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REPORT

OF THE

OSART

(OPERATIONAL SAFETY REVIEW TEAM)

MISSION

TO THE

FESSENHEIM
NUCLEAR POWER PLANT
FRANCE

23 MARCH – 8 APRIL

DIVISION OF NUCLEAR INSTALLATION SAFETY
OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/09/152

PREAMBLE

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

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

FOREWORD

by the

Director General

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

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

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

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

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

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

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INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of the Republic of France, an IAEA Operational Safety Review Team (OSART) of international experts visited Fessenheim Nuclear Power Plant from 23 March to 8 April 2009. 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 Fessenheim nuclear power plant is located in the Alsace plain, in the Haut-Rhin department 26 km north-east of Mulhouse, on the left bank of the Grand Canal d'Alsace. The main towns located near the power plant are : Mulhouse 26 km away, Colmar 30 km, Strasbourg 100 km, Basel in Switzerland 45 km away and Fribourg in Germany 30 km. The geographical position of the plant is further underlined by the financial partnership with EnBW (Germany) holding a 17.5% stake and with three Swiss companies (association of NOK, EOS and EWB) holding 15%.

The plant operates two PWR units of CP0 type with 900 MW capacity each. They are the first two units of EDF's 900 MW series. The first unit was connected to the grid in April 1977 and the second in October 1977. The plant has about 640 employees and 150 permanent contractor staff.

The Fessenheim OSART mission was the 152nd in the programme, which began in 1982. This was the second OSART mission at Fessenheim NPP, the first took place in 1992. This time the team was composed of experts from Armenia, Canada, Czech Republic, Germany, Slovak Republic, Sweden, Switzerland and UK, together with the IAEA staff members and an observer from Estonia. The collective nuclear power experience of the team was approximately 348 years.

Before visiting the plant, the team studied information provided by the IAEA and the Fessenheim 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 good international practices.

The following report is produced to summarise 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 Fessenheim NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

- Senior Plant Managers are improving Operational Safety by their daily visible support for staff behaviours that enhance Nuclear Safety;
- Shift Managers use reference standards specific to each reactor mode for performing safety assessment;
- The plant uses a high-precision radiation monitoring device which allows the detection of radioactive particles inside the equipment to perform a final check of large objects leaving the site.

A number of issues where improvements in operational safety could be achieved were identified by the team. The most significant areas for improvement include the following:

- Corrective actions for safety-significant events are not prioritized and some of these actions are rescheduled;
- Not all opportunities have been taken to eliminate industrial safety risks in the plant related to unprotected hot pipes and equipment, inadequate installed guards on rotating equipment and tripping hazards particularly due to uncontrolled extension cords;
- Leaks of water and oil on the equipment within the industrial buildings are not systematically identified and corrective actions are not always initiated.

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

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1.1. ORGANIZATION AND ADMINISTRATION

The Plant Director performed an in-depth diagnosis of the reasons for lower levels of plant performance in 2006. He instituted an improvement plan based on the principle that every person at the plant has a key role in Nuclear Safety. He also found the plant needed increased staffing and was granted this request. This included increases in Operations, Human Resources, Independent Safety Group, Pressure Boundery Inspectors, Maintenance and Radiation Protection Technicians.

In the subsequent years performance has improved. Front line workers from three different groups including contractors stated that management responds to safety concerns very rapidly. They stated that their supervisors talk about safety and procedures as well as progress in the work. A Control Room Operator said people have reinforced carefulness and the control room is more professional now. The team considers this approach to plant improvement to be good performance.

The plant and the nuclear safety regulator (ASN) were asked seperatly about the most significant issues in their relations. The ASN says the plant submits 2 to 3 times as many exemption requests as other plants in France. The ASN believes this is mostly due to spare parts and documentation concerns at Fessenheim, which is a specific power plant compared to the other power plants in France. Plant management believes the increasing number of requests requiered is due to the application of the new french nuclear law (loi TSN). The OSART team encourages the plant to work together with the ASN to achieve a common understanding of the origin of the exemption requests and of the legal expectations.

Public communication and involvement is taken very seriously and involves a number of innovative forums. While some are legislated, others are unique to the plant and involve those opposed to nuclear power, union leaders from the plant and local politicians. Similar forums are in place to involve neighboring residents in Germany. There is a toll free number the public can call to get a weekly status message about the plant. The system also allows a voice message to be left for follow-up by the plant. The Local Information Commission identified experts to have an independent opinion of the plant. The team considers cross border communication to be good performance.

1.3. MANAGEMENT OF SAFETY

The team considers the plant to have a good practice in Management Support for Operational Safety. Senior Plant Managers are improving Operational Safety by their daily visible support for staff behaviours that enhance Nuclear Safety**.**

Significant events are being investigated and resulting corrective actions are tracked to completion and an Operating Experience program is in place. However opportunities to learn from low level events are not being fully utilized. The team provided a suggestion in the area of reporting lower level events for follow up.

The plant is implementing a new system called SMI (integrated management system) which will describe and optimize cross functional processes using staff involvement and strong management oversight. Only a few processes have been completely implemented so far but they expect the program to be complete by the end of 2010. The implementation plan appears sound and actions are tracked closely. This system is anticipated to have many benefits including efficiency and alignment of work groups, performance monitoring and effective prioritization of management effort. The team encourages the plant to complete the implementation of this new management system.

The plant utilizes a set of Performance Indicators to assess its compliance with safety requirements. However the plant does not utilize the WANO Performance Indicators (e.g. safety system performance, fuel reliability, chemistry performance, grid-related loss factor and contractor industrial safety accident rate) to identify areas for improvement in an international perspective and is encouraged to do so.

During the review the team noted several work practices, situations and conditions which can be considered as an indication of safety culture at the plant.

The positive safety culture features include the following items:

- A number of situations in which the plant staff made conservative decision which were fully supported by the senior management. Examples are detailed in Good Practice 1.3 (b).

- At the Plant an open and thorough communication exists between staff members from different levels in the organization.

- The Plant has several 'Safety Engineers' who inspect equipment in the field and in the control room and bring concerns to the attention of the Control Room Operators. The Safety Engineers write a weekly newsletter to all staff discussing the safety issues that are current. There is a monthly private meeting between a safety engineer, the Safety Department Manager and the Plant Director that is frank and self critical.

- There is an open dialogue taking place among the staff while discussing plant problems. Notable example is the discussions in the Safety Management Committee (GTS) on various plant events especially one involving the human performance.

At the same time some other features indicate that additional efforts could result in the further improvement of safety culture:

- The team observed instances in which management expectations were not met in the field. Examples are: Three way communication, an expectation of management, is infrequently used by operations staff. A Industrial Safety Department Inspector coached workers in the field regarding work place industrial safety and area upkeep, but on a check back later at the job site, no improvement was observed in area upkeep.

- Targets of performance set at the plant do not always appear to be very challenging. Examples include industrial safety accident rate and chemistry parameters. The team observed that the argument "This is agreed by French regulatory body" is often used to defend the status quo.

- A management system is implemented to prevent injuries to workers in the plant. However, the OSART team considers that not all opportunities have been considered to eliminate industrial safety hazards in the plant related to inadequate guards on rotating equipment, tripping hazards because of hanging wires and unmarked elevation drops etc**.**

- The plant depends heavily on support from the EDF Corporate office. However in certain situations this could result in “group thinking” and decreased local initiatives as was noted in the area of Technical Support, Chemistry and Operating Experience.

- Several facts relating to housekeeping and cleanliness problems were observed during the review. Proactive actions taken to keep the working place clean and tidy were found to be sometimes inadequate.

1.5. INDUSTRIAL SAFETY PROGRAMME

The team provided a recommendation to reduce industrial safety hazards due to unprotected hot pipes and equipment, inadequate installed guards on rotating equipment and tripping hazards particularly due to uncontrolled extension cords.

There are other individual industrial safety hazards in the plant including a broken lamp with sharp glass at head level, some un-terminated cables, a broken emergency evacuation sign, an unsecured turbine blade used as a display in the training building which could fall over, lack of emergency lights in the Maintenance Building, a cable tray at eye level protruding into a walkway and a bank of gas bottles with no securing bar.

The employee safety committee says it takes too long for management to resolve industrial safety concerns. They say that Nuclear Safety standards have improved significantly but Industrial Safety Standards have not. To conclude, the team encourages plant management to continue to implement actions to reduce industrial safety hazards in the plant in a timely way.

The employee safety committee stated that contractors are not reporting accidents to avoid losing their contract. The committee also stated that minor accidents are not reported in order to reduce insurance premiums. To follow up on this issue the Plant Nurse was interviewed. The Nursing office saw 82 contractors due to work related incidents in 2008. Once seen, the worker is not involved in the decision to report an accident. If the Nurse recommends the person to see a doctor, then an accident report is filed. There were 12 contractor accidents reported in 2008. 7 Lost Time and 5 with No Lost Time. These facts do not confirm the statement made by the employee safety committee regarding non-reporting of accidents.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.3. MANAGEMENT OF SAFETY

1.3 (1) Issue: Not all opportunities have been taken to learn from low level plant events.

Significant events are being investigated and resulting corrective actions are tracked to completion and an Operating Experience program is in place however opportunities to learn from low level events are not being fully utilized as per the following examples.

- A worker safety isolation tag-out for a filter change was found to be deficient such that the workers would not be protected from the system fluid. This condition was detected by the workers before starting work. However there was no recognition by the Operations Department that this was an adverse condition that could be investigated for improvement in worker safety.
- Only Managers and more senior plant staff can input conditions into the corrective action program database.
- Some adverse conditions are not entered into a corrective action program for example:
  - A procedural step was missed during a Diesel Generator test. This was the subject of an Operational Decision Making telephone conference and the test was repeated. This adverse condition will be discussed at a senior Operations Department meeting but there are no plans to investigate the specific event further.
  - During an Industrial Safety Inspection a contractor did not respond to the request from the inspector to clean up the work site. The inspector discussed this with the Work Group Manager but there was no entry into a corrective action program. The next day gas bottles were found standing unsupported at the same work site.
  - The temperature in Records Vault was 21 degrees C versus recommended limit of 18 degrees +/- 1 degree. Documentation showed recommended temperature limit was exceeded on two occasions in the last 2 months with no action recorded. The next day another limit was identified as 18 degrees +/- 2 degrees. Assuming this second reference is correct there was no deviation. On the second day, the temperature in the room was again found to be 21 degrees but air conditioning maintenance had just been done and the temperature was falling. There was no entry into the corrective action program to document either high temperatures or multiple temperature limits.

- 45 of 82 Industrial Safety Events were not analyzed. 12 lost time accidents, 10 non lost time accidents and 15 near miss events were reported and analyzed for follow up action.

Without learning lessons from low level plant events, there is a risk of more serious events occurring that could be avoided.

Suggestion: The plant should consider including lower level events in the corrective action program to more systematically learn lessons for improvement.

IAEA Basis:
GS-G-3.1,
6.1. Measurement, assessment and improvement should be part of the establishment of a learning culture in the organization. Individuals at all levels should review their work critically on a routine basis to identify areas needing improvement and the means of achieving it.
6.2. To avoid any decline in safety performance, senior management should remain vigilant and objectively self-critical. As a key to this, objective assessment activities should be established. The nature and types of assessment activity should be adjusted to suit the size and product of the organization, should reduce the dangers of complacency and should act as a counter to any tendency towards denial. In addition to the early detection of any deterioration, an assessment of weaknesses in the management system could also be used to identify potential enhancements of performance and safety and to learn from both internal and external experience.
NS-G-2.11
I–3. Evaluation and analysis in depth of operating experience is not restricted to lessons learned from safety significant events. It is also extended to lessons learned from situations and events of lesser importance that would have had the potential to develop into safety significant events but were prevented from doing so by features of the plant design and/or by corrective actions by the operator.

