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REPORT

OF THE

OPERATIONAL SAFETY REVIEW TEAM (OSART)

MISSION

TO THE

RINGHALS

NUCLEAR POWER PLANT

SWEDEN

1-18 MARCH 2010

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/2010/156

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Ringhals Nuclear Power Plant, Sweden. It includes recommendations for improvements affecting operational safety for consideration by the responsible Swedish 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 Swedish organizations is solely their responsibility.

FOREWORD

by the

Director General

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

An OSART mission, carried out only at the request of the relevant Member State, is directed towards a review of items essential to operational safety. The mission can be tailored to the particular needs of a plant. A full scope review would cover eight operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; operational 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 Nuclear Safety Standards (NUSS) programme and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organization for achieving its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power plants.

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

An OSART mission is not a regulatory inspection to determine compliance with national safety requirements nor is it a substitute for an exhaustive assessment of a plant's overall safety status, a requirement normally placed on the respective power plant or utility by the regulatory body. Each review starts with the expectation that the plant meets the safety requirements of the country concerned. An OSART mission attempts neither to evaluate the overall safety of the plant nor to rank its safety performance against that of other plants reviewed. The review represents a `snapshot in time'; at any time after the completion of the mission care must be exercised when considering the conclusions drawn since programmes at nuclear power plants are constantly evolving and being enhanced. To infer 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 Sweden, an IAEA Operational Safety Review Team (OSART) of international experts visited Ringhals Nuclear Power Plant from 1 to 18 March 2010.

Ringhals NPP is part of Vattenfall AB and has four units namely R1 – BWR (Asea Atom) 885 MW, R2 - PWR (Westinghouse) 866 MW, R3 – PWR (Westinghouse) 1000 MW and R4 – (Westinghouse) 935 MW in commercial operation. The units were commissioned in 1976, 1975, 1981 and 1983 respectively. The Owner-Operators are Vattenfall (70,4%) and E.ON (29,6%). There are approximately 1530 workers on site. The OSART mission focused on Units 3 and 4.

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; Operating Experience, Radiation protection; Chemistry; and Emergency planning and preparedness. 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 Ringhals OSART mission was the 156th in the programme, which began in 1982. The team was composed of experts from Belgium, Canada, France, Germany, Italy, Romania, the United Kingdom and the United States of America, together with the IAEA staff members.

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

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

The following report is produced to summarize the findings in the review scope, according to the OSART Guidelines document. The text reflects only those areas where the team considers that either 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 Ringhals NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

- A comprehensive site commitment to realistic training evidenced by the Testen maintenance training facility, the creation of a field operator radiological protection practical training facility and the Barseback training centre where the workforce have the opportunity to conduct realistic in-plant tasks in a low dose environment.

- The use of in-situ gamma spectrometry to determine the surface activity concentrations of radionuclides on the internal surfaces of plant systems to evaluate the effectiveness of the plant's source term reduction initiatives.

- The reduction of Argon-41 emissions from the plant by the use of a gas transfer membrane system.

- The close cooperation with local authorities regarding responses to hostile events at the plant.

A number of proposals for improvements in operational safety were offered by the team. These included the following:

- The plant has a self-assessment programme in place to monitor and improve its safety performance. The team determined that this self-assessment programme could be made more effective to ensure that continuous improvement takes place at the plant. This could include the extension of the use of performance indicators and the systematic use of other inputs such as audits and previous action plans.

- Management expectations exist with respect to operations activities but they should always be followed, particularly regarding the status of systems and equipment, the control of operator aids, housekeeping, reactivity management and the reporting of anomalies.

- The management system for operational experience should include coordinating departmental operational experience to ensure that the process is used consistently and effectively.

- Contamination control measures are in place but these should be enhanced to minimize the potential for the spread of radioactive contamination.

The team also determined that there was too much consideration, at times, given to expert judgment and/or individual experience being used at the plant and that this had not been captured in procedures. Good international practice and the IAEA safety standards place a heavy reliance on procedural guidance to ensure that all expert judgment and individual experience is taken into account to ensure a consistent approach to operational safety.

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

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1.1. ORGANIZATION AND ADMINISTRATION

There are multiple career paths within the plant organization for high potential and highly qualified staff. These people can progress in the organization and are recognized as managers. As such, they can gain experience over an extended period of time, before they assume their positions. The team recognized this as a good performance.

The licence to operate the plant is given by the regulator directly to the plant's CEO. The Vattenfall corporate organization does not have any power of decision in safety matters. Nevertheless, some other topics could interfere with safety. That is why a working group was created at Business Unit "Nuclear" (BUN) level, including plant representatives. The objective is to put in place a global action plan (strategic initiatives) and key performance indicators (KPI) at the BUN level. The team encourages the plant to fully implement the action plan and KPI's.

Actions coming from safety committees or department meetings are recorded in a database. Some other actions coming from quality assurance audits, from industrial safety tours and from the surveillance test programme, are recorded in another database, or are included in the minutes of the tours. However, the team found an inconsistent follow up of these actions, and a lack of trending. The team recommended that the plant trends these open actions, to prioritize them, and to improve the follow up in order to avoid backlogs.

1.2. MANAGEMENT OF ACTIVITIES

The plant put in place a comprehensive communication plan to present important documents such as management expectations or the Ringhals strategic plan. Weekly team meetings are also used to inform the staff about topical matters. The team encourages the plant to ensure that all staff, including contractors, receives such information.

An integrated programme is in preparation to promote the use of human performance tools and covers various tools. The expectations to use these tools are defined, but not yet included in the "Management's Expectations" booklet, and they should be reinforced with plant workers. At the site level, an objective for 25 percent of their time to be spent in the field by the managers was set for 2010. However, this programme does not address how many task observations should be performed at site level and, at present, time in the field is mostly spent to monitor housekeeping and plant condition. The team observed some inconsistencies in the use of the human performance tools and inappropriate work behaviour. The team suggested that the plant reinforce its human performance programme, including task observations.

Management is clearly responsive to constructive criticism and feedback from the plant staff. As an example, a system linked to the plant intranet allows the employees to openly ask questions to the managers. The answer of the management is also published via the intranet and is apparent for all plant staff. The team recognized this as a good performance.

Fitness-for-duty and the good health of the staff are taken into account. An illness prevention programme is in place to help the staff and prevent long duration absenteeism. In 2009, while meeting unexpected challenges during an outage, in a tough and critical situation, the management team allocated additional holidays to the workers involved in the outage to ensure fitness-for-duty, and this was seen by the team as a good performance.

1.3. MANAGEMENT OF SAFETY

The plant put in place an integrated management system (IMS) with line organization and business areas. The plant also developed some performance indicators and recently performed self-assessments focused in the departments. However, cross-departmental activities, like training, emergency preparedness and the surveillance programme, either do not have performance indicators, or have inappropriate targets. In addition, the self-assessment programme does not cover these activities. The self-assessment method itself could be improved by using all relevant inputs and not only SWOT (Strengths-Weaknesses-Opportunities-Threats) analyses. The team recommended that the plant develop an effective self-assessment programme.

In term of safety culture, the plant has recently commenced a programme on the basis of industry guidelines.

During the mission, the team observed behaviours of plant staff in comparison to the safety culture attributes promoted in the IAEA documents and has identified a number of facts related to strengths and weaknesses that could assist the management efforts regarding safety culture at Ringhals.

With respect to the strengths, the team recognized that the plant staff, including contractors, were aware of the "safety first" principle, and were expecting to improve safety performance and strengthen safety culture.

Transparency is also an important attribute of safety culture and in this regard all plant staff were open-minded and cooperative. In addition, the will to share and learn from other experiences was strongly felt by the team members.

However the team also identified areas that could be strengthened to improve the safety culture and encouraged the plant to consider these aspects in the implementation of their safety culture programme.

Regarding the use of human performances tools, the presence of the managers in the field and the use of appropriate indicators, the team has provided the plant with recommendations and a suggestion for improvements in these areas.

Another attribute of safety culture is the implementation of the "defence in depth" principle, one of the defence lines being the use of procedures. The plant could gain significantly in performance by reinforcing the further development, knowledge and use of procedures as part of high professionalism instead of solely relying, at times, on individual experience and coaching.

Generally the plant meets the requirements and standards but the team observed that, in some areas, objectives could be more ambitious to support the plant in striving for excellence.

Numerous relatively minor concerns were identified during the mission and it was evident that they had been in existence for a long time and had either not been previously identified or identified but not remedied. The plant is encouraged to remind its staff that the level of safety culture awareness could be heightened if such concerns were addressed by identification or remediation in a more timely manner.

1.5. INDUSTRIAL SAFETY PROGRAMME

Management's expectations, including industrial safety, were gathered in a booklet distributed and communicated to all staff and contractors in 2009.

However, despite some repeated accidents or near misses, basic personnel protective equipment (PPE) like safety shoes, goggles, or working clothes are not mandatory in the plant. In addition, the team noted some inconsistencies between the use of PPE and the management's expectations. The team also observed a number of unsafe behaviours while work was being undertaken. The team recommended the plant to strengthen its expectations regarding industrial safety.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.1. ORGANIZATION AND ADMINISTRATION

1.1(1) Issue: There is not a global overview, trend, and prioritization method for many management actions at site level.

Actions coming from safety committees or department meetings are recorded in a database. Some other actions coming from QA audits, from industrial safety tours or environmental tours, from the surveillance test program, are recorded in another database, or included in minutes of the tours. However, the team identified the following:

- Even if a deadline is attached to the actions, a prioritization system does not exist for these actions.
- A deadline can be changed with simple dialog between the owner of the action and the chairman of the committee. There are no clear, written rules to allow these changes.
- Changes of deadlines are not recorded, so personnel may not know how many times a deadline has been changed. In such a way, backlogs can artificially be reduced.
- The actions coming from industrial safety or environmental tours are followed by the minutes of the tours during the next tour. However, if a deadline is between two tours, personnel are not made aware of exceeding the deadline.
- For many actions, there are no indicators or trending analyses that are used for a global overview, at site level. This is needed in order to be aware of the workload, to prioritize the actions, and to follow up potential backlogs.
- The use of MIA ('non-technical actions' database) is not mandatory for all the departments actions.

