



INTERNATIONAL ATOMIC ENERGY AGENCY

**REPORT OF THE**  
**OSART**  
**(OPERATIONAL SAFETY REVIEW TEAM)**  
**MISSION**  
**to**  
**FRANCE**  
**PALUEL NUCLEAR POWER PLANT**

**OSART MISSION**  
**17 TO 29 JANUARY 1998**

**and**

**OSART FOLLOW-UP VISIT**  
**21 - 25 JUNE 1999**

**DIVISION OF NUCLEAR INSTALLATION SAFETY**

**OPERATIONAL SAFETY REVIEW MISSION**  
**NSNI/OSART/99/98/F**



## **PREAMBLE**

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of the Paluel nuclear power plant, in France. It includes recommendations and suggestions 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.

This report also includes the results of the IAEA's OSART follow-up visit which took place 17 months later. The purpose of the follow-up visit was to determine the status of all proposals for improvement, to comment on the appropriateness of the actions taken and to make judgements on the degree of progress achieved.

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 eight operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; 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 experts and their plant counterparts are the comparison of a plant's operational practices with best international practices and the joint search for ways in which operational safety can be enhanced. The IAEA Safety Series documents, including the Nuclear Safety Standards (NUSS) programme and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART team members form the bases for the evaluation. The OSART methods involve not only the examination of documents and the interviewing of staff but also reviewing the quality of performance. It is recognized that different approaches are available to an operating organization for achieving its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power plants.

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

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

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

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## INTRODUCTION AND MAIN CONCLUSION

### INTRODUCTION

At the request of the Government of France, an IAEA international Operational Safety Review Team (OSART) visited the Paluel Nuclear Power Plant from 12 to 29 January 1998. The plant is located in the Normandy province, North West of Paris on the South shore of the English Channel. The site consists of four 1300 MWe units, EDF P4 standardized design with a four loop primary circuit.

The mission was the 98<sup>th</sup> in the OSART programme, which began in 1982, and the 9<sup>th</sup> such mission in France. The purpose of the mission was to review operating practices in the areas of Management, Organization, and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry; and Emergency Planning and Preparedness. The team was composed of members from Belgium, Finland, Germany, Mexico, Spain, Sweden, the United Kingdom, and the United States of America, together with the IAEA staff and observers.

During the mission, the team reviewed many of the plant's programmes and procedures in depth, examined indicators of the station's performance, observed work in progress, and held in-depth discussions with plant and corporate personnel. Throughout the review, the exchange of information between the OSART team members and station personnel was very open and productive. Emphasis was placed on assessing the effectiveness of operational safety rather than simply the content of programmes. The conclusions of the team were based on the performance of the plant's operational safety programmes, compared with good international practices.

### MAIN CONCLUSIONS

The OSART team concluded that the senior managers at Paluel are committed to improving operation at the plant. The team found a number of commendable features, including the following:

- The plant staff are experienced and motivated and are committed to making improvements. This is expressed through the initiatives outlined in the “Rigor in Operations” action plan;
- The plant uses several innovative technical programmes to improve the quality of its operation. An example is the use of a helium detection system for identifying condenser tube leaks which enables very small leaks to be identified and corrected;
- The EDF training center uses extensive plant mock-ups and several types of mini simulators to enhance operators’ and other station staffs’ knowledge of plant systems and equipment and nuclear plant fundamentals.

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

- The operating experience feedback programme does not sufficiently capture, analyze and utilize in-house and international operating experience information;

- Field activities conducted by managers and supervisors are insufficiently effective in reinforcing management expectations or ensuring high standards of human performance, material condition and housekeeping;
- The quality and control of some plant documents, including procedures and changes to documents and recorded information are not sufficiently controlled to ensure appropriate usage or accuracy of information.

## FOLLOW-UP MAIN CONCLUSIONS

The IAEA follow-up team received excellent cooperation from the Paluel staff and experienced openness in the discussions and in-plant reviews. The plant staff's attitude facilitated the exchange of information and resolution of questions. In all cases, agreement was reached with the Paluel management on the assessment of the actions implemented.

Management has taken numerous measures to address the OSART issues and improve performance of the station and the positive results were obvious to the team. The great majority of issues were found to be making satisfactory progress. In many cases, the extent of improvement was limited by delayed implementation of improvement actions until after the three planned unit outages in 1998 and by insufficient rigorous management of the initiatives.

Management emphasis has been placed on improving the communications and teamwork throughout the station and the initial positive results were obvious to the team. These efforts have included reorganization at several levels and a Plant Strategic Plan with emphasis on "Succeeding Together".

The team found the most noteworthy improvements to be in performance indicators programmes, in-house operating experience programme, structure of chemistry programmes and radiation protection initiatives. There were also indications of a strengthened safety culture.

The overall impression is that quite a few operational nuclear safety improvements have been achieved, many are well in progress and some are just beginning. Considerable effort remains before some of the desired improvements are actually achieved. The areas considered to need the most attention include management supervisory field tours, field operator rounds, housekeeping, material condition and industrial safety. Continued diligence and management support will be needed including strengthened in-field involvement to ensure timely completion of the planned improvements.

The final statistical analysis of the status of the 25 recommendations and 8 suggestions identified in the OSART mission in January 1998 showed that 18% were resolved 73% were making satisfactory progress and 9% (three issues) were making insufficient progress.

## **1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION**

### **1.1. CORPORATE ORGANIZATION AND MANAGEMENT**

Paluel NPP is a four unit 1300 MWe plant operated by Electricité de France (EDF). The corporate organization consists of departments providing technical, engineering, training and human performance support to all EDF plants. While the EDF corporate strategy aims at maintaining a consistent design basis, common policies and standards on safety, including support resources, decentralization of managerial control is the strategy at Paluel. This is progressing well at Paluel and the plant has taken the new challenge with authority in changing the organization to meet the change in the corporate strategy.

Corporate policies give clear statements to the plant director on his responsibilities for safety and this is assigned by the vice president EPN most recently in February 1997. The plant director enters into a management contract with EPN's nuclear corporate resources department under the direction of the délégué à l'exploitation du parc nucléaire (EPN) which provides financial and other resources to meet the objectives set out in the contract. Major programmes to resolve plant problems are separately financed from corporate funds. This is turned into a strategic plan for the plant, the most recent covering 1994-1997, a specific plan for 1998 and the next plan being drawn up will cover 1999-2002. Besides commercial and energy production objectives, the contract sets out nuclear safety related, personnel accident, radiation dose, and environmental discharge targets to be achieved.

A corporate safety department (DSN) sets out policies on safety and basic quality rules. When requested, they provide the nuclear power plant operations division and plants with safety assessment support when preparing reports for the safety authorities. An inspection capability is provided by an independent (IN) department which performs verification activities at all EDF NPPs and within other relevant corporate departments. The corporate nuclear safety organization includes a plant safety review committee attended by senior EDF management and by the Paluel plant director and a plant operating review committee attended by the plant associate director. These committees provide the consistent design basis for safety of replica plants and enables exchange of experience between the plants and the corporate support engineering and technical departments. There is a strong focus on nuclear safety. However, the policy of EDF and Paluel on fitness for duty should be improved. In particular, the team recommended that a strategy should be developed to prohibit the sale or consumption of alcohol on the site.

## 1.2. PLANT ORGANIZATION AND MANAGEMENT

The Paluel plant management structure is in the process of change and it is the plant director's vision to make all staff become oriented towards a whole plant attitude rather than a unit or group attitude. The current organization is composed of five groups, two for twin unit operations, a technical support group, an administrative support group and a functional support group. The nuclear safety policy statement sets out the responsibility of the plant director. Recently (14 May 1997), the plant director wrote to all working at the plant concerning "safety our primary concern over production needs and projects". It also referred to a "professional safety culture" and "oneness". The responsibility for safety is delegated to his direct report managers i.e. deputy and associate directors and is set out in the organizational memo of the QA manual. A separate letter of delegation is used by the plant director to amplify responsibility. This is a considerable task and each line manager, at least down to those who report to department managers, have such letters of delegation. A number were reviewed and they impose succinct safety responsibilities on each person though they could be improved with the addition of behavioural expectations.

The organization has changed in the last four months as maintenance now directly reports to a deputy director. Among the reasons for this change stated were the growing gap between the twin unit practices of operations and maintenance. The vision is to bring all four unit operations departments together as well in the future. In addition some maintenance is carried out by contractors and the unit operation groups did not have the experience to successfully manage contractors. The logic and the evidence for this change appears sound. A network of committees develop and manage the plant which enables a good flow of information between groups. However considerable time is spent in meetings and as part of an accountability review it may be prudent to review their number. The next change is joining together the I&C sections and separately the chemistry sections within operations for the four units. ECOM (maintenance coordination and optimization), engineering and cost control will be formed into another group. Bringing them together has advantages because it could improve shared competencies and help to achieve the director's aim of a plant centered view.

Off site support services are coordinated through the department manager for ECOM. Contracts are set up to gain both resources and services, that is people as well as complete packages delivering a service or final product. This is particularly important for generic modification work and certain technical services. An example of these is the provision of NDT services to the plant. Support for outages is wholly managed by ECOM using an effective project based management system. This is well structured and site managed, has defined goals and objectives that are monitored and reviewed after the outage for improvements to be made prior to the next outage. This area achieves a high performance and although industrial safety is in need of further improvement, radiation dose reduction strategies have benefited from a good approach to risk analysis. Of particular note is that contractor performance is reviewed and transferred to corporate EDF into a database for exchange of experience throughout EDF.

The strategic plan for 1998 has five priority areas. The first is "to increase our rigor in operation" plus others which set out the need to improve safety culture. The plant director regarded this as the overriding objective for the 1998 management contract. It was launched with a personal letter to each member of staff (dated 15 September 1997) and involved a 1 day seminar for all line supervisors and development of action plans with the department managers. The staff letter referred to the "growing number of events that call into question thoroughness in operation". Media in the form of booklets and posters have been used to communicate the message.

The management contracts set out a number of targets for managers. Action plans, generally, have no profile or periodic targets and sometimes no specific and measurable performance indicators. This means that progress estimation is reliant on views rather than achievement of measurable tasks within each action. The programme of objectives is reviewed at the monthly management team meeting with a good set of indicators but because the plan is not underpinned by linking performance indicators to achievement of actions, managers are implementing the tasks in different ways. It is therefore not possible to have a clear view of either progress of plans or the success of completed tasks. The team consequently recommended that the plant expand its indicator programme as it will be useful for demonstrating accountability of line management. The importance of the rigor action plan should be seen in the context of a decline in safety performance in 1997 as measured by the plant management contract indicators.

However, it is also necessary to set challenging targets to gain appreciable and sustainable improvements in levels of operational safety. This means that performance must be assessed against the best performers in the field. At Paluel, the general number of indicators for the 1997 management

contracts in the plant devolving the plant goals and objectives were restricted to cascading the higher tier indicators to managers but without any reference to a standard of the best that has been achieved worldwide or even in EDF. The team recommended redefining the expectation of plant targets against industry best performance as well as the mean. Industry experience should be sought to improve the knowledge of good practices to achieve these more challenging targets.

A programme of field tours has been introduced but it is not effective in achieving the desired standard of housekeeping, material condition and safety. The team, consequently, recommended that the field tour programme be reviewed and supported by training and coaching to improve the effectiveness.

A key element in the analysis of the gap between staff behaviours now and needed in the future to achieve an improvement in safety as evaluated by the team, is the role of leadership by managers and first line supervisors. All were involved in a one day workshop in late 1997 but the action proposed on “team-based exchange to define collective improvements (self-diagnosis)” will need improved management skills. There is evidence from a review of the field tour programme that managers and line supervisors are not spending enough quality time around the plant to reinforce the rigor action plan and take corrective action to improve standards. This should be built on a lasting foundation and integrated into the rigor action plan. Therefore, because a change in culture is needed, the team recommended that a development programme for management skills to achieve the deserved change based on industry wide experience should be introduced as soon as possible.

### 1.3. QUALITY ASSURANCE PROGRAMME

The quality assurance manual was totally revised in 1997 and simplified from an original version ten years old and reduced in size from some 700 documents to about 250 documents. It attempts to achieve current best principles and has a customer valid expectations file. This QA manual is controlled by the safety and quality department and has been made available electronically to around 50 users on their network. This is an effective practice which although used elsewhere could have further application within EDF. The process of updating many of the supporting documents and procedures has only recently been completed and redistribution of these will need effective control and may need the support of a plant communication programme to ensure that the system is used and understood.

There is an effective audit process and the plant director reviews the audit reports at the plant technical safety committee (GTS) which incorporate all recommendations for corrective actions. He also reviews their completeness and possible extension to other groups within the plant. These actions together with those derived from significant operating experience reports (CRIS), other deviation reports and commitments made to the safety authority are tracked and reviewed on a monthly basis. However, other parts of the quality programme are not effectively supported for example, changes to documents which are unauthorized for safety related operations. This is discussed in section 1.6.

### 1.4. REGULATORY AND OTHER STATUTORY REQUIREMENTS

The regulation by the safety authorities of the plants operated by EDF is carried out by several government bodies but the principle central nuclear safety authority is DSIN which sets basic safety rules, sets national nuclear safety policy and standards which apply to all EDF nuclear plants. It also

approves the operating rules, technical specifications, surveillance tests and emergency arrangements. The inspection programme and enforcement regime is carried out by a regional department of the safety authority (DRIRE) and in conjunction with DSIN as appropriate. In addition, technical support for safety assessments and the development of assessment methods is available to DSIN by the safety authority's corporate support (IPSN). This separate government body has considerable technical expertise to ensure that the safety authority has access to independent and authoritative advice on nuclear safety matters. It was noted that joint training arrangements between EDF and IPSN appear to be a good way of developing a mutual understanding of the need for good safety assessment.

The safety authority draws up the inspection programme setting targets for inspection and the subjects. The range of topics for 1997 were suitably comprehensive for this period noting that DRIRE carried out additional inspections after a recent level 2 INES event at Paluel. When random inspections are included, the safety authority inspectors accomplish typically 20 inspections in a year for the four units. Of particular note is the arrangement for agreement and recording of findings between the inspector and plant director which is structured. Close out of these actions is tracked and reviewed in subsequent visits to the plant.

Periodic safety review of plants is carried out by DSIN and the modifications known as "lot 93" was agreed as a result of these reviews. The DSIN discusses with EDF the time scale for the implementation of these modifications and inspects their completion. It was noted that as part of these agreements a number of surveillance tests arising from "lot 93", which the plant has implemented, are still awaiting approval by DSIN. The plant is taking a safety conservative approach, however, the team suggested that regulator review those outstanding surveillance tests as soon as possible.

## 1.5. INDUSTRIAL SAFETY PROGRAMME

The directors policy on industrial safety is that safety is an absolute priority and takes priority over production needs. The letters of delegation have reinforced this responsibility for line managers to prevent any risk to their staff. Safe work practices are supported and specified in an integrated, well presented, book of rules covering all potential hazards on the plant. These are developed by EDF for all plants and are designed to stipulate how safety from the system will be achieved by isolation of potentially hazardous equipment. This book also identifies all required personal protection equipment from other hazards which cannot be isolated e.g. hard hats, clothing, and hearing protection. It also gives rules for quantification of radiological controls. This rule book is supported by a control procedure specifying the requirement to follow the rule book by everybody working at Paluel and stating the areas of the plant where exceptions apply. Examples are that it is obligatory to wear personal protective equipment in the turbine halls and electrical buildings but non use is tolerated in areas such as offices and when people are outside technical buildings. The requirements are not comprehensively followed by workers at all levels.

Lost time accident statistics have shown no improvement over the last two years and are higher than would be expected from best practice. This does include both EDF staff and contractors whose contribution to yearly man hours worked is approximately equal. While the team supports the intent to give as much attention to contractors as EDF staff and have noted the past initiatives including risk analysis which improved performance before 1995, the number of lost time accidents is typically 40 a year and several times what would be expected for best practice. Contributing to the number of

accidents is the lack of compliance with safety rules and procedures and too few managers present in the field discharging their responsibility by placing a high priority on rule observance. This is of concern in that there is little improvement in the lost time accident rate which could lead to more severe accidents. Most importantly, the industrial safety analysis effort is reactive by only reviewing accidents whereas the best industry performers use a “near-miss” reporting system to be active in deterring accident situations. Experience shows that managers supporting a vigorous “in the field” programme with regular refresher training for workers, does improve accident statistics. The team recommended that the plant review its industrial safety programme with reference to best industry performers, set new improvement targets, display accident performance statistics prominently and suggested that a “near-miss” reporting system be introduced to capture situations that could lead to accidents.

## 1.6. DOCUMENT AND RECORDS MANAGEMENT

The responsibility for document control is centralized by an information and document systems department (SSI) distributing reference documents to satellite holders within other departments. This method is used to provide up to date documents from which working copies can be made as required. These working copies are appropriately distinguished from the reference documents. The arrangements for the update of references and control of other media appeared satisfactory as did the archiving arrangements. Some further work is in hand to improve the fire protection arrangements for the archive. Because a satellite system is used, the document owner is also responsible for the change, amendment and review control of the documents for which it has responsibility.

However, recording and changing information in operations, technical and maintenance documentation is not always satisfactory and is not treated in accordance with good international practice or the plant policy. Some procedures used in the control room during a unit start up during the OSART visit were poorly filled in, with corrections, inclusions and modifications that were not authorized. Work documents were examined with data sheets which were hand corrected that had not been revised to correct errors that were identified the last time the same work was performed. Other instances also indicated that the required level of supervision to ensure that high quality documentation is used for all safety related operations was not being achieved. The team recommended improvement in this area.

As part of the information systems development, Paluel has produced an integrated and networked programme linking plant diagrams, the tagging database, maintenance and operations procedures and work history files with photographs of the related plant. The system called SMISS (scemas mechaniques informatiques site), has also been successfully used with radiological data contours on the plant photographs to produce guidance documents for outage maintenance contractors as part of the ALARA project to reduce doses. The team considered this a good practice.

## **STATUS AT OSART FOLLOW-UP VISIT**

In general, good progress has been made on the Management, Organization and Administration issues. Of the six recommendations, five have made satisfactory progress and one was resolved. Both suggestions showed satisfactory progress to date.

There was one issue concerning the consumption of alcohol at the plant. The station's strategy was an appropriate response to this issue. This is reasonable progress against a clear managerial intent to eliminate alcoholic consumption at the plant in the future.

Three issues were raised concerning the plant organization and management principally because an improvement was necessary in the direction and implementation of the plant's goals to achieve improvement in all aspects of safety. A key enabler found was the benefits of the new organizational structure, which combines a stronger line of accountability from the Plant Director to the Departmental Managers with project coordination by the Associate Directors. A supporting program to develop managerial and supervisory competence was also recommended and progress towards this aim was found. A change in culture was evident in many groups but there was evidence that this is not uniform across the plant and all levels of management and supervision should maintain their drive to change approaches to continue progress towards international standards.

Considerable effort has been applied to revise the Plant Strategic Plan and Management Contracts to target the best standards in EDF. It was important to see that the remaining actions not completed from the Rigor in Action Plan are now included in the Plant Strategic Plan. However the competitive industry of which Paluel is part, demands striving for the best international standard. Improvements have been made at the plant in terms of significant operating events but not so with accident frequency rates and radiological doses. The plant should look outwards to pick out the leading performers and emulate their approaches. Some evidence of a start to this approach was found but it deserves further encouragement.

The Plant Strategic Plan is built around succeeding together and there was evidence that the new structure is promoting this approach. Plant management has committed more time to field tours as an example. However, additional effort in this area is necessary to achieve the desired results.

An issue was raised concerning rules of the technical specifications for safety equipment surveillance that are in force which have been submitted to the safety authorities but have not yet been authorized. Good progress to clearing these was found.

A recommendation and a suggestion were made concerning industrial safety. The lost time accident indicator at the time of the OSART mission was significantly worse than the best in the nuclear industry. Recognition of the need and a desire to improve in this area was found. However station-wide performance has not reached the desired level. Plant standards for field and management tours could have a significant impact here as the link to good housekeeping and safety is still not as strong as desired.



## **DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS**

### **1.1. CORPORATE ORGANIZATION AND MANAGEMENT**

**1.1.(1) Issue:** Alcohol is consumed on the site including consumption by control room staff. The plant policy for alcohol on site permits the consumption of small quantities of wine or beer during the lunch hour. The strategy for controlling alcohol use on site includes limiting the availability to wine and beer, restricting the total amount that can be purchased by one individual to one quarter liter in the restaurant and canteen, and observation by managers and supervisors for possible abuse.

While the team did not observe actual consumption of alcohol in excess of the plant established limits, a few cases were observed where the quantity of wine and beer purchased at lunch time was in excess of the plant established limits. In addition, two empty champagne bottles, which is not sold on site by the canteen or restaurant, were observed in one control room kitchen.

International experience indicates that the availability of alcohol on site should be strictly prohibited. Fitness for duty in all aspects of nuclear plant operation is an essential element in the achievement of overall plant and personnel safety. The availability of wine or beer during the lunch hour could potentially lead to abuse under certain circumstances.

**Recommendation:** Plant management should develop a strategy which will lead to the eventual prohibition of wine and beer consumption on-site.

#### **Plant response/action:**

Plant policies and internal rules were distributed to plant staff in September 1998. Where alcohol is concerned, they quote French legislation in the matter: the admission, distribution and consumption of alcohol are forbidden in the work place. However, over and above these regulations, plant management has decided to implement a strategy leading to the eventual prohibition of alcohol consumption on site.

In the short term, the following actions have been implemented in the plant canteens (for contractors and EDF staff) to bring down the currently low level of alcohol consumption (10% to 15% of canteen users):

- Only 25 cl bottles are available;
- Beer and wine are no longer freely available on the self-service racks but must be requested from canteen staff;
- These beverages are no longer served in the “upgraded canteen”;
- Alcohol-free beer is available;
- End-of-line checks are performed by the canteen staff at the cash register;
- These conditions are displayed in the canteens;

- Departments operating around the clock are provided with a food and drinks order-form to which the same conditions apply.

The managers of both canteens have been notified in writing of all these conditions by plant management.

Moreover, checks at the site entrance will be stepped up by the end of 1999, in particular with the introduction of metal detectors, X-ray machines and contamination monitors (3000 Bq).

On-site regulations will eventually be modified after consultation with the legal authorities for a total elimination of alcohol beverages on site. It should be noted that the above-mentioned conditions are more restrictive than those stipulated by French law.

### **IAEA Comments**

An implementation plan for the elimination of the sale and consumption of alcoholic beverages at the plant was reviewed. It proposed a staged approach recognizing the limitations and expectations of staff arising from French law. The intention to progress to the elimination of alcohol that has been communicated to plant staff is contained in the Internal Rules of the plant, which is posted at the plant gatehouse. Continuation of this policy is now included in the Plant Strategic Plan and practical implementation has started by not putting alcoholic drinks on general sale in the restaurant and limiting the amount available per person when actually requested.

**Conclusion:** Satisfactory progress to date.

## 1.2. PLANT ORGANIZATION AND MANAGEMENT

**1.2.(1)Issue:** The station performance indicator programme has not been sufficiently implemented as a management tool. Specific performance indicators have not been established for many departments in support of and to monitor progress towards higher tier plant indicators. In addition, challenging targets to gain appreciable and sustainable improvements in levels of operational safety have sometimes not been established.

Some indicators for 1997 were limited to cascading the higher tier indicators to managers. In some cases this was without any reference to an expected standard.

Examples were found where performance indicator results were displayed to workers at various locations in the plant. However, Paluel results were not compared with world results or with other plants in France or displayed with management goals for desired results. Examples are industrial accidents and scrams. Industry best practice is to display graphical information that shows the best industry performance as well as mean values for plants to indicate the desired performance improvement. To achieve better performance, it is appropriate to review the practices of world best performers as a source of experience feedback to Paluel.

A system of management contracts has been introduced which specifies what is required of managers with some measurable performance indicators. Examples of these were reviewed and those in 1997 were of various forms and covered in the main task lists but contained little in the way of periodic indicators that are specific, measurable, achievable and timely. The higher tier goals placed on the plant by the corporate management for overall safety performance are not always sufficient to monitor the direct tasks undertaken by the departments. More specific indicators are required at these levels. Extension of such a system throughout the plant would enable management to ensure that progress towards their goals and objectives, including those related to safety, especially the “rigor action plan” are assessed and are indicative of the plants change programme.

**Recommendation:** The plant performance indicator programme should be expanded and include expectations of plant performance against industry best performance as well as the mean.

### **Plant response/action:**

As part of its plans for 1999, plant management has decided to improve department management contracts in order to reinforce its control over department activities.

Each head of department is required to develop 10 to 12 actions within his department. Five of these are drawn from the plant management contract and are common to all departments. Another five actions, also drawn from the plant management contract, are defined after discussion with the associate director assigned to coach the head of department. A few more actions are added to these so that the department’s particularities are taken into account.

In connection with these management contracts, each department puts together about fifteen performance indicators which are monitored monthly with the assistance of the management control

advisory unit. These indicators are a means of distributing site priorities and objectives among the departments and of controlling actions that are specific to each department.

With regard to the plant objective indicator programme, the OSART findings have led us to refer to the best national and international results wherever possible. Furthermore, these results are now displayed at the site entrance in order to keep staff informed of changes being made in plant performance.

Moreover, one of the strategies of the Plant Strategic Plan involves the development of a result-centered culture, particularly regarding the performance of the outage and normal power operations projects. Specific indicators for each project have been established and are monitored by coordinating teams.

In addition, corporate indicators are conveyed to Plant Management Committee members and shift managers on a monthly basis; these indicators are then presented to the work teams: plant availability, number of days without reactor scrams, number of significant operating events, number of tech. spec. violations, compared with the results obtained by other EDF plants.

### **IAEA Comments**

The system of plant management contracts has been revised and a new system implemented which supports the new Plant Strategic Plan (PSU). The core targets of each department manager are related to the PSU and a common list of indicators link to those in the PSU. Further targets are specified related to the specific function of the department manager. The department managers' performance is now compared to the best in the EDF 1300 MW plants.

The overall position of the plants performance is produced annually in the Summary of Performance Indicators. This compares the plant performance against the best plants in EDF but not the best in the industry. Some indicators are accepted as being plant type or design specific and comparisons within such a class are justifiable. However, other indicators such as lost time accident frequency rate and radiological dose are relevant for comparison if improvements toward world class are to be achieved. In such cases, it is still recommended that such comparisons are regularly made and communicated to managers and staff.

**Conclusion:** Issue resolved.

**1.2.(2) Issue:** The “rigor in operations” action plan that was implemented in October 1997 lacks some key management tools to ensure expectations are achieved and improvements made. Station management recognized the need for improvement in safety performance in part based on not achieving desired results in some 1997 safety objectives and in part following some plant significant events. The station wide “rigor in operations” action plan was introduced to address increased responsibility and rigor being applied to all aspects of plant operations and with the aim of bringing about a change in culture.

Although many improvement initiatives are included in the plan, some of the action plan items and associated indicators have not been developed sufficiently to be able to measure intermediate progress or completion. Examples from the list of action items are: “enhance managers involvement in control activities”, “follow-up decisions made by committees” and “make human factor network operational”. Application of the recommendation to expand the use of performance indicators (see issue 1.2.(1)) in the rigor in operation action plan would improve this area.

Key to success of the rigor plan is that it must be supported by effective management and supervisory skills. However, sufficient consideration has not been given to the early completion of a development programme for managers and supervisors to improve their skills to support achieving many of the desired improvement action items. While a one day workshop was conducted in late 1997 to bring about change, a follow-on skill developmental programme has not been introduced.

Industry experience has shown that improvement initiatives that are not systematically implemented with specific measurable achievable targets may not bring about the desired change.

**Recommendation:** Plant management should review the “rigor action plan” to incorporate specific, measurable and timely deliverables and develop a programme for supporting improvements in the skills of managers and supervisors to bring about the desired change.

### **Plant response/action:**

The “Rigor in Operations Action Plan” (PARE) was implemented and monitored throughout 1998. More specific indicators were established and are monitored by the management control advisory unit. Results and critical observations were presented to the Management Committee every three months.

During these presentations, objectives were fine-tuned in order to enable each department to get involved and monitor the phases pertaining to it.

Short-term PARE actions have been factored into the NPP organizational structure, while medium-term actions are still in progress and are being specifically monitored until the end of 1999. These actions are incorporated into the Plant Strategic Plan.

The plant performance indicator programme is monitoring PARE actions that were not completed in 1998.

It should be noted that some PARE actions are being dealt with as specific cases or action plans. These include: “environmentally classified installations”, fuel action plan, corrosion issue, plant compliance review, etc.

These issues are overseen by a member of the Plant Management Committee and are co-ordinated by plant engineers. The Technical Operating Committee produces an action progress report.

As regards the improvement of line management skills, 1998 actions dealt primarily with ground work and problem ownership for 1998, together with the heads of departments.

The management of the plant chose first of all to define the orientations for the management of the site (site project and reorganisation) to then determine and start the professional enhancement of the management, ie of second line managers (heads of departments) and first line managers (heads of sections and operation shift managers).

Newly-promoted Department managers follow systematic training set up by EDF at corporate level. This training consists of three stages :

- Preparing for the new job position about two months beforehand;
- Coaching when taking up the new job position;
- Professional enhancement for management (formulating a project for the department).

In addition to mentoring from corporate level, the exchange of practices with colleagues from other plants, the new department manager is allocated to an associate director. The whole process is overseen by the head of human resources. At the beginning of September 1999, seven department managers will have followed or will be undergoing this process set up in the summer of 1998.

Every Monday morning, the Plant Manager convenes and co-ordinates a plant management committee meeting which is attended by all heads of departments. These meetings are held in order to explain corporate management decisions, present areas of concern for plant management, and convey any technical and social problems of a strategic nature.