1.3 (a) Good Practice: Senior Management Support for Operational Safety

Senior Plant Managers are improving Operational Safety by their daily visible support for staff behaviours that enhance Nuclear Safety**.**

The Plant Director stopped an outage in 2007 after 3 events occurred. He met with the Shift Supervisors as a group and declared his personal support to stop any tasks that could negatively impact safety.

In 2008 plant management made a decision to extend an outage by proactively plugging tubes in two non leaking Steam Generators on Unit 2 after a leak occurred in a tube in the third Steam Generator.

In 2008, the plant pressure boundary inspection department were asked to assess a leak on the secondary side of the plant. They found a weld defect and raised a concern that the whole weld could fail and cause a serious non radioactive steam release. The Inspection Manager was supported in her concern by plant management. The line was isolated and the plant was shutdown to repair.

In March 2009, the Shift Supervisor made a conservative decision to delay the restart of Unit 1 by 8 hours. The person felt confident that the decision would be supported by management and in fact both the manager and the Plant Deputy Director for Production complimented the action.

The Plant has several 'Safety Engineers' who inspect equipment in the field and in the control room and bring concerns to the attention of the Control Room Operators. The Safety Engineers have trained over 400 staff to improve their understanding a compliance with Technical Specifications. Safety Engineers write a weekly newsletter to all staff discussing current Nuclear Safety issues and are very active in supporting safe execution of outages. There is a monthly private meeting between a Safety Engineer, the Safety Department Manager and Plant Director that is frank and self critical.

Automatic Reactor Scrams were reduced from 3.5 per unit per year in 2006 to zero in 2008 through a comprehensive program of human performance improvements and equipment changes.

1.5. INDUSTRIAL SAFETY PROGRAMME

1.5 (1) Issue: Not all opportunities have been taken to eliminate industrial safety hazards in the plant related to unprotected hot pipes and equipment, inadequate installed guards on rotating equipment and tripping hazards particularly due to uncontrolled extension cords.

A management system is in place to prevent injuries to workers in the plant including policies and requirements, management observations, safety department inspections, joint union management committees, performance indicators and root cause determination and correction after events and near misses. Action plans are in place to improve the safety of power tools, correct abrupt changes in elevation on walkways and improve access to some equipment. However the following conditions remain in the plant.

- In 6 locations, thermally hot piping or equipment is not insulated for thermal protection
- 4 components with rotating shafts have installed guarding that is inadequate to prevent staff from contacting the shaft.
- During a single Safety inspection 5 examples were found of extension cords presenting a tripping hazard to employees.
- Several other conditions exist in the plant where hazards exist including a cable strung across a walkway at head height and a gas bottle bank without a bar to secure the bottles in place. An emergency exit in the main access building had a chain and lock across its doors.
- 12 Lost Time Injuries occurred in 2008. This represents a rate is 5.8 injuries per million hours worked. The Utility Target is 4 and the best performance in the fleet is 0.5. One Lost time injury was due to tripping. Current performance does not meet industry standards.

Without eliminating industrial safety hazards the potential for personal injuries will continue to exist.

Recommendation: The plant should reduce and minimize industrial safety hazards in the plant that are related to unprotected hot pipes and equipment, inadequate installed guards on rotating equipment and tripping hazards particularly due to uncontrolled extension cords.

IAEA Basis:
ILO-OSH 2001,
3.10. Hazard prevention
3.10.1. Prevention and control measures
3.10.1.1. Hazards and risks to workers' safety and health should be identified and assessed on an ongoing basis. Preventive and protective measures should be implemented in the following order of priority:
(a) eliminate the hazard/risk;
(b) control the hazard/risk at source, through the use of engineering controls or organizational measures;
(c) minimize the hazard/risk by the design of safe work systems, which include administrative control measures; and

(d) where residual hazards/risks cannot be controlled by collective measures, the employer should provide for appropriate personal protective equipment, including clothing, at no cost, and should implement measures to ensure its use and maintenance.
NS-G-2.14

7.36. The operations manager should also analyse industrial safety related events in the operations department so as to be aware of the direct and root causes of such events. The operations manager should analyse trends in the occurrence of industrial accidents relating to poor industrial safety in the operations department and should take action to reduce the number of events relating to industrial safety.
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, are kept ALARA.

2. TRAINING AND QUALIFICATIONS

2.1. TRAINING POLICY AND ORGANIZATION

Although the effectiveness of training is sufficiently reviewed and individual qualification is maintained, there is no process on periodic evaluation of the training process itself and the team encourages the plant to implement such evaluations.

The trainee assessment process is well developed and implemented and is comprehensive. The team considers this as a good practice.

A well established succession process exists for recruitment and training to timely replace the staff in case of retirement and/or promotion. The team considers this as good performance.

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

The old classrooms are not in good condition. Some lights are unavailable, the floor has been damaged in several areas and some reference materials are not up to date. Training on fire safety, emergency preparedness etc. is provided in these classrooms and the team encourages the plant to improve and maintain the condition in the classrooms. The new building is being constructed and it is expected to replace the old one by the end of the year 2009.

During training sessions, instructor aids provide a realistic environment, such as turbine-hall noise and the use of the real name of shift field operators. The team considers this as good performance.

No process exists for implementation of plant modifications at the simulator and the time for their implementation is long (1-2 years). Although there are compensatory measures in place in the training programme to mitigate differences between actual plant status and simulator, the team has provided a recommendation in this area.

Although the training materials for both initial and refresher training are of a good quality and well organized, there is no process developed for periodic review of the training materials for initial training and a team has provided a suggestion in this area.

2.3. QUALITY OF THE TRAINING PROGRAMME

On-the-job (shadow) training is well organized and provided by skilled staff. However there is no process at the plant to train supervisors/tutors involved in on-the-job training in training/coaching methodology and tutorial skills. Although the plant has recognized this problem and started cooperation with UFPI (corporate training authority) on developing a special training course on tutorial skills, the team has made a suggestion in this area.

2.5. TRAINING PROGRAMMES FOR FIELD OPERATORS

A comprehensive initial training programme is provided in the Craft/Skills Academy and the team considers this a good performance.

2.8. TRAINING PROGRAMMES FOR MANAGEMENT AND SUPERVISORY PERSONNEL

The team considers succession planning and provision of initial training in the Management Skills Academy as a good performance.

2.9. TRAINING PROGRAMMES FOR TRAINING GROUP PERSONNEL

The team considers the well established training programmes and strong assessment of instructors as a good performance.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1. TRAINING POLICY AND ORGANIZATION

2.1 (a) Good Practice: The process of trainee assessment is well developed and implemented and is comprehensive.

Task observations performed by management are an essential means of confirming that staff have acquired and maintained the requisite skills, as they enable management to assess staff skills in their immediate working environment.
As they require management presence in the field, they are also an effective means of:

- implementing good practices across the board
- detecting deficiencies
- discussing work-related issues with the staff (cooperation).

These observations are performed during the initial work authorization phase for recently hired staff, and during the authorization renewal phase for more experienced staff.

This practice is implemented by a number of crafts:

Initial authorization: The training academy arranges for management to perform task observations in order to approve the acquisition of skills at the end of the basic training module, for all specialities.

The training academy also arranges for management to perform task observations in order to issue partial work authorization during the specific training module, for operations and I&C staff.

Renewed authorization: The chemistry, fuel, risk prevention and safety/quality functions also implement this practice. Operations has drawn up observation reference standards and has already initiated the programme (underway for shift managers).

The practice is already implemented within the mechanical maintenance and I&C and is now being extended across the plant under the supervision of the human resources function. A formal agreement has been signed with the DPN (corporate level organization) and the plant has committed itself to the regulator for implementing this practice throughout the plant. It forms part of the human resources macro-process (Integrated Management System - action A141). A deadline has been set for the end of 2009.

Plant results demonstrate that this good practice produces the expected results.

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

2.2 (1) Issue: The plant does not have a process in place for the periodic review, timely modification and updating of the full scope simulator which would reflect actual plant status at every time.

- There is no procedure for the periodic review, timely modification and updating of the full scope simulator.
- There are requirements only for the integration of the 3rd ten year outage (VD3) modifications to the simulator within the prescribed time frame.
- According to the existing schedule, all modifications that will be implemented during VD3 in 2009/2010, will only be implemented at the simulator in 2011. The best industry practice is to implement major modifications in the simulator before starting back the plant after a major outage.
- There are no general requirements for the integration of modifications to the simulator:
  - Modification “APRP BI” (LOCA Intermediate Branch) made on Unit 1 in December 2008has neither been implemented on the simulator nor on Unit 2. This modification will be done on Unit 2 in May 2009.
  - Modification of the instrument ASG001MN (Level of Auxiliary Feedwater Tank) on the Panel 5 made on the plant May 1999 is not reflected on the simulator.
  - The raw water system alarm inhibition switch (SEB), which was installed on Unit 1 in 2005 and on Unit 2 in 2004, is not installed on the simulator.

  Measures are in place to compensate for these deficiencies.

Absence of timely implementation of modifications made on the plant onto the full scope simulator can lead to inaccurate training.

Recommendation: The plant should establish a process for the periodic review and timely modification and updating of the full scope simulator which would reflect actual plant status at every time.

IAEA Basis: NS-G-2.8:
6.7. A procedure should be in place for the periodic review and timely modification and updating of training facilities and materials, to ensure that they accurately reflect all modifications and changes made to the plant.

2.2 (2) Issue: The plant does not have a process for the periodic review of training materials for initial training.

- UFPI (corporate training entity) undertakes a periodic reactive monitoring of the quality of training courses, and it initiates required changes to the specifications and/or contents of these training courses. UFPI also annually updates the simulator training content for maintaining operator skills. Documents on the nuclear safety reference standards training incorporate operating experience feedback annually. However there is no compulsory periodic review of the specifications and content of initial training.
- Several comprehensive training packages for initial training have not been reviewed since 2004.

Without the periodic review of training material it is difficult to guarantee the proper training of staff, which can lead to operator performance problems.

Suggestion: Consideration should be given by the plant to establish a process for the periodic review of the training materials for initial training.

IAEA Basis: NS-G-2.8:
4.27. Theoretical concepts in such areas as reactor physics, principles of operation of plant systems and equipment, thermohydraulics, plant chemistry, reactor safety, industrial safety and radiation protection should be reviewed periodically.
6.7. A procedure should be in place for the periodic review and timely modification and updating of training facilities and materials, to ensure that they accurately reflect all modifications and changes made to the plant.

2.3 (1) Issue: The plant does not have a process in place for training of supervisors/tutors involved in on-the-job training in training/coaching methodology and tutorial skills.

- Although a project for the training of the supervisors/tutors for on-the-job training has been planned for 2009 and is currently being developed with the support of an UFPI (corporate training entity) consultant, no pedagogical training of the supervisors/tutors for shadow training has taken place yet.
- There is no procedure in place for training and evaluation of the pedagogical skills of on-the-job training supervisors/tutors.

Without sufficient supervisory/tutorial skills, instructions provided to the trainees could be ineffective and could produce inadequate training results.

Suggestion: The plant should consider the establishing of a process for training of supervisors/tutors involved in on-the-job training in training/coaching methodology and tutorial skills.

IAEA Basis: NS-G-2.8:
5.31. … 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.
5.32. All staff of the training unit, as well as simulator and technical support engineers, technicians and instructors, should be given training commensurate with their duties and responsibilities.

3. OPERATIONS

3.1. ORGANIZATION AND FUNCTIONS

The new position of "Pilote de Tranche" has been added to the shift team. It is established between the Deputy Shift Manager and the 4 control room operators. The intention is to delegate some activities and allow the Shift Manager to manage the people and activities of the shift. In the view of the team, it is a good practice.

Operations goals are developed from a bottom up business planning approach. This involves all staff and is signed onto by senior management. Integration of ideas is a contract with staff. The Shift Project approach allows full engagement in the development and delivery of the business plan and is seen as a good performance.