With inconsistent follow up of actions, and a lack of trending, the plant may not have a global vision of open actions related to safety and may not be aware of potential backlogs.

Recommendation: The plant should have a global overview and trend of open actions, in order to prioritize the actions, improve follow up, and avoid backlogs.

IAEA Basis :

NS-G-2.4

5.22 . "The appropriate corrective actions should be identified and implemented as a result of the monitoring and review of safety performance. Arrangements should be in place to ensure that appropriate corrective actions in response to audit and review findings are identified and taken. Progress in taking proposed actions needs to be monitored to ensure that actions are completed within the appropriate time-scales. The completed corrective actions should be reviewed to assess whether they have adequately addressed the issues identified in the audits and reviews. "

INSAG-13;62

“Appropriate corrective actions are identified and implemented in response to audit and review findings”

INSAG-13;63

“Progress in taking proposed actions needs to be monitored to ensure that actions are completed within the appropriate time-scales”

INSAG-13;95

“when areas for improvement have been identified, management needs to establish clearly prioritized action plans”

1.2. MANAGEMENT ACTIVITIES

1.2(1) Issue: Human performance tools, including task observations, are infrequently used throughout the plant.

The human performance program has been developed and its implementation is ongoing. At the site level, an objective of 25 percent of time spent in the field by the managers was set up for 2010. However, the following were noted:

- The expectations for human performance tools are defined, but should be additionally reinforced with plant workers.
- There has been no integrated training on human performance tools.
- The target for post job debriefing (PJD) is 5 per month; this is insufficient to provide timely and effective program implementation. Additionally, only one was actually performed in January 2010.
- In many cases, there is no peer-check during tests.
- During a PJB for a reactor building entry, a checklist was used with closed questions; as a result, the workers did not participate fully.
- During an emergency scenario (fire drill), there was a weak use of human performance tools in the control room.
- During observation of electrical maintenance work, there was insufficient use of human performance tools, including self-check and peer-check.
- There is no target addressing how many task observations should be performed at site level.
- The task observations programme does not include the foremen.
- As confirmed by managers, "the field" may be understood as the "sphere of interest" of the managers. So, task observations may not be mandatory.
- The maintenance department fixed a target of only 35 task observations per section per year, which is very few compared with international standards.
- At present, time in the field is mostly spent for housekeeping, material condition, and walk down tours, and not for task observations.

The team also observed inappropriate work practices, which shows that management's expectations are not sufficiently reinforced:

- A worker was observed touching items within a yellow contamination area in RG17 with bare hands despite the facts that the barrier indicates that gloves are mandatory.
- In the plant, a mask with two filters attached is stored on a shelf; it was uncertain if it is a used or unused mask.
- It was observed that the clothes of workers were stored on fire extinguishers, thus concealing the fire extinguishers.

Without appropriate and frequent use of human performance tools, including task observations, human errors could occur and increase the probability of degradation of safety barriers.

Suggestion: The plant should consider reinforcing its human performance program, including task observations.

IAEA Basis:

NS-G-2.4

3.15 "To improve human performance senior managers in each organization should understand and support the need of develop the management and technical skills of all individuals involved in plant activities to the extent necessary to perform their assigned tasks. This support should be in the form of modeling the new behaviors and providing resources including adequate funds to develop and implement management and technical skills programs. "

NS-G-2.6

4.18 "In planning activities (for MS&I), consideration should be given to potential human failures in the performance of such activities. Particular emphasis should be placed on establishing the best work procedure, providing suitable job aids …, to ensure that the potential for errors is minimized at all times. "

GS-G-3.1

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

3.6 "Managers should examine samples of work practices and related information on a regular basis to identify areas needing improvement. They should also encourage each individual under their supervision to look for more efficient and effective ways of accomplishing assigned tasks."

1.3 MANAGEMENT OF SAFETY

1.3(1) Issue: The self-assessment program does not provide an effective management tool for continuous improvement.

- Many cross-departmental activities either do not have performance indicators to measure their efficiency, or have inappropriate targets:
  - Several key performance indicators for training are lacking or have low goals.
  - There is no target for the number or rate of personal contamination events.
  - On the actual indicators, the colour depends on the forecast on what the indicator will be at the end of the period.
  - There is no indicator related to emergency preparedness.
  - There are only a limited number of indicators that cover the effectiveness of the surveillance programme.
- The program for self-assessments related to these activities is inconsistent. For example :
  - Self-assessment has not been performed for the whole work management process; it was only focused on maintenance activities.
  - Risk observation sheets are not used in a systematic way in order to improve these activities.
  - Other useful inputs, like QA audits, tours, previous action plans or corrective actions, are not systematically used for comprehensive self-assessments
- Some indicators are red and do not result in visible corrective actions in the indicator sheets.

Without an effective self-assessment program, the plant could miss opportunities to learn and to improve its processes or activities.

Recommendation: The plant should improve the effectiveness of the self-assessment program to ensure continuous improvement.

IAEA Basis:

GS-R-3

6.2. "Senior management and management at all other levels in the organization shall carry out self-assessment to evaluate the performance of work and the improvement of the safety culture".

6.7 “A management system review shall be conducted at planned intervals to ensure the continuing suitability and effectiveness of the management system and its ability to enable the objectives set for the organization to be accomplished.”

6.8 “The review shall cover but shall not be limited to:

- Outputs from all forms of assessment;
- Results delivered and objectives achieved by the organization and its processes;
- Non-conformances and corrective and preventive actions;
- Lessons learned from other organizations;
- Opportunities for improvement.”

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-G-3.1

6.4 “The management system should ensure that standards of performance are established. These standards should be directly related to the product provided by the organization and based on the objectives set by senior management. Once the standards have been established, performance should be measured against them. These measurements should be monitored at regular intervals to ascertain whether or not improvements in the quality of the product or process are necessary. Performance indicators should be used and other appropriate methods of measurement should be developed. ”

1.5. INDUSTRIAL SAFETY PROGRAMME

1.5(1) Issue: Management expectations around industrial safety are not consistent and plant staff does not always respect industrial safety rules and regulations.

Management communicated its expectations at the end of 2009; however, the following were noted :

- Despite four eye-related events in 2009, the wearing of safety goggles is not mandatory.
- The wearing of safety shoes is not mandatory in industrial areas and workshops.
- The indicator trend for industrial safety accidents is increasing for unit 4.
- Maintenance workers conducting training on steam generator manhole removal were not required to wear hardhats although their heads were close to the manhole bolts.
- There are no warning signs regarding noise or mandatory hearing protection signs at the entrance of the reverse osmosis plant. The noise level in this plant is above 85 dB.
- There is an "ear protection" sign on one entrance of the room 4-H01.13, and none on the other entrances.
- Near one charging pump, there is a small stairway without hand railing, to access above the motor of the pump. In addition, the platform at the top of the stairway is oily.
- In the controlled area, there are small elevations from the ground without black and yellow painting to identify the risk of falling. There were two near misses during one plant tour.
- In the corridor to the controlled area of unit 4, there is no protection at the sharp end of some supports for pipes and electrical cables.
- In the screen house (sea water filters), unused and used masks are stored together in a box, increasing the risk of biological contamination.
- Numerous oil leaks are present in the mechanical workshop, increasing the slip risk.
- In the turbine hall, gas cylinders (propane, oxygen, acetylene) are not properly secured.
- During electrical maintenance, insufficient electrical safety protective measures were used (hands in cabinet with jewellery, no electrical mats or protective eye wear).

Without consistent management expectations around industrial safety, the risks of injury may increase and industrial safety performance may decline.

Recommendation: The plant should strengthen management expectations around industrial safety and reinforce the respect of industrial safety rules and regulations among plant staff.

IAEA Basis:

NS-G-2.4; 6.56

“An industrial safety programme should be established and implemented to ensure that all risks to personnel involved in plant activities, in particular those activities that are safety related, kept ALARA. An industrial safety programme should be established for all personnel, suppliers and visitors, and should be refer to the industrial safety rules and practices that are to be adopted. ”

ILO-OSH 2001; 3.3.2

“The employer and senior management should allocate responsibility, accountability and authority for the development, implementation and performance of the OSH management system and the achievement of the relevant OSH objectives.

Structures and processes should be established which …(f) establish and implement a clear OSH policy and measurable objectives …(g) establish effective arrangements to identify and eliminate or control work-related hazards and risks, and promote health at work …(h) establish prevention and health promotion programmes”

ILO-OSH 2001; 3.9.1 : “Consistent with the OSH policy and based on the initial or subsequent reviews, measurable OSH objectives should be established, which are … (c) focused towards continually improving workers' OSH protection to achieve the best OSH performance … (e) documented, and communicated to all relevant functions and levels of the *organization;* and (f) periodically evaluated and if necessary updated. ”

2. TRAINING AND QUALIFICATIONS

2.1. TRAINING POLICY AND ORGANIZATION

Nuclear safety, safety culture and ALARA concepts are frequently emphasized and made realistic during training in a number of on-site and off-site training venues. However, methods to systematically evaluate and improve the effectiveness of training are lacking. These include use of larger and broader based measures and inputs into training program effectiveness such as student feedback, instructor performance, plant events with training contributors, comprehensive performance indicators, management observations in training, task observations with training weaknesses, and peer plant review and assessment. In addition, several key training performance indicators are lacking or have low goals, and instructor “platform skills” and the standards for conducting evaluations/examinations need improving. The team recommends that the plant systematically evaluate its training activities to improve their overall effectiveness.