This meeting is followed up by coaching or mentoring sessions during which each head of department works together with a manager or a specific line management committee member in order to clarify managerial issues, define objectives and their meaning, prepare information for staff or draw up action strategies.

In order to adapt plant management decisions to his specific department, each department head has been holding meetings with his department management team, comprising all department line managers, since 1998.

For the first line supervisors (MPL), a programme of action was defined in order to give the new managers the means to lead the changes and to become real managers.

This professional enhancement programme will consist of:

- An awareness seminar which tells them what is expected of them by corporate management, introduce them to the plant and to the company;
- Training sessions compulsory for everyone or specific to each MPL (how to communicate with one's team, how to lead an interview, monitoring, how to conduct a meeting...). When the training sessions are specific, they are chosen by the head of department according to the individual's weaknesses or to his professional experience;
- A professional project for each MPL (in situation);
- A tutorate by the head of department.

This programme was set up with training programmes available in the company as well as other training programmes borrowed from other nuclear power plants on the subject (in order to benefit from their internal experience).

Training sessions take place between September 1999 and December 2000.

### **IAEA Comments**

The "rigor in operations" action plan has been reviewed and has been improved by the addition of specific milestone dates for supporting detailed actions and resources monitored by indicators of achievement. This achievement is about 80 per cent complete with actions now either resolved, to be pursued until the end of 1999 or eventually to be incorporated into the new Plant Strategic Plan.

Some important achievements of the plan are the training of some 200 people in surveillance methods, technical specifications and risk prevention as well as initiation of a refresher training program for all staff over the next three years. There is evidence to show that some performance indicators have improved with a notable reduction in significant operating events. However, there has not been an improvement in certain other indicators, such as the industrial safety accident rate.

A program for departmental management development for the 18 staff in this class has been completely revised to act as a focus for improving their competence. The program will take time to be completed but particular support is available if needed in appropriate cases. A program for first line supervisors is in preparation for implementation in September 1999 with a target of completion by the end of 2000. The time to develop this program has considered the timing of the structural reorganization, the definition of first line supervisors and their needs, and makes good use of core and optional elements based on an assessment of need for the supervisor. It is suggested that this program be fully and actively supported by the Plant Director and that empowerment of and commitment by the supervisors is sought through the program. The definition of first line supervisor will leave out some foremen and it is suggested that the consequences of this be assessed and utilized in future programmes.

**Conclusion:** Satisfactory progress to date.

**1.2.(3) Issue:** Managers and supervisors field tours are not sufficiently effective in ensuring high standards of human performance, material condition and housekeeping. Examples of human performance problems are that the standard of industrial safety requires improvement (see issue 1.5.(1)) and field operator inspections are not adequate (see issue 3.5.(1)). Examples of significant material condition deficiency problems are detailed in the maintenance section of the report (see issue 4.6.(1)) and housekeeping problems are noted in the operations section of the report (see issue 3.2.(3)).

Contributing to the weakness, during interviews, some managers and supervisors indicated that they infrequently visit the plant even though the plant director has instituted a process to encourage greater attention to this area by the use of management contracts. Some staff felt that other responsibilities including the length of time spent at meetings left insufficient time for such activities. Some managers indicated that it was not a primary role for them to visit the plant and that they had delegated this to subordinates.

An example of a less than effective management tour was seen in the one case observed, others had limited objectives of coverage, and are typically restricted to an immediate work area, and are not reported in enough detail to lead to a meaningful set of specific corrective actions. Examples of short reports in areas known to have deficiencies were observed.

During field tours, it was noted that some managers and supervisors did not recognize the less obvious performance and equipment defects when they were encountered. Insufficient training or development activities have been conducted for managers and supervisors to provide them with the required skills to effectively recognize human performance and equipment deficiencies and to carry out the necessary actions to immediately correct them by coaching workers in the field and instituting programmes to correct the underlying problems in the longer term.

International experience indicates if supervisors and managers do not have a vigorous in field programme for improving standards in housekeeping, material condition and occupational safety, then they will deteriorate. Once a decrease in these standards starts to occur, they typically result in a decrease in plant safety. An industry wide good practice is to assign areas of plant to supervisors and to hold them accountable for housekeeping and other standards in a particular area.

**Recommendation:** Plant management should review and enhance their policy and methods of implementing and measuring effectiveness of field tours. Training and coaching of supervisors and managers should be used to increase the effectiveness of management field tours and to enhance ownership of plant improvement efforts.

### **Plant response/action:**

The determination of the plant, emphatically stated in the Plant Strategic Plan, to continue in its efforts to improve housekeeping and enhance the amount of quality time spent by managers in the field has led plant management to develop a management field tour policy.



This policy incorporates the following aspects:

- Stepping up the number of field tours and enhancing their effectiveness;
- Improving the system for collating and processing detected anomalies;
- Enhancing the training programme and levels of expectation.

#### Greater number of field tours:

As stipulated in our Plant Strategic Plan, plant management considers that the upkeep of plant facilities plays a fundamental role in establishing a trusting relationship between plant staff and line management. The organizational structure is described in memorandum NA 209 ('Upkeep and compliance of plant installations).

Management housekeeping tours are conducted every Wednesday in the presence of a member of senior management, a plant management committee member, a person in charge of detected anomalies, and representatives from the respective department (all the industrial premises are allocated to operating teams).

Furthermore, these tours are now conducted one Tuesday a month in areas that are not directly linked to the process. The senior administrative manager maintains strict control over the tour schedule.

Within each department, management tours are also regularly conducted by supervisors, and a system for controlling their timely completion has been put in place.

On Tuesdays and Thursdays during outage periods, industrial safety management tours are conducted with regard to specific work areas. The project manager keeps a thorough record of these tours and of any anomalies detected.

In addition, a 'minor task' structure has been up and running since April 1998. Relying on voice mail or e-mail, this system is designed to ensure that minor anomalies can be easily and instantaneously traced and collated without resorting to the maintenance management computer application (SYGMA).

#### Improved collation and processing of anomalies:

The Plant Operations Review meeting (RET) provides a forum for co-ordinating the treatment of detected anomalies. Every Thursday after each management housekeeping tour, a specific RET is held to allocate the treatment of detected anomalies to the various departments.

The Nuclear Logistics Department co-ordinates the processing of deviations. It uses a database to monitor the detected deviations and the corrective actions implemented following the management tours, and provide experience feedback to the respective departments.

Moreover, its role also involves the monitoring of performance indicators on a permanent basis, in order to be able to report regularly to the associate director with responsibility for normal power operations, at the Operational Plant Review Committee meeting (COET).

### Enhancing the training programme and levels of expectation:

The memorandum defining the housekeeping reference (NT/SQ-023) has been revised in order to enhance levels of expectation.

A training course reserved for staff members conducting management tours is currently being implemented.

With regard to first-line managers, the areas of housekeeping and required line-management involvement will be incorporated into actions designed to enhance professionalism, as part of the Plant Strategic Plan.

Where operations staff are concerned, a field-inspection training course is currently in progress.

### **IAEA Comments**

The policy for field tours setting standards that are expected on the plant and the organization of the tours has been completely revised. Members of the plant management team are involved as are appropriate staff responsible for the areas of each tour. It is noted that the revised system was implemented in the operational areas first and extended in 1999 to other areas of the plant.

At present, if the segregation of plant into zones for each tour is combined with the frequency of the tours, one per week, this suggests that on this formal basis an individual on the plant management team tours about only one quarter of the plant per year. It also means that any one area of the plant is only toured about one time each six to twelve months by members of Plant Management. It is suggested that the plant consider now moving to broader zones to increase the turnaround of plant management involvement along with delegating more detailed tours to the department managers. A training programme for managers is being implemented and should be completed as soon as possible to increase the effectiveness of management tours in light of the number and types of deficiencies observed during the follow-up visit.

It was noted that the frequency of tours during outages has increased to two per week. As outage work was not ongoing during this visit, the effectiveness of this change could not be established but it is supported.

**Conclusion:** Satisfactory progress to date.

## 1.4. REGULATORY AND OTHER STATUTORY REQUIREMENTS

**1.4.(1) Issue:** Many of the rules of the technical specifications for safety equipment surveillance that are in force were submitted to the safety authorities but have not yet been authorized. For example, the programme of the diesel generators tests were submitted by corporate level to the regulatory authorities in 1992, but have not been approved. The batch of plant modifications called 'lot 93' have been approved for implementation by the regulator, but not the corresponding changes in regulations for surveillance tests. In these cases where the changes have not been approved, the plant implemented the surveillance as it was proposed to the regulator so there would be no ambiguity for operators. Some defense in-depth is being lost because the external review has not taken place. In addition, the need for the plant to use many surveillance tests which are not approved by the regulator detracts from the importance of only using approved procedures. The regulator informed the plant that they intend to finalize the analysis of these requests by the end of 1998.

**Suggestion:** Consideration should be given by the regulator to review the outstanding rules of the technical specifications for safety equipment surveillance as soon as possible.

### **Plant response/action:**

Surveillance test rules are still evolving significantly and the situation regarding their approval is stabilizing. On 23 March 1998, the plant sent a letter to Central Services (ref. D 5310 – GDT/POS no. 029) setting out the finding and suggestion.

In the first place, it should be remembered that Chapter 9 of the General Operating Rules consists of surveillance test rules approved by the Safety Authority and applied on site at the request of Corporate Central Services (S.C.P.).

The plant surveillance test reference therefore consists of approved rules drawn from Chapter 9 and of rules awaiting approval but nevertheless applied at the request of Corporate Central Services. This reference is made up of 51 rules.

The comparative status of the reference during the OSART in January 1998 and March 1999, is the following:

### Status of the reference in January 1998 (OSART review at Paluel):

Two surveillance test references are being applied:

- One on Unit 1, having incorporated modification batch 93:
  - 20 test rules approved by the Safety Authority are being applied at the request of EDF Central Services and are included in Chapter 9;

- 10 test rules approved by the Safety Authority with reservations, and not included in Chapter 9, will only be applied once Corporate Central Services have addressed these reservations;
  - 20 test rules awaiting approval by the Safety Authority;
  - 1 test rule turned down by the Safety Authority.
- One on Units 2, 3 and 4, not having incorporated batch 93 and comprising 40 approved and applied test rules.

Status of the reference in March 1999 after outage cycles 98:

Only one surveillance test reference incorporating batch 93 and the GEMMES fuel management method (longer fuel cycles), is being applied:

- 23 test rules approved by the Safety Authority are being applied and are included in Chapter 9;
- 18 test rules approved by the Safety Authority with reservations, not included in Chapter 9;
- 7 test rules awaiting approval by the Safety Authority;
- 2 test rules turned down by the Safety Authority.

Conclusion

Since January 1998, the Safety Authority has approved 13 of the 20 unapproved test rules and turned down 2 additional ones. This takes into account the major modifications carried out on the plant in 1998 (GEMMES, batch 93) and their impact on the surveillance test rules.

Nevertheless, the surveillance test reference applied on site has always complied with corporate and regulatory requirements: a rule is applied regardless of whether or not it has been approved, in keeping with the status of the unit concerned.

**IAEA Comments**

Good progress has been achieved to approve the outstanding rules of the technical specifications. Continued effort should be applied in this area to complete the program as this will have benefits to the status at the plant of surveillance tests and their perception with operations personnel.

**Conclusion:** Satisfactory progress to date.

## 1.5. INDUSTRIAL SAFETY PROGRAMME

**1.5.(1) Issue:** Plant industrial safety practices are not always followed by the staff and contractors or enforced by plant supervisors and managers and uncorrected safety deficiencies exist in some areas of the plant. In addition, while the plant's industrial safety accident record for the past several years has been improving, the number of accidents is still significantly above the industry average as measured by the WANO performance indicator programme.

Personnel protective equipment is not always worn in known hazard work areas or conditions or as required by plant rules. In many cases, plant supervisors or managers who were present did not correct the existing deficiencies. For example:

- Safety helmets are sometimes not worn in the areas of the plant where they are required by procedure;
- Hearing protection is sometimes not worn in areas above 90db that are posted as mandatory. Areas such as the diesel generators, when they are running and next to main feedwater pumps are examples. In areas of loud noise under 90db but over 85db that are posted as optional but not mandatory, hearing protection is infrequently worn;
- Eye protection is sometimes not worn when performing dangerous activities such as using an air hose to blow metal chips from machining equipment and drilling into concrete with the drill bit close to the eyes.

Some examples of uncorrected safety hazards observed were as follows:

- Unsecured vertical compressed gas cylinders without caps;
- Tripping hazards such as ladder on the floor just inside a door;
- Steam leaks not roped off to warn personnel;
- No safety chain at the top of a vertical ladder;
- Evidence of smoking in areas where highly flammable sources could exist such as the diesel engine rooms and near the main generators;
- Temporary ladders not held by a safety chain in the containment spray room;
- Crane operation panel cable not deloaded in Unit 4 turbine hall;
- Security door to prevent access to an area where hydrogen is stored was unlocked and open;
- Crane pendant in the pump house lying on a wet floor.

Several of the above weaknesses were not recognized as hazards when pointed out to station staff.

The plant's industrial safety accident rate, while improving, does not meet the utilities objectives and is several times the industry average. Many of the managers and staff that were interviewed believed Paluel's lost time accident rate of 49 occurrences in 1997 to be about at the industry average. The stations performance in lost time accidents is displayed on many bulletin boards but it does not show a comparison with other stations or station goals to encourage improvement.

The review and analysis for improvement is generally limited to reviewing accidents that have occurred. Best industry practice is to use a “near-miss” reporting system to be active in deterring accident situations before accidents happen.

Insufficient attention to industrial safety can lead to degraded barriers to accident and incident prevention and more serious accidents could result. Experience shows that managers supporting a vigorous in the field programme with regular refresher training for workers does improve accident statistics.

- (a) **Recommendation:** Plant management should ensure deficiencies are identified and corrected and display accident statistics prominently. This should include reviewing the industrial safety programme with reference to best industry performers and setting new improvement targets for the plant.

**Plant response/action:**

The Risk Prevention Committee chaired by the associate manager with responsibility for plant outages has established a risk prevention action plan for the entire site.

A veritable guideline for all managerial staff, this plan consists of specific actions and is based on:

- Enhanced risk prevention: prevention plan, contractor involvement, managerial involvement, application of corporate ALARA actions, practical on-the-job training, radiological cleanliness;
- Analysis of accidents and near-misses: detection and monitoring of near-misses, quality of analyses;
- Development of the experience feedback programme: exchange of good practices, incorporation of experience feedback provided by contractors;
- Fire: improvement of the emergency response follow-up team, factoring-in of fire-action experience feedback, fire fighting.

In addition to this action plan, a new risk prevention structure has been set up on the site. This structure is designed to involve managers and department field operators, getting as many people as possible to contribute to improved performance.

The structure relies on:

- Department management contracts which all include a section pertaining to risk prevention with the associated performance indicators;
- The checking and monitoring of actions and results by the risk prevention committee, which acts as a ‘steering committee’ for risk prevention on site;
- Prevention and industrial safety groups involving as many people as possible in the “prevention challenge”.

Four of these Groups have been established:

- A Conventional Industrial Safety Group, one of whose roles is to set up a system for detecting and monitoring near-misses. This group is co-ordinated by a shift supervisor from the Operations Department;
- A Service Sector Group, co-ordinated by a supervisor from an Administrative Support Department, and set up in response to the poor results obtained in 1998;
- A Prevention Plan Group, set up in response to the February 1992 decree, and co-ordinated by a first line supervisor from the Valves and Vessels Department;
- A Radiological Cleanliness Group, co-ordinated by a supervisor from the risk prevention department, whose role is to define and implement actions designed to improve radiological cleanliness by applying strategies included in the corporate project.

### **IAEA Comments**

The industrial safety program has been revised through the Risk Prevention Committee and an integrated action plan put into effect. Accident statistics along with other important safety indicators are displayed prominently at the main points of access to the plant. This action plan does include radiological ALARA targets and involves both operating, maintenance and outage projects. The analysis system for accidents to personnel is better integrated into this committee now although the results over the last 18 months do not show a significantly improving position for the accident frequency rate.

The approach to implementing this action plan has been to gain ownership in departments through the responsibility set out in management contracts and monthly meetings between managers and staff. It is possible that the slower than anticipated improvement in accident reduction is due to an uneven pace of change implemented across the plant through this approach. Some groups are achieving significant accident reduction while others are seeing their accident rate increase. An example is a 'safety hour' in the monthly staff meeting with their manager to focus on accidents, near misses and the lessons that can be learnt for accident prevention. It is suggested that the best practices could be speedily reviewed by the Risk Prevention Action Groups and adopted as models for the whole plant.

It is noted that experience of other companies with similar industrial activities is being gained and this is encouraged. The targets set for improvement at Paluel could be set at a lower level already achieved by others, to show management's commitment for a greater pace of change. It is noted that for the recent outage of Unit 1 more restrictive targets were used and promoted with staff and contractors.

**Conclusion:** Satisfactory progress to date.

**(b) Suggestion:** The station should consider introducing a "near-miss" reporting system to capture situations that can lead to accidents for analysis and identification of countermeasures and to enhance a safety culture at the plant.

## **Plant response/action:**

Analysis of working accidents or near-misses is one of the points of the plant's risk prevention action plan. The idea is to improve the identification, monitoring and the quality of analyses.

Initially, plant management wanted to strengthen the analysis carried out on reported accidents. The following measures have been taken:

- Formal analysis is performed by the line department with support from the risk prevention department for all reported accidents (EDF and contractors) as well as for some lighter injuries that deserve investigation.;
- Department managers and first line supervisor, present the analysis for all EDF staff LTA's to the plant director;
- The person in charge of contractors present analysis for all contractors staff LTA's to the department manager;
- For serious accidents, the analysis is examined by the health & safety at work committee and the Risk Prevention Committee;
- The decision has just been made to carry out a "human factors" analysis, in the same way as for significant operating events.

Near-misses are identified and analysed in some departments such as the I&C Department or the Purchasing & Finance Department. In addition, the plant medical service may initiate an analysis following treatment.

## **IAEA Comments**

A near miss system is included in the Risk Prevention action plan and some progress by individual groups has been made in developing approaches and some effort has been applied to an analysis system for near misses. Balanced by the effort in other areas, this is reasonable progress although much international experience exists in this field already. However, a reduction in accidents has been shown from international experience to be achieved by a program which includes vigorous reporting of near misses accompanied by vigorous attention to corrective actions. This parallels the approach now widely accepted for nuclear safety.

It is suggested that a standard reporting form for accidents, near misses, safety hazards and suggestions to improve safety be designed and implemented uniformly across the plant based on the best ideas from Paluel groups and external experience.

**Conclusion:** Satisfactory progress to date.



## 1.6. DOCUMENT AND RECORD MANAGEMENT

**1.6.(1) Issue:** Recording and changing information in plant documentation is sometimes not performed in accordance with good international practice. Opaque correction fluid is frequently used to make changes to documents and recorded information. Wide use of correction fluid was observed in operations, maintenance and technical support documents including procedures, test documentation, logs and other official records. Recorded data is also sometimes inappropriately scratched out or written over without evidence of why the change was made or by whom.

Specific examples are as follows:

- Some procedures used in the control room, Unit 1 for the unit start up during the OSART mission were poorly filled in, with corrections, inclusions and modifications that were not authorized. For example, the procedure GP 02, increase nuclear power from <2% to 100% after refuelling, pages 17/28 and 18/28, had several non-authorized corrections, using opaque correction fluid, crossed out values without indicating a reason or signing, as well as the addition of notes and changes that were not always authorized;
- Other procedures noted with the use of opaque correction fluid were EP PTR 3, ASG 3.3, and EP OKER 7. Correction fluid was also used to modify some safety tagging documentation such as Unit 2, tag number 2RE 04660;
- Calibration sheets for instruments 1-ASG-051-LP, 1-ASG-302-MD and 1-ASG-402-MD, the latter twice, had correction fluid on the “as found” and “as left” values and new values inserted without authorization;
- Handwritten changes to procedure EP RIS 9, Unit 1 were not authorized;
- Maintenance work documents were examined which use data sheets from planners which were changed using correction fluid but not authorized and not revised so that permanent changes were not introduced before the next scheduled maintenance.

The above practices do not follow the policy for changes to documentation and could result in unauthorized modifications to plant records which could lead to inappropriate operation or maintenance of the plant.

**Recommendation:** Plant management should ensure expectations regarding proper practices for changes to documentation are clearly established and communicated to station personnel and strictly enforced.

### **Plant response/action:**

Requirements regarding the modification of documents have been restated in memorandum NA 34 (Rules for drafting, identifying and distributing documents issued by Paluel NPP).

This memorandum stipulates the quality criteria required by checkers and authorizers when carrying out their checks; it also specifies the checks to be performed before distribution. Likewise, it specifies the rules governing the manual modification of documents (no sticking, no correction fluid, etc.) as well as the procedure to be followed for hand-written modifications.

Staff members are systematically reminded of these requirements during their refresher courses on Nuclear Safety and Quality / Risk Prevention.

With regard to Operations, the surveillance test documents were revised in the course of 98/99. This was done in order to ensure that all criteria included in Chapter 9 of the General Operating Rules were properly addressed and checked at the correct dates.

Furthermore, the Safety and Quality Department is conducting a document quality assurance audit on the Operations, Electrical and Information Systems Departments in March 1999, in order to assess the implementation and results of the plant's organizational structure.

### **IAEA Comments**

The policy for changes to documents incorporated in Application Memo 34 sets standards that meet the recommendation intent for establishing expectations. It has been communicated to staff and a program for revision of outstanding documents has been produced. If this had been widely practiced it would have resolved this issue, however, large variations in the adherence to the standard were observed. For example; the use of correction fluid and the writing over recorded information was observed.

It is noted that Information Systems Department are applying the desired standard rigorously and some departments are applying a practice of working to "clean" procedures, that is procedures that are not corrected by hand, and it is suggested that this practice is reinforced by all line managers.

**Conclusion:** Satisfactory progress to date.

**1.6.(a) Good practice:** The documentation unit has developed over three years a networked computer programme called SMISS (plant computerized system diagrams). SMISS is an application used for the creation, the update, the display and the printing of unit system diagrams. This application is based on a data base including interconnected information on equipment, documents and the tagging database. A special module makes it possible to extract information on all the pieces of equipment included in the system diagrams.

SMISS makes it possible to seek and display a given system, use associated maintenance and operations-related data, and print the latest version of documents to be used as work documents.

SMISS offers tools to zoom from overall layouts to specific pieces of equipment, search for system components (valves, pumps, sensors, etc.), view photos of plant areas and pieces of equipment and their specifications, display of isometrics and detailed drawings, display of and navigation through operating documents and procedures and to printout documents to be used as work documents.

The application is useful to operations, engineering, maintenance and outage planning. SMISS is used as a system engineering tool to plan and review operating and maintenance activities. It has also been successfully used with radiological data contours on plant photographs to produce guidance documents for outage maintenance contractors as part of the ALARA programme to reduce doses. The tagging information is particularly useful to plant maintenance as it gives in real time, access to the state of plant availability. The SMISS system has been found by Paluel to be a powerful tool in plant maintenance and outage planning for speed of visualization of systems as well as assisting in safety improvements for workers.

SMISS is currently available to 45 workstations in the plant (including one in each of the four control rooms).

## 2. TRAINING AND QUALIFICATION

### 2.1. ORGANIZATION AND FUNCTIONS

The management and staff of Paluel and EDF are demonstrating a commitment to improving NPP performance through the use of quality training programmes. Corporate EDF and site training are well-organized and properly structured to support station needs. A nuclear training institute comprised of key EDF and NPP managers supported by 6 EDF advisory teams exists to oversee training provided by the more than 1000 full time consultants and trainers, the 24 training centers, the 12 full scope simulators, 7 function simulators, 11 laboratories and one mini-plant. In addition, the site training organization has adequate classrooms and training facilities to support their needs.

EDF and Paluel develop and approve training goals and objectives on an annual basis. The corporate level goals and objectives are reviewed and approved by the EDF training council. Paluel training goals and objectives are also reviewed and approved on an annual basis by the site human resources committee. The Paluel training organization annually reviews the status of these approved goals and objectives to be assured that they are being met.

Site departments have established annual training plans with objectives. The applicable department manager approves the objectives. The approved objectives are then used to determine individual training needs and requirements. Individual training plans are then established for everyone on site up to and including the plant manager. These plans are kept in a book maintained by the department managers. The plans identify the individuals initial and continuing training needs. Line management reviews this plan with the individual in the second quarter of the year to establish the following years training needs. The manager then meets again at the end of the year to be assured that all training requirements for that year were met.

EDF and Paluel training use a series of procedures that administratively manage the development and implementation of training. The Paluel human resources committee oversees site training to ensure implementation is occurring in a consistent manner in all departments. Training attendance across the plant generally is good. However, some areas have been identified as needing closer attention by management to be assured that the need to reschedule training is kept to a minimum. The team recommended implementing a process that systematically ensures workers attend required refresher training courses.

Significant emphasis is placed on the selection and training of workers at all levels and locations of EDF. For example, candidates to become EDF instructors are selected from various locations throughout France. These candidates generally have extensive power plant experience. Selected instructor candidates spend up to one year in training with a final evaluation before they are qualified. Instructors sign contracts obligating them for four to five years as an instructor before they rotate back to a plant position.

Paluel currently has three full time instructors in the operations training area. All other training areas of the plant use part-time instructors. These part-time instructors work in their department in various capacities and when needed perform instructor duties as determined by the training needs of the department. Part-time instructors are required to attend a "train the trainer" course in order to become qualified as an instructor. Discussions with EDF training managers and Paluel training

managers indicated that systematic formal evaluations are not conducted on instructor performance though this practice is under consideration.

EDF and site training organizations use a systematic approach to training in the form of objective identification, training material development, training presentations and subsequent follow-up on effectiveness. Follow-up includes post training critiques, field observations and assessments conducted every two years by corporate EDF. However, the Paluel site training organization does not conduct a systematic review of training feedback nor do they complete a comprehensive self assessment of Paluel training on a regular basis. The site is considering both of these activities as a future action.

Learning objectives are well written and are approved by Paluel management before training materials are developed. Training programmes and materials that were reviewed contained objectives and training material to support the plant and personnel safety.

Training programmes for all areas of the plant contain initial and continuing training requirements. Official training records for plant workers are maintained in a computer database file, with paper originals maintained in administrative files. Copies of training documentation are also maintained in each workers individual training log. However, the team suggested implementing a documentation system for simulator training records that ensures consistency and accuracy.

## 2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIALS

Paluel training is supported by a number of EDF site and local training facilities. Operations, for example, is supported by an EDF training center located near the plant site. This facility is equipped with state of the art training tools including well equipped classrooms; a comprehensive selection of training mockups with a fully functional mini-plant; hydraulic and thermohydraulic lab areas; a fully functional I&C, electrical and chemistry lab; three mini-simulators in addition to the full scope simulator and a computer based simulator training lab. Operations is also supported by a site training center with three classrooms that provide various specific plant training needs and includes a computer based training simulator used to train operators on normal and emergency plant situations. The team cited both the comprehensive amount of mockups used in the EDF training center and the use of mini computer based training simulators at the site as good practices.

The EDF full scope simulator used for Paluel training replicates the Paluel control room. Simulator fidelity is maintained by EDF. Modifications are identified, approved and installed on an annual basis. Training on the full scope simulator is supported by video and audio equipment. However, it was noted that the video equipment is not able to view and focus on all training areas of the simulator.

Maintenance initial and proficiency training is conducted at the Gurcy and La Perolliere training centers. These facilities are well equipped with mockups that support mechanical, electrical and I&C training needs. Maintenance refresher training is also supported by adequately equipped classroom facilities located at the site.

Fuel handling initial and refresher training is conducted at the CETIC training center. This training facility contains a complete selection of fuel handling equipment including a fully functional fuel handling crane and fuel pool. In addition, classrooms and small mockups are used to conduct refresher training at the site.

On-site and off-site fire training facilities with multiple full-scale mockups are used to provide excellent training for site workers.

Regarding the use of training materials, the team recommended that management ensure all procedures used in conjunction with training in all training settings be the same current approved revision as is being used in the plant.

### 2.3. CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

EDF and Paluel use a process of goal and objective identification to determine training needs. Material to support these objectives are then designed, developed and presented. EDF uses a systematic process to review and evaluate the training it provides. Paluel is considering implementing a similar process to evaluate the training provided by the various departments. Operator initial training is well balanced providing good theoretical and practical training. The shift manager training programme identified and implemented five training goals which address mastery of field practices, control room operator practices, tagging practices, plant operation, team management and nuclear safety in all circumstances.

Operator continuing training is based on a review of worker identified needs, needs identified by line manager observation of worker performance, EDF requirements and industry events. However, the team noted the selection and use of industry experiences could be improved. (See section 4 for additional information). Operators and shift managers are required to attend two weeks of simulator training annually. They also receive up to four additional weeks of refresher training annually in areas identified through line management feedback, operator performance weaknesses and EDF requirements. Plant modification training is conducted prior to modifications being installed in the plant. This training is conducted in “batches”. Currently training is being given on “batch 93 modifications”. These have been installed on Unit one and were scheduled to be installed on two in the near future.

Control room operators, shift managers and shift technical engineers attend refresher training on the simulator. Annual team training is also conducted on the simulator that involves field operators.

Each worker in operations has an individualized training plan. This plan identifies initial and continuing training needs of the worker. Line management reviews this plan with each worker twice per year to be assured that all training requirements are being met. All of the operator training materials reviewed, facilities and mockups observed and classroom presentations seen were of high quality. However, for simulator training, the team recommended that the techniques used to monitor and evaluate trainee performance be enhanced to ensure identification and correction of performance deficiencies. The team also suggested that consideration be given to supplementing the simulator instructors with assistance during training observations to permit close monitoring and evaluation of trainee performance.

### 2.4. FIELD OPERATORS

Field operator training is well structured and systematically presented. The initial training consists of a balance between classroom presentations, laboratory activities and field observations and activities. Field activities are conducted under the direction of tutors and shadow trainers.