The Management Field observation process has been embedded in the Operations Department for two years. It is now being rolled out across the site. Insufficient effectiveness is evidenced by the number of minor deficiencies identified on each tour by the team.

Outage has a strong Operations team and commitment. The outage schedule is reviewed for Technical Specifications and other rule compliance via a manual process. Although a schedule was seen with colour coded risk due to release from service of different equipment and vertical slices are designed to indicate incompatible activities on any particular day, this process is not automated so it depends on the expertise of the reviewer. Use of automatic deterministic computer tools are commercially available to help diagnose conflicts before they occur. The plant is encouraged to consider the nuclear safety benefits against the cost and difficulty of implementation of such a tool.

Each Shift Manager holds an off site seminar with his or her shift team. They carry out a self assessment and identify issues that they perform well and those processes or activities or equipment that needs improving. This is then developed into a Shift Project for the year in support of the business plan. Progress is tracked and accountability for delivery monitored. The team considers this as a good performance.
At the Operations Focus Meeting communication between work groups and the scheduler did not always confidently identify that someone was going to complete the work as planned. This lack of positive confirmation makes accountability less secure and Shift Managers are encouraged to assert the right standard.

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

Field operators have low frequency mobile telephones that enable easy communication with the Main Control Room (MCR) from most areas of the plant. This is a positive situation that could be used at other plants.

The public address system is used for contacting individuals in non-urgent situations and is heard in the MCR. Overuse of this facility is an operator distraction.

Two control room alarm facia windows were followed up, one was 2 months past the expected repair deadline, the second was waiting 12 months for a replacement part. Both were progressed during the period of the review.

Positive – Unit 1 is painted green and unit 2 is painted blue. This can help reduce human performance errors if it is referred to in Pre Job Briefs. Field operator stated that everyone knows the colour so it is not stated prior to work. The plant is encouraged to use this error prevention tool more visibly.

Storage of equipment on the plant does not require the approval of the Operations Department. The plant is encouraged to take control of the process for approving equipment stored on the operational plant.

3.3. OPERATING RULES AND PROCEDURES

Technical Specifications issue associated with refrigeration compressor 0DCC-052CO, 0DCC-053CO and 0DCC-054CO assessed. Compressor 52 and 53 are identified in Technical Specifications and have associated surveillance tests to assure availability. These machines are obsolete and the temporary compressor 54 was installed. In 2007 the law was changed to include pressure regulations that applied to compressors 52 and 53. Agreement was reached with ASN that the temporary compressor 54 could be relied upon but the two existing machines had to be maintained available by surveillance testing every other month. The temperature of the cooled rooms could be maintained below 40 degrees C by the portable compressor and Technical Specifications could be satisfied by carrying out surveillance testing on the two original compressors.

Compressor 0DCC-053CO failed its surveillance test on 12 March 2009 at 16:50. A part was changed but this did not fix it. Further diagnosis identified a pressure controller defect. This spare part is no longer available and it is expected to be August before it is available. At this point the plant declared that the event was reportable to the regulator because the 14 day LCO action statement could not be complied with. Two letters were sent to the regulator on the 23rd and 26th March requesting continued operation based on a commitment to comply with Technical Specifications requirements by October 2009. The ASN made an expertise of the technical report provided by the plant and gave its authorization to this exemption request. The plant is encouraged to complete the analysis of this event to enable learning to prevent similar difficulties in the future.

With the exception of this example, the plant has developed an efficient way to follow Limiting Conditions of Operations (LCO). The team considers this as a good performance.

3.4. CONDUCT OF OPERATIONS

The human performance programme is being implemented in EDF and at the plant. There are improvement leaders (champions) in Operations. A good idea is the training technique to consider that the operator has a camera at the end of his finger and it looks at the identification label as the operator points to the characters. In the future, technical staff will get refresher training. It is the expectation that labels are read aloud. This was observed with the Shift Manager and Reactor operator doing it. However, a Field Operator did not.
In the MCR the reactor operator was interrupted by the other operator but he did not (visibly) take a minute to ensure he was in the right place after the interruption. No error was made at this time.

The question 'what is the worst that could happen?' is part of the Human Performance programme but was observed as being the failure of the surveillance test rather than the unplanned automatic trip of the reactor.

MCR operators are not required to have total focus on the reactor during shift turnover. It is acceptable for one operator to be listening into the brief and attending to alarms. A modification, coordinated by a reactor operator, is being developed to display key parameters to make this task more effective. Other plants have an overlap of operators so that the briefing can be carried out whilst the previous shift is manning the reactor. The plant is encouraged to look at this practice whilst the modification is being prepared.

Shift Manager prepares brief at the start of shift identifying what activities need peer checking. This has not been observed in practice. The appointment of the "Pilote de Tranche" position will regularize the human performance tool use on shift.

Check sheets for reactor operators to confirm that correct alarms are received during surveillance test carried out by I & C have no space for tick/cross or initials. In the example there is a list of alarms expected. The Control Room operator put crosses against them to identify they were received. It would be useful to date the form and initial that each alarm was received and again when each was cleared. This record could then be attached to the work package.

A distinctive feature of the plant in comparison with other French PWRs is that the reactors do not have "grey" control rods and therefore they do not normally perform load following.

Each reactor requires boron dilution of approximately 1 part per million of primary circuit water per 8 hour shift. The timing is determined by reactor conditions. The Reactor Operator carries out routine dilutions as required. Explicit permission and oversight by the supervisor is not required.

A specific pre job brief is not given prior to adjustments of boron concentration of the reactor to compensate for fuel burn-up.

The quantity of water added to the reactor for dilution or boric acid for boration relies on a number of control actions including the automatic function of the equipment to stop the flow. Observation of diverse reactor parameters is carried out to ensure safe completion of the activity.

The expectations of senior management in the plant are that routine and frequent operations to control burn-up do not require special oversight, however, two operators are required to be in the control room during the evolution.

The expectations of senior management in the plant are that unplanned load changes due, for example to secondary side heater train trip, would not launch a specific investigation into the effects of changes in reactivity. The plant is encouraged to consider the reactivity controls stated and supervision provided.

Oil and water leaks on equipment are not systematically identified and corrective actions are not always initiated. The team has provided a suggestion in this area.

Field operator handover was carried out in a men's change room. This was self identified and an attempt has been made to ensure the quality of handover.

A computer logging facility is to be part of the planned operations facilities. Procedure identifies that the Deputy Shift Manager will check all of the logs at the end of shift briefing. This is not done for field operators who have poor evidence of logs for handover. There are no signatures evident. Field Operator has keys hanging from his pocket when he leans over operational equipment. This could interfere with safe operation.

Conditions in the plant show that standards and expectations of Operations Management are not delivered consistently by field operators. The team has made a suggestion in this area.

3.5. WORK AUTHORIZATIONS

Documents are being updated. They do not have independent verification or peer checking included in the appropriate places at this time, as the policy is that the behavioural requirement will be covered at the pre job brief. The plant is encouraged to monitor the consistency of application and effectiveness of this policy over the next year.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

The skills development programme for fire-response team leaders and senior emergency response officers was identified by the team as good performance.

Maintenance of fire barriers in general is adequate. However during the review , the team observed some places with inadequate status of fire barriers:

- Fire barrier of the cable tray 819 C132 on +8,2 m level of Turbine hall has been damaged;
- Fire hatch 0 JSN 212 QG in the Auxiliary Building was kept open with a temporary cable passing through.
- Fire door of room W210 (containment spray system) was not closed on latch.

The plant is encouraged to focus on sealed fire zones.

The plant decided to implement a suggestion put forward by the seconded professional fire-fighter, which involved drawing up a training package an holding training sessions geared towards improving the leadership skills of fire-response team leaders. After conducting two trial sessions 2007 and 2008, all fire-response team leaders were trained.

An identical programme was set up for senior emergency response officers (PCD2), the aim being to better prepare them for managing fire-related events in coordination with the commanders of the external fire brigade. The first part of the programme has provided senior emergency response officers with the skills required to better manage fire related events and gain a better understanding of their role in the organizational structure. This is considered as a good performance.

During observations, the team saw the plant response to a spurious fire alarm, a planned fire drill and a real fire in the laundry. In each case, the fire response team, control room staff and the outside fire brigade performed their roles well.

The team note the fact that a real fire occurred and encourage the plant to investigate root cause and trend information to eliminate future occurrences.

DETAILED OPERATIONS FINDINGS

3.1 ORGANIZATION AND FUNCTIONS

3.1(a) Good Practice Application of human factors specialist knowledge and human performance error prevention tools to shift operations.

The position of "Pilote de Tranche" was created in 2008, with a view to centralising the day-to-day operational-decision making process in a single location: the main control room. The "Pilote de Tranche" is responsible for coordinating the schedule, for setting priorities and for distributing work within the shift crew.
As part of his duties providing direction in the performance of daily activities, he incorporates nuclear safety considerations and manages the shift-manager and deputy shift manager call-up system.

During power operations, he provides technical supervision for both units. When one unit is in outage, he provides technical supervision for the operating unit and common plant, thus freeing up the deputy shift manager to deal with matters on the unit in outage.

In 2008, the position of "Pilote de Tranche" was introduced in one shift crew on a trial basis.
Since the end of 2008, 7 "Pilotes de Tranche" have successfully gone through the authorization process, making a total of 1 per shift crew.

In May 2009, a 4-week trial (2 weeks during power operations and 2 weeks during outage on unit 2) will be conducted at department level, in order to make the necessary adjustments to the creation of this new position.

The operations department has chosen to provide the "Pilote de Tranche" with specific training in human performance tools, thus enabling them to acquire specialist knowledge in this area. They will provide the reference model for the use of error reduction techniques within the crews. Their duties will include reinforcing the use of human performance practices and promoting the use of these practices both within the crews as well as within other departments. This facet is already being implemented within the shift operations crews.

Plant results demonstrating that this good practice produces the expected results:
The trial conducted in 2008 showed that the position of "Pilote de Tranche" has given deputy shift managers more time on shift for providing technical guidance, for going into the field and for supporting crew projects. This will eventually enable shift managers to take a step back from day-to-day, hands-on aspects, allowing them more time to focus on day-to-day operational safety matters and focus their attention on the management of their crews.

The "Pilote de Tranche" (Human Performance specialist) is an additional asset in terms of promoting the use of error reduction techniques. He provides strong support to shift crew management regarding the use of these techniques. The most obvious advantage is that crews are becoming more and more accustomed to using these techniques as a matter of course.

3.3. OPERATING RULES AND PROCEDURES

3.3(a) Good Practice: Shift Managers use of a reference standard for performance of safety assessment.

The Shift Manager's plant safety assessment is an essential safety fundamental. This assessment essentially takes the form of a panel walkdown (including periodic checks performed in the nuclear instrumentation room and in switchgear rooms for plant radiation monitoring channels). At the plant this assessment is performed using a document specific to each reactor mode. The document includes the items to be checked as a minimum requirement by the Shift Manager. These documents list the key technical specification items to be checked during each shift: current Limiting Conditions of Operation and requisite courses of action, special instructions and technical specification exemptions, Surveillance tests to be performed during the shift, important computer and window alarms, checking for absence of technical specification violations, safety-related parameters, key points not covered by alarms and, event-related checks.

The check lists also contain additional checks to be performed at specific intervals during the week:

- Nightly checks: List of work requests, list of current work permits, review of computerized log every 24 hours, rate of change of reactor power and load variations are within the limit of technical specifications.
- Functional check of plant radiation monitoring channels three times a week.
- Weekly check of boron concentration levels in required tanks and primary circuit iodine 131 equivalent every Monday night.

The document also states that the key deviations detected during each shift must be addressed at the operational focus meeting or raised by the Shift Manager with the Safety Engineer during their meeting.

These check lists have a number of advantages:

- Extensive, standardized checks performed by all Shift Managers.
- Technical Specification compliance checks performed at required frequency.
- Assured position of certain valves and components, correct configuration of regulation channels and certain required systems that are not connected up to the main control-room alarm system.

