simulator facilities and the crews do not practice to shut down the plant from the RSS panel (i.e. in Licensed Operator Requalification Training - LORT). The operators perform walk through training at the RSS panels (JPMs) however, no integrated hands-on training is performed.
- There are other differences between the Simulator and the actual Control Room (i.e.: Rod Bank Demand Counters, Monitoring Panel for the Reactor Coolant Pumps and others described in the document "Seabrook Control Room vs. Simulator Deficiencies" These are approved by Simulator Review Committee and reviewed on a biennial basis by the regulator.
- The operators are not trained on operations when wearing Self Contained Breathing Apparatus (SCBA). The simulator training does not contain practices on these scenarios. The crew is trained to put the SCBA on and take them off yearly.

Without simulator facilities and programs that fully reflect, in all cases, the status of the plant the Operations crew cannot be trained in all situations to have all the necessary skills.

Recommendation: The simulator facilities and programs should fully reflect the status of the plant to effectively train Operations crews particularly in accident conditions.

IAEA Basis:

NS-R-2
3.11. Representative simulator facilities shall be used for the training of operating personnel. Simulator training shall incorporate training for operational states and for accidents.

3.12. Plant staff shall receive instructions in the management of accidents beyond the design basis. The training of operating personnel shall ensure their familiarity with the symptoms of accidents beyond the design basis and with the procedures for accident management.

3.13. A programme shall be put in place to assess and improve the training programmes. In addition, a system shall be in place for timely modification and updating of the training facilities and materials to ensure that they accurately reflect plant conditions.

NS-G-2.8
5.7. Personnel specified by the operating organization should be made familiar with the features of safety analysis as part of their training programme. Training and assessment of plant operators should ensure their familiarity with the symptoms of beyond design basis accidents and with the procedures for accident management. Simulators should represent the way in which an accident would evolve. If the available simulator facilities are inadequate, computer based training, classroom training and plant walkthroughs should be used to explain the consequences of an accident involving a seriously degraded reactor core.

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.

6.7. A procedure should be in place for the periodic review and timely modification and updating of training facilities and materials, to ensure that they accurately reflect all modifications and changes made to the plant.

3. OPERATIONS

3.1 ORGANIZATION AND FUNCTIONS

The plant has developed and applied an Operational Focus Performance Indicator (OFPI). The OFPI is updated and discussed once each week at the Operational Focus meeting. The majority of the metrics in this indicator are provided by Work Management, Maintenance and Engineering. The application of the OFPI has resulted in a reduction in the reported number of fire impairments and operator round deficiencies. The team has identified the use of the OFPI as a good practice.

Two weeks prior to planned outages the two operating crews which will perform the unit shutdown rehearse the shutdown in real time in the simulator. This rehearsal includes all procedural steps and turnover from the night shift to the day shift. The same provision is made prior to the restart of the unit. The team recognizes the use of Just in Time training to support safe shutdown and start-up of the unit for planned outages as a good performance.

Component mispositionings are closely monitored and actions are taken whenever mispositionings occur. However, a number of configuration control events are excluded from being counted in the indicator due to exclusion provisions contained in the governing procedure. This procedure is based on a review of industry best practices performed in 2007 and is consistent with industry best practices at the time. The plant is encouraged to consider reviewing current practice for the reporting of component mispositionings to ensure that it remains current with industry best practice and any potential for inaccurate reporting of configuration control events is eliminated.

3.4 CONDUCT OF OPERATIONS

Operations has implemented a Focus on Fundamentals program. This program dedicates two senior nuclear system operators (NSOs) to knowledge transfer and mentoring of junior NSOs.

Operations has developed dynamic learning activities (DLA) which are conducted during Operations crew training weeks. Subsequent to DLAs conducted in the spring of 2010, the plant benchmarked Pilgrim Station and developed a Focus on Fundamentals initiative for the station. This Focus on Fundamentals initiative complements the plant's training program in much the same way that the DLAs do and consists of Senior Nuclear System Operators, overseen by an Senior Reactor Operator (SRO) licensed individual, engaging field activities in a mentoring role. The team considers this as a good practice.

During the review the team found that the plant has adequate procedures and routines in place for the tasks that occur. Furthermore, the team found that the plant's written expectations are known by the staff. However, as a result of review and observations in the field, where a number of deficiencies were found, the team have come to the conclusion that Operations ownership is not being undertaken at a sufficiently high level with respect to:

- The reporting of some perceived minor anomalies;
- Housekeeping;
- The System for controlling operator aids and procedures.
- The control of access to systems and equipment; and
- The administrative burden of the Shift Manager.

The team has developed a recommendation in this area

3.5 WORK AUTHORIZATIONS

The plant uses a combination of deterministic and probabilistic risk evaluation in the preparation of planned work and in response to emergent equipment problems. Either or both of the deterministic and probabilistic tools trigger greater safety oversight or approvals for work to occur or, in the case of emergent equipment problems, to continue. The team recognizes the use of these complementary risk management tools as a good performance.

The team observed that Operations staff who prepare Clearance Requests in support of plant maintenance do not receive consistently all of the expected information from planners with respect to the nature and scope of the required equipment isolations. The training of the affected staff on the requirements for the preparation of Clearance Requests was found to be lacking in detail. The team recommends that the plant should strictly apply the documented process for generating Clearance Requests and train the affected staff to ensure Clearance Requests contain the required level of detail when received by Operations.

3.6 FIRE PREVENTION AND PROTECTION PROGRAMME

Past self-assessments by the plant and walk downs by the team found that the fire prevention and protection program is weakened by the condition of the fire protection equipment and by deficiencies in the control of combustibles. The team recommends the plant improve the condition of the fire protection system equipment and strengthen the control of combustibles.

DETAILED OPERATIONS FINDINGS

3.1 ORGANIZATION AND FUNCTIONS

3.1(a) Good Practice: The Operational Focus Performance Indicator

The Operational Focus Performance Indicator (OFPI) provides an aggregate assessment of operational issues that are impacting, or may impact, overall plant performance. The aggregate impact of pertinent Key Performance Indicators is assessed on a weekly basis. Additionally, Operator Rounds Deficiencies and Abnormal Alignments account for equipment deficiencies that individually may not be significant, but when viewed cumulatively could have a negative impact on Operator performance. The indicator enhances the plant's focus on equipment deficiencies and design limitations that may otherwise receive less attention due to their impacts being minimized through operator performance of compensatory measures. The OFPI is reported on weekly at the Operational Focus Meeting. The Plant Health Committee, Site Nuclear Safety Culture Committee, Operations Management, Work Management, in addition other Station Departments utilize this indicator as a tool in prioritizing work activities and evaluating the effectiveness of actions taken to address deficiencies. The overall intent of the OFPI is to ensure that conditions that challenge the reliable operation of the unit are addressed in a timely manner and that Operator response actions in Abnormal or Emergency Operating Procedures are not adversely impacted by the cumulative effect of multiple minor deficiencies.

The application of the OFPI has directly contributed to a reduction in the number of:

- operator work around deficiencies, and
- fire impairments

An additional benefit of the indicator is the engagement of the Work Management, Engineering, Maintenance and "Fix it Now" (FIN) organizations who are the owners of the majority of the OFPI indicators.

3.4 CONDUCT OF OPERATIONS

3.4(a) Good Practice: Operations has implemented a Focus on Fundamentals program.

The training consists of dynamic learning activities (DLAs) at the human performance lab, the Technical Training Centre and in the simulator where operators are allowed to perform activities and be evaluated on their use of Human Performance tools and fundamentals by the instructor and fellow students. The dynamic learning activities were developed following a fleet self-assessment and are based on a good practice benchmarked at the South Texas Project.

Subsequent to DLAs conducted in the spring of 2010, the plant benchmarked Pilgrim Station and developed a Focus on Fundamentals initiative for the station. This Focus on Fundamentals initiative complements the plant's training program in much the same way that the DLA's do and consists of Senior Nuclear System Operators, overseen by an SRO licensed individual, engaging field activities in a mentoring role. The Focus on Fundamentals initiative concentrates on the use of core human performance tools as well as comprehensive Pre-job Briefs, STAR, field work best practices and enhanced Operator rounds. The Operations Focus on Fundamentals initiative and dynamic learning activities complements the Operations Training program by providing Operators with practical field work and experience.

This program enhances knowledge transfer and mentoring of junior NSOs and system awareness.

3.4(1) Issue: Operations staff's and management's ownership of the plant is not being undertaken at a sufficiently high standard in the following activities:

- The reporting of some perceived minor anomalies;
- The housekeeping;
- The system for controlling operator aids and procedures;
- The control of access to systems and equipment; and
- The administrative burden of the Shift Manager.

Objectives and expectations have been set up for operations activities. However, the following were observed by the team:

- Reporting of anomalies
  - Several areas in the plant have burned out light bulbs.
  - Industrial safety deficiencies are not reported or noticed, e.g. long ladders, valves that require climbing in order to manoeuvre them.
  - Numerous deficiency cards, many older than one year were observed. No demands for solving the deficiencies were made by operations.
  - Numerous old deficiency tags in place, e.g. Fire-Pump House.

- Housekeeping
  - Bottles, paper, and a broken cone found around the Fire-Pump House.
  - In the Turbine Building a maintenance cart was found with tools and spare parts on it. No workers were present.
  - In the Service Water Intake Building a store area is maintained, however the team found numerous items stored in a non-orderly manner.
  - In the Main Control Room cleaning equipment is stored in a non-orderly manner.
  - Duct tape was found within an FME area.

- Operators aids and procedures
  - Unauthorized aids were found in the Fire-Pump Building, and in the Diesel Building. Aids which were not recorded were also found in the Service Water Building.
  - The plant also has maintenance aids, these are documented, and some of these date back to 1993.
  - The team discovered an abandoned Operating Procedure in the Water Treatment building.
  - The plant's surveillance procedures are marked as Reference Use Only; this is not according to Operations expectations or practice.

- The control of access to systems and equipment
  - In the Main Control Room there are two key cabinets, one used for controlled keys and the other used for uncontrolled keys. The controlled keys, as well as the

uncontrolled keys have a log. The log for controlled keys is kept in an orderly manner; however, the uncontrolled key log last entry was made in the year 2009.
  - The security staff have keys which can be handed out without the Shift Managers knowledge.
  - Plant personnel can gain access to protected rooms containing safety related equipment via their badge without the knowledge of the Shift Manager.

- The administrative burden of the Shift Manager.
  - Due to administrative duties laid on the Shift Managers the time needed in the Main Control Room, to obtain oversight/ownership of plant activities could be reduced. The plant is aware of this situation, a Quick Hit Assessment of Shift Manager Administrative Duties has been conducted, AR#1650423.
  - Shift Managers spend a lot of time preparing for the Operations Focus meeting, on average 2-3 hours.
  - Shift Managers provide data to the operations performance indicator.

Without a strong ownership by Operations staff and management, the plant conditions can progressively degrade in term of reporting of anomalies, housekeeping, operator aids and procedure control, control of access to safety rooms, and the administrative load of shift managers which could potentially result in a decline of safety performance.