Field operators attend refresher training each year to maintain their skills. Typically they receive two weeks of EDF required training in addition to two weeks of required site training. Field operators use their individualized training plans to identify initial and continuing training needs. Identified training needs are a product of self-identified worker performance improvements and observations of performance made by the line manager.

Field operators participate in one-day team training annually with control room operators. These field workers, who are actually located in the plant, follow directed actions from the control room operators who are on the simulator. This form of training allows field workers and control room operators to improve their team work, their communication skills and their understanding of plant equipment function and location under abnormal plant conditions. This was cited as a good practice by the team.

## 2.5. MAINTENANCE PERSONNEL

Line management along with subject matter experts from the various maintenance departments designed, developed and are implementing new maintenance training programmes. This effort was done using a systematic process to identify training needs for both initial and continuing training requirements of the workers. All maintenance-training programmes use a task list to identify worker activities. Learning objectives have been developed from these task lists. The objectives are reviewed and approved by line management. Once approved, the objectives are used as the basis for training material development.

All maintenance training programmes use a matrix evaluation form to evaluate trainee performance. These forms are completed by line management and are used as a part of the trainee's annual performance evaluation as well as used by the trainee to determine additional training needs. Each maintenance area uses standard training plans to identify initial and continuing training needs. Annual interviews are conducted between workers and their line managers to identify specific training needs.

Maintenance uses technical inspectors to oversee and control the work of contracted personnel. Paluel developed a specific training course to qualify new technical inspectors. New technical inspectors are assigned a tutor who has attended the EDF "train the trainer" course. The tutor works with the new inspector and his instructors to be assured all necessary identified training actions are completed.

Initial and proficiency training for Paluel maintenance personnel is conducted at two EDF training facilities. The center at Gurey with its 80 instructors conducts training in areas such as valves, diesel generators, basic electronics, basic electricity, power distribution, I&C, field operations, chemistry, radiochemistry and radiological protection. The site at La Perolliere with its 30 instructors provides training in areas such as boiler making, welding, general mechanics, special tools and rotating equipment.

Site training at Paluel is provided by "part time" instructors from within the various maintenance groups. These instructors are chosen based on their plant knowledge as well as their leadership skills. Instructors qualify to instruct by successfully completing an EDF "train the trainer" course. Site classrooms and the maintenance shops are used to conduct training. All maintenance workers hold a nuclear safety authorization license.

## 2.6. TECHNICAL SUPPORT PERSONNEL

The technical support group which consists of the safety and quality team, radiological protection, chemistry, warehouse and the nuclear logistics department uses a systematic approach to identify training objectives and actions based on the standard site and EDF training plan. Training programmes were selected or developed based on the identified objectives. New technicians, for example, are assigned a tutor who has attended the EDF “train the trainer” course. The tutor works with new technicians and their instructors to be assured that all necessary identified training actions are completed. Each worker in the technical support group has an individual training plan. The worker and his or her line manager develop this training plan. The training topics selected are based on the technicians self-identified performance improvement needs, the improvement needs observed by the line manager and requirements from the site and EDF. A follow-up interview is conducted at the end of the year between the technician and line manager to make sure all training activities scheduled were completed.

## 2.7. MANAGEMENT PERSONNEL

Management training at Paluel is based upon a systematic approach using an EDF and site approved selection plan. Potential managers are selected through a series of interviews and evaluations at the corporate level. Candidates who are selected receive basic management training as part of a plan that is developed specifically for them. This training plan is based on the candidates previous work experience and education as well as the requirements of the management position being filled. Position descriptions are currently being developed for all EDF management positions. Doing this will ensure that the training provided will support the specific training of the position.

## 2.8. GENERAL EMPLOYEE TRAINING

The general employee training programme at Paluel was revised about 18 months before the OSART mission. The new programme has consolidated all the key areas of general training into a four-day class. This class is a requirement for all plant workers on a three-year cycle. The new course contains training on radiological protection, ALARA concepts, fire protection, risk prevention, emergency planning and preparedness, safety and quality. The new programme plan is to provide one third of the site personnel with the training each year. Approximately one third of the site has completed this new training to date. This change will help departments to better schedule and attend training. The team identified that many site workers have not attended this training in many years. Management involvement and oversight will be required to make this programme successful.

In 1997, the management team at Paluel launched a day of awareness raising dedicated to improving the site safety culture.

## **STATUS AT OSART FOLLOW-UP VISIT**

General access refresher training courses have been programmed since 1997. In some cases, the number of reschedule training hours has been reduced, and efforts continue to focus on the training that is needed. More challenging goals for training attendance should be persuaded in the future.



The training center, in conjunction with the plant developed a documentation system that ensures more consistency and accuracy in the completion and filing of simulator training records. Some procedures used for training purposes and placed in satellite training areas were found out of date during the OSART mission in 1998. During the follow-up visit, updated versions were in place. Nevertheless, one of the satellite training area rooms was found not in good housekeeping conditions, and improvements were suggested to the plant.

The techniques used to monitor and evaluate trainee performance while on the simulator were found in need of improvement during the OSART mission in 1998. The plant and the training center took satisfactory actions to improve the situation. When observing simulator training for two plant operators, it was noted that the instructors had all information and conditions to perform a good performance evaluation. Discussions with the evaluators and training center management showed that the simulator evaluation system is evolving, and the forms that were recently created really help to provide a more consistent and fair assessment of performance. During these discussion it was concluded that a better filing process for the results of the evaluation is still needed.

In summary, in the training and qualification review area all the issues were being well addressed, with one being resolved.

## DETAILED TRAINING AND QUALIFICATION FINDINGS

### 2.1. ORGANIZATION AND FUNCTIONS

**2.1.(1) Issue:** Attendance at required training is insufficient to maintain qualification for some station staff. This impacts their ability to perform expected tasks. In addition, training resources are significantly impacted by the need to frequently reschedule training as a result of poor attendance. For example, 9 of the 13 fuel handling supervisors in the nuclear logistics department have allowed their licenses to expire by not attending the required 5 days of refresher training every three years. They now must complete refresher training before their license can be reinstated. Attendance at RP1 and RP2 radiological refresher training for access to radiologically controlled areas (RCA) has been poor in previous years. While a new programme has been implemented for about 18 months to provide refresher training, it is not scheduled to be completed for at least another year. As a result, a significant number of staff and management employees that have access to the RCA have not attended required refresher training for many years.

The number of rescheduled training hours, as a result of missed training, for the past several years has been about 9000 hours per year with a significant impact on training resources.

Failure of plant staff to attend required refresher training could result in failure to maintain qualifications for work assignments or in work being performed by unqualified workers.

**Recommendation:** A process that systematically ensures workers attend required refresher training courses should be implemented. The station should also investigate the reasons for lack of attendance and determine the impact.

#### **Plant response/action:**

Once a refresher course is completed, the corporate computer application (Standard Training Management) generates a forecast spanning a six-month period for the next refresher-training period.

The Safety-Quality-Risks Prevention including Radiation Protection and fire refresher training is scheduled over a three-year period, and is currently accomplished at a level of 58 per cent. This refresher training has been set up since the end of 1997. The site's aim is to reach 100 percent of implementation by the end of the year 2000. This refresher training is also part of the renewal of Radiation Protection certifications.

A tracking and follow-up system designed for SQPR refresher training (Nuclear Safety/Quality - Risk Prevention), has been set up in the training section. It is used to monitor the completion of refresher courses for staff with SN (nuclear safety) authorisation, and forecast the creation of future training sessions.

Both these systems are then used by the heads of departments at the annual individual appraisal interviews with members of staff, in order to sign them up for sessions scheduled within the forecast six-month period.

All actions associated with staff training are tracked by means of Individual Training Logs (CIF).

This enables each head of department to use the system to ensure that his staff members participate in the required refresher courses, to analyse the reasons for their absenteeism, to correct any deviations and take the necessary measures to prevent licence suspension (by holding more sessions or organizing specific training actions, in extreme cases).

These arrangements will apply to all refresher-training actions in 1999.

### **IAEA Comments**

The plant established a general refresher retraining programme in 1997, and a whole cycle is to be completed in three years time. The retraining programme seems to be comprehensive and of good quality.

The fuel handling supervisors had their licenses re-validated.

The number of reschedule training hours has been reduced, and efforts are in place to motivate staff and supervisors to attend scheduled training courses. This progress should be closely followed, and more challenging goals for training attendance should be considered in the future.

**Conclusion:** Satisfactory progress to date.

## 2.1. ORGANIZATION AND FUNCTIONS

**2.1.(2) Issue:** Records documenting simulator training sometimes contain conflicting or incomplete information and are not consistently filed. A review of the record keeping system used to track simulator training attendance found several inconsistencies. For example: EDF simulator records documenting trainee attendance do not always agree with site records. Differences included who was present at the training. In some cases, attendance could only be determined through interviews with the individuals. Original training attendance records were not placed in administrative files as required, but were filed in individual's training plan books. One simulator record did not contain sufficient information to determine the date training was conducted.

A simulator training programme that is not properly and consistently documented could result in possible failure to identify and complete training necessary to maintain knowledge and skills.

**Suggestion:** A documentation system that ensures consistency and accuracy in the completion and filing of simulator training records should be implemented.

### **Plant response/action:**

The following improvements have been implemented in order to document trainee assessment and monitor trainee attendance in a consistent manner:

- The assessment sheet has been revised to include a clear layout of the sections to be filled in, with formalized approval. Its distribution route is illustrated by a flowchart with which all players are familiar. It is conveyed to the head of department and staff member concerned. The original is kept in the staff member's Individual Training Log;
- The computer application used to manage training records is automatically updated each time a course is completed. A printout of these records called the 'Individual Training Plan' is sent annually to the staff member and his head of department in order to identify the former's training needs;

The training course monitoring process is defined in one of the plant's QA Manual memoranda (NA 022);

- A trainee record sheet has been designed in order to specify the topics dealt with at training sessions. A copy of this sheet is given to the staff member's line managers for reference purposes. It is kept in the main training center's records in order to facilitate the setting of objectives for the staff member's future refresher training sessions.

Furthermore, Paluel NPP and the main training center have mutually decided to respond to the needs expressed by the operations department concerning simulator refresher training, on a contractual basis. This process is supplemental to corporate requests coming from the Nuclear Operations Department who, on the basis of its corporate event analyses, process developments and management requirements, puts together the upgraded content of refresher and other training courses.

## **IAEA Comments**

The forms developed and implemented by the plant addresses the suggestion provided by the OSART team. When checking some of the individual training files, it was noted that the initial implementation of some of the forms was not appropriate, with some signatures and dates missing. Actions had been taken to improve the situation and the more recent records checked were of good quality. Because the documentation is in its initial implementation, the plant should carefully follow up this implementation enforcing high quality of these records.

**Conclusion:** Satisfactory progress to date.

## 2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIALS

**2.2.(1) Issue:** Operational procedures used in some training activities in the plant and in the Paluel site training center are not the current approved revision. A set of EDF issued normal and emergency procedures are maintained in a room in the plant for training purposes. The procedures are used to conduct field operator training in the plant. However, they are not the same revisions that are used for every day operation in the plant. The procedures used in the EDF simulator training facility at Paluel are the current revisions that are used in the plant. However, the normal and abnormal operating procedures used in the Paluel site operator training facility, for computer based simulator scenario training, are not the same revisions that are used in the plant.

Use of procedures that are not the current approved revisions for conducting training can result in negative training and increase the likelihood of operating errors.

**Recommendation:** Management should ensure all procedures that are used in conjunction with training in all training settings are the same current approved revisions that are used in the plant.

### **Plant response/action:**

The plant has set up an organisation enabling to guarantee that documents used in the operations training center are up to date:

- Normal operating procedures used in the operations training structure;
- State-based operating procedures used by field operators for training on incident operating procedures used by field operators for training areas (6.84 m - units 2 and 4).

The measures taken concerning the management of these documents are described in the department memo: Non-ancilliary document storage areas of the operations department .

This memo states:

- Responsibility for managing these documents;
- The list of documents required for each room;
- How to obtain these documents;
- How to put them in place;
- The associated controls.

### **IAEA Comments**

The procedures in the locations described above were substituted for updated versions. The responsibility for controlling such copies was assigned to the Operations Department. Although the issue was well addresses by the plant, when checking the procedures stored in a room for gathering operators before field training, there were also drawings and other procedures present in the room that were not controlled. In addition, this room was found to be in a state of poor housekeeping. The plant should consider improving this condition.

**Conclusion:** Satisfactory progress to date.

**2.2.(a) Good practice:** Extensive use is made of mockups in the operator's training to reinforce power plant fundamentals.

The EDF training center at Paluel uses a fully functional mini-plant to train operators on plant thermohydraulics, instrumentation and control, team work and communications. The mini-plant is fully functional and can actually be tied to the sites low voltage grid. Use of mockups such as a glass PWR loop, vaporization column, conductivity and saturation models, a gas stripper column and a condensor/steam generator pressure model help operators to understand thermohydraulic fundamentals. Centrifugal pumps and fans, a hydraulic circuit and a pump cavitation display reinforce hydraulic fundamentals. Functional laboratories support operator knowledge in the areas of plant instrumentation, electrical equipment and chemistry monitoring and control. The use of three mini simulators (reactor control, turbine generator and reactor volume control) and the use of a computer based simulator post accident compact (SIPACT) simulator reinforce fundamentals of plant operation in both normal and abnormal conditions.

## 2.3. CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

**2.3.(1) Issue:** During operating crew requalification training and initial operator training, operator performance on the simulator is not closely monitored and systematically evaluated. In each of the two observations of simulator training, the instructor remained sitting at the control console for the simulator throughout the scenario which limited the ability to closely observe trainee performance. Video cameras that were used to support observations in place of observations from the simulator floor are not able to view and focus on all activities in the simulator. In addition, simulator instructors are required to perform additional functions during both training and evaluation activities. They are responsible for monitoring and controlling simulator functions for the scenario and responding to and initiating communications and actions in simulating the roles of various plant workers such as field operators, maintenance workers, radiation and chemistry technicians and supervisors. The instructors are also easily and frequently distracted from their observation duties by additional observers in the viewing room.

During simulator training, instructors use note pads to record significant information relative to the training being observed. A standard form or document is not used by the various instructors to ensure consistency and completeness of the information that is captured for evaluating trainee performance. One of the observing simulator instructors reviews the trainee performance notes taken by the other instructors during the week of training and makes a determination if the trainee has successfully passed or not. These results are then passed on to the trainee's department manager who makes a final determination of performance and suitability for operations.

It was also noted during a simulator scenario observation that a trainee worked for 20 minutes of the assigned 45 minutes in the wrong procedure. The trainee was prompted by the evaluating instructor to change to the correct procedure. This trainee successfully passed the evaluation.

While EDF has a comprehensive selection and qualification programme that produces highly trained instructors, the effectiveness of simulator instruction and evaluation is impacted by the practices that are used.

A simulator training programme that does not include complete and detailed observation along with critical evaluation of operator performance may not identify weaknesses in skills and knowledge that need to be upgraded to reduce the likelihood of operator errors.

**(a) Recommendation:** The techniques used to monitor and evaluate trainee performance while on the simulator should be enhanced to ensure the identification and correction of performance deficiencies.

### **Plant response/action:**

The plant has worked in close collaboration with the Paluel training center in order to improve the techniques used to monitor and evaluate the operators training on simulators. It ensues the following steps:



- A pre-printed observation form is used for the more effective completion of the individual assessment sheet indicating whether or not refresher-training objectives have been achieved. This form is used to list all observable items and is common to all simulator instructors. The individual assessment sheet groups together the lines of progress; it is used by line managers to direct the plant worker's training;
- This solution also provides a means of optimising all simulator-training actions (more detailed observation forms, more accurate use of recorded sequences);
- In addition to these measures, a briefing is held before every session by the instructors to remind shadow trainers (line managers) of their roles and appropriate attitudes (based on guidelines). The purpose of this is to prevent evaluating instructors from being disturbed by the presence of these shadow trainers;
- Furthermore, the Skills and Knowledge National Guide (GNCC) aimed at the operations workers, and drawn up at a national level, has been available since the beginning of 1999. It will give us the opportunity to revise our system of evaluation of skills for issuing the Nuclear Safety Authorisations (SN).

### **IAEA Comments**

The actions taken by the plant adequately address the issue. When observing simulator training for two plant operators, it was noted that the instructors had all information and conditions to perform a good performance evaluation. Discussions with the evaluators and training center management showed that the simulator evaluation system is evolving, and the forms recently created really help to provide a more consistent and fair assessment of performance. During these discussion it was concluded that a better filing process for the results of the evaluation is still needed.

**Conclusion:** Satisfactory progress to date.

- (b) **Suggestion:** Consideration should be given to supplementing the simulator instructors with assistance during training observations to permit close monitoring and evaluation of trainee performance.

### **Plant response/action:**

Owing to the new video camera layout and the addition of two rotating cameras mounted on turrets, evaluating instructors seated at the instructor console have a comprehensive view of the control room and of the activities being performed by the operators. This arrangement has been operational since May 1999.

## **IAEA Comments**

The actions taken by the training center address the suggestion offered by the OSART team.

**Conclusion:** Issue resolved.

**2.3.(a) Good practice:** Use of a computer based multifunctional simulator (SEPIA) at the Paluel site has increased operator knowledge of plant systems during normal and accident conditions. The computer based SEPIA system which uses personnel computers, is tied into the EDF site simulator and is able to use software programming to support its functions. Operators train on normal plant cooldown, transition from intermediate shutdown to residual heat removal, from hot shutdown to hot standby, change from hot standby up to 10% power, coupling to the grid and loading, load following, house load operation, restart after automatic reactor shutdown, dropping load from 100% power to residual heat removal and bringing the residual heat removal system on line and collapsing the bubble. During the simulation of abnormal operations, they train on steam generator tube ruptures (1, 2 or 3 tubes) and primary system breaks.

The SEPIA system is able to display plant system drawings (P & ID's), flow, pressure and temperature curves and control room indications during all stages of normal and abnormal conditions. This allows the students and the instructor to analyze situations and discuss observed phenomena. The SEPIA is a complement to the EDF full-scope simulator in that it helps maintain the skills of workers on specified transients on which they would not work or see because of the frequency at which the transients occur. They are able to practice specifically on steam generator tube rupture scenarios and practice on the use of procedures during accidental situations. It also helps to prepare them for further practice on the full scope simulator.

Currently there are 10 part-time trainers qualified to work with their crews on SEPIA which promotes teamwork and communications. 35 operators have received this training to date with a schedule that allows all remaining operators to attend in 1998.

## 2.4. FIELD OPERATORS

**2.4.(a) Good practice:** Situational training for field operators in conjunction with operating crew training in the simulator has improved the knowledge and skills in dealing with plant accident situations. This one day training session involves entire shift crews. Control room operators from the crew are positioned in the simulator and field operators in the plant. Accident scenarios designed by EDF training instructors are introduced into the simulator. Operators on the simulator respond and use field operators and their tagging supervisor to simulate requests coming from the simulator. Field operators use EDF issued emergency operating procedures and actually move through the plant simulating the requested actions. The team noted that this could be enhanced by ensuring the procedures used are the latest revisions. Proper phone communication techniques with the field are included in the training.

This type of training helps the field operators to have a better knowledge of the plant equipment and systems, and their location and technology during abnormal or accident conditions. Field operators and control room operators are able to better understand times required to move from one area of the plant to another as well as the time necessary to complete requested actions. This training strengthens the crews work as a team. It reinforces the roles and responsibilities of the field operators as well as the control room operators, technical supervisors, shift managers and safety engineers. Following the training session, the entire crew conducts a critical self assessment to identify areas for improvement and corrective actions to be implemented.

### 3. OPERATIONS

#### 3.1. ORGANIZATION AND FUNCTIONS

The operations organization is clearly established and responsibilities are well defined and understood by the department's staff. The organization is such that technical and administrative support are offered to the shift crews, so that the shift personnel are not overloaded by administrative work. In addition, a safety engineer from the quality and safety department gives support to the shift by independently analyzing plant safety, and supporting operations and implementation of the emergency plan in an emergency.

The goals and objectives for 1998 were still under discussion at the corporate level at the time of the OSART mission. In 1997 a significant number of indicators related to nuclear safety did not reach the established goals. This is further discussed in the management, organization and administration part of this report.

Important interfaces for operations are well defined and understood. Well structured meetings involving representatives of most departments discuss topics such as work permit priorities and action follow ups. These meetings help to establish good coordination of plant activities. A programme to develop a better understanding of the maintenance activities is being developed in the operations department. As a result, in 1997 some 35 operators spent 3 to 5 days involved in maintenance activities. This should substantially assist in the further improvement of the cooperation between the operation and maintenance departments.

Shift staff demonstrated adequate experience and knowledge. Authorities of managers and shift crew complements seems to be consistent with the work for which they are responsible.

Shift staffing seems adequate, with one shift manager for two units; one shift technical supervisor, two control room operators, four field operators and one tagging supervisor per unit. In Units 3 and 4 a seventh shift has been implemented since last year. In Units 1 and 2 it was planned to implement this programme in 3 months. A significant part of the time that the shift crews are gaining with this 7<sup>th</sup> shift schedule is being used for the implementation of an operations department strategy to enhance the rigor of the operations activities. Important activities such as specific new training, lineup improvements and self-assessment are included in this strategy. The national laws for working overtime are strictly followed, with a limit of 10 hours per day, 48 hours per week.

A structured programme exists for managers and supervisors to tour the field. Nevertheless, the programme has not been effective. This is further discussed in the management, organization and administration part of this report.

#### 3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

A comprehensive system exists to provide adequate communication during normal and emergency situations. A computerized communication system that keeps the grid dispatcher informed about the plant availability is being installed in the four control rooms and it includes an alarm in the same alarm panel of the red alarms for safety functions and may mislead the control room operators.

The plant lighting seems to be sufficient, but in a few places it could be improved, notably in the elevation 27m of the main steam line buildings, close to the steam dump valves to the atmosphere.

Many operator aids were found in the plant that were not authorized or controlled. The team recommended that the station identify and eliminate non-authorized operator aids in the plant, and implement a plant policy to properly control and authorize all operator aids in the plant.

Some important plant equipment is not clearly or correctly labeled. The team recommended that the plant enhance the plant labeling.

Recently, the responsibility for plant housekeeping verification has been assigned to field operators. In addition, maintenance staff are expected to leave their work areas in good housekeeping condition. The plant reports that significant progress has been made, but inspections in the field revealed degraded plant housekeeping in several areas, and the team recommended that the plant should enhance housekeeping in several areas of the plant.

### 3.3. OPERATING RULES AND PROCEDURES

The technical specifications are contained in three volumes: a first one with the standard specifications for the corporate nuclear part, a second one with the specific requirements for the site, and a third one with the requirements approved but still waiting to be inserted in the first volume. This makes the use of the plant technical specifications difficult, and the plant developed a new document, much more user friendly which incorporates all regulatory requirements that are in force, which is called the “operating document”. The creation of this new document was a good solution and a significant support for control room staff. The challenge remains to carefully maintain the document consistent with the three volumes.

The plant has a good system to record and control the amount of time spent with unavailable safety equipment, within the limiting conditions of the technical specifications for operations. In addition, performance indicators for these values exist.

The quality and control of some plant operational procedures are not in accordance with good international practices. The team recommended that the plant improve the quality and the control of the operations procedures. In addition, recording and changing information in operations documentation needs improvement. This is further discussed in the management, organization and administration part of the report.

Emergency procedures are state oriented. They are of good quality and well implemented. The safety engineer or shift manager, shift supervisor, and panel operators have their own procedures. The safety condition of the plant is supervised independently by these three levels of the shift. Field operators are instructed by control room operators and conduct their operation in accordance with specific activity sheets, called up by the main emergency procedures. Effective training is conducted on this integration of activities during emergency conditions once a year, with the control room operators at the simulator and the field operators simulating the maneuvers at the field. See good practice in the training and qualifications part of the report. In the emergency shutdown panel room, the necessary procedures are effectively stored and access control is good.

There is an appropriate procedure to control temporary changes to procedures. Some deficiencies on the application of this procedure were found. Temporary procedures in the control room are well understood by the operators.

### 3.4. OPERATING HISTORY

Event reports issued in 1997 include 41 reportable events and some 900 safety significant events which are not reportable to the authorities. In addition, specific reports to be considered in the plant and corporate experience feedback programmes are issued. These include reports derived from deficiency reports and corrective actions. The internal experience feedback which includes the lessons to be learned from these events is discussed in the review area of technical support of this report. The number of scrams in the four units caused by human factors was 5 out of 6 in 1994. The scrams from human factors was progressively lowered to 0 out of 7 in 1997. The seven scrams in 1997 had no common causes and depended completely on material conditions. The relatively high index of unavailability of diesel generators was caused mainly by turbocharger problems and loss of control of speed leading to overspeeding. Maintenance specific reports detailing events and preventive actions to avoid repetitions are being produced.

### 3.5. CONDUCT OF OPERATIONS

Operators and shift supervisor are attentive to the panels and seem to be competent to respond to plant conditions and status. Operators are aware of operations manuals and have clear understanding of those.

Insufficient control of number of staff in the control rooms could lead to deterioration in the professional atmosphere, and the team was informed that during outages the number of people sometimes does have an impact. The plant may consider the implementation of stricter control of access to the main control rooms.

Risk assessment has been implemented in some areas. In plant operations with potential risks of transients, some 12 operations were identified as being sensitive and procedures and training were developed and applied. During the recent outage of Unit 1, the risk analysis of system alignments was implemented using work permit risk assessment of safety and availability. Tests that may cause a reactor scram were identified and special arrangements and planning have to be made before the tests are started. Some initiatives on shift groups assessing and creating solutions with respect to some aspects of operations are planned to begin in March 1998. The complete implementation of these actions will help the plant in its the effort to enhance nuclear safety.

Shift supervisor and control room crew turnover is adequate. However, field operators turnover is conducted in the main control room and rarely in the field. The plant may consider the inclusion in the field operator shift turnover a visit to the field, including the most important places where activities affecting plant safety and reliability are being carried out.

Procedures for component and system status change during start up of the plant after an outage are well structured. The changes in status are appropriately authorized by the shift supervisor, shift manager and safety engineer.

Some aspects of field operator plant inspections are not effectively completed. The team recommended that the station improve the effectiveness of the field operator plant inspections. In addition, the station should consider increasing the presence of operation supervisors in the field, actively communicating and enforcing management expectations that are higher than those currently established. This is further discussed in the management, organization and administration part of the report.

The plant restart procedure after events such as reactor trips or planned shutdowns was found to be well structured and appropriately authorized. Assessment of the event and actions to be taken as result of the assessment are well covered. Test results are reviewed by the shift supervisor and authorized by the shift manager. The shift manager is responsible for the plant restart and is advised on aspects of nuclear safety by the safety engineer.

A computerized surveillance test programme for technical specifications requirements was developed. It seems to be well implemented. More than 50% of the rules of the technical specifications for safety equipment surveillance in force have not been approved by the safety authorities. This is further discussed in the management, organization and administration part of the report.

### 3.6. WORK AUTHORIZATIONS

A suitable procedure is provided by the corporate which includes all aspects of work authorizations. The tagging process is based on a request, e.g. by maintenance, and governed by the tagging supervisor. The request of a work order by maintenance includes risk analysis. A five week programme is implemented that covers work permits and surveillance tests. Inter-departmental daily meetings review daily the short term application of this programme. This process helps to achieve good control of services and cooperation among the several plant departments. Work on and tests of safety related systems are well controlled.

The work permit tagging process includes well defined interfaces with maintenance. Authorization is well implemented. After maintenance, requalification testing is carried out and is appropriately authorized on the tagging sheet.

The key control systems for the plant doors and switches were found to have some deficiencies in registering the person who receives the key. The plant may consider review of the plant key control system to assure adequate key control and traceability.

The procedure of temporary modification is appropriate. The temporary modifications document clearly shows authorization lines, risk analysis when required, and the need for appropriate authorization. A maximum of 10 temporary modifications at any time is set as a target. Actually, in Unit 2, there were 15 still implemented. The plant has taken actions that should reduce the number of temporary installations on site, but efforts need to continue to achieve the target figures.

### 3.7. FIRE PROTECTION PROGRAMME

The fire protection programme is in accordance with international practices. Responsibilities are well defined and understood. Nevertheless, some deficiencies were observed in its implementation, including the control of combustible materials, fire barriers and fire fighting equipment. The team



recommended that the plant enhance the fire protection programme implementation. The plant division into fire zones helps to rapidly identify a fire location. The fire detection system is kept in good condition, and provides good information to the main control room.

The plant has an internal voluntary fire brigade team, in addition to the external fire brigade. This strong initiative for plant personnel and maintains a continuous awareness of first fire fighting within the plant. Participation of plant staff takes place in periodic fire fighting drills, conducted under real fire conditions. Adequate fire fighting equipment and communication systems are also available.

### 3.8. ACCIDENT MANAGEMENT

Responsibilities are well defined for accident conditions. The procedures are well organized and trained during simulator exercises and corporate drills.

The plant has a well structured accident management organization and the material is well maintained at the site. In addition, means to assist with operation following beyond design basis accidents are provided at site and corporate level. Well organized documentation for installation, surveillance and operation of these means exist. These means include equipment such as movable diesel generator, movable compressors, a movable pump for spent fuel pit and hoses for charging pump. The instrumentation to be used during the emergency conditions is maintained energized and periodically inspected.

The yearly simulator training on emergency conditions performed by plant operations personnel includes the use of procedures for application of means to deal with beyond design basis accidents. The field operators participate in this training. A structured periodic exercise programme exists, when the equipment is installed in the field. For each device there is a responsible person that is always on call.

