



IAEA
International Atomic Energy Agency

REPORT
of the
CORPORATE OPERATIONAL SAFETY
REVIEW TEAM (OSART)
MISSION

to

EDF

France

23 November – 9 December 2014

DIVISION OF NUCLEAR INSTALLATION SAFETY
COPORATE OPERATIONAL SAFETY REVIEW MISSION
IAEA-NSNI/OSART/14/182

PREAMBLE

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

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

FOREWORD

Director General

The IAEA Corporate 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 organizational factors, 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 corporate organization personnel. It is intended that such advice and assistance should be used to enhance nuclear safety in all countries that operate nuclear power plants.

A Corporate 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 corporate organization. A standard scope review covers four review areas: corporate management; corporate human resources; corporate communication and independent oversight. Depending on the needs of particular organizations, each corporate OSART review can be extended to additional areas such as maintenance; technical support; operating experience; chemistry; emergency planning & preparedness and accident management.

A Corporate OSART is an OSART mission organized to review those centralized functions of the corporate organization of a utility with multiple nuclear plant sites (and possibly conventional plant sites and other business areas) which affect all the operational safety aspects of the nuclear power plants of this utility in the commissioning or operating phases.

Essential feature of the work of the OSART team members and their corporate organization counterparts is the joint search for ways in which operational safety can be enhanced. The IAEA Safety Standards 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 to achieve its safety objectives. Proposals for further enhancement of operational safety may reflect good practices observed at other nuclear power operating organizations.

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 corporate organization and considers additional comments made by corporate organization counterparts. Implementation of any recommendations or suggestions, after consideration by the corporate 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 how a corporate organisation affects the overall safety of its NPPs, a requirement normally placed on the respective operating organization by the regulatory body. Each review starts with the expectation that the operating organization meets the safety requirements of the country concerned. An OSART mission attempts neither to evaluate the overall safety of an organisation NPPs nor to rank their safety performance against that of other organisations' NPPs. 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 operating organizations are constantly evolving and being enhanced. To infer judgements that were not intended would be a misinterpretation of this report.

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

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INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of France, an IAEA Corporate Operational Safety Review Team (OSART) of international experts visited the French Corporate organization EDF S.A. from 24 November to 09 December 2014. The purpose of the mission was to review corporate functions in the areas of Corporate Management; Independent Oversight; Human Resources; Communication; Maintenance; Technical Support; Operating Experience, Chemistry and Emergency Preparedness and Response & Accident Management. In addition, an exchange of technical experience and knowledge took place between the experts and their counterparts on how the common goal of excellence in operational safety and corporate functions could be further pursued.

The EDF Corporate OSART mission was the second Corporate OSART and 182nd in the OSART programme, which began in 1982. The team was composed of experts from Canada, the Czech Republic, Finland, Germany, Slovakia and the United States of America, together with IAEA staff members, one observer from the IAEA and one from the Russian Federation. The collective nuclear power experience of the team was approximately 340 years.

Before visiting the corporate organization, the team studied information provided by the IAEA and EDF to familiarize themselves with the EDF corporate main features and operating performance, staff organization and responsibilities, and important programmes and procedures. During the mission, the team reviewed many of the EDF corporate programmes and procedures in depth, examined indicators of the corporate performance, held in-depth discussions with the corporate personnel and visited Blayais, Saint Laurent, Chooz and Chinon NPPs and DIN-CIPN and DIN-CEIDRE, UTO, FARN and INTRA organizations.

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

The following report is produced to summarize the findings in the review scope, according to the Corporate OSART Guidelines and OSART guideline documents.

MAIN CONCLUSIONS

The OSART team concluded that the managers of EDF S.A. are committed to improving the operational safety and reliability of their nuclear power plants and corporate processes and performance. This was clearly demonstrated by the fact that since the Corporate OSART preparatory meeting in November 2013, the Corporate organization has introduced or extended several programmes contributing to improved performance. The team found good areas of performance, including the following:

- "Academies of Common Knowledge" and "Academies of Specific Knowledge" are effective in training recruits entering EDF Nuclear Generation and Engineering Division, including trainees.

- EDF Corporate has provided successive levels of emergency response resources, such as the Rapid Nuclear Response Force (FARN), that will help the nuclear power plants to cope with extreme unexpected situations.
- EDF has strong relationships with stakeholders and experts through its local, national and international outreach.
- The independence of the General Inspector for Nuclear Safety and Radiation Protection (IGSNR) and Nuclear Inspectorate strengthens the Independent Oversight function across the utility.