Recommendation: The plant should ensure that the ownership of the plant by operations staff and management is undertaken at a high standard in activities such as reporting of anomalies, housekeeping, operator aids and procedure control, control of access to safety rooms, and the administrative load of shift managers.

IAEA basis

NS-G-2.14

2.18 The management of the operations department should be explicitly committed to safety and to established performance standards in plant operations. This commitment should be clearly communicated to the operations personnel and should be supported by the frequent presence of managers at the workplaces of personnel. Safety performance should be improved through leadership and coaching.

2.19 The management of the operations department should be explicitly committed to safety and to established performance standards in plant operations. This commitment should be clearly communicated to the operations personnel and should be supported by the frequent presence of managers at the workplaces of personnel. Safety performance should be improved through leadership and coaching, conservative decision making, a questioning attitude and thoroughness in carrying out plant operating activities should be reinforced.

5.1. A consistent labelling system for the plant should be established, implemented and continuously maintained throughout the lifetime of the plant...

5.4. Particular consideration should be given to the arrangement in the labelling system for the identification by operators of missing or necessary labelling and the process to ensure that the corresponding corrective action has been taken in a timely manner.

5.6. Specific measures should be developed and maintained to prevent unauthorized access to systems and equipment important to safety. These measures should include controlled access to certain rooms or compartments and an effective key control system or other measures to prevent an unauthorized change in the position of, or an unauthorized intervention affecting, certain important safety valves, transmitters, breakers or other specified equipment.

6.17. The system for controlling operator aids should prevent the use of unauthorized operator aids or other materials such as ...

6.18. In addition, all operator aids should be reviewed periodically to determine whether they are still necessary, whether the information in them needs to be changed or updated, or whether they should be permanently incorporated as features or procedures at the plant.

6.20. Plant housekeeping should maintain good conditions for operation in all working areas. Working areas should be kept up to standard, well lit, clean of lubricants, chemicals or other leakage and free of debris; the intrusion of foreign objects should be prevented and an environment should be created in which all deviations from normal conditions are easily identifiable (such as small leaks, corrosion spots, loose parts, unauthorized temporary modifications and damaged insulation). The effects of the intrusion of foreign objects or the long term effects of environmental conditions (i.e. temperature effects or corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) should be evaluated as part of the plant housekeeping programme.

6.21. ...Operations personnel should periodically monitor housekeeping and material conditions in all areas of the plant and should initiate corrective action when problems are identified.

GS-G-3.5
Paragraph 5.163. A process should be established and implemented to ensure that structures, systems and components are uniquely and permanently labelled to provide individuals with sufficient information to identify them accurately.

5.150. Housekeeping and cleanliness should be considered an essential process to provide a clean workplace and to encourage a high standard of workmanship.

3.5 WORK AUTHORIZATIONS

3.5(1) Issue: Clearance Requests, which are used to initiate the clearance development process, do not consistently provide the required level of detail when received by Operations.

- Two governing procedures which are not implemented require that Operations receive Clearance Requests from Planning which contain a description of the isolation state of the component to be worked (See Clearance and Tagging, OP-AA-101, revision 3, section 5.2, Information for a Clearance, page 23 of 157, and NAMS Maintenance Desk-Top Instruction, MA-AA-203-1000-10000, revision 7, Step 16: Adding Clearance Request (Tag out Request), page 39 of 72).
- Interviews with plant personnel show that all of the Clearance Requests for Preventative Maintenance (PM) Work Order (WO) tasks are left blank.
- Interviews with plant personnel show that approximately 60% of Clearance Requests for non-PM WOs contain some or all of the required information and that the number of Clearance Requests containing the required information is increasing over time.
- Action Request (AR) 217938 was submitted on March 2, 2010 on the subject of missing information in Clearance Requests. This finding resulted from a Quick Hit Assessment documented in AR 217664. AR 217938 was closed in March 2010 based on discussions planned to take place between Operations and Planning.
- On-going reporting of Clearance Request problems between March 15, 2010 and January 24, 2011 is documented in ARs 218821, 570797, 571462, 581443, 1605725, 1607504, 1611698.
- Based on interviews with Tagging staff and a review of the content of initial and continuing computer based training material for Planners (NUC TAG 001 NAMS Clearance Process Introduction, and NUC TAG 004 – Fleet Clearance and Tagging Continuing Training) the staff responsible for Clearance Requests have not received sufficiently detailed training on the preparation, receiving and review of Clearance Requests.
- Interviews with Tagging staff indicate that they compensate for the lack of detail in Clearance Requests by ensuring that they gather the information needed to build the required isolations.

The erosion of the Clearance Request barrier in the Tagging process increases the reliance of the organization on the remaining four barriers. The potential for events increases when all barriers are not implemented in the manner prescribed by the governing documents.

Recommendation: The plant should strictly apply the documented process for generating Clearance Requests and train the affected staff to ensure Clearance Requests contain the required level of detail when received by Operations.

IAEA basis

NS-R-2

2.4. The organizational structure shall be established and documented so as to ensure that the following responsibilities are discharged with respect to achieving safe operation of nuclear power plants:

(1) Responsibilities shall be allocated and authority shall be delegated within the operating organization.

(2) Satisfactory conduct of management programs shall be established and verified.

(3) Adequate training for personnel shall be provided…

6.7. A comprehensive work planning and control system shall be implemented to ensure that maintenance, testing, surveillance and inspection work is properly authorized and is carried out in accordance with established procedures. Co-ordination shall be established among different maintenance groups (for mechanical, electrical, instrumentation and control, and civil maintenance), and with operations and support groups (groups for fire protection, radiation protection, physical protection and industrial safety).

NS-G-2.6

4.26 The factors to be taken into account in developing administrative controls and procedures applicable to Maintenance, Surveillance and Inspection (MS&I) should include, but are not limited to, the following:

- the generation of adequate written work procedures;
- …
- the use of work permits in connection with equipment isolation;
- …
- training and qualification of personnel;
- …

5.15 The comprehensive work control system should include any authorizations, permits and certificates necessary to help ensure safety in the work area and to prevent maintenance activities from affecting other safety relevant area. The following specific matters should be considered in the work control system:

- ...
- equipment isolation, work permits and tagging;

5.16 The authorizations, permits and certificates referred to in para. 5.15 should;

- define the plant item, the type of work to be performed and the boundaries of the work area in which the activities of plant and /or contractor personnel are authorized;

3.6 FIRE PREVENTION AND PROTECTION PROGRAMME

3.6(1) Issue: The fire prevention and protection programme is weakened by the condition of the fire protection equipment and by deficiencies in the control of combustibles.

- Implementation of maintenance and approved modifications of fire protection equipment has been delayed. Examples of challenges are:
  - Significant corrosion documented in outstanding Work Orders (616970 and 616971) from May 2006 for the two fire water storage tanks,
  - Corrosion of the diesel fire pump fuel tanks,
  - The 2007 project (07MMOD556) for the replacement of obsolete Pyrotronic detectors in the Fuel Storage Building is on hold,
  - Two Temporary Modifications relating to fuel oil supply (08TMOD004-01, removal of the temporary fuel oil supply tank for the donkey boiler for the heating of the fire water tanks in cold weather, and 07TMOD012-01, return to service of the fire prevention fuel oil tank) do not currently have funding to complete the required engineering and installation work. This represents a significant threat to the target completion date for these TMODs of the summer of 2013,
  - A consistent backlog of fire door work orders (31 open WOs in Q4 2010, 27 open WOs in Q1 2011).
- A self-assessment report titled, “Seabrook Daily Quality Summary “Combustible” – 1/1/11 to 6/15/11”, documents a review of combustibles in various areas of the plant between March 23, 2011 and April 28, 2011 with 6 of 11 reviews showing several deficiencies :
  - 19 Action Requests (ARs) for combustible material storage or lay down areas with no Combustible Material Permit (CMP), and
  - 2 ARs for additional material in area not identified on CMP
- Plant walk downs by the team and counterparts identified examples of the same issues, i.e. garbage bag stored by 1-SW-V-203, paint not covered in paint shop, oil and rags found at FW-P-32-A, plastic and cardboard on drums in the CPS resin laydown area.

The combination of control of combustibles with equipment condition challenges for the fire prevention system increases the potential for damage to safety related systems due to fire.

Recommendation: The plant should improve the condition of the fire protection system equipment and strengthen the control of combustibles.

IAEA Basis

NS-G-2.1

2.1. Principle 11 of the IAEA Safety Fundamentals publication on The Safety of Nuclear Installations is that the design of nuclear installations includes the appropriate application of the defence in depth principle. The concept of defence in depth incorporates multiple levels of protection which are subject to overlapping provisions and should be extended to all safety activities, whether organizational, behavioural or equipment related... Fire is a hazard which has the potential to create a common cause failure mode for which prevention and mitigation measures should be provided.

6.1. Administrative procedures should be established and implemented for effective control of combustible materials throughout the plant. The written procedures should establish controls for delivery, storage, handling, transport and use of combustible solids, liquids and gases.

6.5. Administrative controls should be established and implemented to ensure that areas important to safety are inspected periodically in order to evaluate the general fire loading and plant housekeeping conditions.

6.7. Administrative procedures should be established and implemented to control the storage, handling, transport and use of flammable and combustible solids and liquids in areas identified as important to safety. The storage of combustible materials such as papers and protective clothing should be restricted; large stocks of such materials should be placed in designated storage areas with appropriate fire rated compartmentation and fire protection measures provided.

4. MAINTENANCE

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The plant uses four redundant sets of calibration equipment which match the colour of the channels that they are used to calibrate. Post calibration of the measuring and test equipment (M&TE) when major work is performed provides assurance that the safety related equipment just calibrated is still in tolerance. These two practices could prevent a meter that potentially has a flaw from causing the loss of function of safety related redundant trains or channels. The team has identified dedicated channel test equipment and post calibrations as good practice.

4.4. PROCEDURES, RECORDS AND HISTORIES

The plant makes extensive use of photographs embedded in work instructions. The use of pictures supports the easy identification of components in the field, provides additional cues above and beyond the simple checking of system tags and shows the location of adjusting screws, indications and other key information. The pictures are modified with arrows and text boxes to highlight the component to be worked. Such practice supplies the explicit and implicit information to the workers and has contributed to a reduction in the number of human errors in performing maintenance activities. The team has identified the use of photographs in work instructions as a good practice.

4.5 CONDUCT OF MAINTENANCE WORK

The plant has a procedure for FME, however the FME procedure does not include some important requirements in relation to IAEA Safety Standards, and some requirements are not followed in the FME area. The team recommends that the plant should review and implement strictly the requirements for Foreign Material Exclusion.

Adjustable wrenches are widely used on site. The team encourages the plant to not use adjustable wrenches in the plant.

4.8. SPARE PARTS AND MATERIALS

The storage conditions of products and spare parts are not always properly controlled. The shelf life of some safety or quality related products or spares, is not evaluated. Some parts with a shelf life are not put in the shelf life system and quality level 1 material past its expired life was found in the warehouse. Evidence of rainwater in leakage from the roof of one warehouse was observed. The team recommends that the storage conditions of spare parts and products should be reviewed and strictly controlled.