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

There is a comprehensive site commitment to the conduct of training and the necessary supporting training facilities. In addition, the use of graphic simulators allows new trainees the opportunity to test theories and evaluate the effects of changing plant parameters on the entire plant. The team recognizes these facilities as a good practice.

In addition, several innovative learning methods such as peer learning and safe performance training sessions are used by the plant. The team recognizes these learning methods as a good performance.

The plant routinely uses high quality and standardized training materials for fundamentals and continuing training.

2.7. TRAINING PROGRAMMES FOR TECHNICAL PLANT SUPPORT PERSONNEL

On-the-job training programme requirements have been recently completed for chemistry personnel and are now being finalized for radiation protection personnel. The plant is encouraged to complete these efforts.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1 TRAINING POLICY AND ORGANIZATION

2.1(1) Issue: Methods to systematically evaluate and improve the effectiveness of training are incomplete.

Facts include:

- Self-assessments of training effectiveness are not used or do not include external reviews to evaluate training's impact on plant performance.
- The plant does not have a designated managerial function to coordinate training assessments and activities at the appropriate management level to ensure that site training needs are systematically analyzed and acted upon.
- Management observations of training activities have just started and have yet to be trended for training shortfalls and needs.
- Several key training performance indicators are lacking or have low goals, for example:
  - The plant lacks a quality training "Non attendance" indicator, and lacks sufficient station accountability for training "Non attendance". Training attendance at scheduled courses is not tracked.
  - Some goals are low, such as trainee satisfaction and manager-to-employee feedback percentage.
- There are instructor skill individual and programmatic weaknesses. The team observed instances of weak instructor "platform" skills, insufficient gathering of instructor gaps/strengths, learning objectives are not regularly covered during training sessions, there are insufficient instructor performance indicators, and interviews indicated that there was infrequent instructor continuing training.
- Standards for conducting examinations need improving as several plant practices for evaluating trainee retention of training materials are at a low level.

Failure to identify training shortfalls and strengths in order to improve worker knowledge and skills can result in recurrent human performance errors, rework, and poor worker safety behaviours. Weak instructor "platform" skills can result in poor trainee retention of training materials. Insufficient standards for conducting verification of trainee retention of key objectives and information can result in plant events and rework.

Recommendation:

The plant should systematically evaluate its training methods and activities to improve the overall effectiveness.

IAEA Basis:

NS-G-2.8

4.44. A training plan should be prepared on the basis of the long term needs and goals of the plant. This plan should be evaluated periodically in order to ensure that it is consistent with current (and future) needs and goals. Factors which can change a training plan include: commissioning experience, operational experience and decommissioning experience at the plants of the operating organization; feedback of operational experience from other plants; significant modifications to the plant or to the operating organization; changes in regulatory requirements; and changes in the State's education system.

5.31. Training instructors, on and off of the site, should have the appropriate knowledge, skills, and attitudes in their assigned duties of responsibility. They should thoroughly understand all aspects of the contents of the training programmes and the relationship between these contents and overall plant operation. This means that they should be technically competent and show credibility with the trainees and other plant personnel. In addition, the instructors should be familiar with the basics of adult learning and a systematic approach to training, and should have adequate instructional and assessment skills.

5.35. The training plan should be periodically reviewed and modified as necessary. The review should cover the adequacy and effectiveness of the training with respect to the actual performance of employees in their jobs. The review should also examine training needs, training programmes, training facilities and the training materials necessary to deal with changes to regulations, modifications to the facility and lessons learned from experience in the industry.

5.36. The internal review of training undertaken at the plant or by the operating organization should be an integral component of the on-site training system. The review should cover all stages of the training system, the analysis of training needs, and the design, development and implementation of the training programmes. Training records should also be reviewed. Such a review should be undertaken by persons other than those directly responsible for the training. Plant managers should be directly involved in the evaluation of training programmes. Close co-operation should be maintained in the training evaluation process between the plant management, individual departments and the training unit.

5.40. Activities and practices in operating and maintenance, and compliance with industrial and radiological safety standards, should be monitored to identify any problems due to incorrect or insufficient training.

5.43. On the basis of the results of evaluations, an action plan to improve and correct the training programmes should be developed and implemented. This may lead to improvements in the conduct of training or to changes in the training programmes.

5.44. An independent review of the plant's training plan should be carried out by external organizations. The external review should be considered complementary to the internal evaluation in giving a different perspective to the evaluation of training programmes. The results of the external review should be integrated with the results of the internal evaluation, to identify necessary changes and improvements in the training programmes.

2.2 TRAINING FACILITIES, EQUIPMENT AND MATERIAL

2.2(a) Good practice: Comprehensive training facilities

There is a comprehensive site commitment to the conduct of realistic training and the necessary supporting training facilities. This is evidenced by the following examples:

- At the nearby Barseback training center (shutdown nuclear power plant), maintenance personnel and field operators train in a uniquely realistic environment. This facility provides the workers with an opportunity to conduct realistic in-plant tasks in a low dose environment.
- At the on-site Testen maintenance training facility, refueling and primary systems (steam generator) maintenance personnel practice tasks that result in significant time and dose savings during outages.
- At the on-site fire training facility, plant personnel can train in challenging fire-fighting techniques along with local fire protection personnel.
- Operations training personnel have created a field operator radiological protection practical training facility so that operators may practice their radiological and observation skills.

3. OPERATIONS

3.3. OPERATING RULES AND PROCEDURES

Entries into Limiting Conditions for Operation (LCO) are appropriately reported and documented within reports as well as within the shift supervisor logbook. However, in case the LCO is still present in the following shifts, the subsequent logbook pages do not include the LCO. The information is only given verbally during shift turnover and via the shift turnover preparation sheet. The team encourages the plant to review the current LCO tracking and associated corrective actions and include the remaining allowable out-of-service time according to the LCO.

3.4. CONDUCT OF OPERATIONS

With respect to actions on receipt of alarms and switching components, the plant has verbally communicated its expectation but only in general terms. There is no written policy for procedure use and adherence in this regard, and the team encourages the plant to review this.

The control of access to systems and equipment, which are important for nuclear safety, is not fully developed. This includes unclear entries in key logbooks and the rules for locking doors of rooms containing nuclear safety related equipment. The team has developed a suggestion for this area.

The team found that operations activities oversight is not being undertaken at a sufficiently high level with respect to the:

- Reactivity management programme
- Indication of the status of systems and equipment
- System for controlling operator aids
- Field operator rounds reporting of anomalies
- Housekeeping

The team has developed a recommendation in this regard.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

Fire prevention and protection systems are the subject of an on-going project to upgrade the fire prevention of the plant, scheduled to finish in late of 2010. During the review, weaknesses were observed regarding the comprehensiveness of the fire hazard analysis e.g. fire loading and the integrity of fire cells. The team recommended that the plant should improve its system in fire prevention.

DETAILED OPERATIONS FINDINGS

3.4. CONDUCT OF OPERATIONS

3.4(1) Issue: The control of access to systems and equipment that are important for safety is not fully developed.

The team observed the following facts:

- The plant has no instruction implemented, where the handling of keys is described in detail.
- A tag in the key cupboard replaces every key given to anyone. However, the requirement is to trace all safety related key handling but the plant does not expect entries in logbook for their own operations staff (e.g. field operator). The field operator has all keys, also for both safety trains.
- Operations management has no formal control of key-logbooks.
- Key control in the main control room (MCR) is done with a list on loose sheets of paper; the entries and exits are without time details - just the date.
- Electrical cabinets were found with the keys readily available to unauthorized persons.
- Rooms containing components of both safety trains are not always locked.
- Three keys are currently in use in unit 3. These keys are from unit 4 but are not logged in the unit 4 key-cupboard in the MCR, because the logbook only started 2009/11/30.
- In the unit 4 key-cupboard in the MCR, there are empty but marked hooks, therefore it is not immediately evident if keys are missing.

Without sufficient control of access to systems and equipment, which are important for safety, unauthorized access cannot be prevented.

Suggestion: The plant should consider implementing measures to enhance control of access to systems and equipment, which are important for safety.

IAEA Basis:

NS-G-2.14

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.

3.4(2) Issue: Operations activities oversight is not being undertaken at a sufficiently high level and management expectations are not fully followed.

Objectives have been set up for operations activities. However, the following were evident:

In the area of reactivity management programme:

- In order to avoid dilution of boric acid in the spent fuel pool, some safety alignments have not been considered e.g. a fire hose was full of water and ready to use in the vicinity of the fuel pool and a demineralized water supply valve, close to the fuel pool, was found closed but without a lock.
- The reactor operator prepares an anticipated boron calculation to be used for potential events at the beginning of the shift cycle. However, this calculation lacks an independent verification.

In the area of indication of the status of systems and equipment:

- Numerous deficiency cards, many older than one year were observed. No demand for solving the deficiency was made by operations.
- Several safety-related electrical cabinets were not sealed according the existing requirement.
- Temporary modifications, which were not reviewed by operations, were found. These were not listed as temporary modifications and were not labeled on the field.

In the area of systems for controlling operator aids:

- Drawings on site, reflecting plant design lack any revision number and controller name.
- Unauthorized operator aids were found in electrical cabinets e.g. some lists of places of fuses and diagrams.
- Unauthorized operator aids instructing operators in normal and emergency actions were found in various locations.
- Unauthorised supportive tools and materials used in an inadequate way e.g. a tool for checking oil in the main transformer compartment sump and unauthorized marks on tank level indicators.

In the area of field operator rounds and reporting of anomalies:

- Numerous examples of leakages without deficiency cards were found.
- Missing or bad labeling was also found e.g. labeling with tape or unauthorized modified labeling.

In the area of housekeeping:

- Various and numerous housekeeping concerns were observed particularly on the floor in the spent fuel pool building.

Without operations activities oversight being undertaken at a sufficiently high level, plant safety may be affected.

Recommendation: The plant should ensure that the oversight of operations activities is undertaken at a sufficiently high level in order to fulfill the current management expectations and future plans.