Plant results demonstrating that this practice produces the expected results:
Improvements in the detection of Technical Specifications breaches:

- Simultaneous presence of a group-1 LCO that is incompatible with actions to be taken in response to a special instruction.
- Deviations from requisite course of action in the event of a limiting condition involving the aux. feed system.
- Failures to follow requisite course of action stipulated by special instructions pertaining to the full-length control-rod system.

An example of effectiveness of this practice is that no safety-significant events were reported relating to excursions from level or pressure ranges on safety injection accumulators over the past 3 years. The document makes it easier for new shift managers to perform safety assessments specific to the various outage conditions.

3.4. CONDUCT OF OPERATIONS

3.4(1) Issue : Conditions in the plant show that standards and expectations of Operations Management are not followed consistently by field operators.

In September 2008, the plant started a programme to eliminate labelling deficiencies and the plant has initiated the OEEI programme which among other issues addresses improvement in housekeeping. However the following deficiencies were not identified and reported by the field operators.

- Label of drain valve next to flow meter orifice flange 2 GRH 001 KD is missing
- Missing label of valve 0 SCA 416 / 426 VF outside turbine hall in front of fuel oil tanks
- Missing Labels of 2 KIT room L570 + 11,0 m (Data-Processing System Control-Room)
- Temporary storage of welding equipment exceeds expiry date (Filter deck + 12 m room N509 in BAN)
- Temporary feed cable connected to cabinet 1 LEC 112 CR in room W228 (control rod drive mechanism feed room), passes through room W229 (motor driven auxiliary feedwater pumps) and ends in staircase L211. The cable is traced appropriately through temporary cable penetrations, but it is not in use.
- Diesel 1 LHG Unit 1. Oil and dust accumulated on lower part of the engine
- Water is on floor (fuel building room K411 in RCA). Leak is from a ventilation cooling system.
    - The equipment 2 SAP 11 ZV has a layer of dust and grease on it.

The standards of log keeping are below expectations of management. This is to be resolved when the new facility and computer logging system is available. A procedure identifies that the deputy shift manager will check all of the logs at the end-of-shift briefing. This is not done for field operators. There is no formal sign on to these logs.

It is the Corporate Human Performance policy not to embed the error prevention tools in any procedures. Operation expectation is that they will be used and implemented via pre job briefs. This limits the consistency of application across all shifts.

Insufficient operations standards of labelling, housekeeping, log keeping and use of Human Performance tools within the field operating staff may not support the safe and reliable operation of the plant in all operating conditions.

Suggestion: Operations Management should consider improving the actual standards demonstrated by field operators in comparison with the stated expectations.

IAEA Basis:
NS-G-2-14
5.1. A consistent labelling system for the plant should be established, implemented and continuously maintained throughout the lifetime of the plant. ……
5.3. The plant management should ensure that all valves, switches, breakers and components are labelled using the same labelling nomenclature as that prescribed in current design documents.

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

NS-G-2.14

6.20. Plant housekeeping should maintain good conditions for operation in all working areas.

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

Issue 3.4(2): Oil and water leaks on equipment are not systematically identified and corrective actions are not always initiated.

The plant has developed a leak maintenance programme but there are identified and unidentified oil and water leaks in the plant that could impact nuclear, industrial, radiological and environmental safety.

The following list includes leaks that are either identified by the plant or previously unrecorded and were identified by observation during the OSART evaluation.

- Oil leak from 1ASG003PO AFW Pump 3 non drive end bearing oil supply reservoir. No leak label in place.

- K252 a leaking drain pipe next to the access card reader for the stairs to the fuel pool shows degradation of material condition.

- Boric acid crystals on flow orifice near to valve 2RIS133VP low pressure injection system, on containment spray system flange 2EAS003VB, on the safety injection system flanges 1RIS59VP and 1RIS132VP show signs of previous leakage.

- Room N312 has boric acid crystals near to 1RPE 257 VP coming from inside insulation. There is no defect tag.

- Turbine lubricating oil pumps 1GGR001PO and 1GGR002PO have unidentified oil leaks.

- The plant target is to achieve less then 50 oil or water non radioactive leaks per unit by 2011.

The safety concern associated with fluid oil or water leaks is that the function of the equipment relying on the fluid could be degraded or it may present a personnel or environmental safety hazard.

Suggestion: Operations management should consider ensuring that oil and water leaks are systematically identified and corrective actions are initiated.

IAEA Basis:

NS-G-2.14
4.35. Personnel assigned the task of carrying out rounds … should take note of equipment that is deteriorating and of factors affecting environmental conditions, such as water and oil leaks. Any problems noted with equipment should be promptly communicated to the control room personnel and corrective action should be initiated.

4.36. Factors that should typically be noted by shift personnel include:
—Deterioration in material conditions of any kind, corrosion, leakage from components, accumulation of boric acid.

4. MAINTENANCE

4.1. ORGANIZATION AND FUNCTIONS

The organisational structure of the maintenance departments is developed as a matrix focused on the online and outage projects. Engineers in specialized areas are also integrated into the maintenance organization. Interface with other plant and corporate organizations is clearly defined and works well. The team considers this as a good performance.

Safety is systematically considered as the first concern. Weekly department meetings always start by a safety review and weekly reports presented to the plant management also focus on safety first. The team considers this as a good performance.

GIM-EST, a non-profit organization was founded by EDF, to gather contractors to enhance industrial safety, health and well-being of contractor staff. This has been identified by the team as a good practice.

The proficiency of the contractor personnel is checked by the maintenance coordinator and described in an assessment sheet. After outages, the contractors give written feedback to the plant using a detailed survey (comprising around 100 questions). The team considers this as a good performance.

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The specific tools storage areas in both warehouses (cold and hot) are well-organized and properly labeled and stored. The warehouse work coordinator manages the tool processes in an efficient manner. The “cable frame” developed at the plant for handling cables while performing work was considered by the team as a good performance.

4.3. MAINTENANCE PROGRAMMES

The maintenance programme is well structured, but the team observed some deviations from industry standards in this area:

– Problems with pipe hangers and supports are not corrected in a timely manner;
– Several cable trays are not in proper condition;
– The scope and the timing of preventive maintenance for some equipment is not sufficient.

The team has provided three suggestions in this area.

Technical threats are deficiencies which have not been resolved within a satisfactory time frame or that have been only partly diagnosed, addressed or assigned for processing. These issues are detected by the power-cycle and outage structures, or directly by the crafts. A coordinator is designated to categorize the issue, and to propose corrective or preventive actions. An engineering monitoring sub-committee (VAI) meets every month. The committee is chaired by the Technical Director. The committee defines action items and monitors issue resolution status. The team recognises this as a good performance.

4.5 CONDUCT OF MAINTENANCE WORK

Two General Support Service Workers organized their work to minimize the time a system would be open. When questioned they said they wanted to minimize the potential for release of radioactivity and lower the Foreign Material Exclusion risk. These workers followed a number of other management expectations including identifying a procedure step that could not be done and getting the procedure marked up before proceeding and subsequently stopping the job when the isolation for safe work was found to be inadequate during their confirmation check. The team considers this to be good performance.

4.7. WORK CONTROL

The rapid-response team at the plant enables a quick diagnosis before directing the request to the different maintenance departments. The limits of the diagnosis are well-established. The level of priority for the requests is a good way to schedule maintenance activities (on-line maintenance or annual outages). The team considered it as a good performance.

DETAILED MAINTENANCE FINDINGS

4.1. ORGANIZATION AND FUNCTIONS

4.1(a) Good Practice: GIM-EST, a non-profit organization was founded by the EDF, to gather contractors and to enhance industrial safety, health and well-being of contractors.

The GIM-EST association was set up in 1991 with the support of the public authorities, EDF and contractor companies working on the three Nuclear Power Stations in the north east of France (Cattenom, Chooz and Fessenheim). GIM-EST is a non profit making association (law of 1908).

Organizational structure: the association has more than 50 member companies and structures, major industrial groups, training organizations, temping agencies, etc.. It has an oversight committee consisting of 15 members and four full-time employees (1 industrial safety engineer, 2 project managers, 1 secretary)

Roles and responsibilities: training/advice and industrial safety/contractor living conditions/employment opportunities and promotion of nuclear career opportunities/customer relations.

Agreement with EDF:

- Service agreement between GIM-EST and Cattenom- Chooz- Fessenheim: industrial safety, radiation protection, enhancement of professional skills, skills renewal, working and well-being conditions on nuclear power plants, communication, operating experience, maintenance, etc.
- Charter on progress and sustainable development in the north eastern region: transparent bidding process, development of contractor skills, reduction of individual and collective dose, improved risk prevention, improved working conditions and housing assistance, housekeeping and environmental protection.

Plant results demonstrating that this good practice produces the expected results:

- CIESCT (Comite Inter-Entreprise Securite et Conditions de Travail) committee overseen by the GIM-EST Vice Chairman
- Hiring of a full-time project manager at Fessenheim, who attends contractor instruction sessions, sits on outage industrial safety committees, participates in accident and near-miss investigations (EDF and contract staff), coordinates contractor satisfaction surveys, etc.
- Contractor training initiatives: human performance and error reduction techniques, bolted assemblies, craft training academy for nuclear professionals
- Improving living conditions: list of available housing/accommodation options close to the site.

4.3. MAINTENANCE PROGRAMMES

4.3(1) Issue: Problems with pipe hangers and supports are not corrected in a timely manner.

In 2007, an action plan was created to detect defects on snubbers / hangers / supports in the plant. The action plan was divided in two parts: an inspection of the snubbers / hangers / supports of the plant in order to detect defects and corrective action to repair the defects. The implementation of this plan started in 2008, and the plant expects to finish the plant inspection during the ten year outage and to perform all correctives actions during the outages following the ten year outages.

However the following problems were observed at the plant:

- Unit 2 pipe hangers S 336 a and S 336 b: shaft bent. Deviations had already been observed on the line supported by these hangers. Two defect sheets have been raised to request a recalculation of the pipes and supports. The work will be performed during the ten-year outage in 2010.
- Unit 1 pipe hanger at discharge side of 1RRI 01 PO: counter nut inappropriately mounted. This defect has led to a work request and will be treated during the next outage.
- Unit 2 Pipe hangers SR 12 4S 7m level: Counter-nut inadequately mounted. This defect has led to a work request and will be treated during the next outage.
- Unit 2: a pipe support close to 2 RRI 284 VB is not in the right position. A defect sheet was opened. The analysis is still in progress. A modification of the configuration will be performed during the ten-year outage.
- Significant safety event related to the snubber shaft of steam generator line unit 2 was detected in 2007. The root causes have been analyzed and the conditioning procedure of the line has been modified.

Delayed corrective actions on pipe hangers and supports might lead to damage and unavailability of equipment.

Suggestion: The plant should consider improving timeliness of correcting problems with pipe hangers and supports

IAEA Basis:

NS-G-2.6
9.18. Other items that should be subject to surveillance are those that, if they were to fail, would be likely to give rise to or contribute to unsafe conditions or accident conditions. Such items include:
…
—high energy piping and associated piping restraints;
—structural supports (stack stay wires, pipe supports);

4.3(2) Issue: The plant schedule for improving the condition of cable trays is not comprehensive enough.

The plant has started a program in 2008 to improve the condition of cable trays and corridors. However the following facts related to cables have been observed:

– Overloaded cable trays IN L 322. Cables are hanging over the edge of the tray. Dust on trays.

– Cable trays C24, 25, 26 in room L 211 are overloaded. It is visible that the trays carry too many cables. In addition the cables are hanging over the edge of the trays.

– Room L 322: the cables are resting on the edge of the penetration drilled into the wall. There is no support and no penetration structure.

Inappropriate situation of cable trays increases the risk of cable damage and fire.

Suggestion: The plant should consider establishing a comprehensive schedule for the completion of the activity to improve the condition of cable trays.