4. DETAILED MAINTENANCE FINDINGS

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

4.2(a) Good practice: Dedicated channel test equipment and post calibrations.

In order to prevent a meter that potentially could have a flaw from causing the loss of function of safety related redundant trains or channels, a good practice was identified in the area of control of measuring and test equipment (M&TE) in combining the use of dedicated channel test equipment and the post calibration of M&TE as follows:

- The use of dedicated channel test equipment: Dedicated Channel Equipment involves the use of specific instruments on specific trains or channels. The station has four safety related channels, the tags are colour coded red, white, blue, yellow. The station has four redundant sets of calibration equipment that are marked with the matching colour of the channels that they calibrate. This practice prevents a single piece of M&TE from causing a loss of functions on any more than one channel.
- Post calibrations: Post calibrating M&TE when major work is performed provides assurance that the safety related equipment just calibrated is still in tolerance, so that any suspect readings can be evaluated immediately to ensure full operability and technical specification compliance.

4.4. PROCEDURES, RECORDS AND HISTORIES

4.4(a) Good practice: Photographs in work instructions

The plant makes extensive use of photographs (colour) embedded in the approved instructions and procedures. Pictures of actual plant equipment to be worked, showing its location from afar and up-close, and location in the plant. The use of pictures supports the easy identification of components (configuration control) in the field providing additional cues above and beyond the simple checking system tags. Pictures are used to show the location of adjusting screws, indications, and other key information. The pictures are modified with arrows and text boxes to highlight the component to be worked. Such practice has contributed to reduce the number of human errors in performing maintenance activities.

4.5 CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: The FME procedure does not include some important requirements, and some requirements are not followed in the FME area.

Interviews and observations revealed the following facts:

- Positive lock mechanisms are required in the spent fuel pool area according to procedure MA-AA-101-1000; however, a lot of fasteners on installed plant equipment have no positive lock. Some bolt holes are empty, and regular inspection of the bolts inside the FME level 1 area is not required in the plant.
- Transparent plastic is used in the RCA (radiological controlled area) and non-RCA areas. The station relies on colour strips for visibility. If a portion of the plastic with no colour were to separate, that section would be invisible in water, which could cause a serious FME problem related to nuclear safety in the area of fuel cooling.
- Paint and the concrete of the adjacent floor of spent fuel pool area is broken, the broken particles could become foreign material.
- White tape is required to be controlled to use in FME areas, but it is not well controlled in the spent fuel pool area, it is stuck on the tools, equipment, the floor and the scaffold inside the FME level 1 area. There are many examples of white tape stuck on the scaffold pipes in the storage areas and some equipment.
- Installed legacy tie wraps that do not float exist in spent fuel pool area; however it is required to use the floating type above water in the plant.
- Some unnecessary steel tags (manufacture tags, modification information, construction information and so on) are mounted above the pool on installed plant equipment; two rusted useless steel wraps were discovered in the supports.

Without sufficiently defined standards and strict control, foreign material could enter the system, and cause serious problems in the area of nuclear safety and damage the equipment including nuclear fuel.

Recommendation: The plant should review and implement strictly the requirements as regard to Foreign Material Exclusion.

IAEA Basis:

NS-G-2.5

5.19. A policy for the exclusion of foreign materials should be adopted for all storage of irradiated fuel. Procedures should be in place to control the use of certain materials such as transparent sheets, which cannot be seen in water, and loose parts.

NS-G-2.14

6.20. Plant housekeeping should maintain good conditions for operation in all working areas. Working areas should be kept up to standard, well lit, clean of lubricants, chemicals or other leakage and free of debris; the intrusion of foreign objects should be prevented and an environment should be created in which all deviations from normal conditions are easily identifiable (such as small leaks, corrosion spots, loose parts, unauthorized temporary modifications and damaged insulation). The effects of the intrusion of foreign objects or the long term effects of environmental conditions (i.e. temperature effects or corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) should be evaluated as part of the plant housekeeping programme.

4.8. SPARES PARTS AND MATERIALS

4.8(1) Issue: The storage conditions of products and spare parts are not always properly controlled.

Interviews and observations revealed the following facts:

- The shelf life of some safety or quality related products and spare parts (such as actuators category number 14541 and 17663) are not evaluated, and some parts with a shelf life of more than 40 years are not put in the shelf life system, this doesn't meet the requirements of the new procedure QI-4-NSC-9 rev 2.
- In the production warehouse, a drum of sodium hydroxide, quality level 1, had a shelf life which expired on Jul. 1st, 2001.
- In the production warehouse the material with catalogue number 443026, quality level 2, has no shelf life labelled on.
- The carbon steel and stainless steel materials are mixed together in the mechanical maintenance shop, pipe shop and weld shop, it doesn't meet the expectation and procedure of the plant.
- In the production warehouse, rain leaks down from roof, water can be seen on the floor, and there is some rubbish laying about.
- Warehouse AB103's doors were open.
- Weld materials especially the weld electrodes storage condition, doesn't meet the required standard.
- In the production warehouse, a stored spray can's body is corroded and the press button is missing.
- In warehouse 2, the status light for the heater to heat one safety related spare motor located in 2D04 area to avoid moisture inside had a burned out bulb.
- One 32 inch CS pipe is put out of the door of warehouse 2 exposed to weather, and it is a spare part with receipt number 105838 and purchase number 02291434.

Without a strict control of storage conditions, early degrading of spare parts and use of out-dated products can degrade safety in the plant.

Recommendation: The storage conditions of spare parts and products should be reviewed and strictly controlled.

IAEA Basis:

NS-G-2-6

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

8.37. Items that have a limited shelf-life should, if not used, be replaced at the appropriate time in order to ensure suitability for the expected function when they are needed. Information on storage matters can be found in Safety Guide Q13 on Quality Assurance in Operation, in Ref. [2].

8.38. Storage facilities should provide for convenient and orderly issuing of stored items. This is normally done with the aid of a counter or barrier through which the issue of stocks can take place without contravening arrangements for security and proper environmental conditions.

GS-G-3.5

5.151. It should be ensured by means of a process for handling and storage that only the correct items are used at the installation. For this purpose, items should be identified. Physical means of identification should be used to the extent possible and the identification should be transferred to each part of an item that is to be subdivided.

5.152. Provision should be made for preventing damage, deterioration or loss of items. For this purpose, items should be stored in a manner that provides for their ready retrieval and protection. Storage should be controlled to prevent the deterioration of degradable material, such as elastomer seals, O-rings and instrument diaphragms.

5.153. Maintenance should be performed on certain items held in storage, such as large pumps and motors. Such maintenance should include periodically checking energized heaters, periodically changing desiccants, rotating shafts on pumps and motors, and changing oil on rotating equipment, and other maintenance requirements as specified by the vendor.

5.154. Items removed from or placed into storage, including surplus material returned to storage, should be promptly documented so that the store inventory is kept accurate. The store record system should indicate the locations of materials and parts in all designated storage areas. Access to storage areas should be controlled.

5.155. The handling and storage process should include arrangements for shelf life management. For example, an item whose shelf life has expired should be discarded unless an engineering evaluation is conducted and engineering approval is obtained prior to use of the item.

5.156. For critical, sensitive, perishable or high value items, special arrangements, such as the provision of protective enclosures, an inert gas atmosphere and moisture and temperature control, should be specified and put in place. These measures may also be applied to installed items that are subject to extended out-of-service conditions.

5.157. The handling and storage process should also cover field storage of consumables such as lubricants and solvents to ensure that they are properly stored and identified.

5.158. Storage practices should be adopted to ensure that:

(a)Corrosive chemicals are well segregated from equipment and metal stock;

(b)Flammables are properly stored;

(c)Radioactive material is properly controlled;

(d)Stainless steel components are protected from halogens, sulphur and direct contact with other metals, in particular carbon steel;

(e)Relief valves, motors and other equipment are stored on their bases;

(f)Containers (boxes, barrels and crates) are stacked to reasonable heights and in accordance with instructions of the vendor and storage instructions;

(g)Parts, materials and equipment are repackaged or protective caps are reinstalled to seal items on which previous packaging or protective caps have deteriorated or been damaged or lost while in storage;

(h)Elastomers and polypropylene parts are stored in areas where they are not exposed to light;

(i)Machined surfaces are protected;

(j)Equipment internals are protected from the ingress of foreign material;

(k)Material, equipment and storage facilities are properly protected from rodents;

(l)There is suitable segregation of safety related and non-safety-related components.

5.159. Items removed from storage should be protected. In the handling of items, factors such as weight, size, certification and regular inspection of hoisting or lifting equipment, chemical reactivity, radioactivity, susceptibility to physical shock or damage, electrostatic sensitivity, sling location, balance points and method of attachment should be considered. Special handling tools and equipment should be provided, controlled and inspected periodically as necessary, to ensure safe and adequate handling.

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

Responsibilities and authorities are clearly allocated from the site VP to the engineering department and from the engineering department to different sections. The responsibilities and allocations of authority are clearly documented in procedures. However, the team found that the plant is experiencing some material condition deterioration and degraded equipment conditions. The team has made a recommendation on this issue.

The plant does not carry out a Periodic Safety Review (PSR) as set out in the IAEA safety standards, in relation to both the scope and the frequency. The team has made a suggestion on this issue.

The Probabilistic Risk Assessment (PRA) Group at the plant utilizes an All-Modes Risk Model to effectively manage risk associated with plant configuration on-line (Mode 1), during plant transitions (Mode 2 to 5) and during refuelling outages (Mode 6). The team considers this a good practice.

The Engineering Support Personnel (ESP) Training Program at the plant exhibits excellent line ownership. This ownership has led to control of training topics, timely completion of qualification requirements by new and experienced engineers, the development of a contract engineer qualification process, and an internalization of the importance of verifying qualifications prior to performing work. The team considers this a good practice.

5.2. SURVEILLANCE PROGRAMME

The plant has established and implemented a comprehensive and adequately documented surveillance program. However, the team found that there was some concern with the level of procedure use on Surveillance tests being 'reference use' and not 'continuous use' as expected. Some users were not clear on why surveillance procedures are designated "Reference Use" while their expectation was that they should be "Continuous Use." The team encourages the plant to resolve these discrepancies between standards and expectations and the classification of Surveillance procedures.

5.3 PLANT MODIFICATION SYSTEM

Engineering Change Post Modification Test Plans (PMTP's) test critical attributes to ensure design bases and margins are maintained. Implementation of the PMTP process has resulted in the focused development of design bases critical attributes during the development phase of the design. The Design Engineering Group is involved in the development and review of all Nuclear Projects Group design change packages that are prepared by outside contract engineering resources. This is seen by the team as a good performance.

5.4 REACTOR CORE MANAGEMENT

In the area of core management there exists a strong collaborative team effort between Operations, Reactor Engineering, Chemistry and Juno Nuclear Fuels to continually strive for zero fuel defects and robust core margins. This is a well implemented program, delivering good results over a number of fuel cycles, and using creative and proactive activities to keep improving the plant's fuel performance. The team considers this a good performance.