### **STATUS AT OSART FOLLOW-UP VISIT**

Most of the operations issues indicated by the OSART team in 1998 were regarding field conditions, both in equipment and staff performance. The station issued recently new guidance to minimize, identify and authorize operator aids. Its implementation is still to be effective, but concentrated effort has been put to remove all irregular operator aids in the main control rooms, and that was confirmed to be successful by the follow-up team. In the field, examples of misuse of operator aids were still found. The plant should be more firm in implementing this new policy.

While progress has been made, the plant equipment labeling continues to need improvement. Several irregularities could be seen in most of the areas visited by the follow-up team. The plant developed a new labeling system, but the team found the progress to be insufficient to date. Although several of the housekeeping problems identified during the OSART mission still exist in the plant, significant initiatives were noted that led to some improvements in some of the plant areas. A more vigorously implemented programme to improve housekeeping is recommended.

Significant strengths were noted in the plant programme to review operational procedures, including the surveillance procedures. Further improvements should be considered by the plant in light of the best international practice. When visiting the control rooms, several deficiencies in procedures were

noted such as unauthorized handwritten markings. The control and practical application of the procedures continue to need improvement.

The plant is taking several actions to improve field operator inspection quality, but most of these initiatives have just been or are to be implemented, and sufficient positive results are still to be noticed.

Significant improvements were noted in the number of fire drills carried out after 1998. Fire fighting equipment was found to be well controlled. A more aggressive campaign to stop smoking in the plant is planned to be launched. Significant improvement was noted in this area compared to 1998.

## DETAILED OPERATIONS FINDINGS

### 3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

**3.2.(1)Issue:** Many operator aids were found in the plant that were not authorized or controlled. In addition, the plant does not have written guidance to authorize and control operator aids posted in the plant. During field inspections, examples of uncontrolled operator aids were noted as follows:

- In the control room of Unit 4, the white-board to record safety related equipment out of service had non-authorized handwritten notes referring to technical specifications limits and conditions. The main control panel had a non-authorized handmade system mimic including the valves RRA 204 VP, RRA 208 VP, 23 VP, 40 VP and 50 VP;
- In the control room of the nuclear auxiliary building of Unit 2, there was a non-authorized hand-drawn flow diagram on the panel and several hand-drawn drain valves. The panel also had a non-authorized information note about the unavailability of an alarm that was posted on a piece of paper;
- Several instruments were found in the plant main control rooms and in the field, that have red, yellow and green sliding marks for parameter limits that are not valid;
- Adhesive tape with hand written instructions that had not been authorized were found in many areas of the plant. Examples are as follows: in Unit 3, indicating the lubricant oil leak at the charging pump RCV 171 P0; in Unit 3, diesel generator B, the fuel oil tank had the level indicator, LHQ 620 LN without the official scale that was replaced by a tape with handwritten numbers; in Unit 2, a hand written note indicating that an instrument is out of service in the liquid radiowaste control room panel; Unit 2, identifying room number WA 0510 on the wall. In addition, several non-authorized handwritings on equipment to facilitate maintenance work were identified, such as: identification of flange sides, piping, diesel generator cylinders, cable trays and thermal insulation parts;
- In the Unit 1, electrical building, zone C, two drawings were posted that were not authorized: one on the panel LHT 001 JS, and other on test equipment close to this panel; in the panel OSDA-003CR there was an uncontrolled posted drawing.

Unauthorized and uncontrolled operator aids may lead to human errors and improper safety system operations due to inappropriate instructions and/or information.

**Recommendation:** The station should identify and eliminate all non-authorized operator aids in the plant. In addition, the station should properly control and authorize all operator aids on site.

## **Plant response/action:**

In order to control and authorise display of information in the field, the plant made the decision to set up an organization, described in an application memorandum (ref. NA234) within the Q.A. manual entitled “ Management of information displayed in the field ”.

It contains firstly:

- The classification of information into two groups:
  - Group A: Information describing plant facilities
  - Group B: Information linked to plant operations
  
- A description of authorised forms of information display:
  - A good quality fixed display
  - Information displayed in a rack holder
  - Display panel

In addition, it describes the ways for limiting displays and giving them the necessary level of quality for each group. The basic principle is that each department has an organization enabling it to:

- Centralize information display requests coming from their own personnel;
- Grant or refuse approval for putting up information, in line with the NA234 memorandum;
- Compile an inventory of information that the department displays and the methods for updating it.

In concrete terms, each display in the field has the name of the department that put it there, who is in charge of managing it and a an inventory reference. As such, an anomaly can be dealt with by everyone (field rounds, management walk-about, housekeeping visits, etc) in accordance with the application memorandum, ref. NA209 ‘Keeping plant facilities in line with conformity’ and in the same way as any other anomaly.

It should be noted that equipment labeling, under the responsibility of operations, is not covered by this memorandum.

So as to identify and eliminate all non-authorized writings and drawings, the plant plans to:

- Set up this organization within the departments and have them go over to suitable displays in the field including:
  - Elimination of non-compliant displays;
  - Upgrading and standardization of the display in question in line with the criteria within NA234;
  - Entering the display into the inventory, noting how it is to be updated;
  - Progress checks during management walk-about.

## **IAEA Comments**

A new memorandum NA 234, valid for the four units was issued in April 1999. Several departments participated in its development. It is not prescriptive in order to give the opportunity for each department to tailor its implementation and develop ownership. The plant reported that department staffs have been trained on this new approach to control operator aids. This memorandum has been in force for the last two and a half months, but effective implementation that would result in major

improvement in all areas of the plant was not observed. For example, no department has completed the inventory of existing operator aids, as required by the memorandum. After the OSART mission, a non-structured removal of the most apparent non-authorized operator aids was carried out. During the follow-up visit all control rooms operator aids were found authorized and well maintained. In addition, the number had been reduced. In other plant areas, deficiencies could still be found. In conclusion, implementation has been slow and although significant improvement was observed in key areas of the plant, overall there is still a need of a more vigorous implementation of the recent plant policy regarding operator aids. An insufficient initial implementation of the memorandum NA 234 could lead to low credibility on this plant initiative. In addition, the memorandum does not require a centralized control of the inventory of operator aids in the plant, or establish the need of a periodic review in the field of the status of such control. This may lead to lack of overview of this programme, and consequently failure to control and minimize operator aids in the plant.

**Conclusion:** Satisfactory progress to date.

**3.2.(2) Issue:** Some important plant equipment is not correctly labeled. In addition, the administrative measures to report and reestablish equipment identification has not been well implemented. The team noted many labeling abnormalities. Examples are as follows:

- In Unit 3, the local instruments for the safety injection pump RIS 053 PO had the official labeling: 448 LP, 445 LP, 450 LP and 447 SP, and in addition different handwritten identification: 558 LP, 545 LP, 550 LP and 547 SP. Later the team was informed that the handwritten identification was the correct one;
- In the main steam line building, around the containment, Unit 3, level 27 m, three out of the four valves of main steam dump to the atmosphere were noted as follows: GCT 23 VV that was not officially labeled -only handwritten identification; one steam valve that was not labeled (GCT 22 VV); and GCT 24 VV that had the official label plus a handwritten identification. In addition, the official valve labeling VVP 109 LP, VVP 409 LP and VVP 309 LP had the system initials crossed out and the initials GCT were inserted;
- The following are additional examples of equipment found with handwritten identification in addition to the normal identification labels; in the diesel generator train B, Unit 3, the relays LHQ 506VA and LHQ 507VA; in the Units 1 and 4, the instruments at the pedestal of the high pressure turbine;
- The following are additional examples of equipment that was not labeled: in Unit 4, the heat-exchanger of the component cooling system, train B; in Unit 1 the main feedwater pump; in Unit 3, the valve used to receive turbine lubricant oil from a truck; in the auxiliary steam building, valve at the right of O REA 142 VD, drain above O REA 102 VD, and drain under O REA 130 V.

Inappropriate equipment labeling could lead to improper operations and maintenance activities that could affect plant safety and reliability.

**Recommendation:** The plant should enhance the equipment labeling. The plant labeling policy should be reviewed and clear guidance should be implemented to correct the deficiencies in areas and equipment identification.

### **Plant response/action:**

Plant housekeeping standards are defined in memorandum NT/SQ-023. The practical methods for labeling are described in the technical memorandum NT/SC-002 entitled 'Identification and labeling of mechanical and electrical equipment'. The Operations Department is responsible for identification of equipment. Any staff member that sees faulty labeling must track the discrepancy via a form and send it to the Off-line Operations Structure (TDI) that checks the request being made against the required standard (size, colour, type of mounting support, etc.) and orders the label.

The label is affixed by the team in charge of that particular main plant system.

The plant is setting up a new method for identifying equipment, priority being given to larger items of equipment (1300 in total). The new organization will enable the processing of labeling deficiencies to be accelerated and simplify their replacement in the field.

As for the identification of equipment rooms, any defects observed are dealt with on a case by case basis during the housekeeping tours.

### **IAEA Comments**

The plant developed a new labeling system, using metal plates and stick on labels made in the plant facilities. This has shortened the process of producing the required labeling, compared to the previous use of an external company for this service. There is no revised guidance that reflects this new plant approach to labeling. The substitution was initiated in January 1999, and so far some 2000 new labels have been applied, starting with 1300 labels in large equipment in the four units, and above 500 small equipment after March. The plant has resolved the specific examples indicated in the OSART report, but other action has been limited to that stated above. The new labels can not be used in the containment because they contain chlorides, and also the possibility of becoming loose due to possible high temperatures and humidity.

Several initiatives have been taken by the plant in order to minimize abnormalities with labeling, such special attention on equipment identification during plant management structured tours, as well as when inspecting equipment after work is performed, specially in outages. When visiting the field, the team observed that the progress in improving plant equipment labeling is slow. Many examples of deficiencies in labeling were noted by the team.

**Conclusion:** Insufficient progress to date.

**3.2.(3) Issue:** Inspections in the field revealed degraded plant housekeeping in some plant areas. These areas had accumulations of oil, dust and dirt and the presence of debris (rags, cups, lagging covers, tools, emery cloth, metal parts, paper, cigarette butts etc.). Some water and oil leaks were also found that were not isolated. Areas where improvement is most needed are outside the radiologically controlled area. Examples are as follows:

- Unit 4 feed pumps were covered with chunks of thermal insulation and other parts and debris;
- Pump station building and turbine buildings of Unit 1 and 3, floors mainly in lower levels of the buildings, piping and pumps were found dusty and with debris.
- Diesel generator train B, Unit 3, equipment dusty and greasy. In the main steam line building, around the containment, Unit 3, level 27m, equipment and floor dusty;
- Cigarette butts were found in many areas including turbine buildings, main steam line building and diesel generator rooms. In some of these areas smoking was not permitted;
- Some storage areas were not well maintained. In Unit 1, the predetermined storage area for temporary installations, turbine building, and the two storage areas for emergency equipment in case of an electrical incident, were not well controlled. In the same unit, temporary storage areas for equipment that remained from the outage, such as scaffoldings, were found not clean and not well organized, and made the access to operating areas difficult;
- In the turbine building Unit 1, water from leaks were found on the floor without being confined. An oil puddle was found in the Unit 2, nuclear auxiliary building, charging pump room. In Unit 3, diesel generator train B, a significant amount of diesel oil was found in the collecting tray under the day fuel tank; under the lubricant oil tank, diesel generator train A, Unit 4 another oil puddle was found. Oil soaked absorbent material was found under and around several diesel generators;
- Unit 4 main feedwater pump lubricating oil room floors were covered with heavy deposits from long standing oil;
- Many floor areas in the radiological controlled area had degraded floor coverings. In Unit 4, component cooling system heat-exchanger train B room, the floor drain gutter painting was peeled off and with stagnated water; in Unit 2 electrical building rooms LB 0520, LB 0522 and adjacent rooms: floor painting removed and not reestablished;
- In several areas such as: Unit 2 nuclear auxiliary building, outside of the control room diesel generator A, Unit 1 and Unit 2 turbine building the trash containers were full and overflowing;
- Unit 1 fuel pool area had inappropriately stored tools and minor trash and debris on the floor; clear polyethylene was draped over the walk way near the fuel transfer bay.



Inappropriate housekeeping of equipment and plant areas increases the risk of equipment unavailability and personnel injury.

**Recommendation:** The plant should enhance housekeeping in several areas of the plant. Enhancing the effectiveness of tours by management and supervisors could be assistance in raising the housekeeping standards.

**Plant response/action:**

In addition to the response given to the recommendation 1.2(3) in the MOA area, the Operations Departments schedule housekeeping tours for the end of worksites. Field tours, carried out by the tagging supervisor, enable equipment and housekeeping standards to be checked.

These checks are drawn up in the memorandum NS/CO-226 (Checking condition of plant facilities). Several areas of improvement are being implemented for plant housekeeping:

A programme for resurfacing floor paint

This programme has been underway for several years now, with 50.000 m<sup>2</sup> of renovated floors in the past few years. The associated organization has been formalized via a technical memorandum within the Nuclear Logistics Department (NT/LN 10). This document defines the allocation of work into batches with the associated deadlines:

- Batch 1 currently being carried out during 1999 covering 6,500 m<sup>2</sup> over the 4 units in areas where there is a contamination risk, and 1,800 m<sup>2</sup> outside the radiologically controlled area;
- Batch 2 for the year 2000 covering 24,000m<sup>2</sup> within the radiologically controlled area and 15,500 m<sup>2</sup> outside the radiologically controlled area;
- Batch 3 for the following years.

A corrosion action plan described within the response to the recommendation 4.6(1) in the maintenance area.

An organization of management plant tours associated with a follow-up of corrective actions, described in the response to the recommendation 1.2(3) in the MOA area.

Identification of defects in the field described in the response to recommendation 3.5(1) in the operations area.

## IAEA Comments

Although several of the problems identified during the original OSART mission still exist in the plant, significant initiatives were noted that led to some improvements in housekeeping in several of the plant areas. Examples of improvements are as follows:

- The programme to repair the floors and walls painting is in progress; it seems that that resources and priorities have been appropriately considered. This is a long term programme because deficiencies in the original plant painting led to a large area with paint lifting and cracking. Some initiatives have been implemented that helps to educate the staff in preserving surface damage, such as availability and instructions for use of thick pieces of carpet to protect floor from heavy and metallic equipment, especially during outages. Nevertheless, several examples in Units 1 and 4 were found where heavy metal pieces were placed directly over the floor, and in some cases floors had been recently painted;
- For equipment corrosion, a site overall inspection was conducted and repair prioritization established. Consequently, a repair programme was initiated, and resources and prioritization seems to be appropriate. For example, since 1998 182 containment penetrations in Unit 4 were repaired; auxiliary unit transformers in Unit 1 have been cleaned and painted; and service water pump station for Unit 3 was totally repaired and repainted. In addition, special attention has been given to removing corrosion and adequately painting equipment after it is disassemble for maintenance.

Unit 1, that recently completed an outage, was found generally clean, with most of the outage material removed from the controlled area.

The field inspections conducted by the plant have been more oriented to housekeeping as part of the effort to increase standards in this area.

Some significant housekeeping deficiencies were observed in the plant. Examples include the following: Unit 4 turbine-driven feedwater pumps were dirty with dust and oil, and with damaged thermal insulation material; cigarette ends were found over a wooden platform in the turbine hall, close to the hydrogen bottles to supply the main generator, close to the turbine-driven feedwater pumps, and in a cable tray (Unit 1), and close to the main generator (Units 4 and 1). In all these areas smoking is forbidden. In the solid waste storage area, Units 1 and 4, corroded iron pieces were placed directly on the painted floor, and not in an orderly manner, along with floor protection. In Unit 1, a temporary cable was passed from one room (pump ND 0512) to another, making it impossible to close three doors. In Unit 1, a large puddle of oil was found close to the charging pump in operation. In Unit 4, small puddles of oil were found close to the charging pump.

In conclusion, progress in housekeeping was noticed when touring the plant. To ensure effective, visible and lasting results, the programmes that have been implemented to improve housekeeping need to be more vigorously enforced along with the needed management involvement and support.

**Conclusion:** Satisfactory progress to date.

### 3.3. OPERATING RULES AND PROCEDURES

**3.3.(1) Issue:** The quality and control of some plant operational procedures are not in accordance with good international practice. The majority of operational procedures do not have places to note dates, times and executor signatures at important steps. Some surveillance procedures do not specify tolerances in the acceptance criteria. Plant procedures, specifically system lineups, do not consider independent verification. In addition, uncontrolled procedures and procedures with unapproved changes were found in several places in the plant.

During the last power increase of Unit 1, a safety related surveillance procedure was not timely executed due to omitted specific step in the general operating procedure GP 02, Increase Nuclear Power From <2% To 100% After refueling, and the reactor had to be shutdown as determined by the technical specifications. This procedure normally takes many hours to be completed. To be able to trace the main start up steps there is not sufficient information in the procedure records which requires reference to other documentation.

The following procedures were found with modifications that were not approved:

- Procedure GP 02, used during the startup of Unit 1, had notes included and changes that were not authorized;
- A deviation sheet dated 10 July 1997 was not incorporated into surveillance procedure RIS 9 of the Unit 1 when it was executed on 10 December 1997, although RIS 9 was revised in November 1997;
- Surveillance procedure EP ASG 2.3, revision 3, test of the auxiliary feedwater pump, in use during the Unit 1 startup, had changes that were not approved;
- The temporary procedure 98/12 for containment ventilation test, in execution in Unit 2 during the OSART visit, had non-authorized handwritten inclusions to the text.;
- In the control room of Unit 3, temporary procedure 2245 was being used that had expired one year previously but had the original expiration date and signature covered by opaque corrective fluid and was re-approved for use;
- In an other instance, the shift manager modified the surveillance procedure EP RIS 9, Unit 1, and this had not been reviewed prior to execution.

The following are examples of missing specific tolerances in acceptance criteria in the surveillance procedures: in ARE 2.2, ARE 2.1 the tolerances for steam generator level.

Other examples of procedures with non-approved correction may be found in issue 1.3.(1).

The following procedures were found that were not controlled or were out of date:

- EP ASG 2.3 was in Units 1, 2, 3 and 4 in its revision 3, it had not been replaced by the last revision. Operations management had verbally authorized this situation because they did not want it implemented until after start-up of Unit 1;
- In control room Unit 2 , the procedure FAPP was found out of date -issued 22 October 1992, it had not been reviewed at the required periodicity;
- In the operations training facility at the site, a set of operations procedures was found that was not maintained current. See issue 2.2.(1);
- A cabinet of the administrative building of Unit 3 contained a set of operations procedures for general consultation that were maintained under a note that indicated that the procedures were not controlled..

The lack of good quality and controlled operational procedures could lead to incorrect safety system operations and lack of traceability of important plant data.

**Recommendation:** The plant should improve the quality and control of the plant operations procedures.

#### **Plant response/action:**

Following this recommendation, the plant set up a project study group for dealing with operations documentation quality improvements.

The group is coordinated by an engineer from the safety quality department and its members come from all levels of operations.

The job of the group is focused essentially on:

- Producing two guidelines for writing of documents, one for surveillance tests (NT/SC-020), the other for operating instructions (NT/SC-021). These guidelines incorporate the results of work undertaken at the plant over several years: compliance with surveillance test reference requirements, implementing risk assessments, conclusions drawn up by the ‘Configuration line-ups’ working group;
- Reviewing the outage procedures covering isolation of electrical busbar feeders (44 procedures in total);
- Modifying surveillance test procedures (50 in total);
- Writing new procedures for the boron and water make-up system (system code ‘REA’ in French), including risk assessment and check points (42 procedures).

This project group ceased working on 15 March 1999 and will start reconvening as of September 1999 (after the outages on Units 1 and 2) so as to continue the work already undertaken, with priority being given to three main plant systems: Reactor cavity and spent fuel pool cooling and

treatment system (PTR), Chemical and volume control system (RCV) and Component cooling system (RRI).

As for temporary changes to documents, the plant has stated clearly the rules in a memorandum, reference NA 034.

As part of the management contract for the Operations Departments, a programme of internal checks has been defined and focuses essentially on complying with the reference requirements (NA 034).

### **IAEA Comments**

Some strengths were noted in the plant programme to review operational procedures, including the surveillance procedures. The integration of risk analysis in the revision of critical operations and system line-ups was most notable. The prioritization in the review programme considers the operational experience within the plant, e.g. history of events during system line-ups determined the family of line-up procedures to be first reviewed. This revision process started September 1998 for the operational procedures, and in January 1999 for the surveillance test procedures. It was interrupted during the recent Unit 1 outage, and it is planned to be complete by 2003.

Although an important step for improving the quality of the procedures has been undertaken, the control and practical application of the procedures in the field continues to have many deficiencies.

When visiting the control room, Unit 4, several deficiencies were noted in the control and use of procedures. For example, records were not consistent, with crosses alternating with signatures to indicate a step was complete (D5312 CO/SC-151, page 52/96), a question mark was placed where a value should be registered (EP/SC-510, page 22/34). The procedure D5311 CO/SC-00092 had handwritten correction, and information was provided that the procedure was not updated. In the procedure D5312 CO/SC-350, information was crossed out from page 15 to 18, without any indicated authorization.

Further improvements should be considered by the plant in light of the best international practice. For example, signing the procedure in each step instead of just marking a cross to identify step completion and having a more systematic way of determining independent verification.

**Conclusion:** Insufficient progress to date.

### 3.5. CONDUCT OF OPERATIONS

**3.5.(1) Issue:** Some aspects of field operator plant inspections are not effectively completed. The following deficiencies were observed during field operation inspections and not corrected or reported:

- Several housekeeping, material condition, equipment labeling, operator aids, fire protection and scaffolding deficiencies were observed. See issues 3.2.(1), 3.2.(2), 3.2.(3), 3.7.(1), 4.2(1) and 4.6(1) for additional information;
- Several electrical panels with signs forbidding access were unlocked and open;
- Doors that were intended to be locked were unlocked and open;
- Piping thermal insulation was found damaged, indicating that it was stepped over to permit access to other equipment;
- Turbine building Unit 2, three tank levels, SRI 121 BA, the turbine cooling water system tank and CEX 201 BA were found with level indicator without numerical scale, and the operator takes the value by visual comparison of the instrument level size with the height of the tanks;
- In the turbine building Unit 2, external top level, 5 bottles of gas (SF 6) for high voltage equipment were stored in an open area not well secured and labeled. The operators did not see that as an area of their responsibility and stated that electrical personnel were responsible for the gas bottles;
- Three circuit breakers 4CF1 013, 14 and 15 MO in the pump house were noted to be closed without the appropriate indicating light illuminated. The field operators were unclear as to the expected state of these indicating lights.

In Units 1 and 2, some deficiencies were identified in the operator rounds control system. In one instance, the control room operator did not review and sign the inspection sheets; the sheets had some non-authorized corrections, missing data and unclear parameter limits. In Units 3 and 4, a computerized operator rounds control system is in implementation, and not all potentialities of the system are implemented such as, the parameter trend analysis. In addition, some of the computerized devices used by operators in the field to guide the round and record values are missing the built-in illuminator that makes it difficult to read the screens.

The lack of operators effectively touring the field, identifying and reporting deficiencies may contribute to the unavailability of equipment important for safety or increase the industrial safety risks at the plant.

**Recommendation:** The station should improve the effectiveness of the field operator plant inspections. The operator round control systems in force should be improved and better controlled. The rigor with which the field operators tour and inspect areas and equipment may be enhanced by specific training on inspection techniques. In addition, the

station should consider increasing the presence of operation supervisors in the field communicating and enforcing management expectations that are higher than those currently held.

### **Plant response/action:**

Several areas of improvement concerning effectiveness criteria for field operator rounds have been defined and are currently being implemented:

#### Support for carrying out the operator rounds

The introduction of a new tool for performing the rounds is scheduled for June 1999. This tool will include new software, more user-friendly for the field operators and will make it possible to trend monitor parameters taken during the round as well as surveillance test parameters (see the response to the recommendation 5.2.1 in technical support dealing with trending).

#### Training in field inspection techniques

Specific training in field inspection techniques is currently taking place for all field operators. This training is based initially around a video session, followed by an analysis of the discrepancies that were not identified during the film. During the training session the shift manager makes a reminder about requirements (ref. NT/SQ-023, NA208).

#### Identification of discrepancies observed in the field

The organization linked to the identification of discrepancies in the field has been clearly laid down. It is described in the memorandum, reference NA 124.

These are the main principles within the document:

- Any staff member (from operations) who discovers a visible equipment defect must identify it using a special (equipment defect) label, fixed as close as possible to the problem identified;
- Each label must have a corresponding work request written up, the information on the label must make it possible to track back the work request quickly;
- After repairs are carried out, the department doing the work removes the label from the field.

For leaks, in addition to their identification by use of these labels, the area can be cordoned off and the leak collected as and where necessary.

The organization concerning the identification of defects in the field is up and running as of the end of March 1999.

### **IAEA Comments**

A new computerized field inspection system is being implemented, with staff training in progress. The optimum use of this new tool, including possible trending of parameter is still being discussed.

Field operators training on field inspection techniques has been developed and is being implemented. It includes presentations, videos and exercises.

Green cards to indicate deficiencies in the field have been implemented since March 1999. The system seems to be well structured and integrated to the plant work process system. Nevertheless, most of the deficiencies in the field are not yet identified. The plant should consider establishing a periodic field assessment to confirm that the cards applied to the equipment coincides with the status indicated by the computer records.

A maintenance team for quick repairs in systems that are not related to safety (e.g., lighting, doors, non-process computers) has been created, and will help to speed up elimination of small deficiencies that degrade housekeeping and material conditions. Although the responsibility of this team appears to be well defined, international experience shows that if these small repair are not clearly defined and limited to non-safety equipment, it may challenge the required control and record of activities in safety related systems.

The plant is taking several actions to improve field operator inspection quality, but most of these initiatives have just been or are to be implemented, and effective results are still to be noticed.

**Conclusion:** Insufficient progress to date.



### 3.7. FIRE PROTECTION PROGRAMME

**3.7.(1) Issue:** Some deficiencies were observed where fire doors, combustible material and fire fighting equipment were not always in accordance with plant procedures. Plant fire doors were sometimes found open and obstructed by cables or hoses. For example, in Unit 2, room KB 0611 in the controlled area, the fire door was open and obstructed by a hose connected to test equipment, and the access door to the charging pumps room was prevented from closing by an electrical cable of a temporary installation (the cable shielding was partially damaged).

Deficiencies were found in the control of combustible material: the cold laboratory for Units 1 and 2 had an excessive amount (150 liters) of benzene stored; several wooden pallets were stored in the radiation waste building; wood scaffolding was used in the plant; wooden walkways were used in accumulator rooms in Unit 3 and 4 and battery rooms (e.g., LLA 001 BT); significant amounts of oil were found in the collecting tray under the fuel oil tank L HQ 620 BA of diesel generator train B in Unit 3, and under lubricant oil pump L HP 080 PO of diesel generator train A in Unit 4.

Portable fire protection equipment was found with qualification tags that had no authorization signature of the tests carried out. In the administration building H1, 3<sup>rd</sup> floor one fire extinguisher was not in place as specified in the Fire Action Sheet (FAI), and in Unit 1 on the control room level, the FAI was not updated according to the number and location of extinguishers available.

Furthermore, smoking or evidence of smoking was seen in areas of the plant with increased fire risk such as near sources of hydrogen and the diesel generator rooms. An empty cigarette pack was found in room AGR 012 BA of Unit 1 which is a room that requires a fire permit to work.

In Unit 1 turbine building, the door JSM 703 PD to prevent personnel access to a hydrogen area was unlocked and fully open.

Deficiencies in the fire protection programme increases the fire risk, that could affect the access to and availability of equipment important for safety.

**Recommendation:** The plant's fire protection programme should be enhanced including maintaining the fire doors closed, rigorous control of combustible material and maintenance of fire fighting equipment.

#### **Plant response/action:**

Paluel nuclear power plant has drawn up a station fire action plan focused around reinforcing the lines of defence set up as a protection against fire. This plan strengthens the existing organization that Paluel has developed in this area. In addition, as of this year the plant has committed itself to a national fire action plan that reinforces operational safety of nuclear power plants against one of the major risks namely that of fire.

In addition to the organization and the fire fighting equipment, the station fire action plan develops fire prevention and in particular the following points:

Industrial safety instructions: the action plan makes provision for a review of all the plant's industrial safety instructions (fire action sheets, evacuation plans, industrial safety recommendations, etc.) and a systematic formalisation of no smoking areas.

Control of fire loading: the action plan makes provision for the various departments at the plant to carry out an examination of their activities and their practices so as to eliminate the proliferation of uncontrolled fire loading. This is especially the case for:

- The Measurements and Environment Department's laboratories that has reviewed its organization concerning storage of flammable products;
  - The Operations Department that is making organizational changes so as to reduce the amount of flammable effluents produced by day-to-day plant operations;
  - The Nuclear Logistics Department that has committed itself to the replacement of wood scaffolding sections with parts made from aluminum;
  - The Electrical Department that is studying the problems related to having floor grating sections made of wood in the battery rooms.
- 
- Fire zoning: the Nuclear Logistics Department has fitted all fire doors on the room of the 'industrial' plant facilities with 'groom' devices.
  - Maintenance: the Risk Prevention Department ensures tracking of maintenance activities for fire fighting equipment.

### **IAEA Comments**

Significant improvements were noted in the number of fire drills carried out since late 1998, and in the number of staff qualified for fire fighting. The revised work permits now include fire risk assessment, with specific instructions when applicable. Fire fighting equipment in the field was found well controlled. During the follow-up visit, no fire doors were found open. The amount of burnable material in the plant was noted to be reduced, although unnecessary materials were found such as cardboard boxes left in controlled area, Unit 1, and wood in the turbine hall Unit 1.

A more aggressive campaign to stop smoking in the plant is planned to be launched. The number of cigarette ends found in the plant was significantly reduced compared to 1998. But evidence of non-respect to this non-smoking policy could be found in the turbine halls, Units 4 and 1. In the Unit 1, the cigarette ends were close to the main generator, on a wood platform remaining from the recently completed outage.