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

- EDF Nuclear Generation should consider completing the evaluation phase for the tailored and progressive training program for EDF staff.
- The corporate organization should consider improving its planning and documentation in scheduled outage modification activities.
- The corporate organization should consider completing the ongoing implementation of the new safety event analysis method over the entire nuclear fleet and strengthen the ownership of this new practice

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

1. CORPORATE MANAGEMENT

1.1 CORPORATE STRUCTURE, RESPONSIBILITIES AND LINES OF AUTHORITY

The licensee responsibilities are described in organisational procedure: Nuclear Safety and Radiation Protection at BNIs operated by EDF S.A, General Organisation Memo. Details of the delegated responsibility for the nuclear license flow through the CEO to the Director of DPN to the NPP Plant Director.

The delegation of design authority to the DIN Director is documented in the Nuclear Safety and Radiation Protection at BNIs operated by EDF S.A, General Organisation Memo.

At Corporate and NPPs levels, the senior management cadre is stable with experience gathered through the management rotation policy. During interviews, Senior Managers disclosed a strong allegiance to EDF and do not leave until retirement following a structured career. During the mission the team found an experienced and motivated management.

The organisational structure is described in letters, memos and policies that describe the main Divisions of EDF and their roles and responsibilities and major interfaces. The Organisational memo of the Generation and Engineering Branch (DPI) covers operation of power generating facilities. The Executive Directors define their structures through letters and policies that describe the major interface meetings. The balance of the organisation is defined and documented in the respective Integrated Management Systems.

There is a single Divisional Director of Nuclear Generation who has line authority over stations management. However, due to the size of the EDF nuclear fleet additional support is provided in the form of two Deputy Directors of Operations (DDO).

The DDOs play a role of integration at the corporate level support between the NPPs, the corporate owners of the Macro-Processes of the Integrated Management System, and the Craft Coordination at the national level. They challenge the Station Director of each unit and their staff on their performances and negotiate the human and financial resources. They give the CNO an operational vision of the performances of the NPPs, safe generation, and support him to lead the Nuclear Power Plant Generation Division.

The DDOs marshal the support of the corporate organisation, draw together the operational issues facing the NPPs and act as their advocate, Corporate management use each DDO as a conduit to gain alignment and support at the NPPs. The DDO is instrumental in setting challenging but achievable targets for stations at differing levels of safety performance

The CNO interacts with the DDOs on safety matters to draw on their experienced and balanced judgements and evaluation. The team recognised this as a good performance.

1.2 ESTABLISHING POLICIES, EXPECTATIONS AND INFLUENCING PRIORITIES, PRACTICES AND BEHAVIOURS

EDF is governed by high level policies and charters that describe the remit, behaviours and conduct. Of particular interest is the EDF Group Nuclear Safety Policy that places an overriding priority in the sustainable use of nuclear energy. This is also laid down in the EDF Group code of ethics.

The DPN “Generation 2020” plan provides a strategic multi-year plan and has been produced to deliver long term improvement based on an assessment of the fleet at mid-life. The major priorities are nuclear safety management and industrial performance. Generation 2020 provides a framework to anchor the planning process ensuring progression and continuity of themes year on year so that they are well communicated throughout the organisation. During interviews, the team saw good alignment.

The DPN corporate team implements an annual business planning process including an analysis of NPP performance and the eight Macro-Processes (MP) of the Integrated Management System. Annual objectives (17 performance indicators, including safety indicators) are established for the fleet. Each NPP proposes a plan following an annual review and the DDO negotiates with the Station Director and records the results in a contract.

In preparation for the annual IMS review, the Corporate Macro-Process owners review and challenge the NPP plan and Sub-Process to gain alignment and to contribute to the targets to balance the level of support.

At NPPs, 30 Sub-Processes are reviewed annually and areas for improvement are identified. These are considered alongside a review of 8 MP in senior management reviews. From these are established targets and goals. The NPPs factor these targets into the development of Dept business plans and the NPP business plan which is negotiated with the DDO and a contract signed. The NPP business plan contributes to the overall DPN Division business plan.

The NPP business plan is widely communicated to all of the NPP staff. EDF has an effective communication organisation to support the rolling out of initiatives – see section 4 of this report.

During interviews and in communications to staff, the CEO & Chairman expressed a strong commitment to nuclear safety. The Group Executive Vice President Generation and Engineering expressed a clear view of safety culture and declared a strong intent to maintain a full engineering function including design and construction to support the NPPs. His vision is that Engineering supports safe reliable NPP operation with engineering changes that are well designed and present the best options to DPN. The essences of these principles have been translated through policy and plans and represent some of the key attributes of safety culture in EDF.