IAEA Basis:

NS-R-2

Paragraph. 5.17: Responsibilities and lines of communication shall clearly be set out in writing for situations in which the operating personnel discover that the status or conditions of plant systems or equipment are not in accordance with operating procedures.

NS-G-2.3

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

Paragraph 6.5. The plant management should periodically review outstanding temporary modifications ...

NS-G-2.14

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

Paragraph 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.

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 labeled to provide individuals with sufficient information to identify them accurately.

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

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

3.6(1) Issue: The fire hazard analysis does not consider the integrity of all barriers and the fire prevention program is not sufficiently effective.

The following facts were observed:

- Some fire penetration holes were found, that did not conform to requirements or were not sealed.
- Several sumps participating in the boundary of fire cells were found without water.
- The plant's fire hazard analysis does not take into account all the requirements to ensure the integrity of fire cells.
- There is no sump filling procedures in the plant except in the controlled area. The water level in these sumps form part of the fire barrier.
- The plant procedure for filling the sumps in the controlled area could not be located. The operations department was not able to provide the process that they use to raise the level of water in the sumps.
- Combustible materials such as wood and cigarettes butts were found near the station transformers enclosure.
- Numerous wooden tables and barriers were observed within the controlled area.
- A procedure used for the central fire protection system was not reviewed within the required 5 years time limit for procedure review.
- A cabinet for storage of flammable materials was found to be not electrically grounded.
- A fire door was found opened.
- Combustibles were evident in non-designated locations.

An ineffective fire prevention program could lead to difficulties in dealing with fire hazards.

Recommendation: The plant should strengthen the effectiveness of its fire prevention program and review the fire hazard analysis.

IAEA basis:

NS-G-2.1.

4.2. The technical justification for any deviation from recommended practice ……. that is identified when the fire hazard analysis is updated should include a discussion of the plant modifications that would be necessary to follow accepted practice and the reasons why it is not reasonably practicable to implement such modifications. The technical justification should also describe compensatory features provided to maintain an acceptable level of safety, where applicable.

4.3. If …….. operational improvements have been identified on the basis of the initial fire hazard analysis, the analysis for fire hazards should be repeated for the areas of the plant concerned to confirm the adequacy of the modifications or improvements recommended.

6.17. Warning signs should be erected at the entrances to areas containing combustible materials to warn personnel of restrictions or access requirements and of the necessity to permanently control ignition sources.

NS-G-2.1.

7.1. A comprehensive program should be established and implemented to perform appropriate inspection ……of all fire protection measures (passive ……) specified as important to safety. The specific fire protection systems, equipment, components and emergency procedures included in the program should be identified and documented. Where such documentation is not available (for example, if the fire hazard analysis has not yet been performed and other documentation is incomplete), all fire protection measures should be assumed to be important to safety unless the contrary assumption can be justified.

7.2. The inspection, maintenance and testing program should cover the following fire protection measures:

- passive fire rated compartment barriers and structural components of buildings, including the seals of barrier penetrations ……………..

10.1. Fire protection features are not generally classified as safety systems and thus they may not be subject to the rigorous qualification requirements and the associated quality assurance program applied to safety systems. However, fire has the potential to give rise to common cause failure and thus to pose a threat to safety, and therefore the installed active and passive fire protection measures should be considered safety related. An appropriate level of quality assurance should therefore be applied to fire protection features.

4. MAINTENANCE

4.3. MAINTENANCE PROGRAMMES

Several inspection and repair methods and tools were observed. The technical competence and knowledge of developing inspection and mechanical repair methods, tools and mock-ups in-house have resulted in significant dose reductions for the plant. The team has recognized this as a good performance.

The plant has custom-fitted and implemented a software package which provides it with an ability to effectively and efficiently collect and manipulate data from the work management system in order to analyse and evaluate critical information for maintenance effectiveness. The team has recognised this as a good performance.

4.5. CONDUCT OF MAINTENANCE WORK

The team identified that the set-up, conduct, maintaining the work place and completion of maintenance activities at the work place does not meet the expectations of the present procedure. The team suggested that the plant consider improving the control of maintenance activities at the workplace to meet plant expectations.

4.6. MATERIAL CONDITIONS

The team identified several deficiencies in the areas of oil leaks, a leaking floor drain, missing thermal guarding/protection buckle, corrosion due to leaks, a loose electrical connection and cases of failure tags not being removed after work had been completed and signed off. The team suggested that consideration should be given to further enhancing the effectiveness of the existing programme to ensure timely recovery of the plant material condition.

4.5 CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: The control of maintenance activities at the work place does not meet management expectations.

The following are examples of less than adequate conditions that were found at work places:

- Workers left a tented workplace leaving tools and materials in an uncontrolled and untidy condition.
- Maintenance work site on turbine system 332 was left with tools and materials improperly stored.
- No Foreign Material Exclusion (FME) cover was on the pipe in the intake building while work was in progress.
- There was a missing FME cover on system 332.
- Duct tape was used to complete repairs on two separate locations.

Without attention to details in maintenance workplaces, plant conditions may deteriorate and affect plant safety.

Suggestion: The plant should consider improving the control of maintenance activities at the work place to meet management expectations.

IAEA basis:

GS-G 3.5

5.149. A process should be established and implemented to control maintenance of the systems, structures and components of the installation. Further recommendations and guidance are provided in Refs [8, 9].

5.150. Housekeeping and cleanliness should be considered an essential process to provide a clean workplace and to encourage a high standard of workmanship. The process should include establishing, maintaining and enforcing standards for housekeeping and cleanliness that:

- Prevent the contamination of items and individuals;
- Minimize the risk of injuries;
- Reduce the risk of occurrence of conventional accidents such as fires;
- Protect open systems and equipment from pollution with foreign material during maintenance and modification;
- Control the movement of materials, equipment, tools and individuals in and out of work areas;
- Ensure that cleanliness inspections are performed immediately prior to reassembly of systems or components;
- Encourage individuals to leave an area as clean or cleaner than it was before they carried out activities in it.

ILO Safety and Health in Construction:

3.1.2. All ... areas likely to pose danger to workers should be clearly indicated.

3.3.2. Loose materials, which are not required for use, should not be placed or allowed to accumulate on the site so as to obstruct means of access to and egress from workplaces and passageways.

4.6 MATERIAL CONDITIONS

4.6(1) Issue: The current plant programme to manage material conditions is not fully effective.

There were a number of components which indicated leakage and poor material conditions that had not been previously identified by the plant. These included:

- a number of oil and water leak conditions in units 3 and 4, among them some on the diesels and charging pumps.
- a leaking floor drain near 4-D01.27.
- SW 715 pipe corrosion under a label at 4-H1.08.
- no protective cover on a loose connector at 4-H03.05.
- identified corrosion locations due to leakage.
- a loose electrical connection at 40-323 SIAPRP-01.
- missing thermal guard/protection on 42-415 HTFV.
- eight cases where the work had been completed but the green failure identification card had not been removed e.g. 90117180, 90122992.

Poor material condition and visible leakage could contribute to unavailability of safety equipment.

Suggestion: Consideration should be given to enhancing the effectiveness of the existing programme in order to ensure timely repair to improve the material conditions in the plant.

IAEA Basis:

NS-G-2.14

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

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

- Deterioration in material conditions of any kind, corrosion, leakage from components, accumulation of boric acid, excessive vibration, unfamiliar noise, inadequate labelling, foreign bodies and deficiencies necessitating maintenance or other action;
- The proper authorization for, and the condition and labeling of, temporary modifications in the field (e.g. the presence of blind flanges, temporary hoses, jumpers and lifted leads in the back panels);

6.24. Areas in the plant and systems and their associated components should be clearly and accurately marked, allowing the operator to identify easily the equipment and its status. Examples of such systems are isolations, positions of motor operated and manually operated valves, trains of protection systems and the electrical supply to different systems.

6.25. Temporary tags, such as those marking deficiencies, temporary modifications or temporary warnings, are important sources of information for operators in supervising the work areas. Their proper use should be governed by a policy that is consistent with the overall labeling policy at the plant (see paras 5.1–5.4). The temporary tagging system adopted should provide for easy.

5. TECHNICAL SUPPORT

5.2. SURVEILLANCE PROGRAMME

No global overview of the surveillance programme is performed. Each of the three services: maintenance, in-service inspection and operations perform separate annual reviews. The review of the comprehensiveness of the surveillance programme has been covered by the once-only "Ringhals 3-4 systems verification" project, but is not expected to be done regularly every year. Furthermore, the operation-related surveillance does not systematically consider feedback from Probabilistic Safety Analysis. The team encourages the plant to regularly perform a comprehensive review of their surveillance programme.

5.3. PLANT MODIFICATION SYSTEM

The plant has a web-based plant modification tool (DAP) where all relevant processes linked to modifications are available to the project users with the supporting documentation, tools, clear requirements and interrelationships. Furthermore, a risk management tool (ERM, Early Risk Management) allows the manager of a new modification project to assess risk, based on experience feedback of previous similar projects. The team considers this as a good performance.

The management of temporary modifications is currently not adequately performed by the plant. The team found a number of temporary modifications in existence and noticed that the correct identification, status and follow-up needed to be strengthened. The team suggested that the plant improve its management of temporary modifications.

5.3 PLANT MODIFICATION SYSTEM

5.3(1) Issue: The management of temporary modifications is not adequately performed.

The team found that:

- The numbers of temporary modifications are high (34 for Ringhals Unit 3 and 22 for Ringhals Unit 4).
- Sixteen temporary modifications in Ringhals Unit 3 and 12 temporary modifications in Ringhals Unit 4 date from 2008 or older (back to 2005).
- No date is identified as to when 22 temporary modifications in Ringhals Unit 3 and 19 in Ringhals Unit 4 will be resolved (either by removal or transformation into a permanent modification).
- Several temporary modifications do not have a unique identification number (AUN/KB/TINS).
- There is no indication of the current status of the temporary modifications in the plant.
- The number of temporary modifications has been trended and average between 20 and 35 per unit and per cycle.
- Temporary modifications are not currently included in the plant configuration tool.