**Conclusion:** Satisfactory progress to date.

## 4. MAINTENANCE

### 4.1. ORGANIZATION AND FUNCTIONS

Maintenance activities at Paluel are carried out by three organizations, the maintenance department (SUT) and two instrumentation and control (I&C) groups for the twin unit groups 1/2, 3/4. The structure of the organization is new and was in place since October 1997. The change was to improve performance through establishing continuity between normal operation activities and refueling outage activities. The maintenance group is divided into four subgroups of specialists; electrical department, valves and metal work department, mechanical equipment department and nuclear support department. All groups have been assigned clear responsibilities and authorities and have defined coherent objectives.

Nuclear safety and maintenance policies have been clearly defined in the new organization using a contract that is signed between each maintenance and instrumentation and control subgroup and the plant director through their associate deputy director. This contract establishes the objectives, goals and milestones for the year and is correlated with the ten year outage planning of the group and with the plant director's objectives.

The 1998 management contract has defined goals and objectives but not all have performance indicators to measure progress towards the desired improvements. Because the objectives stated in the document are to bring about improvements in different areas including safety, clear indicators should be established to measure the status and improvements. It is noted that they started to use indicators at the same time they reorganized the structure. The team also encourages Paluel to establish trending to enable analysis of what improvements have to be achieved.

The maintenance group has a safety maintenance committee that is chaired by the deputy director. It reviews the issues related to safety action plans, quality of the maintenance group activities, preparation of safety decisions based on risk analysis, and internal experience feedback. The team considered this as a good approach to safety culture enhancement.

The interface with operations and between maintenance groups including instrumentation and control groups is controlled by two different daily meetings for planning and scheduling of activities. These two meetings are well organized, the interface is considered to be reasonable effective but can be improved as more experience is gained in the five weeks planning. A challenge of the maintenance group is to improved subgroups coordination.

A programme is in place to improve the interface with the contractors. This involves partnership contracts to guarantee skills, professional development and experience comparable to plant personnel. A contractor evaluation process is applied. In addition to the monitoring of activities of specific jobs and analysis of work reports, the type of evaluation is a continuous judgmental review process to obtain overall improvement. The standards set for contractors are equivalent to those of the plant staff for the activity they perform. However, in practice not all contractors are complying with the requirements as observed by the team. The team encourages the plant to set up a process to enable evaluation of effectiveness. At this time, the indicators do not show clearly incidents or events caused by contractors activities.

## 4.2. MAINTENANCE FACILITIES AND EQUIPMENT

Maintenance facilities and equipment are adequate in size and arrangement and promote efficient completion of work. Workshops are well organized, clean and tidy and have the necessary space for preparation and performance of the work.

The maintenance activities are in general well performed by qualified workers. Additional attention should be paid to scaffolding. Although scaffolding construction quality is good, there is no procedure to control where and how it is installed and the time that remains installed. The team recommended improvements in this area.

Each unit has adequate facilities and enough space available for maintenance activities during the refueling outages and during normal operation. It has been noted during the field inspections that the plant carries out significant field preparation to support maintenance so the maintenance activities are reasonably effective. However, improvements can be made, so the team encourage the maintenance and I&C group to monitor and trend the amount rework.

There are measurement and test equipment storage areas for each maintenance group and I&C. To verify the calibration status, an adequate calibration programme is applied to the measurement and test equipment to maintain its accuracy. Decontamination facilities are adequate, including three different remote control decontamination tools which are used to minimize exposure. This activity is performed by a contractor.

## 4.3. MAINTENANCE PROGRAMMES

The preventive maintenance programme is applied so that approximately 10% is executed during normal operation and the other 90% during refueling outages. This a consequence of the preventive programme technical structure. The I&C group and maintenance group are modifying the preventive maintenance programme, since the units are changing from a twelve months cycle to eighteen months cycle. The structure of the new programme is acceptable from the point of view of availability and reliability since they applied a validation test on the equipment.

Paluel has a predictive or condition base maintenance programme that has been designed to improve reliability, maintain high level of safety and availability, and reduce maintenance costs by optimizing the preventive maintenance programmes. It is based on the monitoring of parameters such as vibration, temperature and oil condition on the rotating equipment. The electrical equipment is monitored by infrared thermography, oil condition and battery charge level. A monitoring programme for motor operated valves is being implemented by the corporate unit UTO to monitor acoustic control and tests for thrust and torque and is scheduled to be completely implemented in 1999. The programme is considered to meet current industry standards.

The in-service inspection programme is performed according to the corporate basic preventive maintenance programme (PBMP) and the EDF reference guide (RSEM) published in 1988, and is applied to safety classes of equipment. This programme is considered satisfactory. Three of the units have received the ten years inspection and the Unit 4 is scheduled for 1998.

Non destructive examination and inspections of components is controlled and performed on safety class 1, 2 and 3 equipment using well structured procedures and a well defined programme.

All reports for test since the original fabrication and construction until the actual testing are stored in a well structured archive, with all the requirements for system document control. The work is performed with well qualified personnel from Paluel and GDL personnel assigned to the plant on a permanent basis. They use qualified contractors for those activities when needed, maintaining control on the personnel qualification and equipment calibration.

The tagging system that operation uses to permit the maintenance group to work on a system or equipment in a secure condition is adequate. The tagging sheet requires maintenance to close out the tag out as they complete the work. While the computer control system shows how many tagging sheets are open, the programme does not show when they should be closed out. The team encourage Paluel to implement a system that can easily help on the tagging close out on the delayed works, this could improve the availability of equipment.

#### 4.4. PROCEDURES, RECORDS AND HISTORIES

Maintenance has a policy to use procedures to perform work. The process to prepare a job considers preparation, planning, performance, inspection and historical records. Job preparation is carried out using procedures which include risk analysis, quality plan and data sheets, calibration sheets, drawings, work permit, and component requalification procedure or instructions, for field work performance. Procedures are technically coherent and contain required acceptance criteria. All the necessary procedures were included in the work packages which were reviewed by the team and were properly controlled by the maintenance planners in each group. The work packages are readily available to users.

#### 4.5. CONDUCT OF MAINTENANCE WORK

All maintenance activities are performed with work orders and work permits after the tagging has been put in place and the initiation has been authorized. Work is controlled and performed by qualified workers. After the work is finished, post maintenance/modification testing is carried out to assure required performance.

The evaluation of preparation and conducting of post-maintenance testing is considered adequate. However, improvements can be made in light of the little time that it has been in place.

#### 4.6. MATERIAL CONDITIONS

The plant has made efforts to improve material condition, but significant room for improvement still exists. Deficiencies were identified during plant tours, corrosion problems are evident and a large backlog on the mechanical group shows that attention is required. Most of the deficiencies were old and several of them were not included in a request order in the SYGMA work control system. This indicates the plant field operators and maintenance personnel had not detected or reported them. Additionally, deficiencies tag identification is not used, making it difficult to know if a work request exists, so duplication may exist. The team recommended that a clear expectation for detecting, identifying and correcting deficiencies be put into place.

A system for walkdowns by management exists but appears not to be sufficient, so the team encouraged Paluel to set up a more aggressive programme to ensure the maintenance staff

understand their responsibilities to be observant and to identify and report anomalies that they encounter.

#### 4.7. WORK CONTROL

The maintenance programme is controlled by computer database (SYGMA ) that controls the corrective and preventive maintenance programme. The system initiates a work request for every job and after the analysis and work package preparation it becomes a work order. This computer system is used as a tool to control all work requests that are required to perform every plant maintenance job. Since the reorganization of the maintenance group, every group is making efforts to clarify the status of the existing backlog so improvements can be made.

The organization of the outage and the composition of the different working groups is clearly described in accordance with procedures, so the responsibilities and authorities are clearly defined. Safety is a high priority in the outage process as plans clearly specify safety requirements.

A radiation dose reduction programme is in place to minimize the total radiation dose during the outage and is closely monitored. A programme for experience feedback exists to minimize incidents. A complete report is issued at the end of the outage. It contains topics which may interest the plant management for future improvements.

#### 4.8. SPARE PARTS AND MATERIALS

Procurement, receipt, inspection and storage of spare parts is established in procedures, and the responsibility for procurement and inspection of all safety related parts relies on the corporate organization. All the material and spare parts that are coming via corporate are considered satisfactory. All other materials and spare parts which are procured by Paluel are received, inspected, packaged and stored by the warehouse group. Special attention is observed for the parts having limited shelf life, for which good control was demonstrated.

A fire detection system is installed in material storage areas and manual fire extinguishers are maintained in sufficient quantity. Additionally, flammable and hazardous materials are properly controlled. All documents for safety related spare parts equipment and material are well organized to provide traceability from supply to installation. All non conforming or damaged parts are stored separately to prevent their use. The warehouse activities are considered to meet industry standards.

### **STATUS AT OSART FOLLOW-UP VISIT**

In the maintenance review area, the two issues were making satisfactory progress.

A proper system for analyzing, checking and authorizing the application of scaffolding in the plant was established. Nevertheless, when reviewed in the field, a scaffolding approved for use was noted to have several abnormalities in the installation. The plant should strive for adequately implement of this new policy on scaffolding.

The plant took several initiatives to better control and resolve equipment deficiencies. These include; improved tracking of deficiency reports and work permits, wider involvement of operations and maintenance in deficiencies repair scheduling, identification of deficiencies in the field -green cards, an

equipment corrosion action plan and implementation of a fast repair group for small and not safety related deficiencies.

The implementation of most of these initiatives is quite recent, and assessment of their effectiveness was not yet possible.

The OSART mission occurred 18 month ago and meaningful improvements in material conditions, other than the corrosion action plan, is taking a long time. Lasting oil leaks in several equipments could be seen; turbine driven feedwater pumps continue to be in degraded conditions, most noticeably in Unit 4; equipment grounding cables can be seem disconnected throughout the plant; cables that are cut with terminals not protected nor identified; damaged thermal isolation; and non authorized handwritten markups in equipment to facilitate disassemble and reassemble. In addition, the number of green cards applied in the field is small, and still does not sufficiently help to easily identify what deficiencies have or have not been reported. The plant is encouraged to take a more aggressive position in implementing the recently created programmes to enhance plant material conditions.

## DETAILED MAINTENANCE FINDINGS

### 4.2. MAINTENANCE FACILITIES AND EQUIPMENT

**4.2.(1) Issue:** The placement and duration of scaffolding at the plant is not always controlled resulting in the blockage of access to equipment and area exits, the erection of scaffolding in a manner which may be hazardous to some safety related equipment and scaffolding remaining for excessive periods of time. The Paluel scaffolding procedure does not include information for controlling where scaffolding is erected and for the time it is permitted to remain installed. Examples of problems that were observed are as follows:

Unit 2, in room LA0354:

- Scaffold was touching piping in the room;
- Ladder on the scaffold was only a few centimeters from the safety injection pump.

Unit 2, room LA0355:

- Scaffold was touching ventilation duct at the ceiling;
- Scaffolding blocking passage ways are as follows: Unit 4, main steam line building, el. 27m, room RD 1109, turbine hall, el. 15.50m, door close to ADG 304 VL and in room LA 354, Unit 2;
- In the diesel generator room DA, in Unit 4, scaffolding has been erected since 31 October 1997. There was no indication on the scaffold tag of when it will be removed. There was no evidence of work in progress on the scaffold.

Scaffolding is a temporary installation that if not properly controlled can be an obstacle that can inhibit access to equipment important to safety and can block passage ways.

**Recommendation:** A process should be implemented which ensures that scaffolding is erected so that it does not block access to equipment or passage ways and also ensures that scaffolding is removed promptly when work is completed.

#### **Plant response/action:**

The memorandum entitled 'Management and Use of Logistical Resources' stipulates the requirements for the setting up of scaffolding with regard to:

- Scheduling the installation and removal of scaffolding;
- Carrying out a risk analysis for any scaffolding having to be set up in a room containing safety-related equipment;
- Erecting the scaffolding;
- Administrative control of scaffolding so as to ensure proper tracking.

The memorandum also specifies the organizational structure and responsibilities associated with the installation and removal of scaffolding.



These responsibilities are based on the following principles:

- Each operational department, with responsibility for its particular installation, makes sure that the logistical resources used for the operation or maintenance of the installation do not affect its level of safety;
- Logistical activities being performed on safety-related (IPS) or quality-controlled (QS) equipment are accordingly considered and processed as IPS or QS activities; the same applies to activities taking place near IPS equipment;
- Each operator decides whether or not to authorise the presence of logistical resources on equipment required for plant operation or in rooms containing IPS or QS equipment. This decision is made on the basis of a risk analysis;
- The section in charge of logistics (Nuclear Logistics Department - S.T.L.N.) checks the consistency of the risk analyses with the equipment safety requirements and vouches for the adequacy of their scope. Operating standards must be factored in (compliance with radiation protection areas, fire zones, fire loading, waste zoning);
- All scaffolding and other logistical activities must be brought to the attention of the operator and other craft areas, in particular the user craft. They must therefore be scheduled and provisional installation and removal dates must be specified. Requests must be incorporated into the 5-week schedule and into the outage project;
- The S.T.L.N. is in charge of examining the relevance of requests made by the various crafts and suggesting alternative solutions. It ensures that economic and technical decisions comply with the plant's objectives in terms of duration, budget and dose rate, particularly that of contractors;
- The S.T.L.N. is in charge of controlling the technical quality of scaffolding. It ensures that scaffolding complies with risk analyses and other industrial safety references. Specific checks are carried out on countermeasures and other precautions that may have been taken;
- The S.T.L.N. is responsible for the administrative work associated with the installation and removal of scaffolding. This work is performed in keeping with the scheduled dates of installation and removal and is recorded in mandatory industrial safety registers;
- In addition to their industrial safety responsibilities (CO/SR 014), the user crafts also have to ensure that the logistical resources allotted to their work site are kept intact and in good condition until normal operation is resumed. Any deviations must be reported to the S.T.L.N.;
- All logistical activities (scaffolding and other resources) are carried out in response to certain needs; it is therefore up to the user crafts to inform the S.T.L.N. of the exact period for which the resources will be required.

This organizational structure is coming into force as of the Unit 1 outage in April 1999.

## **IAEA Comments**

The plant programme for scaffolding should be able to adequately address the issue. A proper system for analyzing, checking and authorizing the application of a scaffoldings in the plant exists. However, when reviewing a scaffolding installed in the field under this control, it was noted that several abnormalities in the installation existed. The plant should strive for improvement in the implementation of this new policy on scaffolding.

**Conclusion:** Satisfactory progress to date.

## 4.6. MATERIAL CONDITIONS

**4.6.(1) Issue:** Material condition problems are evident on safety systems and generally throughout the plant. In a sample of significant material condition defects many were found not to be captured by the work control system (SYGMA). Contributing to the lack of identification of defects is that plant deficiency tags are not used, therefore making it difficult for the operators to know what defects have been identified and reported. Some station departments also had difficulty in using the current work control system SYGMA thereby preventing the plant from having an accurate measure of the backlog of maintenance.

Many examples of material condition problems on safety systems were identified. Of the nine checked, only one has a work request issued. Examples are as follows:

- Leak of the antifrost coolant just above cylinder head B8 of DG train B Unit 3:(residual chemical additive around the flanges and screws close to the leak). No work request exists;
- Small lube oil leaks on the cylinder heads with handwritten identification as A6,B2,B4, and B5. No work request exists;
- Unit 3, controlled area, closed to the primary make up feedwater pumps, indication of boron leak in the flange of the stop valve 3REA 052 VB. No work request exists.

Many examples of the material condition problems on badly corroded systems were noted. All of the eight that were checked had a work request issued. Examples are as follows:

- Unit 2, CFI 031 TF surface of rotating drum filter, excessive corrosion. OI NO134436;
- Unit 1, CFI significant corrosion on metallic supports of resin piping for sump drain lines in rotating drum filter. OI NO 143905, DI 00342816;
- Unit 3, erosion and corrosion on SER, SEI, and SED piping. DI 00365548.

While it is recognized that a programme is in place to deal with corrosion problems. there are still substantial amounts of badly corroded equipment in the plant.

Many examples of other mechanical and electrical material condition problems were identified. None of the ten that were checked had work orders issued. Some examples are:

- Unit 1, turbine building, close to the column 08 levels 4, 5, cable not properly mounted and not connected;
- Unit 3, main steam line building, around containment, piping thermal insulation was found damaged, indicating that it was stepped on to gain access to other equipment;
- Unit 1, turbine building, EHC oil leak close to the right intercept valve BD2 with oil leak (the leak was collected by a metal tray);

- Unit 1, feedwater pump #1 large amount of dirt and debris and several water leaks.

Poor material condition can result in long term deterioration of important plant systems decreasing their availability and reliability.

**Recommendation:** A programme should be established to ensure that material condition deficiencies are identified and corrected in a timely manner to maintain and ensure safe operation, availability and reliability of the plant.

### **Plant response/action:**

A field deficiency tagging system has been set in place. It is designed to identify problems associated with material condition, housekeeping and industrial safety, by having labels attached to the equipment concerned. Each label is associated with a work request (DI) which is created in the maintenance management computer application SYGMA. See 3.5.1 .

At the daily plant operations review meeting attended by representatives of the operations and maintenance departments, the work requests issued during the day for a particular unit are prioritized and approved.

Work backlog analysis has been improved by using performance indicators which are common to all maintenance departments and which specify work requests issued by the operations departments in order to differentiate them from those issued by the other crafts for specific purposes (construction of scaffolding, disconnection of equipment, cleaning, etc.). This approach is designed to improve the sorting process in the work request database and provide a better idea of the workload directly associated with plant housekeeping.

Taken from SYGMA, these monthly indicators include:

- The number of work requests received and those closed out over the past month;
- The number of work requests issued by the operations department over the past month;
- The number of work orders being analysed by the department.

In addition, the plant is pursuing its efforts to combat corrosion. The Plant Operations Committee (CTE) has decided to open a corrosion case file. This applies to all equipment repair activities. A schedule is drawn up for a period of several years and the case coordinator regularly submits a progress report to the Plant Operations Committee.

Measures to combat corrosion while performing daily maintenance activities must be taken by the departments in charge of these activities.

The following priority work sites are scheduled for 1999:

- Pump house with repair work to support columns and piping (circulating water filtration system and circulating water treatment system);
- Auxiliary transformers;
- Containment penetration lines (containment leakoff monitoring system) (expert appraisal and repair);
- Start of repairs to turbine hall roofing.

### **IAEA Comments**

The plant has implemented several initiatives to better control and resolve equipment deficiencies. These include; improved tracking of deficiency reports and work permits, including the use of several indicators based on the information contained in SYGMA, wider involvement of operations and maintenance supervisors and staff in deficiencies repair scheduling, identification of deficiencies in the field through the use of green cards; a corrosion action plan with noticeable results in containment penetrations and transformers; and implementation of a fast repair group for small and not safety related deficiencies. The implementation of most of these initiatives was quite recent and assessment of their effectiveness was not yet possible.

Some improvements in material condition were noted by the team. However, the OSART mission occurred 18 month ago, and improvements in material conditions, other than the corrosion action plan is taking a long time to reach the desired level. Lasting oil leaks in several equipments can be seen (e.g. main turbine, diesel generators, charging pumps); turbine driven feedwater pumps continue to be in degraded conditions, noticeably in Unit 4; equipment grounding cables can be seem disconnected throughout the plant; cables that are cut with terminals not protected nor identified; damaged thermal insulation and non-authorized handwritten markups on equipment to facilitate disassemble and reassemble. In addition, the number of green cards applied in the field to identify deficiencies is small, and still does not sufficiently help to easily identify if a deficiency has or has not been reported. The plant is encouraged to be more aggressive in the programme implementation to achieve clearer positive results in enhancing plant material conditions.

**Conclusion:** Satisfactory progress to date.

## 5. TECHNICAL SUPPORT

### 5.1. ORGANIZATION AND FUNCTIONS

The organizational structure is defined and understood although complex because of the scattering of the technical support responsibilities over different departments and sections of the site and the major influence and impact of the corporate level on technical support matters. The interfaces are numerous, but are defined and workable. Nuclear safety is the stated first priority of the engineering department and of the sections active in technical support functions.

The plant engineering department, engineering advisor and the different sections dealing with technical support matters, do not have specific performance indicators that are trended on a periodic basis, so it is difficult to analyze the progress towards the goals that were set.

### 5.2. SURVEILLANCE PROGRAMME

An adequate surveillance programme for safety related equipment exists and is derived from the general corporate rules. A technical interdisciplinary surveillance test work group validates the local programme and resolves issues. Whenever there is a difference between the general (corporate established) operating rules and the plant specific parameters, a deviation sheet (Fiche d'Ecart) is written by the safety and quality department (SSQ) that is submitted to the corporate UNIPE and has to be approved by the safety authorities.

The site surveillance plan for safety related equipment clearly points out the responsible section and can be accessed on the computer network. The organization, planning and execution of the surveillance tests in the sections is done effectively. Malfunctions detected during testing are the subject of a safety analysis followed by the appropriate action.

However, a trending or monitoring programme for the operations surveillance test results does not exist. Also, the execution of the operations surveillance tests needs some improvement in several areas. Handwritten changes to test procedures are not always independently reviewed, some changes are made in an unauthorized manner (e.g. pencil, correction fluid), the tolerance for the expected results is not always indicated and the time to implement handwritten changes takes in some cases longer than five months. The team recommended the installation and implementation of a programme to trend and monitor critical parameters of safety related equipment and use this information to detect and correct early degradation.

The implementation of the surveillance tests in the automation department is done in a professional way and the maintenance section does the trending of vibration monitoring.

Risk analyses are in place and used in various departments (automation & testing, maintenance and operations) for infrequently performed tests, line-ups or interventions. Although they have only been introduced recently in the operations department, they increase the awareness and further development will enhance the quality and reduce risks.

### 5.3. OPERATIONAL EXPERIENCE FEEDBACK (OEF) SYSTEM

In-house nuclear safety related events or incidents are analyzed and fed into the SAPHIR database that is common to all French NPPs. This allows effective experience feedback between the French NPPs. Some examples were seen where the experience feedback of other French NPPs led to changes in procedures. Paluel site has developed some practical PSA (EPS: Etudes Probabilistes de Sûreté) applications to analyze some selected safety related incidents.

In 1997, a total of 923 events were reported at Paluel site. However, most of these events concern STE (technical specifications) unavailabilities, even when they were planned. Human related anomalies/incidents, near misses or industrial safety problems are, in general, not reported into SAPHIR although reporting, collecting, analyzing and trending these events could give more insight in the problems of the plant. The root cause analysis performed on the significant incidents (41 in 1997) and other major incidents concerning availability and safety show however that 80% of the root causes are human factors related.

Although the mean time to analyze the significant incidents decreased in 1997 from 100 days in the beginning of the year to 69 days at the end of the year, it is still higher than the objective of 60 days. The team recommended to lower the threshold for reporting human factors events or incidents and to perform the root cause analysis of nuclear safety related incidents/events in a more timely manner.

The corrective actions from the root cause analysis are managed on a punch list which contains some 110 actions. The priorities given to these actions are not clear and may be in conflict with other action plans and initiatives taken in the different committees.

A corporate organization screens all the events that are available on the SAPHIR system and the foreign events. In 1997, only 36 foreign incidents or publications were analyzed by the corporate service and those regard only "technical" and not "human factor" incidents. International human factors related incidents are not reported to Paluel site. The analysis of the corporate service is not always done in a timely manner. For example, an important report associated with reactor cores was issued by the industry in November 1996 that was still being analyzed by the corporate service.

In 1997, the corporate service selected 830 incidents (national and international) that could be of interest to the French NPPs, 802 of them were of French origin with only 28 from international sources. At Paluel site, the applicability to the site is discussed every two weeks in an interdisciplinary CII workgroup. When an event is selected, a section conducts the plant specific analysis and suggests corrective actions. The station workers in general do not receive direct experience of external information but are informed of the corrective measures taken.

For 1997, Paluel site selected 98 of the 830 incidents for further on-site treatment, only one of the incidents was of foreign origin (incident in Diablo Canyon: deformation of piping caused by the use of ice plug). Although Paluel site has some problems with incomplete control rod insertion, a relevant incident on the list (incident in Doel NPP, 14 June 1996) was not selected by the CII work group. The team recommended the timely analysis and use of relevant industry experience.

#### 5.4. PLANT MODIFICATION SYSTEM

The modifications consist of two groups, corporate (national) modifications for the series of the 1300 MW plants and local modifications (only done on one or more units at Paluel). The corporate modifications, for example the '93 batch which consists of about 100 modifications, are first introduced on one unit and after experience feedback, they are implemented on the other plants of the same series. For the local as well as for the corporate modifications, the interdisciplinary on-site joint team (équipe commune) plays an important role, either as an engineer in the implementation of the national modifications or as the responsible management group for local modifications.

The modifications in the different departments are adequately managed and controlled. However, indicators to monitor the modification process at the site could be improved as the site is now unable to adequately assess the progress of the modification process. For example, trending is not done to monitor the time delays during the different stages of the process, some quality indicators (C1, C2, B3) to monitor how well the preparation and implementation of the modifications is done are only used at the corporate level. The number of non-conformity reports and anomaly sheets generated by a modification are not trended. No trending is done on the incidents due to modifications or on the faults detected during testing or on the review of modifications due to the experience feedback.

The DMPs (temporary modifications) with a lifetime smaller than one cycle and the MPA (I&C provisional modifications) which are introduced before the permanent modification is implemented, are controlled and managed in an appropriate way.

The software tool that the operations department uses to manage the modification dossiers is effective and supplies a quick overview of all the operations documents that have to be changed due to a modification. Operations is however not always aware of changes to the control room documentation that are not under their control (for example: technical specifications, accident procedures).

In the plant, preparation activities were found for the implementation of some modifications that could create hazards in the case of fire or flooding (for example; in room LA0355 of the RCA of Unit 2 ventilation ducts were lying on the pathway, ventilation equipment near the ECCS pumps in the BAN (Nuclear Auxiliary Building) of Unit 3 was not secured and problems were observed with the placement of scaffolding).

#### 5.5. REACTOR ENGINEERING

The corporate UNIPE BC (Branche Combustible) is performing most of the reactor engineering tasks as a service to the French NPPs. For instance, the loading pattern for the new fuel cycle, the safety analysis, the calculation codes, the start up dossier and the start up tests are prepared by UNIPE BC.

In order to transfer more responsibility to the plants, the corporate management decided in 1996 that every site should install a neutronics engineer who acts as an interface between the corporate level and the site. In Paluel, this function was filled in 1997 and it will enable the plant to gain more competence in the field of reactor engineering and increase the plant's ownership in order to assume more responsibilities in the field of reactor engineering.



Plans to provide classroom and simulator training on the start-up tests after refueling to both the performers of the tests and the reactor operators will increase awareness and responsibility.

The team saw opportunities for improvement in the application of and management reinforcement of a questioning attitude in a few instances when decisions were required in safety related areas.

## 5.6. FUEL HANDLING

In general, the organization of fuel inspection, manipulation and storage is clear and controlled. However some improvements could be made during implementation. For example, the unloading and loading sequences of fuel elements during the refueling campaign of 1997 at Unit 1 showed some missing signatures and during visits at the fuel pool area of Unit 1, some housekeeping problems were identified.

## 5.7. SAFETY RELATED COMPUTER APPLICATIONS

The organization and responsibilities between the corporate level and the site are well defined. All changes to levels or parameters on safety related computer applications are well controlled and verified. The site does not trend the availability of the computer applications but is planning to do so in the near future.

The site uses some in-house developed but not formally qualified software tools to calculate safety related parameters. A software tool which is used in the calculation of the RCS flow has not been qualified. This value is used to set the reactor trip levels on low RCS flow. Additionally, there is no formal proof of the verification of the database of the enthalpy values and there is no periodic manual verification of the correct results. The site has made up a list that contains 16 non-controlled software applications and an action plan is to be developed. The team recommended that the software tools that are used to calculate safety related parameters be adequately controlled and verified.

## **STATUS AT OSART FOLLOW-UP VISIT**

In general, good progress has been made on Technical Support issues. Of the four recommendations, three have made satisfactory progress and one was found to be resolved.

Good progress was found in the development of a system, WINSERVIR, to capture and monitor, for trending purposes, plant surveillance data. In fact this approach has been extended to separately trend neutronics data which is of vital importance to support the long term viability and safety of the 1300 MW reactor family.

Another issue related to the reduction of significant operating events and the Rigor in Operation intent was an issue to improve the timeliness of root cause analysis and to reduce the threshold of reporting to capture the human factor contribution to events. This issue has been resolved with an additional suggestion that tracking of actions arising from the new human factors analysis could improve matters.

Satisfactory progress has been made to expand the comparison of experience of nuclear operating events from international sources and within EDF provided by Corporate Departments. For plant specific events on LWRs there is significant progress in feedback and there is support for

international exchanges and workshops. However it is suggested that much more could be learned from the totality of nuclear operating experience in non plant specific matters such as plant management, supervision, human factor contributions to all events especially maintenance and operation, and radiological issues. Broad scanning of such information could enhance the current systems.

The program to control software tools that are used in calculating safety related parameters is well advanced and satisfactory progress was made on that issue.

## DETAILED TECHNICAL SUPPORT FINDINGS

### 5.2. SURVEILLANCE PROGRAMME

**5.2.(1) Issue:** Critical information to monitor or trend the performance of safety related equipment is not gathered during the implementation of the surveillance programme in operations. Also noted were examples of lack of strict control of the content of the operations surveillance procedures and lack of timely update of procedures.

Lack of trending and monitoring of critical parameters can prevent early detection of degradation of safety related equipment.

**Recommendation:** A programme to trend and monitor critical parameters of safety related equipment should be developed and implemented and this information used to detect and correct early degradation.

#### **Plant response/action:**

The plant has developed a number of strategies in order to trend critical parameters of safety-related equipment.