IAEA Basis :
50-SG-Q13
A.2. The (condition monitoring) program should refer to the standards that the items are required to conform with. Typically, these standards require that:
…
—Energized electrical and electronic equipment is operable, supplied from normal power sources, and protected from adverse environmental effects such as … overheating;
…
—Equipment is clean (for example, dirt, debris, tools, parts and miscellaneous materials are not allowed to accumulate on equipment or inside electrical panels);

4.3(3) Issue: The scope and the timing of preventive maintenance for some equipment important to safety is not sufficient.

The following facts reflect deficient behaviour in performing maintenance work.

- One bolt removing and tightening device of the RPV head is damaged and it is not marked with a label. The problem arose during the last outage and this tool is used to open and close the reactor pressure vessel head. This kind of work is not done by the maintenance department but by contractors. Therefore the repair was scheduled in April 2009 during the preventive maintenance prior to the next outage of unit 2 in May 2009.

- One bolt and its nut are missing from the flange of the vessel 2 RPE 004 BA in the nuclear island drain system (2 RPE 004 BA, Room N224). The maintenance archives of the plant show that bolt and nuts have never been changed since the plant is in operation. Since there are no marks on the flange it seems to be a problem dating back to the origin. No preventive maintenance is performed on this component, therefore the problem was not detected.

- Rusty parts on the sodium hydroxide injection pump 1 EAS 003 PO close to the containment spray system pump. For this pump, the preventive maintenance actions is limited to lubrication and oil changing. The last preventive maintenance was performed in 2003.

Inadequate scope and timeliness of preventive maintenance may result in equipment deterioration or unavailability.

Suggestion: The plant should consider ensuring that all equipement important to safety has an appropriate scope and timing of preventive maintenance.

IAEA Basis:
NS-G-2.6
8.1. Structures, systems and components important to safety should be included in the preventive maintenance program.
8.4. Preventive maintenance should be of such a frequency and extent as to ensure that the levels of reliability and functionality of the plant's SSCs important to safety remain in accordance with the design assumptions and intent.
8.48. The maintenance group should periodically review the maintenance records for evidence of incipient or recurring failures. When a need for remedial maintenance is identified, either in this review or during preventive maintenance of the plant, the maintenance group should initiate remedial maintenance in accordance with the administrative procedures mentioned above. If appropriate, the preventive maintenance program should be revised accordingly.

5.2. SURVEILLANCE PROGRAMME

The team observed that some surveillance tests are not performed within required periods. Periodicity of the surveillance programme is controlled by Sygma software, but this control is not sufficient, as evidenced by missed tests.

From 2007 onwards a “Plan for surveillance test improvement” was created which included:

- Updating documentation, including “exhaustive” analysis;
- Every department has committed itself on the conformity of its documentation checking that every criterion for which it is responsible is included in a procedure (“exhaustive” analysis). Equally, the departments have committed themselves on conformity of the scheduling of their surveillance tests in Sygma.
- The Shift Manager checks the actual implementation of surveillance tests planned during his shift based on a redundant chart of the Power Operation schedule. At the end of the week a comprehensive check is carried out by the Shift Manager.
- The Safety Quality department carries out audits (independent verification) in the field of Surveillance Tests. “Flash” audits (lasting for 4 hours) are carried out during the year. A more substantial audit (5 days) is carried out once a year.

This plan has a good potential to resolve the problem of not complying with the required periodicity of tests.

On 10.7.2008, a surveillance test on Diesel Generator B was performed with result “with reservation”. One of the 7 delayed loading steps of the diesel generator to the power supply meant to take place at 5 s was measured as 5.28 s for an expected value including the tolerance of 5.25 s. Investigations showed that the cause of this delay was random defects on the type of relay used for this delay device (TEC 2321 or TEC 2322). Periodicity of this surveillance test is 2 months. The response time of this type of relay on each surveillance test in 2008 was very close to the expected value and sometimes exceeded it on one of the steps, as happened in July and September 2006, and September 2007.

Actions have been undertaken by the plant to solve this problem but have not proved effective. A more extensive action plan in 2006 would have enabled to solve this reliability problem with this type of relay. If there had been a proactive approach in 2006 at site, the problem with the relay could have been resolved earlier.

In 2007, the plant introduced a new system for finding solutions to recurrent technical problems. Every unsolved recurrent problem is collected and investigated in a database “Service Ingenierie”, therefore it is possible to monitor the status of resolution for each problem. There are now about 70 problems in the system. The team encourages the plant to continue this initiative.

The team observed deficiencies in the in-service inspection of containment tendons.

The position of the plant:

- The experimental data are in accordance with US results. The deformations of the concrete which were observed are two times higher than those which were taken into account in the first design computations.

- When the plant was designed, the monitoring system for the containment comprised not only the 4 dynamometers, but also 202 extensometers, 4 pendulums and other systems. Because Fessenheim was the first French plant, quite a lot of instrumentation was introduced. At the beginning, EDF did not know precisely what instrumentation was necessary and sufficient to monitor containment during its life span. This is why EDF wrote a report in 2006 in order to define the necessary and sufficient instrumentation, which can be considered as representative of the building's behaviour for its whole remaining operating period. This instrumentation must be maintained in operation. The initial instrumentation which is not necessary is not maintained if extensive maintenance or replacement is needed. That's the case for the dynamometers.
- The measure of tension in cables, with dynamometer, was stopped on site in 1998 because of their lack of reliability and this decision was covered by an EDF fleet decision in 2006.
- However, the deformations of the concrete, associated with other measurements, are regularly measured in normal operating as well as during the containment tests. They allow to adjust the initial models of calculation of the reactor containment.
- EDF consider the results of the adjusted models, extrapolated in 40 years for the design reference accident (LOCA), confirm the integrity of the reactor containment.
- EDF would prefer not do the lift of test, except if necessary to eliminate a doubt, what is not the case at present.

Nevertheless, the team made a suggestion in this area.

5.3. PLANT MODIFICATION SYSTEM

Before finalizing modification in a system technical support department holds consultations with the users like field and control room operators. In this consultation, human and social impacts of implementation of this modification are discussed and feedback received is incorporate in the modification. The team considers this as a good performance.

In order to trend results of electrical tests and status of devices, a system surveillance modification and a preventive maintenance programme has been created which also includes replacement of end-of-wire contacts and terminal points (to avoid degradation of insulation). The team considers that this modification and this maintenance programme will significantly decrease the number of technical problems and events after its implementation.
There is an extensive safety upgrading programme planned for the 3^{rd} ten year (VD3) outage.

Amongst the about 60 modifications planned during VD3, the team emphasizes the following enhancements:

- VD3 modification programme is focused on seismic reinforcement:
  - Reinforcement of safety related buildings (BAN,BL, BW, BK, SdM) with metal and concrete beams (as a complement to VD2);
  - Maintaining intervals of about 3-5 cm between safety related buildings;
  - Most of the work started in summer 2008, to be finished before VD3 on a given unit.
- Complete replacement of fire protection sensors, and associated I&C systems and piping;
- Replacement of containment hydrogen sensors and adding of explosion risk reduction devices (following external OE from Toulouse chemical explosion accident in 2001);
- cold overpressure protection system SEBIM.

The team acknowledges this programme as a good performance.

The team reviewed on a random sample basis some elements of the safety analysis submitted with the application for operating licence beyond VD3 outage. The team noted problems associated with analysis of internal hazards like internal flooding, fires and missiles in some rooms with safety-related pumps. Charging pumps are located in the same room and they are segregated by a partition side wall. In the team's opinion, the common cause failure due to fire is not sufficiently addressed, because the fire zones are not physically segregated.

Two motor-driven auxiliary SG feed water pumps are located in one room without any segregation. The redundancy of these two motor-driven pumps, that produce each 50% of the required flow is a steam-driven pump that produces 100% of the required flow and which is located in a separated room. Each type of pumps (motor-driven and steam-driven) is equipped with its own fire detection and protection equipment. Nevertheless, in the team's opinion, the fire propagation risk from one motor-driven pump to the other one is not sufficiently addressed, because the two pumps are in one fire zone.

Containment spray pumps rooms: each motor is in separate room, but those rooms are connected with a fire proof door, not protecting sufficiently against potential common cause events of internal flooding caused by the leak of suction lines. The assumed water flooding with flow about $16m^3/h$ is solved by using a draining pump, however the failure of this pump is not addressed.

DETAILED TECHNICAL SUPPORT FINDINGS

5.2. SURVEILLANCE PROGRAMME

5.2(1) Issue: There are deficiencies in the in-service inspection of containment tendons.

- Generic report of NRC on "DEGRADATION OF PRESTRESSING TENDON SYSTEMS IN PRESTRESSED CONCRETE CONTAINMENTS" reported in the Incident Reporting System of IAEA/NEA in 1994 indicates that a number of plants have reported lower-than-predicted prestressing forces for vertical, hoop, and dome tendons. Investigations and analyses have indicated that the relaxation losses in prestressing tendon range from 15.5 to 20 % over 40 years. However, the tendon relaxation loss values assumed in the original design of PCCs vary between 4 and 12%.
- The design principle of EDF fleet in respect of containment presstressing cables is that four cables at the first unit at each site (in Fessenheim on both units) have the guide tube filled with grease, the rest are filled with cement. These four tendons are equipped with dynamometers in order to monitor forces (stress) in the cable.
- The signals from dynamometers at the plant were periodically evaluated from the beginning of operation until 1998, when all dynamometers became inoperable.
- The maintenance instruction for the containment of the 900 MW Unit mentions the presence of 4 tendons equipped with dynamometers in the containment of Unit 1 of the plant, but doesn't contain a requirement concerning periodic in-service inspection for these tendons.

Without clear knowledge about containment tendon status, the plant loses important information about safety behaviour of the third barrier.

Suggestion: The plant should consider reevaluating the safety contribution of measuring the stress in the tendons.

IAEA Basis:
NS-G-2.6
9.12 Surveillance measures necessary to verify the containment integrity include, but are not necessary limited to inspections for structural integrity (such as those performed on liner and prestressing tendons)

6. OPERATING EXPERIENCE FEEDBACK

6.1. MANAGEMENT, ORGANIZATION AND FUNCTIONS OF THE OE PROGRAMME

Management is committed and involved in promoting and reinforcing the use of OE to improve plant safety. In some departments, OE seminars and OE utilization open discussions were organized. The team considers this as a good performance.
At the plant, roles and responsibilities of departments and individuals involved in the OE process are not yet clearly established. Some people within the OE process still need to know what is expected of them to perform their duty in the most effective way. The team encourages the plant to complete this process of defining the roles and responsibilities of individuals.

6.5. ANALYSIS

In-house safety significant events are analyzed in a timely manner. Event analysis group members have adequate experience and knowledge.
In a number plant departments, it was observed that analysis of external events has taken from one month to two years while the plant expectation is 2 months. The team encourages the plant to improve the timeliness of analysis of external events at departmental level so as to meet the set targets.

6.6. CORRECTIVE ACTIONS

Corrective actions arising from analysis of safety-significant events are not prioritized and some corrective actions are frequently rescheduled. The team recommends that the plant should prioritize the corrective actions and set realistic targets for their completion so as to avoid their rescheduling.

6.9. ASSESSMENT AND INDICATORS OF OPERATING EXPERIENCE

The plant is involved in the corporate OE programme. The OE group has a good understanding of all OE processes and actively contributes to their continuing improvement.
In the plant, the effectiveness of the operating experience programme is not sufficiently assessed. The team has a suggestion in this area.

6.6. CORRECTIVE ACTIONS

6.6(1) Issue: Corrective actions for safety-significant events are not prioritized and some of these actions are frequently rescheduled.