DPN has an Operational Nuclear Safety Committee chaired by the DPN Deputy Director which brings together line operational functions and the internal Nuclear Inspectorate to oversee management of safety.

The Nuclear Safety Design Committee is chaired by the DIN Director. The committee discusses the safety requirements and design standards for an internal validation before submission to the ASN. The DPN Deputy Director has a veto authority as DPN has the responsibility for the license.

Management are engaged in safety assessment, management and oversight. Corporate management involve NPPs in a weekly alert meeting and remain in contact through conference calls. Corporate management make routine visits to NPPs.

KPI and action plans are monitored by the corporate organisation to ensure safety goals and plans are progressed and NPPs held accountable. There are monthly reports and the DDO conducts a twice yearly detailed site review and inspection.

The IMS translates and communicates the governing documents and regulatory standards. A quality manual is used in addition to the IMS to implement safety.

EDF has a full complement of policies and management expectations appropriate for a nuclear operating organisation. However, despite EDF having comprehensive policies, programmes and processes the corporate organisation is not always effective in ensuring these are rigorously executed. The team made a suggestion in this area.

At the highest level, EDF has a group safety policy that places the responsibility on line management with corporate responsibility for checking and ensuring the policy is adequately deployed. The higher accident frequency and fatalities was referenced in the IGSNR report which commends increased action by management. Corporate management introduced “Vital Life Safety Rules” to eliminate fatalities. During the mission the team observed evidence of progress. However it should be noted that during the mission a serious electrical safety event occurred at Chooz B.

EDF has a corporate department that conducts the long range planning for the large fleet outage program. Outages are classified into refuelling, maintenance, 10 year and life extension. Since EDF can conduct as many as 48 outages per year it is essential the generating capacity and contract services are co-ordinated. The corporate function conducts studies to extend the lives of NPPs beyond 40yrs and DIN has a specialist team to undertake the project work. This work is a major theme for DIN and is identified in the “DINamic 2020” plan. A comprehensive dialogue is held with ASN for life extension and 10 year outages with the negotiation including a review of safety analysis which commences 5 years before the first 10 years outage. The result of the findings can lead to modifications to improve safety and ageing equipment. For life extension ASN are seeking levels of safety towards the expectation of newer designs i.e. the increase of safety to modern standards. Life extension includes replacement of secondary equipment such as generators and transformers, in addition to primary equipment such as steam generators. These activities were judged to be effective.

The Risk Assessment Process assembles and compiles NPP Risk information in a structured manner to distil the key issues for focus and additional action by decision makers. The team considered this a good practice.

There is a corporate policy stating that contractors are used only for maintenance activities.

EDF is dependent on contractors but seeks to avoid overreliance on a single supplier. To enhance the quality of contract work EDF qualifies contractors for 5 years, evaluates their performance and helps to enhance their skills where appropriate, for example giving access to mock-up facilities (see the HR section of this report).

An ASN/EDF Executive level meeting is usually held once a year between the CEO of EDF and the Chairman of ASN. There are 3 normal types of interface meeting between the regulator and EDF to discuss safety. At the higher level there is a corporate interface called “4+4 meeting” between Executives which are held 4 times a year for each DIN, DPN and DCN divisions. There are standing Technical committee meetings and lastly there are theme or issue meetings of expert groups, forexample the plant 10 year review to explore the scope of work.

However, the introduction of the Nuclear Transparency Act and Regulations has challenged the relationship between ASN and EDF. The Steam Generator replacement project at Blayais unit 3 is currently delayed while issues associated with these regulations are resolved between ASN, EDF and Areva. Although dialogue and work is in progress to restart the project it is now inevitable that completion will be several months behind the original schedule and may have knock-on effects on similar projects that would enhance nuclear safety and plant reliability. When asked a senior EDF manager declared an intent to conduct a

cold debrief of this issue and pursue agreement on a protocol to advance the regulatory relationship once the issue is resolved.

1.3 MONITORING, DECISION MAKING AND CORRECTIVE ACTIONS

Oversight functions are covered in section 2 of this report.

There are twice yearly formal performance reviews on each plant by the DDO using data provided by Corporate MP owners and Nuclear Safety Division, NPP targets can be amended based on these reviews.

NPPs submit monthly KPIs that are monitored by Corporate committees and sub committees. NPPs also send a weekly report of issues and activities to the Corporate organisation. This is disseminated and shared across Corporate and NPPS at the Monday morning Alert meeting.