5.5 HANDLING OF FUEL AND CORE COMPONENTS

In the new fuel storage area and spent fuel pool area, there are no criticality warning notices or certificates posted locally. Criticality controls are established through analysis, design and administrative controls. The team encourages the plant to consider the use of locally posted criticality notices, to reinforce criticality control measures.

5.6. COMPUTER BASED SYSTEMS IMPORTANT TO SAFETY

The team found that, other than the software application on 'RM' system (Radiation Monitoring) the plant does not have a software test facility, or a dedicated team. There is much reliance on vendor test facilities. Although to-date this has not caused significant problems i.e. only one event in 2005 when new software was being checked for the Supplementary Diesel system, which caused an unexpected diesel start. Root cause analysis was carried out which has improved the software change process. Looking forward, the plant is looking at more application of digital or software based controls. The team encourages the plant to consider such evolution proactively in terms of resources and testing arrangements.

The plant has developed in-house software to automatically calculate and display RCS identified and unidentified leak rates. Plant staff are capable of identifying adverse trends in RCS leak rates in a timely manner due to the combination of an automated calculation and associated computer generated alarms. Reactor Engineering also implements the RCS unidentified leak rate monitoring program developed by the PWROG. The team considers this as a good practice.

5. DETAILED TECHNICAL SUPPORT FINDINGS

5.1 ORGANIZATION AND FUNCTIONS

5.1(1) Issue: The plant is experiencing material condition deterioration and degraded equipment conditions.

Although the plant has programs and plans for improving material condition, the following observations were made during the review:

- The Service Water (SW) system has experienced an increasing number of localized through wall leaks since 2006. During the last Refuelling Outage (OR14), following further inspection on the Service Water system piping, additional localized indications of thin wall were found during planned inspections.
- The SW system health report presented to the Plant Health Committee in January 2010, showed "material condition and configuration" as 'red', and also stated that "it is likely that SW will become a major issue for the station in the next 6 – 10 years if remedial actions are not taken".
- For Safety Injection valve 'SI-V-82', CR 05-04509 was issued in April 2005 identifying, during conduct of scheduled ISI examination, a medium quantity of dry boric acid at the body to bonnet joint. The boric acid needed to be cleaned in order to perform ISI [bolting] examination. This CR was closed to WO# 051184. SI-V-82 was cleaned three times under WO 051184:
  - 5/2/05 OR10
  - 10/13/06 OR11
  - 4/29/08 OR12
- Contingency WO# 0534894 was written in September 2005 to replace the body to bonnet gasket. WO# 0534894 was deferred from OR11 to OR12, and then deleted from the OR12 scope under Outage Scope Change Request (OSCR 12-009) with the rationale that the inactive leak does not pose a boric acid corrosion control issue and no evidence of metal loss exists.
- CR# 210441 was issued in November 2009 to clean the boric acid residue and replace the gasket at a later date and was closed to WR# 94002790. In November 2009, the valve was cleaned and WR# 94002970 was closed.
- During the return to power (Mode 3) in the last Outage, further leakage was discovered during the NOP/NOT walk-down. Following various assessments and an ODM, a temporary clamp and seal injection repair was executed. Following a Forced

Outage in June 2011, it was observed that the leakage had returned, using the installed camera arrangement.

- There are no trending reports generated for recurring inactive leaks (B1) in the Safety Injection and Containment Building Spray System Health Reports. There are also no trending reports generated for recurring inactive leaks (B1) in the Boric Acid Corrosion Control Program Health Report.

- In the course of an operating cycle the number of B1 leaks tends to trend up which is indicative of a strategy of cleaning boric acid residue rather than repairing the cause of the leakage.

- Groundwater intrusion is visible on walls and floors in many areas and has existed for a long period of time. Core bores have identified localized Alkali Silica Reaction (ASR) in a couple of continuously wetted areas. ASR results in a reduction in modulus of elasticity of the concrete but well within design limits. Pipe supports on Let-down Line and Seal return line are severely corroded by groundwater intrusion in -26 foot level Mechanical Pen pipe chase (AR 1649294 7th May 2011).

- Condensation problems in many areas, affects pipe work integrity through corrosion, industrial safety risk, and unsightly appearance, normalizing staff to degraded conditions. The lack of progress on Primary Aux Building (PAB) HVAC improvement (Work Order 00622721-01 'Repair/Replace/Redesign Unit substation 17' 12th July 2007), has not allowed a timely improvement in surrounding air environment.

- There are 15 outstanding defects on Diesel Generator 'A', going back to 2007. Oil leaks visible, with about 5 oil soak mats are present. There are 9 defects on Diesel Generator 'B', with the oldest going back to 2006. Each defect has been verified not to directly impact operability.

- Residual Heat Removal and Containment Spray Train 'A' areas were found in a poor material condition. Also the conditions in the Fire Water pump-house and the equipment within, was found to be degraded.

- The material conditions in many equipment rooms is degraded, with paintwork cracked and chipped.

Staff normalization to degraded material conditions around the Nuclear Power Plant can make identification of emergent issues and adverse trends more difficult. 'Bad things' are less likely to stand out. Material condition deterioration and degraded equipment conditions have the potential to affect equipment reliability and safety-system availability.

Recommendation: The plant should prioritize and enhance its programs and routines to improve the material condition and reduce equipment degradation, and thus enhance nuclear safety margins, and also improve the appearance and conditions throughout the facility.

IAEA Basis:

NS-R-2

6.4. The frequency of preventive and predictive maintenance, testing, surveillance and inspection of individual structures, systems and components shall be determined on the basis of:

(1) The importance to safety of the structures, systems and components;

(2) Their inherent reliability;

(3) Their assessed potential for degradation in operation and their ageing characteristics;

(4) Operational experience.

6.5. Repairs to structures, systems and components shall be performed as promptly as practicable. Priorities shall be established with account taken first of the relative importance to safety of the defective structure, system or component.

NS-G-2.6

9.18 Other items that should be subject to surveillance are those that, if they were to fail, would be likely to give rise to or contribute to unsafe conditions or accident condition.

Such items include:

- .....
- high energy piping and associated piping restraints
- structural supports (stack stay ways wires, pipe supports)

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.

116. Principle: Operational excellence is achieved in present and future nuclear power plant operations by: augmenting safety culture and defence in depth; improving human performance; maintaining excellent material condition and equipment performance; using self-assessments and peer reviews; exchanging operating experience and other information around the world; increasing application of PSAs; and extending the implementation of severe accident management.

5.1(2) Issue: The plant does not carry out a Periodic Safety Review (PSR).

The following observations were made during the review:

- There is evidence that the plant carries out specific safety reviews as per national regulation requirements, but these safety reviews are generally not consistent with the full scope of a PSR and do not always take account of improvements in safety standards and operating practices, and the cumulative effects of plant ageing.

- IAEA Safety Standards have established that the first PSR should be undertaken about ten years after the start of plant operation, and subsequent PSR's every ten years until the end of operation. The plant has not established this practice.

- IAEA Safety Standards have established that the scope of a comprehensive Periodic Safety Review should contain fourteen safety factors, divided into five subject areas, namely – i) Plant (design, condition of systems, structures and components, EQ, ageing) ii) Safety analysis (deterministic, probabilistic, hazards) iii) Performance and OE (safety performance, use of external OE and research) iv) Management (organization and administration, procedures, human factors, emergency planning) v) Environmental (radiological impact). This is concluded with a global assessment of plant safety, showing individual safety factor results, and agreed actions and improvements. The plant does not carry out safety reviews covering this scope at a ten year frequency.

As the plant does not carry out a comprehensive safety review covering all safety factors, at a ten year frequency, there is a potential for the plant to fall behind improving international safety standards, and suffer unexpected consequences from cumulative effects.

Suggestion: The plant should consider full adoption of the Periodic Safety Review scope and frequency.

NS-R-2

10.1. Systematic safety reassessments of the plant in accordance with the regulatory requirements shall be performed by the operating organization throughout its operational lifetime, with account taken of operating experience and significant new safety information from all relevant sources.

10.2. A comprehensive periodic safety review (PSR) of the plant would fulfil this requirement. The strategy for the review and the safety factors to be evaluated shall be approved by or agreed to by the regulatory body.

10.3. It shall be determined by means of the PSR to what extent the existing safety analysis report remains valid. The PSR shall take into account the actual status of the plant, operating experience, predicted end-of-life state, current analytical methods, applicable safety standards and the state of knowledge.

10.4. The scope of the PSR shall include all safety aspects of an operating plant, including both on-site and off-site emergency planning, accident management and radiation protection aspects.

10.5. In order to complement the deterministic assessment, consideration shall be given to the use of probabilistic safety assessment (PSA) for input to the PSR to provide insight into the relative contributions to safety of different aspects of the plant.

10.6. On the basis of the results of the systematic safety reassessment, the operating organization shall implement any necessary corrective actions and any reasonably practical modifications for compliance with applicable standards.

NS-G-2.10

3.5. The PSR should be conducted typically every ten years and its duration should not exceed three years. The starting point of a PSR is the time of the agreement between the operating organization and the regulatory body on the general scope and requirements for the PSR and its expected outcome. The end point of a PSR is the approval by the regulatory body of an integrated programme of corrective actions and/or safety improvements (containing a list of corrective actions and/or safety improvements and a schedule). (In general, adequate documentation of the design basis and of probabilistic safety assessment (PSA) is needed for a PSR. If such documentation is not readily available and a major effort would be necessary to obtain it, consideration should be given to obtaining it by means of projects separate from the PSR).

INSAG - 14

Principle:

46. The reference safety level of a nuclear power plant is improved as far as reasonably practicable throughout its operating lifetime, taking into account advancements in knowledge, notably through the feedback of operating experience, and the safety levels of newer plants.

48. Here it is emphasized that, where reasonably practicable, this reference safety level is improved over time. The rationale is that the expected operating lifetime of a nuclear power plant covers decades; what was once considered an acceptable safety level may be judged insufficient 30, 20 or even 10 years later.

Principle:

61. Safety reviews are undertaken to provide an overall view of the actual safety status of a nuclear power plant. They include a determination of whether its ageing is being effectively managed as well as a discussion on the possible evolution of its reference safety level.

62. Safety reviews of the overall technical status of each individual plant, which look forward over a sufficiently long period of potential future operation of this plant (for example ten years), are undertaken to provide confidence that it would be technically feasible to operate the plant in consistency with the applicable safety requirements during the further operating period. Safety reviews take into account the reference safety levels for newer plants as well as the developments in technology and advancements in underlying scientific knowledge and analytical techniques.

63. Safety reviews provide important inputs into the decisions of the operating organizations on the further operating times of the plants and on the investments that they are prepared to make to secure those operating times.