Without properly controlled temporary modifications, current plant status is not adequately reflected and safety may be diminished.

Suggestion: The plant should consider strengthening its management of temporary modifications.

IAEA Basis:

NS-G-2.3

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

NS-G-2.3

6.5. The plant management should periodically review outstanding temporary modifications to consider whether they are still needed, and to check that operating procedures, instructions and drawings and operator aids conform to the approved configuration. The status of temporary modifications should be periodically reported (typically at monthly intervals) to the plant manager. Those that are found to be needed permanently should be converted in a timely manner according to the established procedure.

NS-G-2.3

6.9. An appropriate procedure should be established to control temporary modifications on the plant…….

NS-R-2

7.4. The operating organization shall establish a procedure to ensure proper design, review, control and implementation of all permanent and temporary modifications.

NS-G-2.14

5.39. A time limit should be specified for the duration of temporary modifications. After this time period, the temporary modification should be reviewed for its applicability, safety and necessity in the current plant conditions. After the review, an approval process similar to the initial approval process should be carried out if the temporary modification is to remain in effect.

5.42. Operations personnel should review periodically all temporary modifications for their continued applicability and proper implementation.

6. OPERATING EXPERIENCE FEEDBACK

6.1 MANAGEMENT, ORGANIZATION AND FUNCTIONS OF THE OE PROGRAMME

The activities and responsibilities in the area of operating experience (OE) feedback are widely spread throughout the plant and conducted by different plant departments and groups as described in plant documents and procedures. Each department and group has its own indicators stated in the Balance Score Cards (BSC), which measure progress in the area. However the indicators in the area of OE at different departments and groups are not sufficiently ambitious. The current plant OE related indicators do not always assist effective management decisions. OE in several departments and groups is handled independently and has no link to any database for future tracking and trending. In order to manage License Events Reports (LERs) and related corrective actions, the Operations Department runs its own LERs database that is strictly dependant on the document database and other records. Plant personnel carry out transition of data from one database to another manually. The plant has no system to prioritize corrective actions or future tracking of their implementation. The process for the incorporation of OE data to the plant personnel training programmes has not yet been established. An assessment of effectiveness of the current plant operating experience programme has not yet been performed, and a schedule for such activities has not yet been established. For example, external OE process has not been reviewed since the year 2005. There is no routine review of corrective actions status conducted and reported to the plant management. The OE process owner cannot keep sufficient management control on the activities in this area due to the numerous operating experience “islands” that are functioning at the plant. Such decentralization and inconsistency in objectives and responsibilities among the process participants can lead to deviation from expected status of the system and from management expectations. The team recommended the plant to enhance its operating experience feedback process to ensure it is consistent and effective.

6.5 ANALYSIS

The plant has enhanced its ability to conduct Root Cause Analyses (RCA) during recent years. To ensure that a RCA is conducted appropriately, the plant has developed a routine for quality control of the RCA. Every analysis undergoes a quality review conducted by an independent team utilizing a checklist comprising a number of criteria. This increases management confidence in the performed RCA. The team has identified this as a good performance.

6.8 DATABASE AND TRENDING OF OPERATING EXPERIENCE

There are several databases at the plant related to OE that are managed by different plant departments and groups. The plant OE Department uses the database AvArs that is dedicated to events with human and organizational factor implications. Technical personnel of different plant departments and groups with application of the SAP system analyse anomalous performance or conditions and events related to equipment failures. The latter events may then be displayed in the AvArs database if they meet License Event Report (LER) criteria. Events not meeting the LER (actually low level or minor events related to equipment failures) are kept in the SAP database. AvArs has no link or reference to the SAP or the Darwin database that is used for external operating experience. Currently neither AvArs nor SAP databases are used by the plant departments and groups to fully track and trend LERs, human performance related events and low-level events. The plant has no current method to perform analysis of low-level events and trends despite possessing the potential, as the data is available from various databases. The databases contain all the necessary data to arrange an effective trending process with regard to internal and external events. The team suggested that the plant considers providing the necessary arrangements for tracking and trending of low-level events and corrective actions.

DETAILED OPERATING EXPERIENCE FINDINGS

6.1 MANAGEMENT, ORGANIZATION AND FUNCTIONS OF THE OE PROGRAMME

6.1(1) Issue: The management system for operating experience does not coordinate departmental operating experience to ensure that the process is used consistently and effectively.

During the review the team noted that:

- the operating experience administrative procedures do not sufficiently cover all the stages of the plant operating experience process.
- the distribution of the departmental and group responsibilities in the area of operating experience is not consistent.
- plant events are treated by numerous separate data bases.
- the operating departments do not use the plant events data base (AvArs) to handle License Event Reports (LERs) and subsequent corrective actions, but utilize their own informal LERs data bases.
- the plant has no system to prioritize corrective actions.
- the plant activities in the area of external operating experience are performed separately and are not an integral part of the plant OE system.
- a process for the transition of operating experience data to the plant personnel training programmes has not yet been established.
- the current plant operating experience related indicators do not assist effective management decisions.
- the plant operating experience process in its current status is new; therefore assessment of its effectiveness is not possible and a schedule for future assessment of the effectiveness of the plant operating experience system has not yet been developed.

As the operating experience process is decentralized and inconsistent, the plant may miss opportunities to learn from internal and external operating experience for the benefit of safety.

Recommendation: The plant should enhance its management system for operating experience to ensure the process is used consistently and effectively.

IAEA Basis:

NS-G-2.11

2.12. A detailed procedure should be developed by the operating organization on the basis of the requirements for a national system established by the regulatory body. This procedure should define the process for dealing with all internal and external information on events at nuclear installations. The procedure should precisely define the structure of the system for the feedback of operational experience, the types of information, the channels of communication, the responsibilities of the groups and organizations involved, and the purpose of the documentation produced. …The procedure should be made available for review or approval by the regulatory body, if so required.

5.6. Generating too many actions may overwhelm the intended beneficiary and may result in some important actions being left pending for too long. Corrective actions should therefore be prioritized. Those actions affecting safety should be given the highest priority, while the actions that are desirable rather than essential should be shown as such. Corrective actions may be immediate, interim or long term with a need for detailed evaluation.

7.2. Information on operating experience should be made readily accessible to plant personnel. …Effective use of the feedback of operational experience should be actively encouraged and reinforced by plant managers and supervisors, including the use of operating experience in refresher training for plant.

8.1. A periodic review should be undertaken of all stages of the process for the feedback of operational experience to ensure that all of its elements are performed effectively. Continuous improvement of the process for the feedback of experience should be an objective of the review. An effective process for the feedback of operational experience can contribute significantly to minimizing the recurrence of events.

9.1. The operating organization or licensee should be responsible for integrating operational experience feedback into its quality assurance/ management system4 in accordance with national and international standards. The operating organization or licensee should establish procedures for the control of activities at the site for the feedback of operational experience to ensure that they are consistent with the objectives of the management system.

6.8 DATABASE AND TRENDING OF OPERATING EXPERIENCE

6.8(1) Issue: The plant operating experience system does not provide sufficient arrangements for tracking and trending of low level events and corrective actions.

During the review the team noted that:

- the plant administrative documents and procedures do not make provision for monitoring low level events.
- the plant databases, other than AvArs, are not tailored to analyze low level events.
- the coding system and methods established at the plant to enable events to be characterized and then tracked and trended is not fully utilized for low level events and corrective actions.
- the trending of certain events is conducted by separate groups (e.g. maintenance) according to their own departmental methodology.

Without thoroughly tracking and trending low-level events, the plant may not achieve the timely identification of adverse trends and the subsequent prevention of significant events.

Suggestion: The plant operating experience system should consider providing the necessary arrangements for tracking and trending low level events and corrective actions.

IAEA Basis:

NS-G-2.11

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

5.8. In addition to the documentation and tracking of actions associated with each single event, a systematic compilation of actions should be made to provide a historical information base of lessons learned. When these actions are compiled and sorted on the basis of the systems affected or the safety issues raised, they can serve as solutions for similar problems that could arise in the future at the plant or at other plants.

The purpose of an event trending process should be to determine the frequency of occurrence of certain conditions that have been gathered from reports on minor and major problems and event investigations. These data include information about equipment failures and shortfalls in human performance, and situational data that describe conditions at the times of the events.

7. RADIATION PROTECTION

7.2. RADIATION WORK CONTROL

The “defence-in-depth” principle is applied to contamination control, including zoning of plant areas, physical barriers and use of protective clothing. During the review, the team observed a number of sub-standard worker practices relating to the use of protective clothing, use of monitoring instruments and storage of potentially contaminated equipment. The high number of controlled area exits does not aid effective control of contamination. The team noted that the number of reported contamination events is significantly lower than the number of alarms recorded by the pre- and final contamination monitors. This reduces the plant’s ability to detect and to take prompt action to contain contamination, and to determine root causes. Furthermore, the team also observed that the radiation protection programme tends to result in the initial contamination monitoring taking place towards the outer boundaries of the controlled area, rather than close to the source. The team recommended that the plant enhance the contamination control aspects of the radiation protection programme to reduce the risk of personal contamination or unauthorized release of radioactive material.

Radiation work permits and departmental procedures are used to provide information on the limitations, precautions and protective equipment requirements to maintain doses as low as reasonably achievable (ALARA). The plant has a system to classify different zones according to the radiological hazard. Physical barriers and signs are used to indicate different zones, and to restrict access. However, the team noted that the plant does not perform a systematic verification of the effectiveness of the physical controls that prevent access to high radiological risk areas. The team made a recommendation in this area.

A risk-based survey programme is used to verify the radiological conditions in work areas. The team observed some ineffective survey techniques being used, which were immediately corrected by task observation and coaching from more experienced staff. The team encourages the plant to use practical training and coaching to improve worker performance within the controlled area.