Each corporate macro-processes owner (functional directors of DPN) analyses the monthly results and discusses them with the NPP Macro-Process owner. The results of corporate assessments are circulated and MP owners provide comments. The DPN Corporate Team then meets to conduct a review.

Nuclear Safety monitoring starts with the Nuclear Safety Council (CSN) comprising the CEO, COMEX Members, Production and Engineering Directors and support functions. At the Nuclear Generation Division Level there is the Nuclear Safety Review Committee (CSNE) chaired by DPN Deputy Director (Technical) and is composed of DPN division directors, the station directors and the independent safety oversight function.

During Business Plan preparation the Corporate Macro-Process owners agree their strategies and KPIs with NPP Sub-Processes owners responsible for implementation. Throughout the business planning processes KPIs are defined in NPP/Corporate committees.

The Operating Experience Feedback and Corrective Action Programmes are covered in detail in Section 7 of this report.

1.4 PROVIDING RESOURCES CONSISTENT WITH RESPONSIBILITIES AND NEEDS OF SITES

The demographic issues facing EDF and the resultant training and knowledge transfer requirements are covered under section 3 of this report.

Human resources needs are requested by NPPs and authorised by corporate.

The corporate organisation retains certain experienced personnel and technology in DPN as a central resource to support all NPPs. This resource is available in real time should a maintenance, modification or industrial policy be needed. Skilled contractors and tooling are made available to support execution. An example is support for the wear on the control rod guide tube strategy for the 1300MW units.

For DIN, staffing needs and organisational developments to increase efficiency are identified annually by the management team. They review the level of technical skill and technical standards both internally and in suppliers in 12 areas. Management has identified the current risk areas as project management, Nuclear Safety and I&C.

EDF policy directs management to consider safety, complexity and risk when making a decision to contract work. EDF has a policy to ensure they are not dependent on single suppliers. EDF has recruited and trained staff to better control and supervise the quality of

work conducted by contractors and to ensure certain core skills are retained within the company e.g. valves and welding.

Obsolescence of major components is managed by DIN. Other obsolescence is managed on behalf of the NPPs by UTO. Because some replacements for obsolete parts may need to be designed and manufactured there is a multi-year plan which looks out 3 to 5, and sometimes 10 years ahead. UTO has the procurement engineering function and manages inventory levels led by a steering committee comprising site Departmental Directors and chaired by DPN.

1.5 MANAGEMENT OF CHANGE

There is a documented process for change management. Guidelines are based on the relative importance to safety of organizational changes. For safety-related organizational changes an impact analysis (based on INSAG-18) is carried out. The team reviewed documents in relation to Maintenance & Operations Methods (MME) and the IT system (SDIN) project.

The key points that contribute to successful implementation of the program are:

- the managerial support both at national and local levels,
- involvement of field managers from the design phase,
- involvement of users in the decision making including simulation workshops,
- involvement of safety support in the teams applying INSAG18 approach at local and national levels,
- a standardized and documented method of deployment based on the experience feedback documented and controlled both in the design phase and during deployment,
- specific teams to support users both at local and national levels,
- the SDIN Institute is a place for training but also a real simulator of activities, and for testing experience sharing among users.

The change management process is being well implemented in DPN and the team has identified this project and methodology as a good performance.

During interviews some managers outside DPN had difficulties explaining where special impact analysis on nuclear safety has to be made before the organisational changes are implemented. The team encourages EDF management to emphasise the importance of remaining focused on maintaining and enhancing the overall safety of the organisation before and during organisational changes.

1.6 MANAGEMENT INTERFACES BETWEEN NUCLEAR AND NON-NUCLEAR GENERATION PLANTS.

There is clear differentiation in the EDF group between the other divisions such as the thermal and hydro division. Both DPN and DIN are structured to be independent but in the support functions, there is some minor overlap. During inspections there was no evidence of personnel or resources being diverted from nuclear priorities to other EDF non-nuclear divisions.

DETAILED CORPORATE MANAGEMENT FINDINGS

1.2 ESTABLISHING POLICIES, EXPECTATIONS AND INFLUENCING PRIORITIES, PRACTICES AND BEHAVIOURS

1.2 (a) Good Practice: The Risk Assessment Process assembles and compiles NPP Risk information in a structured manner to distil the key issues for focus and additional action decision makers.