- Corrective actions arising from analysis of safety significant events are not prioritised. There is a procedure describing only the requirement of informing ASN about rescheduling corrective actions taken as a result of safety significant event analysis. However, no detailed guideline exists on rescheduling of the corrective actions for safety significant events as well as those events which are not reportable to the ASN.
- As per the plant practice, deadlines for the corrective actions are approved by the Plant Safety Committee, while all subsequent rescheduling of these deadlines is approved by one single person namely the Nuclear Safety Advisor. Industry best practice is to raise the level of approving authority for each subsequent rescheduling of a corrective action.
- The team observed a number of instances when corrective actions were rescheduled frequently. Some examples are:
  - Safety significant event “Failure to check reactor protection test rule criterion within required periodicity’’ was reported on 30/07/06 and corrective action 07/158-Action 2 ESS n 349TR 2 was developed for it. The implementation deadline was set at 31/01/08, which was postponed twice to 31/10/08 and 28/02/09. The corrective action was finally completed on 27/03/09.
  - Safety significant event “Unit taken into fall back condition to perform maintenance on distribution valve 2SAR 657 VA’’ was reported on 18/05/07 and corrective action 07/289-Action 3 ESS n 375TR 2 was developed for it. The implementation deadline of the corrective action was set at 30/11/07, postponed to 30/06/08 and then implemented 10/07/08.
  - Safety significant event “Failure to comply with work condition in a worksite with contamination risk’’ was reported on 04/09/08 and corrective action 09/018-Action 4 ESR n 51TR 1 was developed for it. The implementation deadline of the corrective action was set at 15/03/09. The corrective action is not implemented yet and is therefore overdue. It had not been rescheduled at the time of writing this report.

Rescheduling of corrective actions involving significant events could result in recurrence which could have an adverse impact on the safety on the plant.

Recommendation: The plant should prioritize corrective actions and set realistic targets for their completion so as to avoid their rescheduling.

IAEA Basis:

GS-G-3.1

6.71 Senior management should ensure that corrective actions are subjected to approval, prioritized and completed in a timely manner on the basis of their significance. Managers should be held accountable for meeting due dates for corrective actions. Extensions or exceptions to due dates for completing corrective action should be controlled and should be made only in response to new issues of higher priority.

6.9. ASSESSMENT AND INDICATORS OF OPERATING EXPERIENCE

6.9(1) Issue: The effectiveness of the Operating Experience (OE) programme is not sufficiently assessed.

- The plant OE process is decentralized and in each department this process is led by an OE coordinator. However, there are no requirements for self-assessment of OE process at departmental level.
- An annual plant quality audit is carried out in which the OE programme is included in a very limited way and some key elements of OE programme, like effectiveness review of implemented corrective actions are not part of this audit.
- At Corporate level, the Operating Experience Screening Committee (CID) evaluates the performance of each French plant OE process on an annual basis. This evaluation is done on the basis of a plant OE index which includes indicators such as: quality of investigation of significant events and fast-track operating experience reports, events reported to SAPHIR database and timeliness of response to corporate requests. For the last two evaluations, this index for the plant has been below fleet average.

Without sufficient assessment of the effectiveness of the Operational Experience programme, opportunities for improvement could be missed.

Suggestion: The plant should consider establishing a detailed self-assessment programme for effectiveness review of its OE process.

IAEA Basis:

NS-G-2.11
8.2. The operating organization or licensee should periodically review the effectiveness of the process for the feedback of experience. The purpose of such a review is to evaluate the effectiveness of the overall process and to recommend remedial measures to resolve any weakness identified.

NS-G-2.4
6.62. The effectiveness of the operating experience programme should be assessed periodically to identify areas of weakness that require improvement.

7. RADIATION PROTECTION

7.2. RADIATION WORK CONTROL

Radiation work authorization (radiation work permit RTR) is a part of the process for planning of work within the radiation controlled area (RCA). To optimize dose planning the computer program PREVAIR was introduced in 2006. As a result of this improvement, positive experiences have been observed during the power cycle and during outage. In addition, operating experience can be included during the planning of similar operational work. The team considers this as a good performance.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

For the optimization of radiation protection, the plant has introduced a system (computer program developed on site) to manage the accumulated individual dose over a period of 12 months for each person who reaches 16 mSv. This prevents staff from exceeding the regulatory limit for each person having access to the RCA. Trending of doses over the last years shows that this effort has been effective. The team considers this as an area of good performance.

In recent years extensive radiation protection (RP) protective measures have been planned and executed during outages:

- purification of primary loop for a duration 10 times longer than the standard recommendation;
- installation of ALARA areas within the RCA;
- several locations shielded by lead;
- cleaning to reduce contamination.

The result of these measures can be seen in the collective dose, which has decreased over the past years and has now reached the same value as French NPP's operating 1300 MW units. The team considers this as a good performance concerning implementation of the ALARA principle.

The programme in place ensuring decontaminable coverage of materials within RCA for easy removal of contamination does not always correct isolated defects in a timely manner. The team has made a suggestion in this area.

The plant has a whole body counter on site to monitor internal contamination. Accreditation of the whole body counter is required by law in France. Due to the organization of the corporate project for the accreditation of all sites in France (selecting a lead site, and organizing the accreditation schedule for the other sites) this audit will take place in Fessenheim at the end of 2009, only after the 10 year outage of unit 1.

In the field of external radiation monitoring, passive dosimeters used in French NPPs are capable of measuring gamma Hp(10) and beta radiation Hp(0,07). Plant staff in general were not aware of the fact that passive dosimeters were also capable of measuring beta radiation.

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

The plant has a special monitoring device (CORAMAT) in use to perform a final check of large objects leaving the site. This high-precision monitoring device also allows the detection of radioactive particles inside the equipment, which might have entered during use inside the radiation controlled area. The team considers this as an area of good practice.

C1 monitors are not sufficiently capable of achieving their intended function to detect contamination on the protective clothes of personnel entering the changing room. In addition plant practice does not ensure the control of spread of radioactive substances within the RCA following a C1 alarm (C1 monitors are used to control surface contamination on the protective clothes of staff before entering the changing room, this area is called the ‘clean’ area of the RCA). The team has made a recommendation in this area.

Monitors used for the detection of contamination of personnel at the exit of the RCA (C2 monitors) are not state of the art, but a replacement by new monitors will take place in September 2009 before the 10 year outage of the plant.

The individual dose monitoring equipment in use in France has been improved within the past few years to measure neutron dose more accurately. The team considers this as an area of good performance.

The existing personnel decontamination and medical treatment area is in good condition and is adequately equipped. The facility is spacious. The team considers this as an area of good performance.

7.5. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The team has identified areas for improvement in the field of minimizing solid waste. A reduced filter replacement frequency could contribute to keeping the generation of radioactive waste to the achievable minimum, practicable. The following example were observed:

- Air in-leakage to the RCA (under negative pressure) at the bottom at the RCA access corridor from changing rooms to the containment spray area;
- Air in-leakage to the RCA due to a wide step at the door and no attached edging to that door where the spent fuel tools are taken out (K252/250).

The team observed that no formalized instructions were available for the use of gloves in the hot laboratory. As a result of IAEA walk-downs, an instruction for the use of gloves within the hot laboratory has been drawn up.

7.6. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

At the personnel decontamination and medical treatment area in the medical center, adequate equipment was available. Further possibilities for support exist e.g. fall back facility and contracts with civilian hospitals as well as a military hospital in the surrounding area. The team considers this as an area of good performance.

DETAILED RADIATION PROTECTION FINDINGS

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

7.3(1) Issue: The programme in place ensuring decontaminable coverage of materials within the radiation controlled area (RCA) does not always correct isolated defects in a timely manner.

Plans are in place to renew floor painting in significantly large areas inside RCA and such work is already in progress. However, opportunities in individual cases when damage is observed are not taken to repair painting:

- Many defects of protective painting exist in a large number of rooms in both units 1 and 2 within the RCA;
- After the replacement of two different types of equipment by new equipment, the remaining space of the former larger floor surface is not protected by paint;
- Following replacement of an expansion joint in W 130 the protective cover is missing;
- Partly damaged wooden equipment is used in the hot laboratory.

Insufficient surface protection of materials within the RCA will lead to dispersion of radioactive substances into these materials and could result in inappropriate dose to plant personnel.

Suggestion: The plant should consider enhancing the programme on adequate covering of materials within the RCA with decontaminable covering, including correction of isolated defects in a timely manner.

IAEA Basis:
NS-G-2.7
3.2 The radiation protection programme should cover …
(i) removal of sources of radiation
3.67 For the control of radiation exposure of personal, consideration of the optimization of radiation protection is required in the design and operation …
(e) effective procedures for the control of contamination

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

7.4(1) Issue: The C1 monitors are not sufficiently capable of achieving their intended function to detect contamination on the protective clothes of personnel entering the changing room. In addition plant practice does not ensure the control of spread of radioactive substances within the RCA following a C1 alarm.

C1 monitors are used to control surface contamination on the protective clothes of staff before entering the changing room, this area is called the 'clean' area of the RCA.

- C1 monitors are not providing full coverage of the person;
- A warning on lack of supply of spare parts was issued by EDF corporate;
- The plant staff is aware of this deficiency but no temporary compensatory measures are in place except the frisker to control the contamination of hands and feet;
- No decision on replacement within the next years is foreseen;
- No investigation of contamination at the worksite or in the area around C1 is triggered by an alarm of the C1 monitor.
- Events when C1 alarm is triggered are not reported, and therefore statistical data about frequency of such situations are not available.

An inadequate programme to investigate contamination alarms (C1) reduces the effectiveness of controls to limit radioactive particles to the worksite. Inadequate control of contamination increases the risk of spreading contamination into the hot changing room.

Recommendation: The plant should ensure that C1 monitors are fully capable of detecting contamination on the protective clothes of personnel entering the changing room and also ensure the control of spread of radioactive substances within the RCA following a C1 alarm by reporting and treating such cases.

IAEA Basis:
Safety series 115, International Basic Safety Standards for protection against ionizing radiation and for the safety of radiation sources.

I.23. Registrants and licensees shall:
(g) provide, as appropriate, at exits from controlled areas:
(i) equipment for monitoring for contamination of skin and clothing;
(ii) equipment for monitoring for contamination of any object or substance being removed from the area.

NS-G-2.7
3.3 The operating organization "shall designate as a controlled area any area in which specific protective measures or safety provisions are or could be required for:
(a) Controlling normal exposures or preventing the spread of contamination during normal working conditions.

7.4(a) Good Practice: Use of a special monitoring device (CORAMAT) to perform a final check of large objects leaving the site.

Fixed measurement instrumentation is used to detect radioactive contamination on long and cumbersome items like scaffolding tubes, equipment with a ventilation system, tools, neon tubes, etc. Large detectors on both sides and the top of a conveyor belt allow high precision monitoring. These gamma detectors allow the detection of radioactive particles inside the equipment, which might have entered during use inside the radiation controlled area. This device facilitates the work of staff responsible for performing final checks in the sense of guaranteeing the quality of the checks, thus improving performance. In addition, the time to perform these control checks is reduced which results in less exposure for workers. This effort in improving contamination checks is achieving the expected results. Site detectors have not been triggered since this monitoring device has been put into use.

8. CHEMISTRY

8.1. ORGANIZATION AND FUNCTIONS

The team has identified that chemistry goals are not established to promote further enhancement of chemistry performance and has made a suggestion in this area.

The team has also identified as good performance the training process of chemistry staff to assure its high competence and availability for fulfillment of tasks assigned. After receiving basic training, on-the-job training is gradually provided for various tasks of chemistry technicians. In this manner, after completion of the training, technicians are able to perform any task from a full range of chemistry department duties. Regular supervisory observation and evaluation in the field is performed. Skills development is performed through regular participation of technicians at various training courses selected according to chemistry department needs. Despite excellent fuel integrity results over the past ten years, readiness to perform in-core sipping test is maintained by regular staff refresher training one month before outage.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

The team identified as a good performance plant practices during the shutdown process. A conservatively low primary coolant activity value is set as the end point of primary coolant purification causing certain extension of shutdown process. This practice has resulted in favorable equipment radiation and also outage collective exposure trends over past years. Modification of shutdown purification practices also contributes to reduction of radwaste generation and reduction of used ion exchange resin degradation risk.