5.1(a) Good practice: The Probabilistic Risk Assessment (PRA) Group at the plant utilizes an All-Modes Risk Model to effectively manage risk associated with plant configuration on-line (Mode 1), during plant transitions (Mode 2 to 5) and during refuelling outages (Mode 6). This All-Modes PRA allows configuration risk management to be performed using the same PRA tool (Safety Monitor), the same risk thresholds, and similar processes for the plant in any configuration. In addition, the At-Power PRA explicitly includes all internal hazard events (internal flood, internal fire) and external events (seismic events, high wind, etc). Another PRA model has been developed for fuel in the spent fuel pool. These models allow for quantitative assessment of all locations where irradiated fuel is located - reactor core, spent fuel pool, or in transit.

Examples/Results Achieved

- On-line configuration risk evaluations are performed weekly by the PRA department. This evaluation identifies maintenance configurations that, if they occurred simultaneously, would result in excessive risk. In most cases, the risk management action is simple - to maintain schedule adherence which assures important activities do not occur at the same time. In a few cases, the maintenance schedule is revised to control critical activities that should not occur at the same time.
- Risk assessment of the proposed outage schedule is performed prior to each refuelling outage. This assessment allows Outage Management to optimize the schedule with regard to risk. During each outage, the PRA Group evaluates the schedule daily and works closely with Outage Management to assure schedule changes do not introduce any excessive risk. There were no unplanned/unintended risk colour changes during refuelling outages OR12, OR13 and OR14 due to the PRA group support and integration with the station.

5.1(b) Good practice: The Engineering Support Personnel (ESP) Training Program at the plant exhibits excellent line ownership.

This ownership has led to control of training topics, timely completion of qualification requirements by new and experienced engineers, the development of a contract engineer qualification process, and an internalization of the importance of verifying qualifications prior to performing work.

The following items are in place to ensure qualified contract engineers perform work at the plant:

1) A list of Contract Engineers working at the plant is reviewed at the ESP Training Review Committee (TRC) Meeting on a monthly basis for inclusion of personnel into the ESP Training Program Continuing Training Program. Selected Contract Engineers (based on their work activities) are required to attend the same Continuing Training as in-house engineers.
2) A unique Qualification Guide has been prepared for Contract Engineers to provide qualification of the work activity processes that are employed at the plant. Contract Engineers are required to be qualified for tasks that in-house engineers are qualified to perform.
3) The qualification verification tools in place allow for verification of qualifications of all engineering personnel, including Contract Engineers. Contract Engineers are required to verify qualifications similarly to those of in-house engineers (in accordance with QM 4.11).

The ESP Training Program also utilizes a New Engineer Training Kick-off Meeting to provide new engineers with a clear understanding of the expectations and requirements associated with training and qualification. The meeting covers topics such as Accreditation History, Qualification processes and requirements, Training Attendance Expectations, and utilization of the Learning Management System (LMS) database.

5.6 COMPUTER BASED SYSTEMS IMPORTANT TO SAFETY

5.6(a) Good Practice: Reactor Coolant System (RCS) leak rate management.

Reactor Engineering developed in-house software to automatically calculate and display RCS identified and unidentified leak rates. Key attributes of the automated calculation are:

- No need for operator supplied input data.
- The software accommodates expected operational events such as RCS makeups, Reactor Coolant Drain Tank automatic pump downs, and Volume Control Tank diverts while still maintaining the leak rate calculation.
- Current leak rates are always available to the operators through the station computer.
- Operator set point adjustable computer generated warning alarms are used to detect small changes in leak rate. These operator adjustable leak rate alarms help with timely identification of small increases in leak rates.
- Calculated leak rate values are used directly to monitor compliance with administrative limits on allowed leakage. These administrative limits are set at very low levels (starting with an investigation of leak rate increases in excess of 0.05 gpm) and, when exceeded, call for escalating levels of investigation and monitoring to identify and correct the source of the increased leak rates.
- Computer generated Technical Specification alarms will alert the operator that a condition exceeding a Technical Specification limit has occurred.
- Calculated leak rate values are used directly to by the operators to satisfy Technical Specification surveillance requirements for a periodic RCS inventory balance.
- An on demand computer screen displays the leak rates for the last 72 hours allowing for quick evaluation of near term leak rate trends.
- An RCS leak rate monitoring inoperable alarm if insufficient data exists to allow for a meaningful calculation.

Examples/Results Achieved:

Plant staff are capable of identifying adverse trends in RCS leak rates in a timely manner due to the combination of an automated calculation and associated computer generated alarms. Reactor Engineering also implements the RCS unidentified leak rate monitoring program developed by the PWROG. The purpose of this program is to look for small but statistically significant increases in the RCS unidentified leak rate. In this process a baseline leak rate is determined and action levels are defined if a change in the leak rate is identified. Leak rates normally being monitored are well below the values allowed by Technical Specifications. For example the baseline leak rate in the previous operating cycle was 0.01 gpm. The Technical Specification limit for RCS unidentified leak rate is 1.0 gpm.

6. OPERATING EXPERIENCE FEEDBACK

6.2 REPORTING OF OPERATING EXPERIENCE

When the plant personnel identify or question an adverse or potentially adverse condition outside their normal area of responsibility they are encouraged to report it. The initiated Condition Report is then screened by the Initial Screening Team and the Management Review Committee. This Condition Report is then coded with the "Good Catch" attribute. Good Catches are recognized by department managers at shop floor and team meetings. Additionally one Good Catch is selected each month and its initiator is rewarded. His\her good catch is then published in the next Performance Improvement Digest. The team considers this to be a good practice.

Plant personnel, at all working levels and throughout all departments, are motivated and supported to initiate Condition Reports for any unwanted or unexpected conditions. This is reported through the Corrective Action Program (CAP) and minimizes the potential that a condition adverse to quality would go unreported. There is no "minimum" threshold for Condition Report initiation. Last year the plant processed 12130 Condition Reports. The team considers this to be a good practice.

6.3 SOURCES OF OPERATING EXPERIENCE

The team encourages the plant to regularly perform screening of US regulation 10CFR21 reports and include IAEA Incident Reporting System reports in the scope of their Operating Experience process. Both reports are easily accessible over the internet. There are other processes in the plant and outside the plant that ensure that information from these reports are captured. However proactive plant engagement can eliminate the possibility of missing important information from these sources and the team encourages the staff to enhance their activities in this area.

6.5 ANALYSIS

The team found that the Operating Experience process would allow the start of some Causal Evaluations and Causal Factor determinations to be delayed which can negatively influence the quality of evaluations results. Furthermore this can delay important actions for the prevention of more significant events. The team suggests that the plant enhance attention to the timeliness of the event investigation and analysis process to improve the ability of the staff to recognise significance and early signs of safety related system, structure or component degradation. The team has identified a suggestion in this area.

6.6 CORRECTIVE ACTIONS

The team found that in some cases the plant is prematurely closing the corrective actions which could adversely influence the effectiveness of preventing recurrence of failures or abnormal conditions. The team suggests that the plant improve the process in the Corrective Action Program to avoid premature closure of actions.

6.7 USE OF OPERATING EXPERIENCE

The team found that Operating Experience information is not easily accessible to station personnel. The unavailability or difficulty in easily retrieving required information from Operational Experience databases prevents staff and evaluators in fully assessing and understanding actual problems during event investigations and trending processes, and in using operating experience information in the field. The team suggests that the plant consider increasing the user-friendliness of accessing available information stored in OE databases.

DETAILED OPERATING EXPERIENCE FINDINGS

6.2 REPORTING OF OPERATING EXPERIENCE

6.2(a) Good Practice: Good Catch program

The plant recognizes "good catches" – the use of a questioning attitude that identifies issues and/or prevents problems.

Promotion of a questioning attitude is performed via Human Performance tool training and reinforcement. Recognition of this is facilitated by the Condition Report process. Condition Reports (CR) are initiated to document issues with plant equipment, procedures, PMs, and programs. These CRs are then screened by the Initial Screening Team and the Management Review Committee. When personnel identify or question a situation outside their normal responsibility, these CRs are then coded with the "Good Catch" attribute.

Good Catches are recognized by department managers at shop and team meetings. Additionally, the Performance Improvement group monitors Good Catch performance and selects one good catch each month to more publicly recognize. This person is then awarded a designated parking space for the next month. The next Performance Improvement Digest (a publication highlighting Performance Improvement functional areas) includes a photo and synopsis of the good catch.

In 2010, over 339 good catches were documented, and to date, the 2011 numbers exceed 138.

6.2(b) Good Practice: Healthy Reporting Culture - Low-threshold, High-volume reporting system.

Participation in the CAP program is in place at all worker levels and throughout all departments, including the supplemental departments of Security and Nuclear Projects. Self-identification of Issues and Performance is measured (SIPR) and is valued by department managers and workers.

Plant personnel exhibit ownership of the Condition Report (CR) process, using it to identify plant and equipment concerns, process issues, facility problems, and other areas of frustration and interest. The CR program often contains questions and documents Good Catches.

Leadership review and involvement in CAP allows better understanding of personnel concerns, affords the opportunity for cognitive trending, provides insight into the quality of procedures and preventative maintenance documents, and allows for the early identification of safety culture potential issues. This engagement in CAP, both by initiation and via screening and ownership, enables leadership to gauge the culture of the organization and to take immediate action(s) to address issues and concerns with plant equipment, processes, training, procedures/PMs, and people.

Plant champions the "when in doubt, fill it out" philosophy for CR initiation. This philosophy ensures that all unwanted or unexpected conditions are reported in through the Corrective Action Program (CAP) and minimizes the potential that a condition adverse to quality would go unreported. There is no "minimum" threshold for CR initiation.

Approaches which facilitate their good practice:

- Work requests initiated through the operating experience database (NAMS) "wizard" (referred to as SPOE – single point of entry), are issued as a WR/CR pair automatically.
- Computer kiosks are available at several locations within the Owner Controlled Area and Protected Area to allow CR initiation for personnel that do not have access to the Local Area Network (LAN).
- Paper CRs can also be submitted and are subsequently entered into the NAMS system verbatim (excluding names).
- Station leadership has reinforced expectations for supervisory personnel to initiate a CR when requested by a supplemental worker, vendor or visitor.
- Anonymous CR entry is available from any computer and is the default "originator" at the computer kiosks.

Last year plant processed 12130 Condition Reports.

6.5 ANALYSIS

6.5(1) Issue: The Operating Experience process would allow the late start of Causal Evaluations and delayed Causal Factor determination which can negatively influence the quality of evaluations results.

- CR 208571 "LP Turbine C coupling misalignment" issued in October 2009 (during the outage) was approved in August 2010. Equipment failure mechanism is still not determined.
- For Significance Level (SL) 2 many investigations start immediately and some Apparent Cause Evaluations (ACE) are not required. Other ACEs are assigned usually few days after discovery of the failure and therefore the initial investigation could be delayed. This can result in a missed opportunity for the most reliable information in case of HP events (ACE is assigned for around 50 % of all SL 2 Condition Reports).
- The Quality of Cause Analyses indicator (percentage of CR evaluations that pass final approval) value decreased from 95.6% to 87.9 % (Green to Yellow) in May.
- High humidity and cold Service Water pipelines in Primary Building results in condensation of water. Water is corroding iron bolts of heat exchanger. No thorough analysis has been performed to address the causes and prevent further corrosion (floor is just covered with special coating to prevent slipping).