Description: Nuclear Generation Division has implemented a Group Risk mapping process by deploying an operational risk assessment tool on all processes, projects and NPPs. The process applies the Direction Contrôle des Risques Groupe (DCRG) methodology which defines an objective scale for a variety of potential impacts specific to Nuclear Operations, namely Safety, Production and Radiation Protection. As a result the potential safety impact of each risk can be assessed and prioritised in an all risks format.

The systematic use of the risk analysis methodology allows for a consolidated and prioritised map of DPN's macro risks. Each macro risk has an owner who has responsibility for the implementation of risk control strategy. The risk mapping process is an essential pillar of the Nuclear Generation Internal Control System and is integrated into MP1 "Leading the DPN" thus being an essential tool in decision making and prioritising in a large nuclear business.

Advantage: The DPN risk mapping supplies DPI and EDF Group a macro risk map which alerts Divisions to emerging trends and to request analysis.

Benefits: The risk mapping of macro risks is challenged by management every 6 months and has been enhanced thus reducing the number of risks from 45 in 2011 to 25 in 2014 and incorporating a visual representation that illuminates the prioritisation of the risks aligned with a predictive analysis of the future risk.

Issue 1.2(1): Despite EDF having comprehensive policies, programmes and processes the corporate organisation is not always effective in ensuring these are rigorously executed

The practice used at the corporate level to assess the adequacy of the management processes is not sufficient to ensure effective implementation of the EDF Management Systems (MS).

The team has identified the following facts:

- There is no systematic and consistent way in presenting results from reviews of MS within the different Divisions. Some results are presented in the form of letters, reports, presentation etc.
- In some MP previous annual review improvement actions were identified as being only partially complete, and no evaluation was completed of the reason. These actions were simply carried forward to the next annual review.
- The effectiveness of the MS review processes is not always evident, on the reviews records e.g. the OEF system is a part of macro-processes MP3, MP7 & MP8 but there are no arrangements in place for an integrated assessment of OEF effectiveness.
- Practices where management expectations are still not met have been identified in Chemistry, FME, Modifications preparation and OE.
- During several OSART missions to NPPs, deficiencies in handling, storing and labelling auxiliary and operational chemicals were observed, e.g., Chooz NPP 2013, Cattenom NPP 2011, St. Alban NPP 2010, Chinon NPP 2009, etc.

Previous OSART plant missions observed the following:

- Deviations from FME expectations at spent fuel pools
- Behaviour of workers in the field not always in accordance with expectations
- Supervisor not always correcting wrong behaviour of workers in the field
- Field observations by Managers are mostly schedule driven

Without rigorous execution and evaluation of policies, programmes and procedures effectiveness cannot be ensured.

Suggestion: EDF should consider enhancing corporate evaluations to provide assurance that management processes are always rigorously executed at all levels.

IAEA Bases:

GS-R-3

3.8. Senior management shall establish goals, strategies, plans and objectives that are consistent with the policies of the organization.

3.10. Senior management shall ensure that measurable objectives for implementing the goals, strategies and plans are established through appropriate processes at various levels in the organization.

3.11. Senior management shall ensure that the implementation of the plans is regularly reviewed against these objectives and that actions are taken to address deviations from the plans where necessary.

5.4. The development of each process shall ensure that the following are achieved:

- Process requirements, such as applicable regulatory, statutory, legal, safety, health, environmental, security, quality and economic requirements, are specified and addressed.
- Hazards and risks are identified, together with any necessary mitigatory actions.
- Interactions with interfacing processes are identified.
- Process inputs are identified.
- The process flow is described.
- Process outputs (products) are identified.
- Process measurement criteria are established.

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

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

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

GS-G-3.1

5.17. The process owner:

- Should track indicators so that performance of the process is clear and any necessary immediate adjustment of the process is possible;
- Should use additional indicators to show the improvement of the process and to show whether the specified targets have been reached;
- Should conduct reviews of processes to identify preventive actions and improvements

6.12. Individuals and management (other than senior management) at all levels in the organization should periodically compare present performance with management expectations, worldwide industry standards of excellence and regulatory requirements to identify areas needing improvement.

6.17. Self-assessment should actively identify opportunities for improvement. To prevent significant performance problems, self-assessment should seek to identify weaknesses that could cause more serious errors or events.

6.57. Determination of the cause of a non-conformance may require a thorough investigation by technically qualified and experienced individuals. The investigation may need to include the participation of the individuals involved and those who identified the non-conformance, to gain a complete understanding of the problem. The managers responsible for the determination of the cause of the non-conformance should assign sufficient resources to the task.