The team has also identified as a good practice the use of a mobile demineraliser facility during unit restart periods.

With regard to primary chemistry, some out of optimal range fluctuations of primary water lithium concentration were observed by the team, being caused mainly by load changes. The team encourages plant to consider some proactive approach for prompt fine adjustment of lithium injection after boration and to look for suitable software for optimization of Chemical and Volume Control System purification after deboration in order to achieve better adherence to optimal pH value of the primary coolant.

Plant outage lay-up practices were identified by the team as a good performance. These cover thorough preparatory outage planning and subsequent conduct of assigned activities during outage with involvement of chemistry, operations, maintenance and radiation protection staff. This approach effectively addresses corrosion risk of equipment during outage periods and contributes to dose rate reduction for steam generator associated repairs and inspections.

8.3. CHEMICAL SURVEILLANCE PROGRAMME

The team found some areas for improvement in the plant chemistry surveillance programme and has a made suggestion in this field.

As regards plant chemistry monitoring practices, almost all chemistry on-line monitor signals are wired to control room recorders. Evaluation of trends requires appropriately frequent visits by chemistry staff to the control room. One daily reading of on line monitor data is performed with a hand-held electronic field data logger following subsequent transfer of data to the chemistry database Merlin. In the event of any parameter fluctuation, the chemistry database Merlin must be updated by additional manual inputs, in some cases by converting chart recorder data to numerical values. This practice results in an increased number of control room visits, represents unnecessary burden of chemistry staff and also introduces certain inaccuracies. The team therefore encourages the plant to analyse possibilities for facilitating of chemistry on-line monitors surveillance.

The team has recognized as a good practice that the plant has introduced a policy for reducing errors in low periodicity and occasional sampling – mandatory pre job briefing and simple, user-friendly single-page sampling instruction sheets for facilitating safety related sampling activities.

8.4. CHEMISTRY OPERATIONAL HISTORY

The team has identified as a good performance regular meetings of chemistry and technical support staff. At these meetings, operating experience topics are discussed, analyzed with tasks assignment and tracking.

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

For Chemistry laboratory and on-line instrumentation, well managed quality system is implemented with support of Merlin software. However, laboratory balances were found to be located in the several hot and cold laboratories at workbenches next to other instrumentation. No separate room or place is provided for balances to ensure that they remain functionally sound. The team encourages the plant to consider relocation of balances not linked to particular analytical instruments to a separate space with reduced environmental disturbance (corrosion, humidity, vibrations, etc.)

The team has also identified some deficiencies in post-accident sampling and analysis and has made a suggestion on this topic.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

The team has found that except for simple checks of diesel generator fuel, no other input or periodic checks of any chemicals and reagents delivered to the plant are performed. Reliance is placed on the supplier’s declaration of compliance with specified quality criteria and randomly performed quality checks at corporate level. The team encourages the plant to consider implementation of internal checks with regard to possible safety implications.

DETAILED CHEMISTRY FINDINGS

8.1. ORGANIZATION AND FUNCTIONS

8.1(1) Issue: Chemistry goals are not set in a challenging way to promote further enhancement of overall plant chemistry performance.

- Objectives of the Chemistry Section were established within the Technical Support Department objectives, but these were not approved by the plant management until the second half of March 2009. These objectives did not contain chemistry goals.
- Chemistry programme goals do not cover the full scope of plant systems – goals are set for concentration of oxygen in condensate, action conductivity and sodium concentration in steam generator blow down, corrected activity of I-131 and total activity of fission gases in the primary coolant and activity of radioactive effluents. These goals are not set in a sufficiently challenging way, only compliance with plant water chemistry specifications expected values is being anticipated.
- No goals are set for primary chemistry and Flow Accelerated Corrosion related secondary chemistry aspects and trending of steam generator tube sheet sludge lancing results is not evaluated.
- Although planned within coming Process Management implementation in the second half of the year 2009, regular monitoring and trending of above goals is not formalized yet at the plant management level.

The setting of chemistry goals in a non-challenging and non-comprehensive way does not promote improvements in plant chemistry as an integral part of safe operation.

Suggestion: The plant should consider revising its policy in setting chemistry goals to assure appropriate staff motivation and to demonstrate adequate management support in promoting overall enhancement of chemistry performance.

IAEA Basis:
DS 388
2.3 The operating organization should set challenging goals and objectives for the chemistry programme. The expectations of the management concerning the implementation of this programme at the plant should be clearly stated. Chemistry staff should understand, support and implement this programme. Feedback from programme performance results should be used to enhance the quality of the chemistry programme and regimes.

2.5 Chemistry performance indicators should be established to monitor the accomplishment of goals and objectives, and should be promoted and communicated to the staff. The management should periodically reinforce their expectations, monitor and assess performance, and correct deviations.

50-SG-Q13

401. Management should ensure that chemistry and radiochemistry work provides optimum protection for plant systems and materials. The requirements for chemistry and radiochemistry work should include:

…

—Goals for improvement in chemistry and radiochemistry.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

8.2(a) Good Practice: Use of mobile demineraliser facility during unit restarts after outages.

Plant has implemented use of mobile demineraliser during restarts instead of feed and bleed practice for achieving of satisfactory quality of the condensate:

- This mobile facility consists of 2 m^3 of mixed bed resin and mechanical filters and it is used for both units.
- The facility is used when vacuum in the condenser is created and uses condensate pump to recirculate condensate. When satisfactory water quality is reached, water is supplied to the feed train. The facility remains in operation until 20% of reactor power is reached.
- This technology assures good quality of condensate, saves about 1000 m^3 of demineralised water per restart and reduces associated releases of morpholine and make-up water plant regenerant solutions to the environment.

8.3. CHEMICAL SURVEILLANCE PROGRAMME

8.3(1) Issue: The plant chemistry surveillance program is not comprehensive enough to deal with all chemistry aspects of safety related systems.

- Diesel generator cooling circuit chemistry specification is not included in the corporate chemistry specification applied at the plant. Chemistry parameters are defined only in the diesel generator preventive maintenance programme. In this programme, requirements for pH, concentration of phosphate and density are defined. Annual analysis is required and it is performed by the external laboratory. Protocols of analysis demonstrate that for one diesel generator, requirement for phosphate concentration has not been met since 2007 and for the other two diesel generators the same criteria have not been met since the last analyses performed in August and September 2008. No deterioration of diesel generator availability due to cooling system has been observed so far. Except for requesting repeated sampling from February 2009, no corrective actions were taken towards meeting of above criteria due to environmental constraints of cooling media replacement. Various construction materials are used in the above circuit but no parameter to monitor corrosion processes is formally established.
- Well water serves as supply for makeup water plant. This water has very low total organic carbon (TOC) content, but demineraliser technology operates with many interruptions (integrated equivalent operational time only 80 full days during a year). Some ion exchange resins in the above system have been in operation since plant start-up. Status of the resins was checked recently and declared as satisfactory. Risk of potential microbial growth inside the filters during standby periods, especially in high temperature summer seasons cannot be fully excluded. Monitoring of such a risk is neither formally requested nor performed through TOC or any other adequate parameter.
- There is neither a formal requirement nor actual checking of the organic matter content in the purchased boric acid and any of primary system boric acid solutions, although the plant has a certain capability to detect presence of organic substances through ion chromatography analyses.
- Chemical concentration of corrosion product in the primary coolant during operation is neither specified nor monitored, only activities of activated corrosion products are measured. Activity measurement itself serves only as a delayed indicator of foreign material intrusion or elevated corrosion rate because of relative long activation period. The acoustic emission measurement method implemented for monitoring of loose parts in the primary circuit is capable of detecting only limited scope of foreign material ingress.

Without a comprehensive chemistry surveillance program the plant may fail to implement effective countermeasures for impurity control and for assuring reliable operation of all important systems.

Suggestion: The plant should consider updating its chemistry surveillance programme in order to enhance both monitoring capabilities and timely responses towards impurity control.

IAEA Basis:
DS 388

4.1 The chemistry control includes the correct application of the appropriate chemistry regimes of safety and safety related systems depending on the design and materials.
4.2 To achieve adequate chemistry control, the chemistry organization should take into account a graded approach in the different areas of chemistry control mainly for the primary, secondary and other significant safety and cooling water circuits.
4.13 The concentration of the chemical inhibitors that are added to cooling systems should adequately be controlled and monitored. The chemistry parameters to keep the proper treatment and the impurities should be controlled to minimize corrosion of the system and loss of integrity
6.1 The operating organization should establish and implement a chemistry surveillance programme to verify the effectiveness of chemistry control in plant systems. It is also essential to verify that SSCs important to safety are operated within the specified limit values. Such a surveillance programme should help to detect trends in parameters, to discover and eliminate undesirable effects and consequences of out-of-range chemistry parameters.

50-SG-Q13
403. Chemistry and radiochemistry work normally consists of:
—Monitoring, sampling and trending chemistry and radiochemistry parameters at specified frequencies to ensure the timely detection and correction of abnormal or unacceptable trends and conditions;

8.3(a) Good Practice: Effective human performance error reduction policy reduces multiple safety risks and facilitates performance in non standard sampling operations.

The plant has implemented a policy for the reduction of human performance errors in low-periodicity or occasional sampling in non standard sampling circumstances:

- A sampling procedure has been drawn up where sampling activities are evaluated and categorized with regard to overall safety risks;
- Simple highly illustrative single page instruction sheets were developed containing information on safety risks, defining sequence of all associated activities involving communication, checks and manipulations and picture of particular field conditions for easy orientation;
- These sheets are plastic-coated in order to assure damage proof and easy decontaminability if required;
- For safety-related sampling activities, a single set of these instruction sheets is available in the supervisory room. In the event of a sampling request, a pre-job briefing with chemistry section supervisory staff is inherently initiated as technicians are expected to collect the relevant sampling sheet from the supervisor before going to the field.

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

8.5(1) Issue: Post accident sampling and analysis capabilities are not verified for severe accident conditions.

- A post accident sampling system is installed at each unit of the plant allowing sampling from the low-pressure safety injection system. Sampling capability is periodically tested in accordance with elaborated plant procedure. Specification exists for chemical and radiochemical parameters to be analyzed after sample is taken. However there is no postulated activity of the sampled media in the beyond design basis accident conditions, so no radiological calculations exist to estimate individual doses for whole process of sampling activities and to verify that sampling can be performed.
- The sampling procedure requires some manual operations to be performed in the sampling glove box. Corporate support with robotics-based technology is expected, but testing of robotics technology for this purpose in the particular plant field conditions has not been done yet and fully robotized sampling ability has not been demonstrated.
- Sample is planned to be transferred into effluent laboratory for analysis but ability of this laboratory to perform required analyses was not analyzed from radiological point of view. In such a case, adequacy of laboratory preparedness cannot be guaranteed.

Without fully implemented post accident sampling and analysis capability, preparedness of the plant for its activities after a severe accident may be compromised.

Suggestion: The plant should consider verifying full capability of sampling and corresponding analyses in post accident conditions.
In international practice, this verification involves definition of source term, evaluation of associated radiological implications, implementation of necessary technical measures and updating of regular testing programme.

IAEA Basis:
DS 388

6.44 A post accident sampling system (PASS) or another adequate sampling facility should be ready to operate when required by emergency procedures and also considered for use in taking regular samples from plant systems.
6.45 For proper PASS operation the following should be provided:

a) PASS operation procedures;
b) radiation protection measures evaluated in advance and applied when PASS is used;
c) programme for preventive maintenance;
d) regular checks of PASS operability;
e) regular training for personnel designated for PASS operation (taking grab samples and performing subsequent activities).

NS-R-2
2.35. Site personnel shall be trained in the performance of their duties in an emergency.