The potential late start of Causal Evaluations and delayed Causal Factor determination can delay important actions for the prevention of more significant events.

Suggestion: The plant should consider enhancing attention to timeliness of the causal evaluation and causal factor determination.

IAEA Basis:

NS.R.2

2.21 Operating experience at the plant shall be evaluated in a systematic way. Abnormal events with significant safety implications shall be investigated to establish their direct and root causes. The investigation shall, where appropriate, result in clear recommendations to the plant management, which shall take appropriate corrective action without undue delay. Information resulting from such evaluations and investigations shall be fed back to the plant personnel.

6.6 CORRECTIVE ACTIONS

6.6(1) Issue: The Operating Experience Process is not fully effective in ensuring timely closure of corrective actions.

- In a sample of 12 Condition Reports from 2010 connected with procedure changes, 26 actions (assignments) are defined and closed. Five of those actions are improperly closed (CAP non-compliances).
- Formal effectiveness reviews are performed on small number of Condition Reports (SL 1 events and 10% of SL 2 of corrective actions).
- Root Cause Evaluation (RCE) report "LP Turbine Coupling C Misalignment" states that "closing actions before they are complete" contributed to the event.

Premature closure of corrective actions can adversely influence the effectiveness of the prevention of recurrence of failures or abnormal conditions.

Suggestion: The plant should consider ensuring timely closure of corrective actions to improve the effectiveness of the Operating Experience process.

IAEA Basis:

NS.G.2.11

5.2. The development of recommended corrective actions following an event investigation should be directed towards the root causes and the contributory causes, and should be aimed at strengthening the weakened or breached barriers that failed to prevent the event. Personnel at nuclear installations are responsible for implementing corrective actions promptly and effectively. A sense of personal interest or 'ownership' should be promoted by involving the members of the organization's event investigation team in formulating the corrective actions to be recommended.

6.7 USE OF OPERATING EXPERIENCE

6.7(1) Issue: Operating experience information is not easily accessible to station personnel and in case of urgent use it could be unavailable.

- A search for a CR in the NAMS database was performed to find an event with a Yellow bootie in Turbine Building. It took several minutes longer than expected. The search was performed by experienced professional (background: OE, QA, MA supervisor). The same person performed a search to find the plant response to a NRC document about underground cables. He was not able to find it in 12 minutes.
- Recent Operational Experience discussed in Pre Job Briefings is not written in the tool "Operations Pre Job Brief" for procedure OX1426.01 "DG 1A Monthly Operability Surveillance".
- For the analyses of 12 sampled CRs in NAMS, an evaluator (skilled OE expert) needed a much more than estimated maximum 2 hours.
- For Root Cause Evaluation 208571 "LP Turbine C coupling misalignment" (approved in October 2010) in NAMS, the Corrective Action Program Coordinator (CAPCO) should put event codes (causal codes and applicable notes) in CR system. However as this was not done the information is not accessible.

The difficulty in easily retrieving required information from Operational Experience databases (NAMS) could prevent staff and evaluators in fully assessing and understanding actual problems during event investigations and trending processes, and in using operating experience information in the field.

Suggestion: The plant should consider increasing the user-friendliness of accessing available information stored in OE databases.

IAEA Basis:

NS.G.2.11

6.1. The IAEA Safety Requirements for Operation [2] states in para. 2.23 that "...operating experience shall be carefully examined by designated competent persons for any precursors of conditions adverse to safety, so that any necessary corrective action can be taken before serious conditions arise".

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 organization 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.

7. RADIATION PROTECTION

7.1 ORGANIZATION AND FUNCTIONS

The plant has established the Radiation Protection Program according the US federal regulations. However, the limits are not in line with the IAEA Safety Standards, in fact they are higher than those established by the BSS-115.

There is no visible application of the RP sectors' specific key performance indicators; therefore the organization can lose opportunities for continuous improvement, whilst it resides in a skill mode performance approach. The use of specific key performance indicators could improve the resilience of the organization in case the plant experiences a change in the performance mode. The ALARA principles are clearly defined; however, minor radiological events like portal contamination alarms or small articles monitor alarms are not tracked and trended in a timely way.

There is also a gap regarding the health surveillance for the radiation workers. No specific program is assigned to cover their health, which is below the established international standards. Moreover, the radiation protection organization does not include medical clearance for entering into the radiological controlled areas. The team made a suggestion in this area.

7.2 RADIATION WORK CONTROL

Training and instructions are provided for the radiation workers. However, there are examples showing that inadequate instructions are provided. In some instances, poor self-monitoring practices were observed, while radiation protection technicians did not correct these in a timely manner. The defence in-depth criterion is not required for monitoring when leaving working areas inside radiological controlled areas; in cases where workers apply such practice, it is undertaken only due to their willingness and skills.

The authorized doses and dose rates for assigned radiological work permits (RWP) are far higher than the actual performed values. The set points for dosimeters are not in accordance with the work to be performed, giving opportunities for non-authorized evolutions under the RWP.
The control of designated areas and individual work sites is not effective. The layout of the RCA access points is such that it permits interaction between people leaving and going inside the RCA; also, the working areas are ergonomically poor, bringing opportunities for poor contamination control and inadequate behaviours.

Vehicles leaving the Restricted Area (which matches the concept from BSS-115 for a Supervised Area) of the plant are not automatically monitored by vehicle portal monitors; instead, they are manually monitored. An automatic monitoring system may provide a more robust barrier.

Radioactive Materials Storage outside the RCA occurs at the plant. The criteria at the associated fencing and posting potentially could permit people working nearby the containers to receive a dose greater than that for the public, even in case where they may not be radiation workers and do not use dosimeters. The team made a recommendation in this area.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

The plant has a 5 years ALARA plan, which encompasses many actions for reducing the outage work dose. However, no actions are in place or planned to reduce the low dose rates at the plant, either during outage or online.

The radiation protection ALARA staff do not balance and/or compare the collective dose against man-hours, and do not present this to the plant staff, in order to permit a better understanding of the importance of optimizing the time spent inside radiation areas and reinforcement of the necessity to reduce the low dose rates inside the RCA.

The practice to provide "dose extensions", when a worker is allowed to receive doses above the authorized administrative limits, is not specific to the job to be performed, is not formally accepted by the worker and is not approved by the Plant Manager. This gives the opportunity for using this exception as a common feature that is not presented in the RP specific key performance indicators.

The plant uses the old standards from ICRP26, which was superseded first by the ICRP-60 (1990) and later by the ICRP-103 (2007). Therefore, the units and quantities used by the plant are not in line with the IAEA BSS-115 – International Basic Safety Standards for Ionizing Radiation and for the Safety of the Radiation Sources. The team made a recommendation in this area.

7.4 RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

The plant has an adequate program for radiation protection instrumentation. However, the RP calibration facility has an irradiator which delivers as much as 8 Sv (800 Rem) per hour. The interlock arrangements allow the operator to go inside the irradiation room while the irradiator is running. This is a gap regarding the safety of the source, because a failure in the detector's protection features combined with inadequate behaviour may cause severe health damage. The team made a suggestion in this area.

7.5. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The plant has a comprehensive effluents monitoring program, encompassing all the pathways for the plant releases. Nevertheless, the team encourages the plant to continue their efforts to monitor for any tritium movement in ground water.

DETAILED RADIATION PROTECTION FINDINGS

7.1. RADIATION PROTECTION ORGANIZATION AND FUNCTIONS

7.1(1) Issue: The plant radiological administrative limits, use of performance indicators and health surveillance are not aligned with the international standards.

- The plant's administrative limits for temporary contractors is 30 mSv per year (3 Rem/year), which is above the prescribed limit in IAEA BSS-115 of 100 mSv/5 years (averaging 20 mSv/year).
- There is no specific medical requirement for workers going inside the RCA. The radiation workers are treated exactly as the non-radiation workers in the plant. RP don't receive information from Medical Dept.
- Alarms of the portal contamination monitor are not tracked and trended on a routine basis. The RP Supervisor of the Main Control Point does not track the number of daily alarms. The reason given is that there are various alarms due to radon concentration, frequently challenging the alarms at the portals and contributing to workers not considering the importance of the alarms.
- Some contamination alarms sounded in the Small Articles Monitor at the exit of RCA. No records are made by RP regarding the alarms. The RP Supervisor said that they were radon alarms.
- Plant specific RP key performance indicators do not include indicators about the number of portal contamination monitor alarms or rate of alarms, and there is no ALARA average collective dose rate index.
- No control is in place to log the number of dose extensions performed above the administrative limits.

Suggestion: The plant should consider improving the radiological administrative limits, specific performance indicators and health surveillance program and in line with international standards.

IAEA Basis:

BSS-115

2.23. The normal exposure of individuals shall be restricted so that neither the total effective dose nor the total equivalent dose to relevant organs or tissues, caused by the possible combination of exposures from authorized practices, exceeds any relevant dose limit specified in Schedule II, except in special circumstances provided for in Appendix I. Dose limits shall not apply to medical exposures from authorized practices.

II-5. The occupational exposure of any worker shall be so controlled that the following limits be not exceeded:
(a) an effective dose of 20 mSv per year averaged over five consecutive years;
(b) an effective dose of 50 mSv in any single year;
(c) an equivalent dose to the lens of the eye of 150 mSv in a year; and

(d) an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.
NS-G-2.7

2.9 …the operating organization of the nuclear power plant is required to ensure that doses conform to the dose limits specified by the regulatory body in respect of the exposure of workers and of members of the public (Ref. [2], paras I.4 and III.2). These dose limits should be in accordance with those specified in Schedule II of the BSS….

3.61. Health surveillance programmes shall be: (a) based on the general principles of occupational health; and (b) designed to assess the initial and continuing fitness of workers for their intended tasks" (Ref. [2], para. I.43).

3.62. … It should utilize the services of a physician who has been adequately trained in radiation protection and has the necessary understanding of the biological effects of radiation exposure and the risks associated with exposure, both in routine operations and as a consequence of an accident [6].

3.64. The supervisor of the health surveillance programme should be consulted on the use of protective clothing and respiratory equipment by personnel who wear such clothing or equipment for performing their duties.

3.65. In general, specific medical information about an individual is confidential. However, if an individual is not medically fit to perform his or her tasks, the physician should inform the management, as appropriate, in accordance with the recommendations of the regulatory body.

RS-G-1.1

4.7 Management should record information on the way in which they are implementing optimization of radiation protection. This information could include the following: (a) The rationale for proposed operating, maintenance and administrative procedures, together with other options that have been considered and the reason for their rejection; (b) Periodic review and trend analysis for occupational doses to various work groups, and other performance indicators; (c) Internal audits and peer reviews, and the resulting corrective actions; (d) Incident reports and lessons learned.

7.2. RADIATION WORK CONTROL

7.2(1) Issue: Radiological control and supervision of activities as regard to radiological conditions in the plant are not fully effective.