#### Trending of surveillance test results:

An organisational structure is being implemented in order to trend surveillance test results. It is described in memo NA 251 of the plant quality assurance manual. Surveillance test results pertaining to safety-related equipment are captured in the WINSER database. This database is used to trend these parameters over a period of time and detect possible drifts. In the event of an anomaly, the relevant departments perform an additional analysis in accordance with the standard procedure for processing anomalies. The software is scheduled to be installed in June 1999, and will be put into operation in the following months.

#### Trending of neutronic parameters:

As part of the local action plan to monitor reactor cores in operation, the neutronics engineer has implemented a trend analysis of neutronics parameters, as described below:

- Daily trending (reading and calculation) of parameters indicating the unit's load-following capacity. This data alerts the operators before they reach thresholds which, if exceeded, would result in non-compliance with Technical Specifications. This action, described in technical memo NT/ES 037, was implemented in response to neutronics experience feedback;
- Furthermore, in an effort to improve reactor control, changes to operating parameters are trended over a period of time and compared with the provisional theoretical curve established by EDF/UNIPE. A monthly analysis is conducted in order to forecast and optimise subsequent core loading patterns;

- The critical boron concentration trend is indicative of the natural cycle length. The shift manager uses this curve to conduct a reactivity review as a backup to the one carried out by the operator;
- Corporate case file AP 9703 deals with the potential consequences resulting from a blocked shutdown control rod assembly in a distorted fuel element. This phenomenon concerns all Paluel Units and Unit 3 in particular. The drop time of all control rod assemblies is systematically measured at least 3 times per cycle in order to trend this safety-related parameter. The frequency of these checks depends on test results.

Monthly printouts of these parameters (critical boron concentration, A and K coefficients, control rod drop time) are sent to the various craft departments, shift managers and safety engineers.

The advantage of trending these parameters lies in the ability to optimise reactor control and performance, and to alert the operator before reaching a critical zone on a relatively long-term basis.

#### Trending of mechanical parameters:

Vibration levels are trended as part of the basic preventive maintenance programme, on approximately 80 items of equipment per unit (pumps, fans, etc.).

Vibratory speed and displacement are trended for a specific period of time, depending on each item of equipment (approximately 3 months on average).

Data is captured by means of a vibration sensor. A vibration-monitoring software program (GALILEE) is used for safety-related equipment. This program compares readings taken under normal conditions with alarm and shutdown values. Any changes recorded with regard to normal conditions are analysed by the maintenance departments and may give rise to preventive maintenance work.

#### Functional analysis:

In addition to the above-mentioned analyses performed by the line management departments, the site Engineering Department also carries out a functional analysis in order to forecast equipment behaviour in the longer term.

This type of analysis includes an inventory and assessment of equipment unavailability, as well as the respective cause and duration. Conducted once a year, the analysis is submitted to the Plant Operations Technical Committee. Together with the functional reliability review, it is a means of determining equipment behaviour and can eventually be used to improve on local and corporate maintenance programmes, with the participation of the corporate engineering departments.

Functional analysis is currently performed for the auxiliary feedwater system (ASG) and the emergency power supply systems (LHP, LHQ, LHT, LLS).

It has also served to justify the operating and maintenance methods employed for these systems, and has helped identify specific areas where monitoring is required on a more regular basis (ASG pumps, diesel vibrations).

Furthermore, Paluel NPP will be co-ordinating an experience feedback seminar on the subject of functional and trend analysis in May 1999.

## **IAEA Comments**

A good effort has been made in setting up systems to monitor and trend the safety significant parameters. Routine surveillance data can now be captured in the WINSERVIR database. Engineering staff have been trained in its use and the documentation needed to implement it are in the process of being changed. This program is on target for useful data feedback in the later part of 1999.

The use of System Engineers to analyze such data has been proposed based on other station experience and if implemented would be a first for EDF.

Separately, neutronics data trends are now available and have been in operation for twelve months. In addition, the system of vibration condition monitoring on rotational equipment has been improved with graphical and frequency spectrum analysis, enabling the early detection of plant deterioration. Completion and implementation of these programs should resolve the issue.

It is noted that work to propose changes in the threshold settings of start-up protection equipment is proceeding conservatively in advance of corporate proposals and clearance by the safety authority.

**Conclusion:** Satisfactory progress to date.

### 5.3. OPERATIONAL EXPERIENCE FEEDBACK (OEF) SYSTEM

**5.3.(1) Issue:** The in-house operational feedback (OEF) programme does not capture human factors related issues and the time delay to perform root cause analysis is substantial. Most of the events reported to the network system SAPHIR are technical specification unavailabilities (for example the surveillance test T2 LIN on 14/01/98 at Unit 4 placed some logic out of service and was reported into the system). Human factors related events, near misses and industrial safety problems are, in general, not reported to the system. Reporting, collecting, analyzing and trending these events could give additional insight into the problems of the plant (for example, the operations department was not aware of the number of control room operator errors). Contributing to this, 80 percent of the root causes of the 41 significant incidents of 1997 were human factors related.

The time delay in conducting the root cause analysis of the significant incidents decreased from an average of 100 days at the beginning of 1997 to 69 days at the end. The goal is 60 days which is considered as high when compared to international standards.

Lack of a fully effective in-house experience feedback process could result in the failure to learn from experience and lead to actions plans that are not addressing the real problems of the site.

**Recommendation:** The in-house operational feedback (OEF) programme should be improved by lowering the threshold to report the human factors related incidents and performing the root cause analysis in a timely manner.

#### **Plant response/action:**

##### Time taken for processing significant operating events (CRIS):

The 1998 Nuclear Safety report (RA/AS-123) presents results obtained by the plant in the area of nuclear safety. In 1998, 44 significant operating events were reported, with the average processing time of 69 days by the end of 1997 dropping to 60 days by the end of 1998 and decreasing further to 58 days by February 1999, despite a slight increase in the number of events. 80% of these events are human-factor (HF) related, a fact that has led to a significant improvement in the associated analyses.

##### Organisational principles: lowering the threshold for performing Human Factor analyses on safety-related events

Human factor analyses are now formally incorporated into our significant operating event reports and plant operating event reports. In 1997, a human factor analysis was performed for each of 40 events. In addition, 1000 safety-related events were entered into the system, and no mention is made of human factor analysis on the corresponding SAPHIR sheets. These 1000 sheets are a valuable source of information for nuclear safety. As a result the site set up an organization to deal with these events from a human factor perspective. This organization is described in technical memorandum NT/ING 356.

### General implementation principles:

A simple system adapted to the process already in place for OEF processing with namely no action plan associated with each event.

The HF analysis process consists of three phases:

A – detection

B – analysis and classification

C – use of data

#### A - detection

The system put forward provides us with a redundant means of determining whether or not a safety-related event has a human factor element as a cause. The detectors' level of professionalism (knowledge of the plant, of the organisational structure, of work practices,) enable them to distinguish human-factor related events from those brought on by simple equipment failure or external causes, without having to conduct a detailed analysis and with an acceptable margin of error.

To be fully effective, detection takes place as close to the action as possible, in terms of time, place and craft.

#### B – analysis and classification

Analysis must remain brief and, most importantly, result in a classification being made into one of seven primary HF groups:

1. Individual behaviour
2. Skills of players involved
3. Organisation
4. Communication
5. Man-machine interface
6. Documentation and computer aids
7. Conditions in the work place

This phase of the analysis may require discussion with the people involved. This should not take place too long after the event's occurrence. At this level, a sound knowledge of the craft, its associated working methods and a human factor culture are necessary.

#### C - Use of data

Action plans are consolidated using the data collected from the HF classification groupings. This data is used to provide concrete examples during self-diagnosis sessions, while the HF network and managerial staff use statistical trend analyses of similar events to prioritise their actions.

## Flowchart and players involved

Taking into account the above-mentioned principles and the current situation, the process is as follows:

### Detection

95 percent of all report sheets are currently opened by the operations department (operators or shift supervisors). In addition, the shift manager and safety engineer systematically meet in order to examine events classified under Group 1 in Technical Specifications. Thanks to the combined perspectives of the shift operations manager and safety engineer, the HF aspect of a safety-related event can be assessed almost immediately. This is done on a formal basis for safety-related events belonging to group 1 only. Filling in a HF section (yes/no) on the SAPHIR sheet ensures traceability of HF detection.

### Analysis

The analysis is entrusted to a specific department. This department uses the skills of its HF representative to conduct a brief analysis of the event and classify it under the appropriate group.

### Tracking

The Technical Co-ordination department is currently responsible for administrative tracking. Every Tuesday after the Plant Operations Review Committee meeting, SAPHIR sheets issued over the past week are reviewed in the presence of a representative from the HF network and the various crafts, in order to ensure consistency in detection criteria, analysis and feedback.

### Processing

At the monthly meetings held by the HF network, a summary is produced of the analyses and trends obtained from the results of the above-described process.

Discussions are held within the HF network in order to gain a better understanding of the trends observed.

Depending on the significance attributed to a particular trend by the HF network and on the time scale in question, the summary concerns itself primarily with:

- Ensuring that the plant has the appropriate resources for processing the data;
- Proposing actions in order to rectify any identified deviations. For example:
  - assimilation and discussion of data within the work teams during self-diagnosis (or other) sessions;
  - incorporation into safety culture sessions;
  - incorporation into existing training modules, or development of new ones;
  - incorporation of working methods (line-ups, etc.).



The human factor consultant submits these proposals to the head of the safety and quality advisory unit for approval and possible implementation in the future.

This organisation allows human factor analysis to be extended to include all safety-related events (category 'EIS'), whereas until 1998 this type of analysis was limited to significant operating events and plant operating events (categories CRIS and CRIL respectively).

### **IAEA Comments**

Good efforts have been made to implement proposals seen at the time of the OSART and to improve the time taken for root cause analysis. A Human Factors (HF) Network has been established and the Human Factors "Platform", a senior team performance group, is now working with increasing involvement of members of the Plant Management Committee, which is vital if this approach is to succeed. The involvement of a staff member outside of management could significantly enhance ownership of this system.

A new system of "Self Diagnosis" for teams to draw out human factor improvements has been implemented and this appears to be increasing the involvement of team members. This has been introduced from other plants but has been extended to maintenance teams for the first time in EDF.

Event analysis involving a human factor viewpoint is now available and has been used in a limited number of significant events based on a decision by plant management. The near miss events are reviewed by the HF Counterpart with line management and actions agreed. However, the agreed actions are only tracked for significant events and not yet for near misses. If this last part of the process were included this could significantly enhance the programme.

**Conclusion:** Issue resolved.

**5.3.(2) Issue:** International operating experience is not analyzed in a timely manner and feedback to the site only consists of a fraction of the available experience. Incidents that are human factors or organization related are, in general, not analyzed. Only 36 international incidents in 1997 of technical origin were analyzed by the corporate service, 28 of these analyses were made available to the French NPPs in 1997. From that list, the interdisciplinary work group CII from Paluel has selected only one for further analyses. That list contains however an incident with incomplete control rod insertion (14 June 1997: incomplete control rod insertion). Although Paluel has some problems with control rod insertion, this incident was not selected.

The analysis of the international reports is not always done in a timely manner. For example, an important report associated with reactor cores was issued by the industry in November 1996 that was still being analyzed by the corporate service. Appropriate staff at the plant are not aware of its existence in spite of the recommended immediate attention condition of the report.

Non-effective use of external experience could lead to avoidable incidents and could lead to a lagging behind the rest of the nuclear industry in the development of improvements to programmes, processes and equipment.

**Recommendation:** Industry operating experience should be analyzed in a timely manner and the site should receive and analyze relevant information and utilize it to improve plant performance.

### **Plant response/action:**

The operation of EDF nuclear power plants, which are among the biggest in the world, involves the total mastery of applied technical solutions and the effective exchange of international experience with our foreign counterparts, through the intermediary of OEF-gathering agencies and twinning operations to which EDF is committed.

Consequently, the rational and effective use of international data should contribute to enhancing the nuclear safety standards of our plants.

### Event-related experience feedback

The standardisation of EDF nuclear power plants (plant series, consistent modification batches) is a cornerstone of reactor safety. It is therefore of prime importance that EDF gives priority treatment to experience feedback from events occurring on its own plants, and that it draws conclusions enabling it to aim for the highest nuclear safety standards. This principle was mentioned by the Head of the Nuclear Installations Safety Directorate (DSIN) at the Paluel OSART exit meeting. Experience feedback is processed by means of computer applications (such as SAPHIR), on-site organisations (CII) and structures set up by the Corporate Resources Department (CID, OEF Committee, Corporate Cases, Corporate Analyses, etc.).

Furthermore, EDF also examines events occurring on nuclear power plants abroad. In an effort to rationalise and ensure the consistency of international experience feedback, its analysis is entrusted to the Corporate Resources Group and co-ordinated by the Corporate Plant Co-ordination Department. Data from these events is obtained through a number of information channels common to all nuclear operators, such as WANO and INPO. When these organisations receive data that could supplement EDF's store of information, the respective events and assessments are generally incorporated into Corporate Cases or Analyses dealing with a similar issue. In such a case, certain international events would form a complete corporate analysis file if EDF considered the event to be of sufficient interest (e.g. corporate analysis following the massive inflow of grass at Salem).

Plants are informed of international events via the CID network, which selects the most interesting events and provides plants with a copy of the corresponding report. Processed at corporate level, these events are subjected to a literal analysis at plant level. Three of them have been selected by the site's external OEF-processing group (CII). However, the plant does produce an annual international event report with a view to providing staff with concise information: for 1998, copies of technical memorandum NT/ING 363, including 45 OEF sheets (FIREX) initially analysed at corporate level, were widely distributed.

#### Other activities

As part of its effort to open up to international experience, the plant has signed twinning agreements with nuclear operators abroad. Two active twinning programmes are currently up and running, one with Byron NPP (USA) and the other with Balokovo NPP (Russia). To give an example, visits to Byron were arranged in 1997 in order to observe good scheduling and housekeeping practices. In 1998, a plant engineer completed a two-week training course at Byron as part of an exchange in condition-based maintenance practices. Other visits focusing on operations and maintenance are being planned. The experience feedback gleaned from these exchanges is then made available to the plant (presentations at management and supervisory staff meetings, for example).

Managers regularly attend NUMEX conferences where they have the opportunity to meet with counterparts from other plants and exchange information on their respective operating practices.

In addition, Paluel staff members regularly participate in Peer Reviews and Overall Safety Reviews (EGS). Information gleaned from these reviews is fed back to plant managerial staff. Overall Safety Reviews conducted by the EDF Safety Inspectorate are also an area where the plant has made progress.

#### **IAEA Comments**

Progress has been made on the analysis of international operating experience for those events identified by the plant and corporate departments who have increased the number of such events from 28 in 1997 to 45 in 1998. Of these, Paluel staff have selected several for further analysis themselves to add to the guidance given by corporate departments. Of particular note was a possible personnel safety related risk from high voltage circuit breakers.

The plant staff have started to scan for themselves technically related feedback from NUMEX reports. However aspects of international events related to radiological safety, human factors,

industrial safety not of the same plant type as Paluel, which are available directly through WANO as an example, are not available to Paluel staff for their own analysis of relevance. If broad scanning of this material was added to the feedback program this could further enhance the programme.

Of specific relevance to this issue was the investigation of the experience of reactor cores and the recalculation of protection thresholds which was being considered by corporate departments. Paluel staff have themselves now proposed a conservative approach to this problem verified by corporate departments to resolve the matter.

Parallel interest to learn from others has been demonstrated by the involvement by Paluel staff in visits, missions, and evaluations to other plants and site workshops with international participants carried out at Paluel. These have not only involved the nuclear industry but also the petrochemical industry with companies that are acknowledged as improving in conventional safety matters.

**Conclusion:** Satisfactory progress to date.

## 5.5. REACTOR ENGINEERING

**5.5.(1) Issue:** The site uses in-house-made software tools to calculate reactor trip levels that are not properly controlled and verified. For example, to calculate the RCS flow (procedure RCP114) from the temperature and the power readings, the site uses an in-house-made software tool. The calculated RCS flows are used to set the reactor trip levels by low RCS flow. The programme contains also a database of enthalpy values.

The software tool has not been qualified, there is no formal proof of the verification of the database of the enthalpy values and there is no (periodic) manual verification of the correct results.

Use of uncontrolled software tools can lead to errors in the trip levels and affect nuclear safety.

**Recommendation:** Software tools to calculate safety related parameters should be adequately controlled and verified.

### **Plant response/action:**

At EDF corporate level, quality assurance regulations governing computer applications used for quality-controlled activities are laid out in two prescriptive documents:

- Instruction 26: this document stipulates the quality assurance regulations to be applied to all phases of the development, use and upgrading of safety-related computer applications;
- Directive 64: this document sets out the requirements for compiling and monitoring data used in the computer applications, which, in the event of inaccuracy, could put nuclear safety at an unacceptable risk. This data is referred to as 'sensitive data'.

Principles and responsibilities pertaining to computer software quality assurance are described in a memorandum (NA222) included in the plant's Quality Assurance Manual.

On-site responsibilities for the ownership and approval of data contained in the data bases used on the plant are described in a memorandum (NA179) included in the plant's Quality Assurance Manual.

### Organisational principles

The Information Systems department compiles an inventory of all plant and corporate computer applications. The remaining departments compile an inventory of software packages and computerised tools. For each computer application being used on the site, one department is responsible for each of the following phases:

- Writing up of specifications (owner);
- Development of the application and verification of its technical compliance (contractor);
- Testing, approval of specifications and qualification for industrial use (owner);

- Specifics for the use of the computer application within the organisation (user departments).

The impact on the safety of the installations is assessed and computer applications are classified as level 1, 2, 3 or NCS:

- 1 – Risk of an accident classified under category 3 or 4.
- 2 – Risk of failure to comply with technical specifications.
- 3 – Risk of failure to comply with a quality assurance requirement.

NCS – computer applications having no impact on nuclear safety, or that are backed up by an effective result-monitoring system, are ‘non-safety classified’.

For computer applications classified as level 1, 2 or 3, the owner department must perform a risk analysis and define countermeasures to be set in place on the site.

The organisational structure set up by the plant was presented and explained to information system representatives from each department (October 1998) and to members of the plant management committee (November 1988). Each department ensures that its staff is aware of the quality assurance requirements pertaining to computer applications.

The following is a summary of the progress to date:

#### Computer applications used by crafts involved in the process

In the course of 1998, priority was given to compiling an inventory and ensuring the compliance of computer applications used by crafts involved in the process (I&C, Testing, Operations, Chemistry). This inventory included both corporate and plant applications as well as software packages.

A total of 23 computer applications were identified. On 05/03/99, the situation stood as follows:

- Computer applications have been abandoned or will be very soon (by the end of 1999);
- Computer applications are not safety-classified (the others are);
- A risk analysis has been completed for 1 computer application;
- For other computer applications classified as level 2 or 3 (8 in total), analyses are in progress and will be completed by the end of 1999. In the interim, specific measures have been taken (alternative hard-copy procedure, etc.);
- With regard to procedure RCP 114, the associated plant application has been classified as level 2 (risk of failure to comply with Technical Specifications), as defined by IN 26; and
- As a result, a risk analysis is in progress and the appropriate measures will be taken to deal with the risks identified.

### Computer applications developed at corporate level

On-site studies to determine the adaptability of corporate risk analyses are carried out once the computer application is installed on the site (new computer application, significantly upgraded application) or when the corporate organisation performs an overall risk analysis (to absorb its deficit).

### Computer applications developed by the plant

All new computer applications developed by the plant are subject to the measures defined in the site organisational structure.

As far as existing computer applications are concerned, the analyses will be completed by the end of 1999.

All local computer applications are tested and qualified during their development phase. In the past, test reports were not formalised and will not be recompiled.

### Software packages and computerised tools

Software packages and computerised tools are distinguished by the fact that they are small items that are developed within a department and used by that department only. Alternatively, they may be tools that are sold in the shops, with a built-in computerised component.

For this type of computer application, each department is responsible for its internal inventory and for ensuring that the application complies with plant organisational requirements. All actions will be completed by the end of 1999.

### **IAEA Comments**

Good progress was been in resolving this issue with a program that had identified 23 software programs which were safety related and which needed to be controlled and only 6 with outstanding actions for completion. Of these, two required action by corporate departments. A plant committee reviewed the classification of safety relevance. To rectify the root cause, a corporate instruction has been introduced to set the standard for control in the future and the whole program is targeted for completion by the end of 1999. It is further suggested that an audit be carried out in 2000 to verify that the system of control is maintained.

**Conclusion:** Satisfactory progress to date.

## 6. RADIATION PROTECTION

### 6.1. ORGANIZATION AND FUNCTIONS

The ALARA principle has been applied within EDF and at Paluel for many years. During the last five years, ALARA work has been intensified. The ALARA principle has been brought up as an important base for all activities involving radiation. Both corporate and local instructions are at hand clearly describing what the ALARA principle implies and how it should be implemented. Efforts have been made to make all staff aware of the requirement of applying the ALARA principle.

The managers in the different departments at the plant have been delegated the full responsibilities of radioprotection. They are supported in this by the risk prevention department (SPR) and the risk prevention committee (CPR). The responsibilities are clearly defined in instructions and are well understood throughout the organization. The assignments and responsibilities of the manager, deputies and foremen in the SPR are clearly described in organizational documents.

Overall radioprotection standards are provided by the EDF head office and are implemented by the SPR at the plant. In case of a need for local standards the SPR is in charge of their development.

Corporate policies, limits, objectives and performance indicators are set by EDF. They are implemented at the plant.

The SPR has recently been reorganized to get all radiation protection staff into one common department. In addition to radioprotection, the common department also has the expertise in industrial safety and fire protection. There is a commitment to the managerial aims and goals in improving the SPR in its duties and progress is already recognized. The SPR staff is believed to be adequate.

The approach to radiation protection activities at the plant are based on cooperation between the concerned parties. The SPR is fully aware of the importance of cooperation with other departments and is working on its establishment. The organizational climate seems to be good, though there is still some need for further work on improving the commitment in applying the ALARA principle in the work management in operational, maintenance and technical service departments.

The SPR is considered as the plants competence in radioprotection and is accordingly given authority to control activities involving radiation and the resources to implement an effective programme. The SPR has been given an independent role within the organization and has the opportunity to communicate directly with the plant manager if needed and is involved in setting policies in this area. The SPR has a staff of 34 people which is adequate.

There are requirements on the qualifications of the staff. Job-rotation within the SPR is an explicit strategy of the SPR to achieve a broad and deep competence. The staff appears to be very capable and confident. Representatives from the SPR take part in the training in radiation protection of plant and contractors personnel.



In 1993 the plant and some local contractors made a commitment towards reinforcing the cooperation in the radiation protection area. The objective was to reduce individual and collective doses. This implies an extensive cooperation in preparing the work according to the ALARA principle. The plant and the contractors have made good progress. The team considers this initiative as a good example of measures to improve the ALARA commitment in work management and decreases in individual as well as collective doses has already been observed among the contractors involved.

## 6.2. RADIATION WORK CONTROL

The plant staff initial basic training in radiation protection is for two weeks at the plant and is believed to be adequate. The contractors have a one week training session arranged by the employer through certified training companies. However, refresher training needs improvement. (see section two of this report)

Training for special tasks is arranged for plant or contractor personnel at the plant or at special facilities in France. There is, for example, a steam generator mock up at the plant for training workers before an outage.

For each job to be performed involving radiation, there is a thorough preparation carried out by assigned persons in the maintenance department in cooperation with the SPR. This results in a written description of the job regarding dose rates, radiation protection measures, expected doses etc. This document is given to the workers who perform the work. This document can if needed be complemented by special training or by advice from the SPR. Samples of documents were reviewed and were found to be consistent with good principles.

As EDF applies the “self protection” policy on workers, the document issued to workers at the plant provides information on the working condition and not on protective measures. Accepting the “self protection” principle and providing the necessary means, the procedures are considered as adequate and are followed. The supervisor and the workers are expected to take necessary measures to be able to perform the work in a safe way following the ALARA principle.

The entries to the radiological controlled area, RCA, are given reasonably good space and clarity. Only small and personal belongings are allowed to be taken into the RCA. When they are taken out through the personnel exit they have to be monitored in a special “box monitor”.

In order to enter the undressing area, personnel must pass through a monitor which alarms at a significantly higher level than the contamination level which is set on the final monitor. In the undressing area, the potentially contaminated clothing and shoes are removed in a random manner with no controlled undressing process to limit the spread of contamination. Personnel then proceed from this area without passing any intermediate step over barrier directly to the final portal monitors. In addition, some workers who frequently visit the RCA remove their potentially contaminated clothing and store it for reuse. The team suggests that the plant consider reevaluating the undressing and monitoring procedures in the zone located immediately before the exit from the RCA.

The boundary of the RCA is marked with green radiation hazard signs. Information on ambient dose rates, hot spot dose rates, date of the measurement and when it should next be made is written on chalk boards at the entrance of the area. These boards are complemented with yellow, orange or red

radiation hazard signs giving information on the conditions for access. Hot spots are marked with special signs.

Areas within the RCA are surveyed regarding dose rates, surface contamination and airborne contamination. The surveys are carried out according to a fixed mapping scheme. The frequency of surveys varies between weekly, monthly and every 6 months depending on the risk assessed. Additional surveys are performed if the situations calls for it.

In many areas in RCAs the floor painting has started to peel off resulting in uncovering of the concrete. This results in a risk of having radioactive material/liquids penetrating the concrete producing radiation hazards and increased rad waste volumes. A programme for restoring around 30000 m<sup>2</sup> of floor surfaces in prioritized areas has recently been decided upon. This work is scheduled to be finished in the year 2000.

Individual contamination checks are performed when leaving a work site where risk of contamination exists. However the contamination pancake monitor in Unit 1 fuel building was found to be not working.

Control of the presence of airborne contamination is made by means of a fixed monitoring system, KRT, in the RCA. Manual air sampling is made based upon need.

### 6.3. INTERNAL RADIATION EXPOSURE

Internal contamination is measured by whole body counting (WBC). Plant staff are checked routinely every six months and contractor staff are checked when arriving and leaving the plant. Additional WBCs are made when needed. On average, 10 000 WBCs are performed per year and about 10 individuals are found to be internally contaminated. The assessed doses to these individuals have been far below 50 mSv.

### 6.4. INSTRUMENTATION, EQUIPMENT AND FACILITIES

The SPR possesses an exceptional number of RP instruments. This is due to the recent reorganization when all RP resources on site were put together.

Maintenance and calibration is performed by a contractor and there are well documented control of the instruments on site. Every instrument is documented with information on maintenance, checks and calibrations. Calibration is performed by the contractor annually. Instruments are checked for good working order monthly by the SPR.

When an instrument is handed out from the SPR store it is not checked for response by the radiation protection technician. The user has an opportunity to check the response of his gamma meter against a source outside the store. When the instrument is given back, the radiation protection technician checks it again before storing it. Instruments are routinely checked to be in order once a month. It is the policy of the plant to not require personnel to use hand held gamma meters in the RCA unless they think it is necessary. The team has observed that hand held gamma meters are not always used by the personnel doing work in the RCA and in cases when this is done, the gamma meter is not always checked to ensure a proper response. The plant should review this process to determine if personnel should always have immediate access to a gamma meter when staying in the RCA and if a

routine should be introduced to ensure that gamma meters are checked to ensure correct response by the radiation protection technician before issue.

The SPR has a sufficient supply of protective equipment and material. The use of protective equipment is part of the plant staff training. The respiratory equipment is controlled as required. Facilities for storage of protective equipment and laundry of protective clothing are adequate in space and well maintained.

## 6.5. PERSONNEL DOSIMETRY

RP instrument and dose measurement equipment are calibrated according to standards required by French regulations which are based on relevant international standards.

In France, the employer is responsible for the dosimetry concerning his employees. Consequently, the contractors are responsible for tracking their doses. The tracking of the contractors individual as well as collective doses during the time the contractor is on site is of course also a concern of the plant.

There are two different dosimetric systems of controlling the individual doses. The first is the legal dosimetry where film dosimeters are used. The second system is the electronic dosimeter system which makes it possible to follow the individual doses currently at the plant. The electronic dosimeter system is connected to the MICADO computer system and the programme is well developed and efficient.

Individual as well as collective doses are available in “real time” in the MICADO system during an outage. It is in the interest of the supervisors/managers to control the results as dose control is included as an objective in both job preparation and in management contracts.

The medical service at the plant is in charge of dose assessments in case of an internal contamination. The assessments are made by means of their own capabilities and support from specialized laboratories. The procedures are at hand and arrangements in place for the support.

If any unusual events occur an evaluation is made. All events of importance are evaluated in order to understand what happen and why. The results are documented in reports.

## 6.6. RADIOACTIVE WASTE, STORAGE AND DISCHARGES

Objectives regarding the annual volume of solid radioactive waste are part of the plant management contract. However there is hardly any difference between the objectives for 1997 and 1998 and the team was able to identify opportunities to reduce solid radioactive waste, indicating that the objective could have been more challenging.

The storage of solid radioactive waste is well arranged regarding barriers, shielding and radiation hazard signs in order to minimize exposures of the workers. The area where the waste is treated and sorted is rather small which dictates a very structured way of utilization. Improvements in the utilization may result in additional decreased doses and contamination.

The effectiveness of the management of radioactive waste could be increased if the control of material taken in to RCA and the structure in sorting and processing of solid waste in the waste handling building was improved. The team suggested improvement in this area.

The total annual released radioactive gaseous effluents is normally well controlled, around 1 percent of the limit. The annual amount of radioactive liquid effluents is less than 0.5 percent and the amount of tritium in liquid effluents is less than 50 percent.

Annual objectives are set in the plant management contract, but only on liquid releases. Objectives on gaseous releases are not set because they are considered low already. The latter decision may not truly be in accordance with the ALARA principle.

Each unit has an extensive monitoring system for gaseous effluents from different operational systems and buildings. This enables tracking of the origin of releases.

Environmental control is performed by a comprehensive monitoring programme based on regulations from the authority.