The workplace monitoring programme includes *in-situ* gamma spectroscopy to analyze the deposition of nuclides on internal surfaces of active systems. Furthermore, the plant uses dose rate data to formulate a “plant dose rate index”. These tools are used to inform decisions on the optimization of primary coolant chemistry, thus minimizing plant source terms and occupational doses ALARA. This technique is considered by the team to be a good practice.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

Signs are used to indicate general high radiation areas, localized radiation “hotspots” and low dose rate waiting areas. The team observed a number of workers using these areas to good effect. Photographic libraries and virtual tours are also available to aid location of plant components during work planning, however the team found that these highly effective visual aids were not used during the observed pre-job briefings.

The radiation protection group participates in national and international operating experience exchange and ALARA benchmarking networks. This information is used to evaluate protection measures, set dose constraints, plan doses and aid optimization of work practices. The team noted that the plant could improve the process used to review doses and re-evaluate work methods when actual doses are likely to exceed the estimated dose. A suggestion was made in this area.

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

Mobile communication technology is used to aid the exchange of information between workers and their supervisors in plant areas. Use of this technology in these circumstances is considered a good practice.
Some defective protective clothing was found in-use within the controlled area. The team encourages the plant to enhance arrangements for the detection, repair or disposal of these defective items.

7.5. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The plant has a management system and facilities for the decontamination, storage and treatment of radioactive wastes. Off-site treatment, storage and disposal facilities are available for the majority of solid radioactive wastes produced by the plant. Plant observations indicated some extraneous packaging material in the solid radioactive waste. It was also observed that housekeeping arrangements at the waste handling facility could lead to wastes from different units being mixed together. The team encourages the plant to continue with efforts to avoid waste production at the source.

The plant has a management system and facilities to minimize the production and discharge of radioactive liquid and gaseous effluents. The team noted that considerable effort has been made in source term reduction and in the development and use of effective abatement technologies. The team considers the plant to have good performance in the application of Best Available Techniques.

7.2 CONTROL OF DESIGNATED AREAS AND INDIVIDUAL WORK SITES

7.2(1) Issue: Contamination control measures are not sufficiently robust to minimize the spread of radioactive contamination.

The team found a number of deficiencies in the programme relating to contamination control, including:

- The minimum detectable activity of the installed contamination monitoring equipment at the exits from the fuel building and the containment building are approximately 350kBq.This is equivalent to approximately 175kBq/m2 or nearly 4.5 times the permissible surface contamination limit for the “Blue” area designation.
- There are no portable/installed contamination monitoring instruments provided at exits from “Yellow” contamination areas.
- There are over twenty exit points from the controlled area.
- The number of alarms recorded on the pre- and final contamination monitors exceeds the number of contamination events reported at the exit points from the controlled area. In 2009, approximately 900 alarms were registered, yet only 300 events were reported.
- Numerous deficiencies in worker practices were observed, including:
  - A radioactive liquid sample was removed from a nuclear sampling system glove box without being surveyed for contamination.
  - Five workers were observed passing through the pre-monitors without monitoring tools & personal items in the small articles monitors provided.
  - Two workers with partially lowered zips on their controlled area coveralls, thereby exposing skin or under-clothing.
  - Potentially contaminated hoses were not labelled in accordance with plant instructions.
  - Inconsistent and incomplete marking of controlled area tools in the active workshops.
  - On 9 June 2009, a worker was found to have contaminated personal clothing at the site boundary, due to the handling of a radioactive pipe flange within the non-radioactive workshop in Building RG22.

Without robust contamination control measures, the risk of contamination of personnel and the plant areas is increased.

Recommendation: Contamination control measures should be enhanced to minimize the potential for spread of radioactive contamination and to ensure adequate containment, as close to the source as reasonably practicable.

IAEA Bases:

NS-G-2.7

Paragraph 3.9 "Access to a controlled area is required to be restricted by way of a limited number of checkpoints in order to limit the spread of contamination…"

Paragraph 3.13 "Before items are removed from any contamination zone… they are required to be monitored as appropriate…"

Paragraph 3.19(b) "Task related monitoring should generally be conducted to supply information…a basis for immediate decisions on the execution of the tasks".

Paragraph 3.29 "The equipment to be provided for measuring radiation & activity and sampling and analyses may include:…(d)(ii) contamination monitors, such as portal monitors and hand and shoe monitors…"

Paragraph 3.55 "Site personnel, including contractor personnel, should be specifically trained and qualified in the use of protective clothing…"

7.2(2) Issue: No systematic checks are made to verify the effectiveness of physical barriers and safety devices designed to prevent exposure to ionizing radiation or unauthorized release of radioactive material.

During the review, the team identified the following:

- There is no periodic checking of the status of radiological barriers that should be locked shut and there is no self-checking by plant personnel that barriers are properly closed upon exit.
    - Pre-monitor bypass door was found unlocked.
    - Exit door from the controlled area to 4-P2.05 was not fitted with a means to recognize unauthorized opening and passage (e.g. a tamper-evident cover/alarm).
    - Door to yellow zone was found unlocked due to a defective lock mechanism.
    - In March and August 2009, 2 yellow zone doors were found unlocked or wedged open.
- There is a high availability of keys for normally locked areas (Yellow and Red Zones).
    - Red zone keys are held by Operations Technicians.
    - Yellow zone keys are held by Operations and Chemistry Technicians.
    - The red zone key also allows access to bio-shield areas when the reactor is at full power.
- In February 2009, a member of staff entered Room 4-H2.06, which was designated as a red radiation zone whilst transfer of a spent ion-exchange demineralizer was in progress. The installed radiation monitor and alarm intended to warn entrants of high radiation levels in the room did not function correctly.
- No periodic maintenance or examination routines exist for an electro-mechanical interlock intended to prevent accidental exposure of a high activity gamma irradiator source.

Without effective control of physical barriers or safety devices, the risk of unauthorized entry to high radiation areas and unauthorized release of contaminated persons/materials from the controlled area is increased.

Recommendation: A programme should be implemented, that periodically evaluates the correct status and effectiveness of physical barriers and safety devices for high radiological risk areas.

IAEA Bases:

Safety Series No.115

Paragraph I.23(e) "restrict access to controlled areas by means of …physical barriers, which could include locks or interlocks…"

Paragraph I.23 (h) "periodically review conditions to determine the possible need to revise protection measures…"

Paragraph IV. 10. "Systems and components of sources that are related to protection or safety shall be designed, constructed, operated and maintained so as to… restrict to levels which are as low as reasonably achievable…. the magnitude and likelihood of exposure of workers and members of the public."

Paragraph IV. 11 (e) "…to ensure that safety significant systems, components and equipment can be inspected and tested regularly for any degradation that could lead to abnormal conditions or inadequate performance;…"

NS-G-2.7

Paragraph 3.60 "Measures should be taken to ensure that the equipment is properly maintained…"

7.2(a) Good practice: In-situ gamma spectroscopy to determine surface activity concentrations on internal surfaces of plant systems.

The plant has for many years performed a systematic analysis of the deposition of radionuclides on the internal surfaces of primary coolant and auxiliary systems components using a portable high-resolution gamma spectrometer.

Furthermore, the plant uses radiation dose rate data from a number of fixed points to calculate a “dose rate index”. This index can be used to evaluate the effectiveness of the source term reduction initiatives and to aid wider understanding of how plant operations affect radiological conditions around the plant. Whereas collective radiation exposure is a function of dose rate and occupancy (i.e. the scope of an outage) , the use of an indicator of radiation dose rate on the plant enables an assessment of the effectiveness of the plant chemistry and radiological protection programmes to be made; independent of the outage workload.

These tools have yielded information that has assisted in determining the optimal primary coolant chemistry to reduce source term and optimize occupational doses as low as reasonably achievable. As an example, in 2008, increasing deposition of Ag-110m was detected on cool surfaces of the chemical and volume control system (CVCS) indicating a leaking control rod. Conventional sampling of the coolant system was unable to detect this release and deposition. The leaking control rod was replaced before the Ag-110m became a significant contributor to dose rates around the CVCS.

7.3 IMPLEMENTATION OF THE ALARA PRINCIPLE

7.3(1) Issue: The plant's arrangements for planning, setting dose constraints and reviewing performance does not optimize individual and collective exposures.

The following facts were found during the team review:

- Effectiveness of dose constraints
  - The plant safety rules and departmental procedures have specified an individual dose constraint of 10mSv to aid optimization of work. In 2009, a detailed review of the outage plans did not identify any worker likely to exceed the dose constraint. By the end of 2009, 44 workers had received doses greater than 10mSv.
  - There is no evidence of a formal pre-review or prior authorization of these additional exposures to determine whether they were justified or optimized.
- There is no structured forum (e.g. an ALARA committee) to ensure the systematic review of occupational doses and to act as a forum to engage workers on ALARA matters.
- Work group doses are presented to each department, but results are not challenged by departmental managers to improve performance.
- Dose alarms are set at 2mSv per entry, independent of the task to be performed.

Without effective arrangements to set goals and review performance, opportunities to restrict individual and collective exposures are not optimized.

Suggestion: The plant should consider enhancing measures to improve departmental ownership of their occupational exposures and to ensure that doses are optimized where they are likely to exceed the relevant constraint.

IAEA Bases:

NS-G-2.7

Paragraph 2.22 "In order to apply the principle of optimization, individual doses should be assess at the operational planning stage…Options predicted to give estimated doses that would exceed the constraint should normally be rejected."

Paragraph 2.31 "…The operating organization should ensure that mechanisms are in place to involve workers, to the extent possible, in the development of methods to keep doses…as low as reasonably achievable and to provide feedback on the effectiveness of measures…"

Paragraph 3.72(d) "Department managers are responsible for implementation of the plant's radiation protection programme… for their field of activity. To this end they should…. periodically review the performance of their departments…"

7.4 RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING AND FACILITIES

7.4(a) Good practice: Use of low-power mobile telephones in the controlled area

Mobile telephones are used to improve communications during work activities. The system is also used to automatically alert personnel in the event of a building evacuation alarm.