- A worker leaving the posted contaminated controlled area of the Spent Fuel Pool touched with his cotton gloves the cover of the container for used protective clothes. The RP Supervisor coached him to use his rubber glove for such action. The worker also touched a contaminated part using his cotton glove, expected to be clean.
- A worker removed the alarmed flashlight from the Small Articles Monitor – SAM with his naked hand, placed it over a table and left the RCA (removing alarmed materials from SAM is not the RP expectation). The RP Tech at Main Control Point went to check the alarmed material only when requested by RP Supervisor.
- A worker triggered an alarm from the SAM and opened the monitor's door and re-closed the door. When doing this, the equipment recounts the background assuming the alarmed material as zero counts. This behaviour provides an opportunity for releasing contaminated material without RP control.
- After sampling the ventilation system, the Chemist left the area, passed by 2 contamination monitors and did not check for contamination.
- Setting alarms for RWP dosimeters: systematically these are set as 100 mR/h and 20 mR per entry, even for maximum doses rates varying from 0.3 to 3 mR/h and doses less than 0.1 mR. This contributes to avoiding a condition report but also avoids knowing the minor deviations regarding adherence to the approved RWP.
- RP opts not to use decimals of mR. The lowest measurable value is 1 mRem or 1 mR/h (or 10 microSv or 10 microSv/h according to SI units).
- A routine RWP for Chemistry permits sampling for every system in the RCA, independently of the radiation levels – the set point for alarms are 20 mRem (200 microSv) and 100 mR/hour (or 1 mSv/hour). The set point for the RWP is not specific to the job.
- Electrical cables pass through the contaminated fume hood of the RCS Sampling System, preventing it from being completely closed when not in use.
- The plant considers all the Protected Area as a Restricted Area. Such consideration increases the size of the area under RP concern, permitting the storage of more radioactive materials in containers or buildings which alters the background area.
- There is no posting stating that the Protected Area (security definition) is also the Restricted Area (RP definition by NRC 10 CFR 20) which matches the concept for IAEA NS-G-2.7 Supervised Area definition.
- Radioactive material is stored in the outside area of the plant buildings, some for long time and in one case with poor material conditions, also the label on one box was not readable.
- RP do not post frequency and/or dates in the RP postings, only the radiological values. This reduces the accountability from the plant workers relating to the radiological levels, since the workers in general have no way to see if the frequency is being obeyed and that the dates reflect the last movement for the radioactive materials in the area.
- RP do not have the inventory of the boxes with radioactive material permanently stored inside RCA or have the control of their keys, which remains with the user

(I&C, etc).
- One person left the RCA without passing his gloves trough the Small Articles Monitor.
- No postings indicating "Controlled Area" are posted in Dry Storage Cask.

The plant workers do not always follow the instructions provided for adequately self-monitoring when leaving radiological areas; RP technicians work reactively according to the demand; and the RWP program effectiveness could be improved by setting alarms specific to the source term, considering job and workplace. This increases the potential for a radiological challenge and reduces the effectiveness of the radiation work control.

Recommendation: The plant should ensure that the radiological control and supervision of activities as regard to radiological conditions in the plant are fully effective.

IAEA Basis:

NS-R-2

8.4. All site personnel shall have individual responsibility for putting into practice the exposure control measures which are specified in the radiation protection programme. Consequently, particular emphasis shall be given to training all site personnel so that they are aware of radiological hazards and of necessary protective measures.

NS-G-2.7
2.20. The optimization of the measures for protection and safety associated with any particular source or operation in a practice should be subject to dose constraints. [2.21.] A dose constraint is a source related value of individual dose used to restrict the range of options considered in the process of optimization. A dose constraint is not a limit but a ceiling on the values of individual dose that should be considered acceptable in the optimization process. It is used prospectively for the planning and executing of tasks as well as for design purposes.

2.22. In order to apply the principle of optimization, individual doses should be assessed at the operational planning stage, and the predicted individual doses for the various options should be compared with the appropriate dose constraint. Options predicted to give estimated doses that would exceed the constraint should normally be rejected.

2.23. For occupational exposure in a nuclear power plant, the constraint should be related to a particular task or a complete operation. It should therefore be set by the operating organization on a case by case basis according to the specific circumstances of the exposure. The regulatory body, rather than itself stipulating values of constraints, should generally encourage the operating organization of the plant to develop constraints, subject to regulatory control.

3.11. Changing areas shall be provided, as appropriate, at the entrances to and exits from those zones which are contaminated or may become contaminated (Ref. [2], para. I.23). Changing areas should be designed to prevent the spread of contamination by means of partition into a clean side and a potentially contaminated side. The facilities that should be provided are specified in paras 3.56–3.60.

3.13. Before items are removed from any contamination zone, and in any case before they are removed from controlled areas, they are required to be monitored as appropriate (Ref. [2], para. I.23) and suitable measures should be taken to avoid undue radiation hazards.

3.14. The operating organization "shall designate as a supervised area any area not already designated as a controlled area but where occupational exposure conditions need to be kept under review even though specific protection measures and safety provisions are not normally needed" (Ref. [2], para. I.24). Supervised areas should be delineated by appropriate means, with account taken of the nature and extent of the radiation hazards. Approved signs should be displayed at appropriate access points, and the conditions should be periodically reviewed to determine whether there is any need for protective measures and safety provisions or for changes to the boundaries of the supervised areas.

3.44. ...Information and instructions that may be given in the RWP in addition to a description of the work would include for instance: (a) details of average dose rates and possible areas of elevated activity in the working area on the basis of a survey made prior to the work or otherwise estimated; (b) estimates of contamination levels and how they might change in the course of the work...

3.56. The management should provide certain facilities that are necessary for effective radiological control in the operation and maintenance of the nuclear power plant and for responding to emergencies. The facilities should include:... (c) an equipment decontamination facility, a storage area for contaminated items and tools, a special workshop for maintenance of radioactive components and a store for radiation sources...

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

7.3(1) Issue: Control of the occupational exposure for the plant's workers is not always fully effective.

- When collecting reactor coolant water samples, the worker opened valves with one hand and used the other to take notes in the procedure. During the flushing and even when not in use, the contaminated fume hood remained with its window opened. Later, the worker had the reactor coolant water flowing in contact with his gloved hands (while holding the flasks). However, the procedure was behind him, he had to move about 1 m out of the contaminated fume hood to check the procedure. To dispose of the contaminated gloves, he had to walk throughout the clean area to place them in the contaminated bin.
- When passing through the Portal Contamination Monitor, a worker used the wall detector to support his left shoulder, thus increasing the distance of the right side of his body from detector – RP tech at MCP did not correct it, in fact the RP technician did not observe and coach people leaving the RCA.
- Filter transfer bell – the lifting ring was covered by plastic and labelled as contaminated; it could be decontaminated instead of bagged, then leaving only fixed contamination.
- No specific lab coat is used to perform sampling inside RCA. The same lab coat is used to collect the samples and walking throughout clean areas until arrival to the Hot Lab.
- The plant does not have a comprehensive plan to reduce low levels of radiation. Such a plan could considerably reduce collective dose and also contribute to improving oversight in RCA. Low dose rates are not effectively considered within the ALARA arrangement of the plant.
- The ALARA Group does not balance and compare the collective doses against man-hours. This would enable the plant better to understand the importance of optimizing the time spent inside radiation areas.
- The RP Shift Technician stays at the Main Control Point while logged as inside the RCA. The RP manager stated that he is required in to be logged to promptly attend any alarm inside RCA. While this practice is useful to improve prompt response, it does not support good ALARA practices. Potential concerns are: biased numbers about manpower used in RWP's, difficulty understanding work load, and an inaccurate ratio of Collective Radiation Exposure/Total Man-hours.
- The plant provides "dose extension" according to the need, when a worker may receive doses above the limits, however, this authorization is not specific for the authorized task or operation, and may allow a worker to continue to work for a long period. In addition it is not required to have the worker's sign the extension form.

There are examples of poor contamination control at the plant, an absence of an ALARA Plan for low level radiation, and with no proactive use of dose constraints on specific work or operation to be performed. Such practices could lead to spreading of contamination.

Recommendation: The plant should improve the effectiveness of workers' exposure controls.

IAEA Basis:

NS-G-2.6

6.13. Arrangements for the feedback of MS&I experience should include, but are not limited to, the following: (a) Collecting, evaluating, classifying and recording details of abnormal events or findings, in order to detect precursors, common mode failure mechanisms and deficiencies of equipment or personnel; (b) Providing experience gained from actual activities to the design groups, in order to enable them in the future to improve plant features which have a bearing on MS&I, such as ease of access, ease of disassembly and reassembly, and implementation of the ALARA principle...

NS-G-2.7

2.3. ... In nuclear power plants, dose limitation should be applied to: —doses due to occupational exposures incurred in the plant by the personnel of the operating organizations; —doses due to occupational exposures incurred in all plants and facilities by contractors; —doses due to exposures incurred by members of the public as a result of activities in radioactive waste management and effluent discharges deriving from the nuclear power plant. Account should be taken of doses due to exposures arising from other sources and facilities.

2.14. The optimization of protection and safety measures, or the application of the ALARA principle (to keep doses as low as reasonably achievable, economic and social factors being taken into account), should be carried out at all stages during the lifetime of the equipment and installations. In the optimization, all relevant factors should be taken into account, such as: (a) the balance between doses to workers and doses to the public; (b) the balance between present doses due to discharges and future doses due to confinement of the same radioactive substances solidified as waste; (c) exposures arising from different tasks; (d) requirements relating to nuclear safety, conventional safety and radiation protection; (e) options for radioactive waste management and decommissioning.

2.19. Operational considerations for a dose control programme include the actions to be taken once the plant is operating in order to optimize doses to workers involved in routine operation, maintenance, repairs, refuelling, plant modifications, in-service inspection and waste management (the handling, transfer, storage and disposal of radioactive waste). Such actions should include actions for reducing the amount of radioactive products in reactor systems, as described in Section 3.

3.75. Finally, each worker should also have specific responsibilities, such as: (a) putting into practice the exposure control measures specified in the RPP; (b) identifying and suggesting improvements and good practices for the reduction of exposure wherever possible.

NS-G-2.8

5.5. All persons likely to be occupationally exposed to ionizing radiation — that is, not only radiation protection staff — should receive suitable training in (a) radiation risks and (b) the technical and administrative means of preventing undue exposure and applying the ALARA (as low as reasonably achievable) principle.

RS-G-1.1

3.1. A dose limit is defined in the BSS as "The value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded." The limits on effective dose for occupational exposure apply to the sum of effective doses from external sources and committed effective doses from intakes in the same period (Ref. [2], para. II-5):

The occupational exposure of any worker shall be so controlled that the following limits be not exceeded: (a) an effective dose of 20 mSv per year averaged over five consecutive years; (b) an effective dose of 50 mSv in any single year; (c) an equivalent dose to the lens of the eye of 150 mSv in a year; and (d) an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.

7.4 RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

7.4(1) Issue: Gap in the Calibration Facility irradiator regarding entry inside irradiation room during irradiation session.