NS-G-2.2
8.6. Operating procedures should be verified and validated to ensure that they are administratively and technically correct, are easy for the operator to use and will function as intended.

NS-G-2.7
5.5. Training measures should cover the following topics to a level of detail commensurate with the assigned tasks and responsibilities of the respective worker or supervisor:
(l) where appropriate, actions that should be taken in the event of a nuclear or radiological emergency or an accident in the transport of radioactive material.

9. EMERGENCY PLANNING AND PREPAREDNESS

9.2. RESPONSE FUNCTIONS

At the plant, no person with the authority to initiate the on-site emergency plan is present on a 24-hour basis. Unforeseen communication and transportation problems could cause unnecessary delays in the immediate actions. The team recommend the plant to have a person on site, at all times, with the authority to initiate the plant emergency organisation

The plant is not authorized to initiate off-site alert. The team suggest that the plant should continue to discuss this with the authorities.

The NPP has developed tools to assist communication staff to prepare the first communication messages and press meetings. The tools consist of:

- Analysis Sheet
- Key Emergency Messages
- Template for First Press Release
- Media response pack

These communication aids assists the communication staff in order to give timely and reliable information to the press and the public. The team consider this aid as a good practice.

9.3. EMERGENCY PLANS AND ORGANIZATION

In the event of an activity release, it is important that all resources can work together in an organized and effective manner. Measuring points in the environment have been standardized with the French and German authorities so that a common set of points are used.
The use of the plant vans equipped for activity measurement is now synchronized with external resources to ensure efficiency. This organization is considered to be a good practice.

9.5. EMERGENCY RESPONSE FACILITIES

In order to obviate having to successively call each muster point by telephone, staff members gathered at muster points are informed by means of regular messages put out by the local command centre. The command centre can send messages to a single muster point or to all muster points together. These messages are sent via an internal communication system that is hooked up to a secure telecom system. Each muster point officer can activate the loudspeakers of his own muster point from his telephone. Counting of staff at muster points has been facilitated by the installation of badge readers at the entrance and exit. The local command post uses an interface to monitor staff numbers at each muster point in real time. This equipment is simple to use and has many possibilities for the organization to communicate in order to reduce radiation exposure and avoid overreaction among the staff. The team consider this as a good performance.

At the plant adequacy of muster points to accommodate all persons has not been sufficiently analysed. The team made a suggestion in this area.

9.7. TRAINING, DRILLS AND EXERCISES

The plant draws up a 3-year emergency exercise schedule. This schedule is reviewed at the beginning of each year with the members of the EPP Committee. According to this schedule, the EPP engineer assigns on-call staff to the various planned exercises. He uses a spreadsheet to anticipate potential deviations by simulating the absence of staff members (exceptional circumstances, management decision, etc.). This long-term overview facilitates the coordination of EPP on-call staff training and ensures compliance with prescribed objectives. There were no deviations in 2008 related to exercise completion and staff participation. The team considers this as a good performance.

9.2. RESPONSE FUNCTIONS

9.2 (1) Issue: There is no permanent presence at the plant of a person with the authority to initiate the on-site emergency plan.

- Site emergency director, PCD1, who is authorized to initiate the plan, is present at the plant during office hours only.
- The authority is not delegated to the shift manager, PCL1.
- Communication to PCD1 is available through several diversified methods such as digital message pager, mobile phone and standard telephone.

Without the permanent presence of a person having the authority to implement the on-site emergency plan, unforeseen communication and transportation problems could cause unnecessary delays in the immediate notification to the off-site authorities and timely implementation of protective actions for both plant personnel and the public.

Recommendation: The plant should have a person on site, at all times, with the authority to initiate the plant emergency organisation.

IAEA Basis:

GS-R-2 Sec. 4.23

Each facility ……. Shall have a person on the site at all times with the authority and responsibilities: to classify a nuclear or radiological emergency and upon classification promptly and without consultation to initiate an appropriate on-site response; to notify an appropriate off-site notification point ….

NS-R-2 Sec. 2.32

The operating organization shall establish the necessary organizational structure and shall assign responsibilities for managing emergencies. This shall include arrangements for; prompt recognition of emergencies; timely notification and alerting of response personnel; and provision of necessary information to the authorities, including timely notification and subsequent provision of information as required.

9.2 (2) Issue: The plant is not authorized to initiate the offsite alert.

- The authorization to initiate the external alarm lies with the Préfet (State representative).
- Unforeseen communication problems could cause unnecessary delays in the immediate notification to the public.
- The plant is aware of the issue and the subject was discussed in a meeting with participants from the plant, Préfet du Haut-Rhin and ASN.

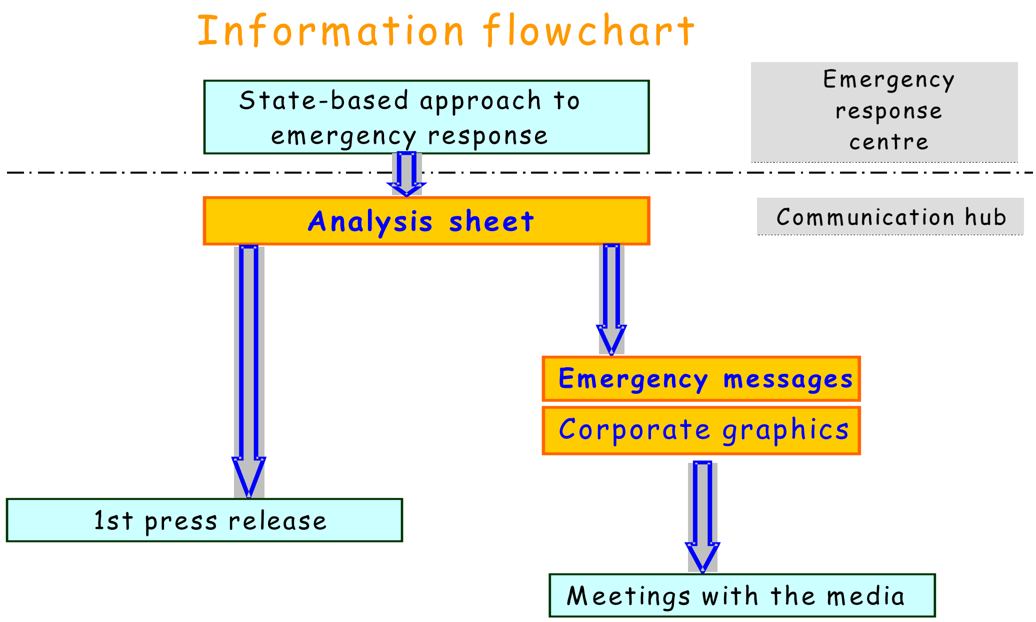
Without the plant being authorized to initiate the offsite alert, necessary and immediate notification and timely protective actions for the public could be delayed.

Suggestion*:* The plant should consider obtaining the authorization to initiate the offsite alert.

IAEA Basis:
GS-R-2 Sec. 4.53 Upon declaration of an emergency class the public shall be promptly warned of the emergency and informed of the actions that they should take. There shall be no undue delay that could jeopardize the effectiveness of the protective actions.

9.2 (a) Good Practice: Aids to Local Communication Command Post

The plant has developed tools to help staff from the communication command post to prepare the first communication messages and press meetings, as well as to respond serenely to telephone or face to face media communication.



This consists of the following elements:

A) Analysis Sheet:
The communication command post uses an analysis sheet which rapidly decodes the event and describes it in a reliable manner.
This provides the head of the communication command post with data and documents on the nature of the event and with key emergency messages.
B) Key Emergency Messages:
An emergency message is planned for each type of emergency event.
The emergency message is used by the head of the communication command post and the site spokesperson in preparing for their meetings with the press.
Each one contains:

- 1 introductory sheet (key aspects: human, environmental, technical),
- 4 sheets : « what has happened»; «protective measures»; «consequences » and «actions taken »,
- Prompts for the most likely questions.

Each message identifies the slides that can be used for media purposes. Those slides are provided by corporate communication services (used by all EDF communications functions).

C) Template for First Press Release:
Approved templates provide speed (within one hour after the command station has been set up) and guarantee the factual accuracy of the first press release.
A template for the first press release is planned for each key emergency message.
Once the event has been diagnosed using the analysis sheet, the head of the communication command post selects the appropriate template, fills it in, has it checked and then issues the release.

D) Media response pack (based on OEF):
These documents help the person in charge of telephone communication and the person in charge of face to face contact with media to better handle media attention.
The document provides clear and polite responses to be used for any impatient questioning by journalists.
These sheets have been drafted in response to needs identified during communication-specific EPP exercises.

Plant results demonstrate that this practice produces the expected results and
press releases issued during EPP exercises are published within the required time frame.

9.3. EMERGENCY PLANS AND ORGANIZATION

9.3 (a) Good Practice: Harmonization of measuring points between the plant and the national authorities of France and Germany.

In the event of an activity release it is important that all resources can work together in an organized and effective manner. Measuring points in the environment in the event of emergency have been standardized with the French and German authorities so that a common set of points are used.

During an emergency, measurements would be carried out and compared. This practice leads to an increase in the number of measurements since the teams no longer take measurements in duplicate at neighbouring points.

This practice has been implemented since 2005 for the French part and 2009 for the German part. It was tested by a joint exercise with the authorities. This practice has led to validated measurements (since taken in the same places), an increase in the number of measurement points (with sharing of results by fax) and an increase in the area covered by these measurements.

9.5. EMERGENCY RESPONSE FACILITIES

9.5 (1) Issue: The area to assemble people is not sufficiently analysed to assure that all persons at the plant could shelter in the event of a nuclear or radiological emergency.

- No written in-depth analysis has been performed to ensure that the assembly points are able to accommodate all personnel present at the plant.
- The plant is planning to reduce the number of assembly points from seven to four.
- In the event of an activity release one or more of the assembly points might become inoperable.

- During operation approximately 400 persons are present at the plant and during a ten-year outage this number will increase to approximately 2000 persons.

Insufficient space at muster points might lead to unnecessary radiation exposures in the event of an activity release.

Suggestion: The plant should consider performing a detailed analysis of the total area needed for assembly points to ensure that all persons at the plant have the possibility to shelter, even during a ten year outage.

IAEA Basis:

GS-R-2 Sec. 4.51

The operator of a facility in threat category I, II or III shall make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. This shall include the arrangements: …….. The facility shall provide suitable assembly points for all persons on the site……

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-2.14**; Conduct of Operations at Nuclear Power Plants (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)
- **50-C/SG-Q**; Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations (Code and Safety Guides Q8-Q14)
- **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
- **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

▪ ***TECDOC, IAEA Services Series etc.***

- **IAEA Safety Glossary** Terminology used in nuclear safety and radiation protection 2007 Edition
- **Services series No.10**; PROSPER Guidelines
- **Services series No.12**; OSART Guidelines
- **TECDOC-489**; Safety Aspects of Water Chemistry in Light Water Reactors
- **TECDOC-744**; OSART Guidelines 1994 Edition (Refer only chapter 10-15 for Pre-OSART, if appricable.)
- **TECDOC-1141**; Operational Safety Performance Indicators for Nuclear Power Plants
- **TECDOC-1321**; Self-assessment of safety culture in nuclear installations
- **TECDOC-1329**; Safety culture in nuclear installations - Guidance for use in the enhancement of safety culture
- **TECDOC 1446** OSART mission highlights 2001-2003
- **TECDOC-1458**; Effective corrective actions to enhance operational safety of nuclear installations
- **TECDOC-1477**; Trending of low level events and near misses to enhance safety performance in nuclear power plants
- **TECDOC-955**; Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident
- **EPR-EXERCISE-2005**; Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, (Updating IAEA-TECDOC-953)
- **EPR-METHOD-2003**; Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)

- **EPR-ENATOM-2002**; Emergency Notification and Assistance Technical Operations Manual
- **ILO-OSH 2001**; International labour office: Guidelines on occupational safety and Health Management Systems

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