Since introducing the system, radiation protection supervisors have noticed more frequent and higher quality communications with the radiation protection technicians working in plant areas. This system has helped remove barriers to prompt and open communications, enhancing the quality of radiation protection coverage to work parties. This also allows supervisors to be informed immediately of any events, and to deploy promptly their technicians.

8. CHEMISTRY

8.1. ORGANIZATION AND FUNCTIONS

A set of four performance indicators have been developed to monitor chemistry control performance and measure its effectiveness. Targets have been assigned to each threshold value and reports are produced quarterly. However, the chemistry control programme is not sufficiently supported by other specific indicators. Failure to consider some specific indicators could lead to an incorrect evaluation of the chemistry control programme and inferior practice. The team encouraged the plant to develop more specific performance indicators for an appropriate evaluation of the chemistry control programme and practices.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

The degassing of primary make-up water in storage tanks using a gas transfer membrane system allows a reduction of dissolved argon gases (Ar-40) entering the primary circuit, and as a consequence, the potential for Ar-41 emissions from the plant is significantly reduced. The team recognised this technique as a good practice.

The generation and transport of radioactive products within the nuclear systems are considered, controlled and minimized by optimizing the chemistry conditions in these systems. The effects of introducing elevated lithium and pH have been evaluated by extensive water and corrosion products sampling during operation and shutdown, frequent fuel scraping campaigns and annual activity measurements on primary system surfaces. This extensive primary water chemistry control and evaluation programme was recognized by the team as good performance.

8.3. CHEMISTRY SURVEILLANCE PROGRAMME

The chemistry surveillance programme is developed on the basis of the chemical control programme. However, quality control practices are not improved enough to support an effective quality control programme in order to increase the confidence of chemistry personnel on its control of activities. The team suggested the plant improve its chemistry quality control programme to avoid any possible deterioration of analytical and working practices.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

The plant developed a database for approved chemicals that contains classifications, material safety data sheets and other safety information for all used chemicals. Although every chemical product used and stored in the plant must be approved, registered and labelled, the team found examples when chemicals control practices were not followed in the field. The team suggested the plant improve the actual chemicals control programme and practices in order to increase the confidence of appropriate chemical control and usage.

DETAILED CHEMISTRY FINDINGS

8.2 CHEMISTRY CONTROL IN PLANT SYSTEMS

8.2(a) Good practice: Argon 41 emission reduction.

Degassing of primary make-up water in storage tanks using a gas transfer membrane system has led to significant reductions of dissolved argon gases (Ar-40) entering the primary circuit, thereby reducing the source term for the activation of Ar-40 and hence the potential for Ar-41 emissions from the plant.
Supporting facts and effects:

- Production of Ar-41 concentration in the reactor coolant has been reduced by about a factor of 10.
- Airborne emissions of Ar-41 through the main stack have been reduced by a factor of 10.

8.3 CHEMISTRY SURVEILLANCE PROGRAMME

8.3(1) Issue: The quality control programme is not sufficiently comprehensive to provide for the analysis of deviations or to ensure that corrective actions are implemented in a timely and efficient manner.

Although the plant has developed a chemistry quality control programme, the team found the following:

- Some control charts are performed with standards, which have a higher concentration than the expected concentration of a plant sample. For example, the control chart for sodium is obtained by analysing a standard solution of 20 ppb sodium, while the concentration in many plant systems is 1 ppb or less.
- Quality control data is inconsistently trended and evaluated. Results are plotted outside the control chart area and corrections without a supporting signature were observed on some control charts.
- Corrective actions are not carried out in an appropriate time frame as per chemistry quality control procedure requirements. The distribution of measured values on both sides of the theoretical value was not observed for some control charts. For example, 23 consecutive results, situated on the same side, have been seen on control charts for 1000 ppm boron and 100 ppm hydrazine standard solutions.
- Blind samples are not introduced to periodically confirm the analysts performance.

Without strengthening the quality control programme, the plant could miss an early warning of deterioration in calibration standards or systematic faults in analyses caused by an instrument, an analyst or a reagent.

Suggestion: Consideration should be given to improving the chemistry quality control programme in order to ensure the appropriate analysis of deviations and ensure that corrective actions are implemented in a timely and efficient manner.

IAEA Basis:

DS 388:

"6.38. Adequacy and accuracy of procedures should be checked regularly by intra- and inter-laboratory tests, to identify analytical interferences, improper calibrations, analytical techniques and instrument operation. These test results should be evaluated to determine the causes of unacceptable differences and deviations, tacking into account short-term and long-term effects"

50- C/SG-Q13:

"403. Chemistry and radiochemistry work normally consist of: … evaluating chemistry data to identify control problems and analytical errors, and to correct them/ controlling of laboratory conditions, practices, equipment and materials to ensure the accuracy of the analytical results…"

8.6 QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

8.6(1) Issue: Chemicals control practices do not fully support an effective control programme.

Although the plant has established a procedure to control chemicals, it is often not followed in the field. The following examples were noted:

- Several containers containing chemicals (propane cylinders, oil canisters, plastic bottle and canisters with unknown content), used in maintenance and electrical workshops were not identified and labelled as required by plant procedure.
- The chemicals storage cabinet in the maintenance workshop does not indicate, for personnel awareness, its contents.
- Batteries were found stored together with chemicals in a cabinet in the maintenance workshop.
- Safety information sheets were not attached to several compressed gas cylinders (compressed air, oxygen, propane, acetylene, argon and nitrogen) located inside the controlled area, turbine building, and beside the chemical storage tanks (ammonia and hydrazine).
- The chemistry laboratory quality control procedures do not provide a consistent format for reagents and standards identification. This results in the use of paper labels, as well as handwritten markings directly on the container.
- Unknown content within one plastic bottle, which was found in an active chemistry laboratory – even the marker writing was also unclear.
- The bulk hydrazine storage tank was not labelled and there was no warning signposted.

Shortfalls in chemicals control practices could lead to inappropriate chemical usage and personnel injuries.

Suggestion: Consideration should be given to improving the chemical control programme and practices.

IAEA Basis:

DS 388_Draft_v_3_2

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

9.10. When transferring a chemical from a stock container to a smaller container, the latter should be labelled with the name of the chemical, date of transfer and pictograms to indicate the risk and application area.

Safety in the use of chemicals of work – ILO

4.2.1. All chemicals should be marked so as to indicate their identity.

4.2.4. The marking of chemicals may be impracticable because of the size of the container or nature of the package. They should, however, be readily identifiable by such means as tagging or accompanying documents.

4.2.5. Each container or layer of packaging should be marked. The particulars should always be visible on the container or package during each stage of the supply and use of the chemicals.

4.4.1. Employers should ensure that when chemicals are transferred into other containers or equipment, the contents are indicated in a manner which will make known to workers their identity, any hazards associated with their use and any safety precautions to be observed.

9. EMERGENCY PLANNING AND PREPAREDNESS

9.2. RESPONSE FUNCTIONS

For conditions involving an emergency at the plant, it is important to have a well trained response organization that can respond quickly to support the operating staff at the plant both during normal and off-normal hours. The plant has a well-defined response organization with necessary positions defined in the Ringhals Emergency Preparedness Plan. The requirements for the response team and for training staff to fill those positions have been defined, but more work remains in this area. Following declaration of an event that requires mobilization of the emergency response organization, these positions will be filled by personnel trained in that function following notification by the Rapid Reach phone system. With the exception of expectations of a few positions during major holidays, there is no plant wide expectation for personnel that support emergency positions to remain available to be able to respond to an emergency during non-business hours.

To measure the effectiveness of off-hour reporting, the emergency preparedness staff instituted an off-hours drill to call in members of the response organization. However the ability to fully staff the response organization within two hours was not tested. The Emergency Preparedness organization developed a document describing on-duty requirements for the Emergency Response Organization. This document sets expectations for some positions but not all to be available for response during holidays. There is not a similar expectation for the rest of the response positions or for other times excluding holidays.

In order for emergency responders to provide effective support, information in the various response locations should be up-to-date, and there needs to be an ability to display critical parameters to the emergency staff, while allowing for effective communication of emergency status and plant conditions. While the plant is able to adequately communicate with on-site and off-site organizations, changing technology has caused the need to evaluate effective information technology and communication equipment in the Technical Support area and the Emergency Command Centre. The plant has decided to perform a technical evaluation of the Emergency Command Center in order to identify needs, requirements and shortcomings, as well as to propose solutions, in order to create an Emergency Command Centre that is fully effective and robust. The area for the emergency responders to work in the main control room is small and could be a distraction to the operators in the event of an emergency. The team suggested that the plant consider performing an in-depth analysis of actual staffing and equipment needs in comparison with IAEA safety standards and best international practices, and take appropriate actions to ensure optimization of the response capability and response facilities.

Some events require a coordinated response that exceeds either the capabilities or the time demands of the normal plant line management, but do not require the full activation of the emergency response organization. The plant has established a Crisis Management Group to effectively manage these types of events, which could include an off-site personnel tragedy, and may need the attention and expertise of various disciplines in order to relieve the burden on operating management. The team recognized the establishment of this group as good performance.

9.7. QUALITY ASSURANCE

The plant has focused considerable resources on maintaining effective relationships and communication with off-site response organizations.

Fire-fighters, medical staff, and police responders have all trained with the plant staff in order to improve or refresh understanding of key emergency response functions required of both on-site and off-site responders. Recent training, including familiarization at the site with large numbers of police responders as well as table top drills to better define police response in an emergency that may include intruders with hostile intent, help improve understanding of roles for staff and police. The team recognized this coordination of the Emergency Response organization with local authorities as a good practice.