- The RP calibration facility has an irradiator which delivers as much as 800 Rem/h (8 Sv/h) – however, sometimes the operator goes inside the irradiation room while the irradiator is running.

Even if operator states that it is only done at low radiation level and that there are beam interlocks, there's still a concern that the facility enables such evolution. This is a high risk situation, in case of interlock failure, inappropriate behaviour and beam scattering.

Suggestion: The plant should consider reinforcing the access controls to go inside the irradiation room while the source is exposed.

IAEA Basis:

NS-G-2.7

2.34. In para. I.4, the BSS (Ref. [2]) state that, to fulfil their responsibilities:

Employers, registrants and licensees shall ensure, for all workers engaged in activities that involve or could involve occupational exposure, that: (a) occupational exposures be limited as specified in Schedule II; (b) occupational protection and safety be optimized in accordance with the relevant principal requirements of the Standards; ... (d) policies, procedures and organizational arrangements for protection and safety be established for implementing the relevant requirements of the Standards, with priority given to design and technical measures for controlling occupational exposures; (e) suitable and adequate facilities, equipment and services for protection and safety be provided, the nature and extent of which are commensurate with the expected magnitude and likelihood of the occupational exposure;...; and (k) necessary conditions to promote a safety culture be provided.

8. CHEMISTRY

NOT REVIEWED

9. EMERGENCY PLANNING AND PREPAREDNESS

9.2 RESPONSE FUNCTION

The arrangements for the management of people on site but outside the protected area during emergencies are not fully effective in terms of evacuation and accounting. Also some of the signs for evacuation routes from the site in case of emergency situations are not posted. The team identified this as an issue and recommends the plant revise and enhance the effectiveness of the emergency arrangements for people on site during emergencies to comply IAEA safety standards.

9.3 EMERGENCY PLANS AND ORGANIZATION

The Radiological Emergency Plan includes two main parts in line with international standards: onsite and offsite plans which are well coordinated. It establishes organizations and response to emergencies at the plant level with well-coordinated notifications and recommendations to both States of New Hampshire and Massachusetts. The agreement between the two States provides for coordination of actions in case of emergency situations. However the two States can take different decisions on intervention actions based on the same recommendation from the plant's emergency response organization. The team encourages the plant to further consider appropriate levels of interventions and advise both States to agree on a common approach to potential intervention actions.

The on-site emergency planning and preparedness activity of the plant is coordinated by a 5-member organization headed by the Manager of the Emergency Preparedness Department who reports directly to Site VP. The cooperation of on-site and off-site organizations concerning emergency planning and preparedness is continuous and efficient, which is recognized by the team as a good performance.

9.4 EMERGENCY PROCEDURES

The plant is generally well prepared for identification and classification of emergency situations at the plant and at the interim dry storage facility; however the procedure used for emergency classification and the procedure for coordination and dissemination of public information with offsite emergency response organizations does not include guidance for IAEA International Nuclear Event Scale (INES) classification to guarantee the timely classification of all credible emergencies based on the internationally used scale for trans-boundary information. The team encourages the plant to consider enforcing the understanding and use of INES rating for communicating to the public and to the regulator the severity or estimated severity of an event in case of emergency situations. The existing emergency response classification system should not be confused with the International Nuclear Event Scale.

9.5 EMERGENCY RESPONSE FACILITIES

The plant has three dedicated emergency response facilities: the Technical Support Centre, the Operational Support Centre and the Emergency Operations Facility (EOF) which is located outside the emergency planning zone approximately 14 miles (22.5 km) from the plant. All centres are well equipped; however the team suggests that the plant should consider improving the capabilities of EOF to assure that adequate emergency management and response is provided for all emergency situations.

9.6 EMERGENCY EQUIPMENT AND RESOURCES

The plant has implemented and is utilizing a reliable redundant radiological field monitoring and communication system which minimizes opportunities for human performance errors and provides for prompt information to key personnel in the EOF and decision makers. The plant's emergency response organization (ERO) offsite monitoring teams (OMTs) utilize a web-based program known as WebEOC to record field monitoring data and to transmit the data to dose assessment personnel. The team acknowledges this system as a good practice.

DETAILED EMERGENCY PLANNING AND PREPAREDNESS FINDINGS

9.2. RESPONSE FUNCTIONS

9.2(1) Issue: The arrangements for the management of people on site during emergencies are not in compliance with IAEA safety standards and are not fully effective.

- The plant does not have comprehensive procedures and arrangements in place for evacuation and accounting of persons on the site but outside the protected area during emergencies.
- The routes to the only assembly area outside protected area are not marked.
- Some signs for evacuation routes from the site in case of emergency situations are not posted.
- The public address speakers for the effective and timely communication of information to people outside the protected area are limited to the assembly area and two warehouses only.
- The protective tools including potassium iodine for the potential number of contractors and visitors outside protected are not available.
- The effective arrangements for accounting for all persons on the site and to locate and recover those unaccounted, do not effectively address persons outside protected area.

The reduced effectiveness of emergency arrangements outside the protected area but inside the plant's site could jeopardize urgent protective actions and countermeasures for all persons on site during nuclear or radiological emergencies.

Recommendation: The plant should revise and enhance the effectiveness of arrangements for the management of people on site during emergency situations to comply with IAEA safety standards.

IAEA basis:

GS-R-2

4.51 The operator .....shall make an arrangements to ensure the safety of all persons at the site ..for all persons on the site to take appropriate action immediately upon notification of an emergency; to account for those on the site; to locate and recover those unaccounted for; to take urgent protective action; .... and "shall be provided with a sufficient number of safe escape routes, clearly and durably marked, ... The facility shall provide suitable assembly points for all persons on the site and "shall be provided with a sufficient number of safe escape routes, clearly and durably marked, with reliable emergency lighting,

GS-G-2.1

4.15. .....adapt urgent protective actions to protect workers and the public, including the application of operational intervention levels (OILs) with arrangements to revise the

OILs as appropriate to take into account the conditions prevailing during the emergency.

Operational intervention level: A calculated level measured by instruments or determined by laboratory analysis that corresponds to an intervention level or action level. OILs are typically expressed in terms of dose rates or of activity of radioactive material released, time integrated air concentrations …

Appendix V.19. to be most effective, stable iodine prophylaxis should be provided before or shortly after an intake of iodine (i.e. before or shortly after a radioactive release)….

9.5. EMERGENCY RESPONSE FACILITIES

9.5(1) Issue: The Emergency Operating Facility has limited space and access arrangements which could impair effective emergency management and response during emergencies.

The Emergency Operations Facility (EOF) is the only base of operations for overall emergency management, radiological assessment, industry support coordination, interface with offsite emergency response organizations, and establishment of long term recovery operations.

This facility is required to manage the plant response to nuclear and radiological events. The team identified the followings:

- The arrival of staff required for necessary notifications and response may be restricted or delayed if a contamination event occurs at the entrance to the EOF.
- The existing facility is the only facility to accommodate up to 100 assigned staff and potentially 50 visitors to respond and be operational within 60 minutes after declaration of an event classified as an alert, site emergency or general emergency. The recent analysis made by the plant shows that space required for effective response should be almost doubled in the new facility.
- There is no redundant facility in place.
- Limited access to EOF in case of contaminated visitor could delay response or notification actions.
- The contract to construct the new facility with the required space for effective management and response to emergency situations is pending.
- The effectiveness of the EOF has the potential to be adversely affected in some emergency situations.

Suggestion: The plant should consider improving the capabilities of EOF to assure that adequate emergency management and response is provided for all emergency situations.

IAEA basis:

GS-R-2

5.25. Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation (such as procedures, checklists, telephone numbers and manuals) shall be provided for performing the functions specified in Section 478. These items and facilities shall be selected or designed to be operational under the postulated conditions (such as the radiological, working and environmental conditions) that may be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (such as the communication frequencies of other response organizations), as appropriate. These support items shall be located or provided in a manner that allows their effective use under postulated emergency conditions.

5.26. For facilities in threat category I or II emergency facilities shall be designated where the following will be performed in the different phases of the response: the coordination of on-site response actions; the co-ordination of local off-site response actions (radiological and conventional); the co-ordination of national response actions; co-ordination of public information; and co-ordination of off-site monitoring and assessment. Several of these activities may be performed at a single centre and the location may change in the different phases of the response. These emergency facilities shall be suitably located and/or protected so as to enable the exposure of emergency workers to be managed in accordance with international standards.

9.6. EMERGENCY EQUIPMENT AND RESOURCES

9.6 (a). Good Practice Radiological field monitoring & communication system.

The plant's emergency response organization (ERO) offsite monitoring teams (OMTs) utilize a web-based program known as WebEOC to record field monitoring data and to transmit the data to dose assessment personnel in the Emergency Operations Facility (EOF). ERO OMTs are deployed into the field in dedicated vehicles to conduct radiological surveys and environmental sampling. The OMT uses the WebEOC application to enter its team identification number, its location, and the survey results information using the data entry screen. When the data entry is saved, the information is immediately transmitted to the EOF where it is displayed on a large screen for viewing by EOF dose assessment staff which allows prompt recommendation and intervention. The redundancy of measurement is also assured. New Hampshire and Massachusetts state field monitoring personnel are equipped with laptop computers with the same WebEOC field data communication capability.

This method:

- Eliminates the need to verbally communicate information over cellular telephones or via radio transmission.
- Minimizes opportunities for human performance errors resulting from repeated manual transcription and communication of data.
- Provides for prompt information to decision makers.

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

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

Good practice

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

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

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

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

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

- **SF-1**; Fundamental Safety Principles (Safety Fundamentals)
- **Safety Series No.115**; International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources
- **Safety Series No.117**; Operation of Spent Fuel Storage Facilities
- **NS-R-1**; Safety of Nuclear Power Plants: Design Requirements
- **NS-R-2**; Safety of Nuclear Power Plants: Operation (Safety Requirements)
- **NS-G-1.1**; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)
- **NS-G-2.1**; Fire Safety in the Operation of Nuclear Power Plans (Safety Guide)
- **NS-G-2.2**; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)
- **NS-G-2.3**; Modifications to Nuclear Power Plants (Safety Guide)
- **NS-G-2.4**; The Operating Organization for Nuclear Power Plants (Safety Guide)
- **NS-G-2.5**; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)
- **NS-G-2.6**; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)
- **NS-G-2.7**; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.8**; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)
- **NS-G-2.9**; Commissioning for Nuclear Power Plants (Safety Guide)
- **NS-G-2-10**; Periodic Safety Review of Nuclear Power Plants (Safety Guide)
- **NS-G-2.11**; A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide)
- **NS-G-2.12**; Ageing Management for Nuclear Power Plants (Safety Guide)
- **NS-G-2.13**; Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide)
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- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power Plants Safety Guide (Safety Guide)
- **GS-R-1**; Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (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)
- **GS-G-2.1**; Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
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- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
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- **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)
- **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
- **SSG-13;** Chemistry Programme for Water Cooled Nuclear Power Plants

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

- ***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)

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