## 6.7. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

Cabinets containing necessary equipment for use in a radiation emergency situation are placed at muster points. The equipment is checked every six months.

France is applying the ICRP standards and is also obliged to apply the EU Basic Safety Standards in the regulations on dose limits for life saving operations.

## **STATUS AT OSART FOLLOW-UP VISIT**

The Risk Prevention Department, working in conjunction with the other plant departments, has made significant progress in addressing the OSART suggestions for improvement in the radiological protection area.

The changes in the physical arrangements at the entrance and exit to the radiological controlled area in Unit 1 combined with the disciplined removal of protective clothing is a noteworthy improvement. This should be of assistance in the plants efforts to minimize the spread of contamination. Implementation of similar changes at the entrance and exits of the other units is recommended as soon as possible. In conjunction with the changes it will be necessary to ensure that personnel strictly follow the newly established procedures. This approach is significantly different than used at many other French plants and may of interest to them in their efforts.

The efforts to minimize radiological waste have also been extensive. The key to success in this area will be completion of the initiatives and compliance with the programmes.

## DETAILED RADIATION PROTECTION FINDINGS

### 6.2. RADIATION WORK CONTROL

**6.2.(1) Issue:** The exiting and the undressing process when leaving the RCA does not minimize the potential for contaminated people reaching the final monitor. The plant relies on the final portal monitor to determine if contamination exists. Good international practice requires that every effort is made to ensure that individuals are free of contamination before the check at the final portal monitor. In addition, in some cases, potentially contaminated clothing is reused for subsequent visits to the RCA.

The plant has a premonitor (C1) which is set at 150 Bq/cm<sup>2</sup> which does not monitor shoe contamination. This is set at a significantly higher level than the final monitor (C2). Personnel must pass through the C1 premonitor to reach the undressing area. Once in the undressing area, the potentially contaminated clothing and shoes are removed in a random manner with no controlled undressing process to limit the spread of potential contamination. Personnel then proceed from this area without passing any intermediate step over barrier to limit the potential for contamination reaching the final portal monitors. They then enter the final portal monitor which is set at 8 Bq/cm<sup>2</sup>. There have been an average been 30 to 40 decontaminations necessary each year as a result of personnel alarming the final portal monitor.

In addition, some workers who frequently visit the RCA remove their potentially contaminated radiation clothing and store it for reuse.

While the final portal monitor is there to ensure that no contamination exits outside the RCA above the allowed levels, undressing and monitoring practices could result in unnecessary spread of contamination in the RCA. It should not be relied on to detect known contamination which can exist right up to the final portal monitor (C2). The practice of reusing clothing inside the RCA which may be potentially contaminated could result in the spread of contamination and personnel skin contamination.

**Suggestion:** The plant should consider reevaluating the undressing and monitoring procedures in the zone located immediately before the exit from the RCA. More disciplined undressing procedures, the use of a step over barrier before reaching the final monitor and discontinuing the reuse of potentially contaminated clothing should be part of this reevaluation.

#### **Plant response/action:**

In 1998, Paluel NPP made the following changes to the procedure for exiting the RCA:

- Creation of a clean area between RCA exit portals C1 and C2;
- A temporary arrangement was put in place during the outage on unit 4 in 1998. Experience feedback shows that the solution is compatible with the RCA exit area.

The undressing procedure has been modified and the route is designed in such a way as to make staff follow it intuitively. After going through portal C1, workers have to perform the following actions in the following order:

1. Remove hard hat and skull cap
2. Deposit small objects
3. Remove shoes
4. Remove gloves
5. Remove coverall
6. Remove T-shirt
7. Remove socks
8. Pass the first step-over barrier
9. Put on slippers
10. Carry out body-check and equipment-check (small objects)
11. Pass the second step-over barrier leading to portal monitor C2

The "clean" area is delineated by partitions and a step-over barrier. Staff can only gain access to it in underwear and slippers (except for the guard stationed there permanently during outage periods, who wears basic gear). Socks are removed at the first step-over barrier.

A body and equipment check (small objects) is performed by means of the MIP 10 frisker before passing the second step-over barrier, which gives access to portal monitor C2.

Furthermore, in keeping with provisional clause no. 51 (Standardisation of procedures for the detection and treatment of contaminated personal effects), staff are systematically required to shower in the cold change-room if the C1 and/or C2 portal monitor alarms are triggered.

Additional measures have been set in place:

- Reinforced checks when exiting the reactor building hatch (body and equipment);
- Lowering of exit monitor alarm thresholds (portal monitor C2);
- Increase in counting time (portal monitor C2 and 'box' monitor for small objects).

The actions described above form part of the plant's radiological cleanliness action plan, derived from corporate directives issued in 1998. This action plan, detailed in the technical memorandum reference NT/SR-384, is based around three main areas:

- Proactive involvement on worksites: strengthening assistance and controls in the field:
  - strengthening RP assistance provided for high risk worksites;
  - field observation visits on worksites coordinated by the 'RP Cleanliness' Safety Prevention Group;
  - inclusion of RP cleanliness in management field tours.
- Training, Informing and Communicating:
  - practical training for EDF workers on good RP worker practices;
  - changes, over time, to the content of SQPR and QSP refresher training courses to include practical aspects and new requirements and RP standards;
  - informing the radworkers in the line management departments;
  - a communication campaign dealing with radiological cleanliness using various existing supports: information memoranda, the plant newsletter, etc.

- Subsequent actions: strengthening the integrity of containment barriers:
  - reactor building exit controls reinforced;
  - R.C.A exits improved and controls reinforced;
  - improved efficiency and material controls at the laundry;
  - plant roadway controls reinforced;
  - new ‘whole body counting’ equipment installed at the plant medical service;
  - plant exits fitted with C3 portals for monitoring individuals and ‘crev’ detection beacons for vehicles.

For carrying through this action plan, the power plant has taken on additional competencies by recruiting a specialist engineer for the Risk Prevention Department.

### **IAEA Comments**

The changes described above were implemented at the entrance and exit to the RCA on Unit 1 prior to the recently completed outage. Based upon the positive experience during that outage, it is planned to implement the changes on the other units prior to their next outage.

Training was also conducted for the plant staff and contractors on radiological practices that included the proper procedures for exiting the RCA. Additional visual guides for undressing sequence are also being prepared.

Observations at the exit of the Unit 1 RCA showed a large improvement in the physical layout with an arrangement that should aid in minimizing the spread of contamination. However, it was noted that additional efforts will be necessary to ensure personnel exiting the RCA follow the newly established procedures.

**Conclusion:** Satisfactory progress to date.

**6.2.(a) Good practice:** The plant has taken an initiative to increase the quality regarding radiation protection in contractors work. The contractors are required to take part in an early preparation of their engagements in outages including involvement in detailed work planning. Training in radiation protection is given to the workers as a part of basic training to improve the workers professionalism. The importance of reducing collective and individual doses is emphasized. The plant provides information on radiological conditions on the work site, dose results and advice in risk prevention to support the contractors. The contractors are expected to track doses and act in compliance with the ALARA principle. A mutual experience feedback makes it possible to make improvements in several aspects. To make sure of the contractors ability to comply with the plants objectives, a qualification system is complemented by EDF. As contractors usually receive 80 - 90 percent of the total outage collective dose it is of great importance for both parties to cooperate in optimizing the doses received during outages according to the ALARA principle.

Individual as well as collective doses have decreased progressively. All contractors reduced doses in 1997, one contractor by a factor of 10.



## 6.6. RADIOACTIVE WASTE STORAGE AND DISCHARGE

**6.6.(1) Issue:** Some solid radioactive waste is unnecessarily generated by bringing unneeded material into in the RCA and practices in the area used for sorting and processing solid radioactive waste could be improved. Examples of unneeded materials that were observed inside the RCA include the following:

- Significant quantities of untreated wooden scaffold that are difficult to decontaminate are stored in the RCA;
- Wooden pallets are used in the RCA;
- Plastic wrapping is used unnecessarily;
- Newspaper and magazines are taken into the RCA.

In addition, the area for sorting and processing contaminated material in the waste handling building is small and the use of it is unstructured. This affects the efficiency of sorting and may additionally result in increased individual doses.

Bringing unneeded materials into the RCA can result in the generation of unnecessary radioactive waste.

**Suggestion:** Management expectations for minimizing radioactive solid waste should be established, clearly communicated and strictly enforced.

### **Plant response/action:**

Paluel NPP is determined to make progress where the environment is concerned, and is particularly keen to improve its performance in reducing the amount of solid radioactive waste produced. The Plant Strategic Plan for the period of 1999-2002 sets an average goal of 80m<sup>3</sup> per unit for the next four years. In view of our current results, this means that we will have to reduce significantly the volume of solid radioactive waste produced on the site.

The creation of an environmental management system at Paluel NPP, with a view to obtaining ISO 14001 certification in 2002, reflects plant management's commitment to improving environmental performance.

An action plan for the reduction of solid radioactive waste has been drawn up for 1999. It consists of short-term and medium-term actions to be implemented on the units during power operations and outage.

The following is a broad outline of the action plan:

During power operations periods efforts are focused on reducing the amount of equipment and material brought into the radiologically controlled area and all packages with the following specific actions:

- A number of actions have been taken in order to eliminate the packaging of equipment and material brought into the radiologically controlled area;
- Containers have been (or are being) produced to transport certain pieces of equipment or substances from the general warehouse in the cold area to their place of use in the radiologically controlled area;
- The following items are primarily concerned:
  - ion exchange resins packaged in 50 liter plastic drums;
  - water filters in cardboard and plastic packaging;
  - boric acid packaged in 30 liter plastic drums.
- Measures have been taken at the entrance to each radiologically controlled area (RCA) to ensure that work team leaders unpack their equipment under the following conditions:
  - instructions displayed at the entrance to the RCA;
  - bins installed to collect waste;
  - checks carried out by the technician in charge of waste management at RCA exits on all 4 units, to ensure that the instructions are complied with. This technician is also responsible for listing specific problems arising from the application of these instructions, in order to develop additional resources or to modify our organizational structure.
- Before the 1999 outages begin, a tool warehouse inventory will be performed in order to bring down to a strict minimum the number of items used in the radiologically controlled area;
- A study has been undertaken in order to examine the possibility of placing several water filters in one container (only one filter is currently authorized per container). The objective is to reduce the number of containers produced on the site for conveyance to the radwaste ground storage facility.

During outage periods efforts are focused as follows:

- A goal has been set to determine the number of maintenance waste drums produced during 1999 outages (goal depended on content of outage schedule);
- Monitoring is being performed by means of a performance indicator expressed in terms equivalent to “the number of drums”;
- Performance indicator results are conveyed to the outage manager on a weekly basis and is posted on the outage record chart;
- Actions have been taken to make EDF supervisors, staff members and contractors more aware of the issues involved;
- Warehousemen are being briefed on the ‘waste’ objective set for the outage period; they are being instructed to adapt warehouse movements to suit the exact needs of users on the work sites;
- The Nuclear Logistics Department (S.T.L.N.) perform checks on waste-producing consumable items leaving the warehouse (vinyl, adhesive tape, absorbent paper, rags);

- The Risk Prevention and Nuclear Logistics Departments conduct a preliminary study of work sites requiring containment, in order to design the most suitable means of containment and keep the amount of waste produced to a minimum;
- Management field tours conducted during outage periods take into account waste management practices on the work sites (collection, production, initiatives taken by work team leaders to reduce the amount of waste produced);
- Reducing the amount of wood in the controlled area: An action is being realised to reduce the amount of wood (scaffolding planks) in the controlled area, with a view to have it reduced by 50 percent for the final deadline set for 31/12/99.

Waste management study (radiological and non radiological)

In addition to the above actions, a waste study has been undertaken in February 1999. Taking an overall approach, it deals with waste management at Paluel NPP.

The study is being conducted in response to a corporate directive , with a view to reviewing the waste management process, identifying areas of improvement and compiling a waste management reference.

The following points will be dealt with:

- Description of the current situation: production, management, processing, elimination;
- Waste zoning: rooms, buildings and areas of the plant will be classified so that waste can be processed according to ‘conventional’ or ‘nuclear’ procedures;
- Monitoring and justification of waste production;
- Description and justification of waste processing systems being used;
- Commitment to making improvements, review of improvements being made.

The Plant Management Committee has decided to open a case file for the waste management study. The case director is the head of the Safety and Quality Advisory Unit, a member of the Plant Management Committee. The case co-ordinator is the technical support engineer from the Nuclear Logistics Department.

Conclusions of the study will be submitted by the end of 1999.

### **IAEA Comments**

The station action plan for reducing radiological waste has resulted in many initiatives to reduce the amount of material that is unnecessarily taken into the RCA and eventually has to be processed as radiological waste. Some of the initiatives were recently implemented and others are in progress. A challenging goal for the amount of generated radiological waste has been established when compared to the amount of generated waste in recent years.

**Conclusion:** Satisfactory progress to date.

## 7. CHEMISTRY

### 7.1. ORGANIZATION AND FUNCTIONS

There are two chemistry sections at Paluel, one for Units 1 & 2 and another for Units 3 & 4, under two different managements. The plant has taken the decision to change the organization and by March 1999 there will be only one chemistry section and only one head for the four units. The chemistry section will remain part of the operations department. The chemistry section has the responsibility for primary and secondary circuit chemistry and performs both routine chemical and radiochemical analysis. In addition, it performs all analyses that are required for other areas, mainly within the operations department. The cooperation between the different departments of the site is considered to be satisfactory. The relationships with corporate organizations are good, especially with the Chemical and Metallurgical Laboratories (GDL) in Paris, with the Nuclear Fuels Group (GCN) and the Safety Radiation Protection and Environment Department (DSRE).

During the evaluation, chemistry staff demonstrated very good knowledge and understanding of current techniques and analysis procedures. They also have adequate experience. The training practice for the laboratory personnel is carried out according to a standard level.

The chemistry section together with the operations department developed and implemented a technique to detect sea water intrusion in the condenser, by helium test, which is very sensitive. The detection limit is equal to 0.008 liters/hour. The team considered the technique to detect very low levels of sea water intrusion in the condenser at the Paluel site as a good practice.

The team identified some weaknesses in quality control policies and procedures when compared with good industry practice and recommended some areas be improved. These include: lifetime control for chemical standards, control of the use and the storage of chemicals reagents and quality control of chemical analysis.

### 7.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

In general, the ammonia conditioning plus hydrazine, as sequestrant of oxygen, in the secondary system is an efficient way to prevent erosion-corrosion. But in this case, due to high decomposition of hydrazine in ammonia it is not possible to increase pH above 9.8, due to the steam generator blow down resin system. Consequently, the hydrazine concentration sometimes is below the values desired, and thus the corrosion rates in the secondary system will be accelerated.

The team recommended that the plant ensure that the chemical limits as stated in chemical specifications are rigorously followed. In addition, the procedures should be revised to give direction for when the limits are reached including the time during which chemical parameters must be returned to within specifications.

To minimize corrosion product and activity built up in the primary system, the plant follows the coordinate boron-lithium curve. At the present time, this practice seems to be effective in helping to minimize plant dose rates.

### 7.3. CHEMICAL SURVEILLANCE PROGRAMME

The chemical surveillance programmes are well described in different procedures, and a predetermined routine analysis with defined frequencies is followed. These programmes cover most of the analysis. The overall surveillance programme is well defined for each of the on site laboratories by use of the computer network. The associated software is used to generate a daily surveillance schedule sheet for each laboratory. Chemical surveillance control is strongly based, in the secondary side, in on-line analyzers. There are adequate calibration programmes and different procedures to perform the calibrations and verifications. This system provides good information to the chemists when any adjustment is required.

Chemical analysis results are entered into the computer system manually and it is possible to generate a well described table with a summary of results. Analysis methods are clearly understood and normally followed. The quality control of analysis is not completed in the majority of parameters analyzed, but the quality of the analysis results are in accordance to the written chemical procedures.

The fuel integrity is well monitored by analysis of xenon and iodine in the primary circuit during the programmed transients. These values are communicated to the nuclear fuel group (GCN) by the computer network for evaluation. In the outages, the plant can detect very well the number and size of leaks on nuclear fuel, by a special cell in the spent fuel pool analyzing Xe-135.

#### 7.4. CHEMISTRY OPERATIONAL HISTORY

The chemistry section does not have a general procedure for document management in either unit. No index exists of documentation that is in the storage system. The implementation of a computerized index may help in the ability to retrieve the documents. The storage place is a standard cabinet and has facility to lock the documents for security.

The external experience feedback comes mainly from the chemical and metallurgical laboratories (GDL) in Paris, but there is no systematic process to implement lessons learned from external and internal experience. This is discussed further in the technical support section of this report.

The reported data is adequate and includes tables showing monthly summary of the chemistry status. All manual chemistry analysis results are in the on site computer system network, but it is not easy to have graphics which can be trended for use in evaluating chemistry performance.

Significant events are written as required, e.g. water sea intrusion in condenser tubes or defects on nuclear fuel.

#### 7.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

The laboratories are very clean, well illuminated areas and the housekeeping is good. The more important and precise laboratory equipment is located in a separate area of the cold and hot laboratories and thus the danger of contamination is minimized. There is evidence of enough spare parts of laboratory equipment to achieve continuous laboratory functions. The water used for chemical standards has a low conductivity and comes from special equipment. There are readily available safety facilities such as shower and eye wash. The team found that the environment laboratory documentation calibration programme, measures, controls and radioactive sources management were according to high standard.

The team suggested the plant take periodic measurements of total organic carbon (TOC) mainly in demineralized water, to check if satisfactory conditions persist. Further actions should be taken as appropriate depending on the actual presence of TOC.

The team recommended that the plant implement effective labeling for chemical standards and samples.

The team encourages compliance with the safety precautions and radiation protection rules when taking samples from the reactor building to the hot laboratories of both units.

The team suggested that the plant measure iodine and aerosol activities and hydrogen concentration in the containment atmosphere under accident conditions. In addition, there should be the capability to take grab samples.

## 7.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS

The plant has a list of approved operational chemicals by chemical and metallurgical laboratories (GDL). However, the chemistry section does not routinely perform chemical analysis to control these chemicals. The team encourages the plant to perform analysis of most important operational chemicals, like boric acid, lithium hydroxide, hydrate hydrazine before they are injected into the different circuits. The team recommended that these operational chemicals be checked when received in the plant after purchase to be sure that they are in accordance with the EDF chemical purchasing specifications.

## 7.7. RADIOCHEMICAL MEASUREMENTS

The plant uses two different gamma spectrometry systems to determine activity concentrations in the primary coolant and the activated circuits. These are performed accurately in the two different hot labs. Liquid samples of effluents are measured accurately by gamma spectrometry, total gamma. The analysis of aerosols, iodine and noble gases are routinely performed and evaluated. Ordinary analysis of alpha are performed at the site. When the activity of total alpha is above of 4.0 E-6 GBq/m<sup>3</sup> alpha spectrometry is performed.

The surveillance programmes includes the amount and quality of equipment and procedures necessary to calibrate, check and maintain the radiochemistry equipment.

## **STATUS AT OSART FOLLOW-UP VISIT**

Improvements were noted in the chemistry area and appropriate action has been taken on the OSART recommendations and suggestions. Three recommendations were resolved and the actions for one recommendation and the two suggestions were considered to be making satisfactory progress.

The reorganization in this area has resulted in more focused attention being given to the station chemistry programme. It has also resulted in a new organization to provide oversight as well as assistance.

The plant has made outstanding improvements in enhancing the structure and formality of many of the programmes, policies and procedures. It is recognized however that many of the programmes are recent changes and considerable effort will be needed to ensure that they are effectively implemented and achieve the highest levels of performance. In some of the areas, the need for additional supervisory and management involvement is indicated.

The progress made by the plant in meeting chemistry specifications and improving the labeling and control of samples and standards were found to be noteworthy.

## DETAILED CHEMISTRY FINDINGS

### 7.1. ORGANIZATION AND FUNCTIONS

**7.1.(1) Issue:** The lack of policies, procedures and programmes in chemistry is inconsistent with good industry practice and is resulting in some inferior practices. The following are examples where there were no established policies or procedures:

- Programme for lifetime control for chemicals standards;
- Programme to control the use of chemicals reagents, e.g. inflammable solvents and toxic chemicals;
- Programme for quality control of chemical analysis, which includes trend analysis results and statistics treatment.;
- Administrative procedure to control storage of chemicals reagents in the different laboratories.

Some examples of weaknesses associated with the lack of policies, procedures and programmes that were observed in the field are as follows:

- There were unnecessary quantities of flammable solvents, like toluene and benzene stored in the cold laboratory Unit 1 & 2;
- There was no administrative procedure to control toxic chemicals, which were stored in the cold laboratory Units 1 & 2;
- No administrative control is applied in the cold laboratories of Units 1 & 2 and Units 3 & 4 for chemicals segregation.

Lack of chemistry policies, programmes and procedures could lead to incorrect analysis and results that could lead to violation of chemicals limits or challenge plant personal safety.

**Recommendation:** The plant should establish quality control policies, procedures and programmes consistent with good industry practice. These include: lifetime control for chemicals standards, control the use and storage of chemicals reagents and quality control of chemical analysis.



## **Plant response/action:**

The bringing together of all laboratories within one department called the Measurements Performance and Environment Department, as of the January 1, 1999 means the setting up of a single management organization where the aim is to optimise resources and skills through fostering motivation of plant personnel.

Chemistry has created a Methods Branch specifically in charge of initial analysis, second level checks and incorporating experience feedback. This approach will, given time, eliminate discrepancies over work practices.

The updating of the QA manual (organization memoranda, application documents) and the associated department memoranda, demonstrates a willingness on the behalf of chemistry to implement good industry practice.

The monitoring of standards, chemical reagents and their shelf life is managed using the procedure numbered "GA/LB 90" .

The amount of flammable solvents and toxic chemical products has been limited as much as possible. When not in use, they are managed and stored in just one place, in line with applicable legislation.

The setting up of the Methods Branch enables trend analysis to be done. Statistical processing of the results is under the responsibility of the senior supervisors within the branch.

The department memorandum, reference NS/OR 239 (organization of the laboratory section) describes how this is organized.

Trend analysis (already performed for the area of effluents, under development for other areas) is carried out for critical parameters via the A22 computer application using end of month documents and monthly printouts from GDL.

These printouts, presented as tables, curves and reports show changes for the critical parameters as defined by GDL for the site and for all EDF nuclear power plants. This approach provides an overview of French power plant chemistry.

The operator is kept informed as to any drifts or abnormal values for any critical parameter. It is the on-going contribution made by laboratory supervisory staff during the various plant operations meetings both for outage and inage periods that enable proactive and corrective measures to be taken for any abnormal changes to parameters. Any discrepancies observed are dealt with in accordance with the application memorandum NA 166 (Processing chemistry discrepancies) .

To make trend analysis of chemistry and radiochemistry parameters easier, Paluel has expressed its desire to have the 'MERLIN' (measurements, samples and readings from nuclear industry laboratories) computer application set up rapidly, currently due for the end of 1999.

## **IAEA Comments**

The station Chemistry Department has been reorganized and the programmes revised to be more structured and formal. Numerous procedures and policies have been implemented that have, in the short term, addressed many weaknesses including those identified in this issue. It is recognized that the new organization is young and many of the programmes have been recently implemented. This of course means that ongoing efforts will be necessary along with significant management attention and

support to maintain and enhance the current improvements. In light of the short time since implementation of the programmes, significant improvements were obvious.

**Conclusion:** Issue resolved.

**7.1.(a) Good practice:** The station has implemented an effective method of detection of very low rate of sea water ingress into the condenser, by helium test.

The detection of sea water ingress is done by measuring sodium and cation conductivity in the steam generators and then reviewing previous “sea water ingress” records in order to identify the tube bundle area where the leak is most probable. (i.e. steam impacted tubes). A load reduction is then scheduled (between 60 percent and 75 percent) of nominal power depending on the temperature) by keeping the sea water circulation pump of the unaffected train in service. This allows for better vacuum quality and suction of helium. A suction fan is then installed inside the water box of the leaking bundle, blowing towards the outside of the turbine hall, to avoid increasing the background noise signal of the helium being measured by mass spectrometry. An accurate mass spectrometer is then installed at the outlet of the condenser vacuum pumps (CVI).

Helium is injected at 7 bar from pressurized gas bottles to one tube at a time into those tubes that have been identified as probable leakers. The injection takes place in the sea water outlet water box. The helium injection device is equipped with an isolation valve in order to avoid dissemination of helium outside the tubes during changeover from one tube to another.

The tube or tubes identified as leakers are then plugged. Restart of the sea-water circulation pump and power increase completes the necessary actions.

Recently, plugging of 2 leaking tubes representing a total leak of 0.188 liters/hour on Unit 4 (one leak of 0.18 liters/hour, plus another of 0.008 liters/hour) was carried out. The detection of even smaller sea water ingress leaks can be envisaged considering the signal given by the mass spectrometer.

The method is presently limited by the detection threshold (and not by the quantification threshold) for measuring sodium using atomic absorption spectrometry. This measurement is used to identify the leaking condenser tube bundle and allows the identification of a total leak rate per bundle greater than or equal to 0.008 liters/hour.

## 7.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

**7.2.(1) Issue:** The plant is not always being operated within existing chemistry specifications. Chemistry procedures exist that specify limits, but in several instances it was noted that the limits were not respected. In addition, some procedures have limits but do not specify actions if a specification is not met. Examples of violation of chemical specifications are as follows:

- In Units 1 & 2, it was noted on several occasions in the SIT laboratory that the hydrazine concentration in feedwater was between 40 and 50 ppb. In Unit 4 the value was 34 ppb, a very low value in comparison with the specification value 50 ppb. It was also noted that there is a pH limit which is in conflict with the hydrazine limit;
- In the Unit 2 SIT laboratory, the oxygen analyzer 2-SIT-123 MGI was reading between 4.5 and 5.2 ppb for more than two months. The limit for specification is 3.0 ppb. Oxygen and hydrazine were periodically found out of specification in all four units during the review;
- In the makeup water treatment plant, the silicometer at the end of chain, often exceeds 20 ppb. As a consequence, the chain is then automatically placed in the recirculation mode. After several minutes, the silicometer reading goes to zero resulting in the plant returning to the operating mode and sending water to the storage tank of the secondary system or the primary system even though the true value is still above 20 ppb. This occurs since the silica meter takes 30 minutes to complete its measurement cycle.

The silica value in Unit 1 was 1000 ppb in the primary circuit, exactly the limit value of chemical specs. The intended value is 600 ppb.

The lack of adherence to chemical limits could lead to increased deposits and increased corrosion rate of affected systems and consequently to deterioration of systems boundaries.

**Recommendation:** The plant should ensure that the chemical limits as stated in chemical specifications are rigorously followed. In addition, the procedures should be reviewed and strictly implemented to ensure that the appropriate action is taken when outside chemical specifications.

### **Plant response/action:**

Chemistry specifications must be adhered to due to their immediate and longer-term effect on plant equipment. In accordance with the doctrine of GDL, a distinction has to be made between two big families of chemical specifications: those that are linked to the Operating Technical Specifications and those that are not. Those parameters not included within Operating Technical Specifications have a limit value, without any allowance for exceeded tolerance. In the event of a limit value being exceeded, the operator initiates suitable corrective actions. For most of the technical specification parameters to be adhered to, either limit excellence allowances have been defined and/or safe shutdown conditions are applied. Whenever an expected value is exceeded, one can assume that there is an anomaly that should be identified and corrected so as to return to normal operating conditions as soon as possible. Exceeding a limit value implies an immediate corrective action.

There is a QA organization in place enabling deviations to be identified and dealt with.

The double check process has been strengthened and formalised through the department memorandum NS/OR 239 (organization of the laboratory section) whose application is under the responsibility of senior supervisory staff .

Eventually, the user-friendly 'MERLIN' computer application will provide substantial support for carrying out monitoring activities.

The automatic metering of the common silica concentration for two make-up water production lines is subject to a permanent operating instruction. This forbids the simultaneous use of both production lines bringing the measuring cycle down to fifteen minutes and eliminating the risk of silica being transferred to the storage tanks.

### **IAEA Comments**

The plant has placed increased emphasis at all levels within the Chemistry Department on the importance of maintaining chemistry parameters within specification.

Following the Chemistry Department reorganization in April 1999, significantly more emphasis has been placed on monitoring of performance in the chemistry area and improvements have been made in maintaining parameters within specification.

Three levels of chemical analysis results review have been established to ensure action is taken when chemical parameters approach the limits of expected values. These reviews are now done by the laboratory staff, foremen, and an independent review by the newly established Methods Branch. Trending of parameters is also done by the Methods Branch.

**Conclusion:** Issue resolved.

## 7.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

**7.5.(1) Issue:** Many chemical standards and samples are not appropriately labeled with the date, hour, technician, signature, lifetime and laboratory as required by plant procedures. The plant procedure for samples and standards requires correct labeling but plant personnel frequently do not follow this procedure. Almost all of the samples and chemicals standards inspected were not correctly labeled. Frequently, most of the required information was not included in the label.

There were some samples and chemical standards found unlabeled in:

- Cold laboratory Units 3 & 4;
- BAN REN laboratory in Unit 3;
- Water treatment laboratory.

If the samples and chemical standards are not correctly labeled, laboratory analysis could be in error and improper decisions made based on faulty analysis results.

**Recommendation:** Compliance with the plant procedure on labeling chemical standards and samples should be reinforced. Routine checks should be carried out to assure compliance and further corrective actions taken as necessary.

### **Plant response/action:**

The laboratory procedure about labeling of samples has been revised and is implemented via worksheet GA/LB 091.

Compliance checks are carried out during management field tours and discrepancies are corrected.

Calibration and reference standards are managed in accordance with worksheet GA/LB 090 (see response 7.1(1) .