DETAILED EMERGENCY PLANNING AND PREPAREDNESS FINDINGS

9.2 RESPONSE FUNCTIONS

9.2(1) Issue: The plant does not fully address the emergency preparedness organization response capability and emergency facility resources.

The following facts refer:

- Expectations for timeliness of fully implementing the response organization positions are not clear in the Ringhals Emergency Plan or other emergency documents, and as there is no stated expectation for the time requirements of the emergency organization to be fully functional following the declaration of an emergency.
- There are no practical requirements to ensure that personnel to be called out in an emergency will be able to fully staff the response organization.
- Except for eight key positions, there are no on-call reporting requirements for the remainder of the emergency response positions defined by the emergency plan, and no requirements for reporting for days other than major holidays. Technical positions needed to support radiological dose determinations, plume assessments, protective action recommendations, and technical support for mitigating actions are not on the list of positions expected to be on call during holidays or other periods.
- During emergencies, the Site Emergency Director's announcement that the emergency response organization is staffed and all other responders can go to the assembly areas would be delayed if all functions were not staffed.
- The capability to ensure a fully functional response organization within two hours has not been demonstrated/recorded through drills or actual events.
- There is no common display panel for the responders in Technical Support to share information from the Emergency Command Centre, and the addition of nine emergency responders to the MCR may be a distraction for operators.
- The Emergency Command Centre equipment needs to be reviewed to ensure communication with on-site and off-site organizations can be effectively maintained.

Without clear mobilization response time guidance as well as appropriate analysis and communication tools and facilities, the plant could have difficulties in case of emergency situations.

Suggestion: The plant should consider performing an in-depth analysis of actual needs in comparison with IAEA safety standards and best international practices, and take appropriate actions to ensure response capability and response facilities are appropriate.

IAEA Basis:

GS-R-2

4.2. The on-site emergency response shall be promptly executed and managed without impairing the performance of the continuing operational safety functions.

4.7. For facilities in threat category I, II or III the transition from normal to emergency operations shall be clearly defined and shall be effectively made without jeopardizing safety. The responsibilities of everyone who would be on the site in an emergency shall be designated as part of the transition. It shall be ensured that the transition to the emergency response and the performance of initial response actions do not impair the ability of the operational staff (such as the control room staff) to follow the procedures needed for safe operations and for taking mitigatory actions.

4.24. Operators of a facility or practice in threat category I, II, III or IV "shall ensure that adequate [arrangements are] made for [identifying a situation that warrants emergency response and] generating adequate information promptly and communicating it to the responsible authorities, for32, 33:

> (a) the early prediction or assessment of the extent and significance of any [unplanned] discharge of radioactive substances to the environment [or exposures];
>
> (b) rapid and continuous assessment of the [nuclear or radiological emergency] as it proceeds; and
>
> (c) determining the need for protective actions [for the public and workers]" (Ref. [3], Appendix V, para. V.5.)

4.27. Arrangements shall be made for response organizations to have sufficient personnel available to perform their assigned initial response actions.

4.35. Arrangements shall be made to provide expertise and services in radiation protection promptly to local officials and first responders responding to actual or potential emergencies involving practices in threat category IV. This shall include arrangements for on-call advice and arrangements to dispatch to the scene an emergency team that includes radiation specialists capable of assessing threats involving radioactive or fissile material, assessing radiological conditions, mitigating the radiological consequences and managing the exposure of responders.

4.40. For facilities in threat category I, II or III arrangements shall be made to provide technical assistance to the operational staff. Teams for mitigating the consequences of an emergency (damage control, fire fighting) shall be available and shall be prepared to perform actions in the facility…The personnel directing mitigatory actions shall be provided with an operating environment, information and technical assistance that allows them to take effective action to mitigate the consequences of the emergency. ...

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.

5.27. [For facilities in threat category I] "on-site emergency control centre, separated from the [facility] control room, shall be provided to serve as [a] meeting place for the emergency staff who will operate from there in the event of an emergency. Information about important [facility] parameters and radiological conditions in the [facility] and its immediate surroundings should be available there. The room should provide means of communication with the control room, the supplementary control room and other important points in the [facility], and with the on-site and off-site emergency response organizations. Appropriate measures shall be taken to protect the occupants for a protracted time against hazards resulting from a severe accident." (Ref. [11], para. 6.87.)

GS-G-2.1

5.2. Inadequate responses to emergencies can often be traced back to an inadequacy in one or more of these infrastructural elements. The following gives some examples: ….. Other common problems are that items of communications equipment used by response personnel are not compatible and therefore response organizations cannot communicate with each other…

VI.1. Response time objectives are suggested time objectives for selected critical response functions or tasks for facilities in threat categories I, II and III. They should, once established, be part of the performance objectives for a response capability and should be used as part of the evaluation criteria for exercises (Ref. [2], para. 5.36). These time objectives were developed on the assumption that: (a) emergencies resulting in severe conditions can be classified and off-site officials can be notified within minutes [49];44 (b) severe conditions warranting protective action on the site can occur within minutes; (c) releases can occur from a facility in threat category I that require the implementation of urgent protective action to prevent deterministic effects within the PAZ within one or two hours; (d) monitoring within the UPZ may be warranted within 4–6 hours following a release to identify locations where additional protective actions may be needed; and (e) the news media will become aware of events and will become a major source of information for the public within hours.

From Table 12 of the Guide, for the facility level, the recommended response time to support these objectives are less than 2 hours for… Emergency operations facility/incident command post is fully functional (all organizations represented and to ..Fully activate emergency organization.

9.7. QUALITY ASSURANCE

9.7(a) Good Practice: Cooperation With Local Authorities.

The plant has made a commitment to close coordination with local police that has resulted in a better overall understanding of how off site and on site organizations will respond to events involving radiological concerns as well as fire, rescue, and potential hostile actions. In many cases, events involving hostile actions can change the way an emergency response organization responds to a radiological event. Actions taken by the plant in this area have helped to improve plant safety through a defense in depth concept provided by the emergency responders.

Together with police officers and group leaders for the local security company, the staff assigned as Engineer on Duty has undergone training, including Table Top exercises directed at criminal attack. During the training, it was repeatedly emphasized that the primary objective for the responders is to maintain reactor safety and that apprehension of the criminals is secondary. In 2008, a functional exercise in physical protection was carried out with 21 police officers, 23 engineers on duty (all) and 9 group leaders from the plant's security force. The evaluation of this training and exercise showed this type of exercise to be very valuable and has given all participants more in-depth knowledge of their own roles and knowledge and understanding of the roles of other responders The commitment to cooperation included on site familiarity training of 160 police officers in 2007 through 2009, and 110 police officers undergoing refresher training at the site in during the same period.

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 ongoing work. In general, it is designed to stimulate the plant management and supporting staff to continue to consider ways and means for enhancing performance.

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

Good practice

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

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

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

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

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)
- **NS-G-2.14;** Conduct of Operations at Nuclear Power Plants (Safety Guide)
- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power Plants Safety Guide (Safety Guide)
- **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)
- **GS-G-3.1**; Application of the Management System for Facilities and Activities (Safety Guide)
- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
- **RS-G-1.1**; Occupational Radiation Protection (Safety Guide)
- **RS-G-1.2**; Assessment of Occupational Exposure Due to Intakes of Radionuclides (Safety Guide)
- **RS-G-1.3**; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)
- **RS-G-1.8**; Environmental and Source Monitoring for Purpose of Radiation Protection (Safety Guide)
- **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
- **DS388;** Chemistry Programme for Water Cooled Nuclear Power Plants (Draft Safety Guide)

▪ ***INSAG, Safety Report Series***

- **INSAG-4;** Safety Culture
- **INSAG-10**; Defence in Depth in Nuclear Safety
- **INSAG-12**; Basic Safety Principles for Nuclear Power Plants, 75-INSAG-3 Rev.1
- **INSAG-13**; Management of Operational Safety in Nuclear Power Plants
- **INSAG-14**; Safe Management of the Operating Lifetimes of Nuclear Power Plants
- **INSAG-15**; Key Practical Issues In Strengthening Safety Culture
- **INSAG-16**; Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety
- **INSAG-17**; Independence in Regulatory Decision Making
- **INSAG-18**; Managing Change in the Nuclear Industry: The Effects on Safety
- **INSAG-19**; Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life

- **INSAG-20**;Stakeholder Involvement in Nuclear Issues
- **INSAG-23**; Improving the International System for Operating Experience Feedback
- **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 Services 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-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)

TEAM COMPOSITION OF THE OSART MISSION

HENDERSON Neil
IAEA
Years of nuclear experience: 34
Review area: Team Leader

GEST Pierre
IAEA
Years of nuclear experience: 31
Review area: Deputy Team Leader

DEPAS Vincent
Electrabel – Tihange NPP
Years of nuclear experience: 23
Review area: Management Organization and Administration

MORTENSEN George
Institute of Nuclear Power Operations (INPO)
Years of nuclear experience: 33
Review area: Training and Qualification

WILLING Carsten
Kernkraftwerk Philippsburg (KKP)
Years of nuclear experience: 26
Review area: Operations 1

FRANZETTI Christophe
EDF – Chooz NPP
Years of nuclear experience: 20
Review area: Operations 2

HALL Barry
Bruce Power
Years of nuclear experience: 26
Review area: Maintenance

BUCALOSSI Andrea
European Commission – DG Joint Research Centre
Years of nuclear experience: 13
Review area: Technical Support

MARTYNENKO Yuri
IAEA
Years of nuclear experience: 26
Review area: Operating Experience

LUNN Matthew
British Energy Generation Ltd – Sizewell B
Years of nuclear experience: 10
Review area: Radiation Protection

ZOTICA Dorina
Cernavoda Nuclear Power Plant
Years of nuclear experience: 26
Review area: Chemistry

MILLER Christopher
US Nuclear Regulatory Commission
Years of nuclear experience: 28
Review area: Emergency Planning and Preparedness