### **IAEA Comments**

The program for labeling and control of chemical samples and standards has been strengthened. A new system with color coded labels that have clear information and appropriate places for data has been implemented. Standards are being controlled by one work station. Information regarding the sampling points, purging of samples etc., has been included in a new procedure. Performance in this area is to be monitored by the department field tour programme. Deficiencies identified through the field tours are to be recorded and corrected.

Observations in a cold laboratory revealed good compliance with the programme. However, some weaknesses were observed in the laboratory that was toured inside of the radiological controlled area. Increased management/supervisory attention inside the radiological controlled area is indicated.

During the observations, some weaknesses were observed in the methods used to document analysis results such as overwritten data and missing signatures.

**Conclusion:** Satisfactory progress to date.

**7.5.(2) Issue:** Routine measurements of organics in demineralized water are not conducted by the plant even though it is possible for organic pollution to cause corrosion problems.

It is a widespread international practice on PWR plants to periodically measure total organic carbon mainly in demineralized water. Examples are found in USA, Spain, Japan, and various industry guidelines. With this kind of measure, it is possible to control the organic compounds ingress in the different circuits especially in makeup water, since non-ionized organics may escape detection by conductivity measurements. Long chain and complex natural (agriculture) and synthetic (industry) organics in demineralized water can be converted to organic acids at elevated temperatures.

If raw water with natural organic pollution is used for the production of demineralized water it is very important to take care to assure complete removal of organics, especially when the raw water has been chlorinated, as is the case at Paluel.

**Suggestion:** Consideration should be given to taking periodic measurements of total organic carbon (TOC) mainly in demineralized water to check if satisfactory conditions persist. Follow-up actions should be taken as appropriate depending on the actual presence of TOC.

#### **Plant response/action:**

The strategy for monitoring total organic carbon (TOC) is drawn up by the Corporate Chemical and Metallurgical Laboratories (GDL) of EDF. A summary of the situation as of February 1, 1999 is as follows:

A campaign for measuring TOC was carried out by GDL during summer 1986 on raw water before treatment and on demineralised makeup water for each EDF PWR plant that was operating at that time. The results showed how efficient the treatment was, in all cases a very significant reduction in TOC was observed: for Paluel TOC dropped from 1970 ppb (raw water) to 155 ppb (make-up water).

Since 1995, EDF has undertaken another series of studies focusing on secondary side corrosion of SG tubes using laboratory tests and surface examination of removed SG tubes. These studies looked at, among other aspects, the influence of organic compounds present as deposits on the tube external surface. It should be noted that all the SG's so far replaced on EDF plants have been for primary side stress cracking, except for one unit – Saint Laurent B1 – where it has been established that weak mechanical characteristics of a particular batch of (*inconel*) 600 MA alloy was basically the cause of accelerated secondary side corrosion, especially on No.2 SG. So far, these studies have not shown clear evidence of an active contribution of organics towards SG tube corrosion.

Nevertheless, in addition to these studies into corrosion of (*inconel*) 600 and 690 alloys, GDL decided to undertake a new set of studies looking at organics over 1999 and through to 2000, dealing with two areas:

- The identification and quantification of organics at various points around the secondary circuit compared to measured TOC in the same circuit and in the make-up water.



Measurement campaigns will be undertaken both during winter and summer on several plants, chosen according to the type of raw water used for treatment, the make-up water preparation process, the results of examinations of deposits on removed SG tubes, the type of chemical conditioning used on the secondary circuit and the time elapsed since start-up of the plant following refueling and maintenance;

- The setting up of a database bringing together the ionic chromatography and capillary electrophoresence analysis characteristics of aqueous solutions for the various approved products used for maintenance operations during outage so as to be able to quickly identify the product concerned in the event of pollution during start-up.

For this study, out of the 20 EDF nuclear power plant sites, 10 were chosen to carry out a new campaign of TOC measurements due to the various parameters that can influence the results: origin of the make-up water (bore-hole, backwater, etc.), type of secondary side conditioning (morpholine, ammonia, other type of amine, etc.), nature of cooling source (sea water, river water) and type of cooling (open, closed with cooling towers, etc.) .

Paluel was chosen among these power plant sites for a campaign of measurements starting in September 1999. At least two summer/winter campaigns are planned. They concern:

- The whole of the make-up water treatment plant;
- An entire secondary circuit, including the SG blowdown and treatment lines.

This study should enable the make-up water measurements from 1986 to be updated. If at the same time the contribution of organics to SG tube corrosion is clearly established – although this is not currently the case as has already been pointed out – then EDF could decide to implement selected improvements.

Currently, although TOC measurements on demineralised make-up water is not performed on a systematic basis at EDF's PWR plants, an abnormal presence of organics in the secondary circuit can be easily detected by carrying out a trend analysis of cationic conductivity measurements, especially on the SG blowdown lines and on condensates from the moisture separator reheater. Any organics that could be present in the make-up water from poor performance of the demineralization plant would decompose due to the secondary circuit temperature conditions and produce partially ionised groups. In the event of an upward trend in cationic conductivity, then measurement using either ionic chromatography or capillary electrophoresence allows the overall nature of the pollution (mineral or organic) to be determined as well as the type of compound involved. Correlating this data with those of neighboring units using the same make-up water storage tank enables a conclusion to be drawn as to the level of quality or pollution of the make-up water and to undertake if needed the necessary investigation on the make-up water treatment plant. Once the ionic chromatography and capillary electrophoresence analysis database has been completed, in the event of a degree of pollution not causing fundamental concerns for the make-up water, it should be possible to identify the product causing the pollution both more rapidly and more precisely by comparing those products being used during maintenance operations against the characteristics contained in the database. In the event of poor correlation, additional investigation into organics is called for; thus a periodic evaluation of organic pollution, even if slight, must be performed by the operator when the unit is under power.

As for the treatment of make-up water, page 63 out of 105 of the 'Good practice guidelines for demineralization of make-up water' (Ref: D5713/LND/RB/96 3014 dated 25/03/96) asks that a

two-monthly measurement of organic content be made (using  $\text{KMnO}_4$ ) so as to check the efficiency of pretreatment on O.C. In the event of an anomaly being identified, a measurement of organics is also to be done on the weak anion resin bed to prevent poisoning and to guarantee the efficiency of the strong anion resin bed downstream and therefore finally the quality of the make-up water. As stated on page 27 of the 'Training file for preparing demineralised water for EDF power plants (Ref: D5713/RB97 3165/GDD/BTF) issued on 9/02/98 and associated with the good practice guidelines , pretreatment enables organic content to be reduced by between 30 and 60percent depending on the nature of the water. Several parts of the same document between pages 35 and 40 indicate the operating conditions for anion resins with relation to organics.

Where the raw water has been chlorinated, as pointed out by the expert, additional attention is required concerning organic content. Indeed, the free chlorine reaction (hypochlorite ions, hypochloric acid) in the presence of certain organic compounds containing reduced nitrogen produces chloroamines whose oxidising properties damage ion exchange resins (break-down of the polymer matrix, as explained on page 26 of the training file) and thus reducing the performance over time of the demineralization treatment process. To limit this risk as much as possible, page 63 of the good practices guidelines recommends periodical measurement of the total excess chlorine on the demin. train inlet lines, while limiting its concentration after reduction to 0.05ppm (expected value) / 0.01ppm (limit value) as mentioned on page 65.

We therefore consider that given the current situation concerning understanding of the effect of organic compounds on secondary side corrosion of SG tubes, the practice of monitoring of organics described above and that we recommend provides sufficient guarantees as to the integrity of the equipment. Nevertheless, the studies that we are currently undertaking in this area should enable us to make more precise conclusions about this point over the coming years.

### **IAEA Comments**

The importance of minimizing TOC is recognized by the plant. Additional studies looking at organics will be done through 2000. These studies should allow more precise conclusions about the need for additional monitoring of organics.

In addition to the plant response, the plant will be using a mobile purification facility during unit start up to aid in improving the quality of steam generator make up water to further eliminate the possibility of organics resulting from outage work.

The plant also plans to replace the make up water plant demineralizer resins in the near future based upon resin age and a recently conducted study.

**Conclusion:** Satisfactory progress to date.

**7.5.(3) Issue:** The iodine and aerosol activity concentration and the hydrogen concentration in the containment atmosphere can not be determined under accident conditions.

The iodine and aerosol data together with hydrogen concentration are required to estimate the magnitude of any release to the environment from the containment, and also to have information available on hydrogen-oxygen concentration. This has been a generally accepted industry practice. In addition, the post accident sampling system should make it possible to take grab samples in an easy and safe way, with reasonable radiation exposure for workers during post accident sampling.

At Paluel NPP, it is not possible to take these samples. It is physically possible to measure total beta in an air sample of containment and gamma total and boron in the water sample in case of a design basis accident (DBA) and severe accident. In DBA it may take 30 days after an accident before it is possible to obtain grab samples for water and 7 days before it is possible to take air samples. In case of severe accident it is not possible to take grab samples.

It is essential to measure the iodine and aerosol activity concentration, for a proper evaluation of the source term to determine the risks to the population and the hydrogen concentration in the containment to avoid an explosive hydrogen-oxygen mixture.

**Suggestion:** Paluel should reconsider its ability to measure iodine and aerosol activity and hydrogen concentration in containment under accident conditions.

#### **Plant response/action:**

The strategy for taking measurements under accident conditions is defined by the Industrial Safety, Radiological Protection and Environment Department (DSRE) of the Nuclear Operations Division. Within this framework, two aspects need to be examined:

- Measurements required for assessing releases into the environment (iodines and aerosols);
- Requirements for measuring hydrogen and oxygen concentration linked to accident management.

Concerning the first point, DSRE has determined that assessment of environmental releases can not be done using measurements of containment air activity. Indeed, this method has two disadvantages:

- The first is that these measurements and the assessments that follow would be available too late for providing information to the public authorities and thus to enable civil protection measures to be taken in a proactive way;
- The second disadvantage is that these measurements would not provide information about one of the most important hypotheses linked to assessing the amount of activity released, namely containment leak rates.

The assessment methodology for potential radioactive releases and radiological consequences must be based on the plant status. This can only be done in a short period if the specialists have predefined standard data covering a sufficient number of accident situations.

The hypotheses dealt with through the standardised sheets have been discussed and approved by a joint EDF/IPSN working group, whose mission is to put the hypotheses and the tools available during emergencies to the test and to boost research into areas insufficiently covered by currently available studies. Some of hypotheses chosen deal with certain accident envelope conditions, i.e. assumed to be worse so as to take into account uncertainty, while others are more realistic i.e. where test results are available.

Concerning the second point dealing with measuring the concentration of hydrogen, it should be made clear that there is a real need to do this in the event of a serious accident (core fuel meltdown). In addition, as you underlined it, the decision has been made to fit each unit with two on-line hydrogen meters, each one being linked to two sensors in different points of the reactor building. While waiting for their installation, scheduled to take place with the second ten-year outages for the units at Paluel (the equipment is currently undergoing certification), the national emergency response team will make a calculated estimation of the hydrogen value.

Finally, we would like to add a few details about the current means available for measurements and taking samples during accident conditions.

Currently, it is possible to take air and water samples under all conditions of design-basis accidents. On the other hand, this is not required by the procedures, as accident management is not based on manual measurements but on automatic measurements. The measurements involve high level of total gamma activity of air in the reactor building (via KRT 40 – 43 MA sensors) and total gamma activity (KRT 61 MA sensor placed near the RCS piping) and boron measurements (on-line boron meter) on a sample of primary coolant .

The time period stipulated of 7 days for taking an air sample and of 30 days for a water sample have been given as an indication only. They represent the order of magnitude of the minimum time period taken into consideration in the assessment of the radiological conditions associated with taking these samples.

As for serious accidents, we consider that it is not currently possible to take samples, basically due to radiological constraints.

Suitable adapted means will be developed, if necessary, as a best possible response to the real situation .

### **IAEA Comments**

Plans are in place to install two in-line hydrogen meters in the reactor buildings after the equipment is certified. In addition, commitments have been made to develop suitable adapted means for sampling, if necessary, as a best possible response to the real situation.

**Conclusion:** Satisfactory progress to date.

## 7.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS

**7.6.(1) Issue:** Chemicals are not always checked when received at the plant after purchase, and some of them are not in accordance with the EDF chemical purchasing specification.

Important plant chemicals that are in the EDF document for chemical specifications for purchase, were found to have been received by the plant without documentation of previous analysis. In some cases, the documentation contained the supplier's specification, and sometimes these specifications were above the limits specified by EDF documentation. The plant does not have an administrative procedure to control chemicals before applying them in the plant. Examples are as follows:

- The deliveries of boric acid on 01/11/96, 02/18/97 and 06/16/97 did not have the certificate of analysis, for comparison with the specification;
- The deliveries of lithium hydroxide on 04/24/97, 08/22/97 and 08/26/97 did not comply with the purchase specification from the document D5001/BTE/RC 93 1010 in the parameters of chloride and fluoride. The parameters are 10 times greater in the supplier specification than in EDF specification;
- The hydrogen peroxide used for the oxygenation in the primary circuit, is not in accordance with the chemical specification written in the same document referenced above;
- The chemistry section does not conduct analysis on diesel fuel for the emergency diesel generators before unloading or for routine fuel analysis on the various diesel fuel storage tanks. However, this is done annually by an external laboratory. In the two of three analysis report inspected, numbers 97050131 and 9705132 with date of reception 05/07/97, the concentration of sulfur was 0.25% and 0.26% respectively when the specification is not greater than 0.20%.

Uncontrolled chemicals that are added to plant systems could lead to violation of chemical limits, and consequently create corrosion products and degrade systems integrities.

**Recommendation:** The plant should ensure that at least the operational chemicals listed in document D5001/BTE/RC931010 including fuel are checked when received in the plant after purchase and verify that they are in accordance with EDF chemical purchasing specification.

## **Plant response/action:**

Directive No. 43 defines the methods to be applied for corporate management of 'PMUC' products (products and materials for use in power plants). The main points deal with quality control of products and optimized stock management.

The current organization only deals with products identified for use in power plants.

- The central purchasing center only delivers to the plants those products having undergone the certification analysis process by either: Corporate Chemical and Metallurgical Laboratories (GDL) for the chemistry area;
- The Industrial Safety, Radiological Protection and Environment Department (DSRE) for aspects involving the environment;
- The General Occupational Health and Medical Service (SGMT) for toxicological aspects;

Checks are carried out on certified products by random analysis of one batch of products per supplier.

The conformity certificate of these products is checked by the power plant. This check is described in the department memorandum that deals with 'PMUC' products.

The central purchasing center is responsible for the QA organization of suppliers.

Boric acid, lithium hydroxyde and hydrogen peroxyde are now included on the list of certified products and are dealt with as described above.

For other non-certified products, such as sulphuric acid and caustic soda, sampling and analysis takes place upon delivery.

The discrepancies observed with diesel fuel were analysed by the site engineering department. It concluded that the higher values identified have no effect on the safety function of the emergency electrical supply generators. We are however implementing all possible steps to adhere to this new operating criteria; the return to values below specification taking place progressively as fuel is renewed when storage tanks are topped up. This has been confirmed by analyses carried out on the latest samples. Tank fills are now done with diesel fuel of lower sulphur content, following a change in supplier and in specification. A complete emptying of the tanks is forbidden to avoid unavailability of the diesels

In addition, the management organization of diesel fuel and the corresponding responsibilities have been reviewed at the plant with the accent on clarification and simplification.

## **IAEA Comments**

The operational chemicals used by the plant have been reviewed and where missing from the list of approved chemical they were added to the list of PMUC products. All PMUC products undergo certification analysis by Corporate or GDL with two exceptions. Sulfuric acid and caustic soda sampling and analysis is done at receipt by the plant.

Diesel fuel is receipt inspected, analyzed and stored by Corporate for distribution to all stations. Random receipt sampling is conducted by the station along with annual sampling and analysis of all storage tanks. The organizations involved and processes associated with ordering, receipt and analysis of diesel fuel have been highly simplified. Requirements to immediately inform the Chemistry Department of out of specification analyses has been proceduralized.

**Conclusion:** Issue resolved.

## 8. EMERGENCY PLANNING AND PREPAREDNESS

### 8.1. EMERGENCY ORGANIZATION AND FUNCTIONS

The use of centralized resources and standardization between the plant sites has enabled EDF to achieve well thought out emergency arrangements.

The corporate organization develops master procedures for the on-site emergency plan (PUI). The on-site organization has successfully adapted these procedures for site use. At Paluel, there is one full time coordinator responsible for fire fighting and the PUI. Responsibilities for the emergency procedures are distributed among the respective members of the emergency response organization. The site organization has close contacts with the Rouen prefecture and local off-site organizations. The prefect is the director of the off-site emergency response.

Feedback from emergency exercises and other items important to emergency preparedness are handled in the PUI steering committee. The committee keeps track of improvement measures. Each improvement measure is assigned to the person who is responsible for accomplishment and has a time limit for realization. Progress of the measures is monitored. Good progress has been demonstrated in completing these improvement measures in 1997.

Manpower resources are considered sufficient during an emergency, generally 4-6 alternative persons are allocated to each duty. One of these is always on call.

### 8.2. EMERGENCY PLANS

The PUI describes clearly the responsibilities and tasks of the emergency response organization. Typically the PUI procedures are sequential and relatively rigid and therefore somewhat inflexible. However, this helps to keep them easily understandable.

The same emergency classification are used by on-site and off-site organizations. The classification covers all situations that may occur.

The classes are:

- Level 1 for conventional accidents;
- Level 2 for accidents of a radiological nature with consequences limited to the site;
- Level 3 for accidents where significant amounts of radioactivity are released or expected to be released outside the site.

For off-site protective measures there is an inner five km emergency planning zone (EPZ) and an outer EPZ from five to ten km. In the inner EPZ, evacuation is the ultimate measure. In the outer zone sheltering and iodine tablets are considered sufficient for protecting the population. This is consistent with good international practice. There are about 3000 inhabitants in the inner zone and about 14000 in the outer zone.

### 8.3. EMERGENCY PROCEDURES



Procedures in the emergency response centers are quality-controlled. On-call personnel have copies that are working documents and not controlled. In emergencies and exercises, procedure sheets are taken from the controlled files and distributed to the members of the emergency response organization. The PUI procedures are typically reviewed and, if needed, updated yearly. The maximum review period is 2 years.

In France, national level organizations prepare recommendations for the prefect regarding protection of the public. This system lessens the possibility of conflicting recommendations. In the early phase of an emergency, these recommendations could, with a different form of organization, in principle come sooner from the power plant. However, very rapidly developing accidents are not considered credible by Paluel. In principle, this is a weak point, because some of the worst accidents have been of this type. On the other hand, this makes the procedures simpler and more efficient for some other types of accidents and leads to more efficient use of resources. The decision not to consider rapidly developing accidents credible by Paluel is important and affects in many ways both on-site and off-site emergency procedures. For off-site procedures, it is assumed that there is at least 24 hours before significant radioactive releases can begin.

Decisions concerning off-site protective measures are made in the Prefecture rear emergency center (PCF) in Rouen. The Prefecture forward emergency center (PCO) in Dieppe directs operations in the field. Therefore, the PCO adds one step to the information flow and may cause some delay of the response. The PCO is not decisively nearer to Paluel than the PCF. Therefore, the PCO seems to give no advantage for emergencies at Paluel and could be omitted in order to streamline the response. The role of the PCO is under discussion in the prefecture.

#### 8.4. EMERGENCY RESPONSE FACILITIES

The on-site emergency organization is distributed into five response centers which are the local management command center (PCD), the local assessment emergency center (PCC), the local logistics emergency center (PCM), the technical support center (LTC), and the local operations emergency center (PCL).

PCD, PCC and PCM are normal office rooms in the main office building and located near to each other. If they become uninhabitable, the alternative PCD, PCC and PCM in the security building are used. They are shielded and have filtered ventilation like the PCL in the control room and the LTC near the control room.

Partly due to the distributed way of working, quite a large staff is devoted to the response centers. PCD, PCC and PCM in the security building have limited room space and table areas. Therefore they are not as efficient for the whole intended staff as the corresponding rooms in the office building. Renovation of the security building PCD, PCC and PCM is under study. The team was of the opinion that Paluel NPP could benefit if the renovation of these facilities proceeds to realization. After renovation, the groups leading the on-site emergency response could always be located in the security building.

In the emergency response centers, except PCL, the wall area could be more effectively utilized for record keeping of important occurrences, decisions, jobs etc.

The power plant has provided a mobile communication and command center (PCOM) to be used for directing the fire fighting, rescue and first aid operations on the site in PUI level 1 situations.

The emergency response organization members are in an extensive on-call system with 462 persons part of the system and of these, 86 are on-call at the same time for a one week period. Persons in the PUI on-call system also belong to the technical on-call system. The on-call system provides good coverage. In most drills 100 percent of the 86 on-call persons have come to the plant to their emergency duty positions within the 1 hour limit.

## 8.5. EMERGENCY EQUIPMENT AND RESOURCES

The power plant is equipped with a comprehensive communication system providing access to several independent telephone and radio networks.

In case of need, a prerecorded message to the loudspeaker system can be initiated from the control room.

Outside normal working hours, the on-call personnel who form the emergency organization are contacted by use of home telephones and pagers. Telephones are the primary means of contact. The automatic telephone calling takes about 30 minutes, but the pager system contacts all on-call persons at the same time. Experience has been that a large part of the on-call personnel react to the pagers.

The plant has good reserves of equipment and supplies for emergency purposes. For example, there are 260 sets of self contained breathing apparatus and 220 reserve breathing air bottle sets plus 120 smaller evacuation sets on the site.

The plant is well equipped with monitoring and sampling devices. In addition to a typical automatic dose rate monitoring network around the site and meteorological instrumentation, the plant has two vans for taking samples, measuring and recording dose rates, measuring iodine and other air contamination. The same vans are used for environmental surveillance during normal operation.

For emergencies, there is a fire truck and a first aid vehicle available. These are manned and maintained by the voluntary fire and rescue team, which receives the same training as the off-site fire brigades. This is unique to Paluel among the EDF sites. A system with 10 permanent assembly points and lifeline system is used to guide the external emergency services, e.g. fire brigade or mobile intensive care unit. A field operator draws the lifeline from the nearest assembly point to the place of the accident. Sufficient off-site fire fighting and rescue resources are also available.

In the PCCs, there is a computer system with software called GEEE. This is used for estimating the consequences of radioactive releases and for display, collection, storage and transmission of environmental radiological data. This dose assessment system can handle only predefined scenarios. With GEEE, it is possible to estimate releases that are caused by a steam generator tube rupture and by-pass the stack. The actual releases in this case cannot be calculated, because the release pathway by-passing the stack is not instrumented. This problem is under discussion at a national level.

There is a well equipped personnel decontamination facility with enough room space in the plant's medical center.

In St Riquier, just over 5 km from the site, Paluel power plant has a fallback facility connected to a sports hall. If it were necessary to evacuate the plant, the evacuees would be transported to the fallback facility, which has rooms, equipment and supplies for decontamination purposes.

For announcing the alarm to the population in the EPZs, the off-site authorities would use primarily mobile equipment. For informing the public in emergencies the prefecture has agreements with public and private radio broadcasters and with public (but not private) TV broadcasters.

At the end of 1997, distribution of stable iodine was started in the area within 10 km from the power plant. About one half of the population have sought their iodine tablets from the pharmacies. If stable iodine were needed in an emergency, the off-site organizations would distribute tablets to the remaining half of the population.

## 8.6. TRAINING, DRILLS AND EXERCISES

Criteria for required general training are in the PUI. Recommendations for job-specific training were recently put into the PUI and a large number of on-call personnel have already completed the training.

Requirements have not been established for ensuring on-call personnel participation in exercises, drills and training for assigned emergency response duties. Follow-up of the exercise, and drill experience and job specific training of the emergency response organization members is difficult because the number of members is large and this information is not readily available. Because follow up does not cover sufficiently the whole emergency response organization, it is not assured that all alternative persons in the on-call system receive adequate training for specific PUI functions and adequate exercise experience, especially for PUI level 2 or 3 situations. In general, the training, drill and exercise programme at Paluel is sufficient.

Maximum duration of the exercises has been one work day. Conducting a longer exercise, where changing the staffing would be necessary, could bring new experiences and is under discussion at a national level.

The system of assembling and evacuating plant personnel has been tested.

## 8.7. LIAISON WITH PUBLIC AND MEDIA

There are four alternative trained persons in the emergency response organization to write press releases. One of these is on-call. For normal operations events like scrams the same procedure is used, which also provides training for emergencies. All Paluel press releases go to the prefect for agreement before release.

Paluel has good facilities for distributing information in emergencies. On the site there is a conference room, with a communication connection to the EDF corporate conference room in Paris. There is also a room for journalists providing them with 12 direct external telephone lines. In PUI level 3 situations all reporters would be guided to the prefecture in Rouen.

The prefecture distributed an information leaflet to the population of the EPZs in 1997. The telephone catalogue has not been used to give people instructions on how to behave in case of a nuclear emergency in a form which is always available.

#### **STATUS AT OSART FOLLOW-UP VISIT**

Since the OSART Mission in January 1998, the study for the renovation of the security building PCD, PCC and PCM has been completed and renovation is planned to be completed in 2000. This will result in centralizing the groups leading the on-site emergency response. An annex is also planned for the security building which can be used for decontamination if necessary.

**SUMMARY OF STATUS OF RECOMMENDATIONS AND SUGGESTIONS OF THE  
OSART MISSION TO PALUEL - JUNE 1999**

	RESOLVED	SATISFACTORY PROGRESS	INSUFFICIENT PROGRESS	WITHDRAWN	TOTAL
Management, Organization & Administration	1R	5R 2S			6 R 2 S
Training & Qualification	1S	3R 1S			3 R 2 S
Operations		3R	3R		6 R
Maintenance		2R			2 R
Technical Support	1R	3R			4 R
Radiation Protection		2S			2 S
Chemistry	3R	1R 2S			4 R 2 S
Emergency Planning and Preparedness					0 R 0 S
TOTAL R (%)	5 (20%)	17 (68%)	3 (12%)		25 R (100%)
TOTAL S (%)	1 (13%)	7 (87%)	0 (0%)		8 S (100%)
TOTAL (%)	6 (18%)	24 (73%)	3 (9%)		33 (100%)

## DEFINITIONS

### DEFINITIONS - OSART MISSION

#### **Recommendation**

A recommendation is advice on how improvements in operational safety can be made in the activity or programme that has been evaluated. It is based on 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.

#### **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 or 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.

#### **Good Practice**

A good practice is a proven performance, activity or use of equipment which the team considers to be markedly superior to that observed elsewhere. It should have broad application to other nuclear power plants and be worthy of their consideration in the general drive for excellence.

### DEFINITIONS - FOLLOW-UP VISIT

#### **Issue resolved - Recommendation**

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

#### **Satisfactory progress to date - Recommendation**

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

### **Insufficient progress to date - Recommendation**

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

### **Withdrawn - Recommendation**

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

### **Issue resolved - Suggestion**

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

### **Satisfactory progress to date - Suggestion**

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

### **Insufficient progress to date - Suggestion**

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

### **Withdrawn - Suggestion**

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

## ACKNOWLEDGEMENTS

The Government of France, the Nuclear Installations Safety Directorate (DSIN), Electricité de France (EDF) and the staff of Paluel Nuclear Power Plant provided valuable support to the OSART mission to Paluel. France has provided significant contribution to the OSART programme by sending experts to other OSART missions, according a cost free expert to the staff of the Operational Safety Section of the IAEA, in providing consultants to review the OSART programme and in hosting OSART mission to nine French plants. Such close cooperation between France and the IAEA in all nuclear activities has established many personal contacts and a common basis for efficient work.

Throughout the whole OSART mission and the follow-up, the team members enjoyed excellent co-operation and fruitful discussions with Paluel Nuclear Power Plant managers and staff, other EDF personnel and staff of local and national authorities. Information was provided openly and in the spirit of seeking improvements in operational safety. There was a rich exchange of knowledge and experience which contributed significantly to the success of the missions. It also established many personal contacts that will not end with the completion of the missions and submission of this report. The efforts of the plant counterparts, liaison officers, interpreters and the secretary were outstanding. This enabled the OSART team to complete its mission in a fruitful manner. The IAEA, the Division of Nuclear Installation Safety and its Operational Safety Section wish to thank all those involved for the excellent working conditions during the Paluel Nuclear Power Plant review.



## TEAM COMPOSITION OSART MISSION

### Experts:

#### **ARREVILLAGA, Fernando - MEXICO**

Laguna Verde NPP

19 years of nuclear experience

Area: Maintenance

#### **CASCANTE-MARISTANY, Carlos - SPAIN**

Asco NPP

24 years of nuclear experience

Area: Chemistry

#### **DAHLGREN, Kerstin - IAEA**

Division of Nuclear Installation Safety

15 years of nuclear experience

Assistant to Team Leader

#### **DIAZ-FRANCISCO, Jose - IAEA**

Division of Nuclear Installation Safety

24 years of nuclear experience

Area: Operations I

#### **HOLLINGER, Wayne - IAEA**

Division of Nuclear Installation Safety

31 years of nuclear experience

Team Leader

#### **LÖWENDAHL, Bengt - SWEDEN**

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Area: Radiation Protection

#### **MARCHESE, Christopher - UNITED KINGDOM**

Sizewell A Power Station

26 years of nuclear experience

Area: Management, Organization  
and Administration

#### **MICHIELS, Wim - BELGIUM**

Doel NPP

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Area: Technical Support

**MÜELLER, Klaus-Walter - GERMANY**

TÜV Energie- und Systemtechnik

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Area: Operations II

**SCHMIDT, Terry - UNITED STATES OF AMERICA**

Byron NPP

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Area: Training and qualification

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Olkiluoto NPP

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Area: Emergency Planning and Preparedness

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15 years of nuclear experience

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## TEAM COMPOSITION OSART FOLLOW-UP VISIT

### Experts:

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Training and Qualifications

Maintenance

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Team Leader

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Chemistry

Emergency Planning and Preparedness

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Technical Support

### Observer:

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