2. INDEPENDENT OVERSIGHT

2.1. FUNCTIONS COVERED BY INDEPENDENT OVERSIGHT

The EDF Policy clearly defines the requirement for independent oversight. Corporate functions in EDF are established to conduct an independent assessment at all levels of EDF structures:

- Group level
- Corporate level
- NPP level

Each level of management shall implement an independent oversight system, the purpose of which is to independently assess the way in which the nuclear licensee fulfils its role. The primary role of the independent oversight function is to ensure that safety remains the overriding priority, while at the same time performing verifications and providing management with support and advice. Each level within the company shall incorporate the independent oversight function into its organisations in order to provide independent oversight at the appropriate level. At management level, the independent oversight function shall report to the leader of the respective level. In the event of a serious breach of nuclear safety rules, the independent oversight function shall be duty bound to raise the alert, reporting where appropriate to the upper management level within the organisation. All assessment levels are reviewed by Inspector's General for Nuclear Safety and Radiation Protection office (IGSNR).

The independent oversight function is supplemented by WANO Peer Reviews organized every four years at each NPP and OSART visits missions at one French nuclear power plant per year.

Continuous improvement within the independent oversight function is managed through self-assessments, annual management system reviews of independent assessment units and feedback from line management.

During the review and visit to St. Laurent NPP it was noted that EDF conducts independent assessments at each management level and that escalation of significant safety issues is a duty for independent assessment functions at all levels in line with EDF policy, nevertheless the counterparts were unable to provide an example where the oversight function needed to escalate an issue.

Several issues have been identified during the review and are to be considered by EDF corporate to further strengthen the independent assessment function:

- Inspection team activities at corporate level NPP level are primarily compliance based.
- The EDF process at corporate and NPP level is solely made up of EDF personnel.
- Independent assessment process at corporate level does not set sufficiently ambitions or challenging objectives for operational safety performance indicators compared to PWR fleets in the world .

2.2. ORGANIZATION OF INDEPENDENT OVERSIGHT

The unit responsible for conducting independent assessments at EDF Group level (CEO level) and across the whole of EDF group including nuclear assets abroad is the IGSNR.

The independent function IGSNR comprises a team of five independent members, including the Inspector General who is the only person from outside the EDF Group. Four members of the team are from the EDF Group and have broad experience in the nuclear industry, from operation to engineering.

The IGSNR liaises closely with the company's other in-house oversight entities on corporate and plant level. IGSNR activities focus largely on in-field observations in the form of meetings and interviews, with the majority of its time devoted to discussions with personnel directly involved in nuclear safety matters: members of the workforce, the independent safety oversight function, first-line leaders, newcomers, contractors, subject-matter experts, fuel personnel, support functions, risk prevention personnel, station senior management.

Every power plant and corporate function is inspected at least once every three years by IGSNR.

These inspections, participation in committees and interaction with plants form the basis of IGSNR monthly meetings with the CEO and IGSNR annual reports which are prepared independently from EDF corporate line structures.

The highly independent team of experts reporting directly to the CEO is recognized by the review team as an effective function in line with the IAEA Safety Standards. Based on the review IGSNR has sufficient authority to discharge its responsibilities regarding an independent assessment.

The Inspector General also holds regular but informal meetings with the regulator.

The team recognizes the establishment of IGSNR at CEO level, its function and assigned authorities as a good practice

The Nuclear Safety Council Committee Meeting (CSN) at CEO level is a platform to decide on strategically important safety issues at group level. Director of Nuclear Generation (DPN) and Director of Engineering Division (DIN) are members of CSN. The Inspector General participates in this meeting and has authority to raise any concerns. CSN can also be challenged by more ambitious performance objectives of the EDF fleet. The team has identified that EDF is missing the opportunity to involve highly experienced experts in nuclear operations from outside the utility to be involved in the oversight process. Safety Council Committee has a limited possibility to challenge the CEO and members of CSN from EDF top management in nuclear safety performance using different opinion from external experts with international experience.

EDF is encouraged to consider the benefit of further strengthening its oversight function and to challenge the group level corporate management by bringing outside experts, highly experienced in plant operations, into the independent oversight process.

On Corporate Level - Nuclear Generation Division (DPN) –an independent assessment line consists of two main units: the Nuclear Safety Director and the Nuclear Inspectorate. The Nuclear Safety Director is supported by 30 experts on corporate level providing safety analysis, second level event cause analysis (some 200 events analysed out of 700 reported

significant events per year) and trends of safety indicators in order to challenge the Nuclear Generation Director and two deputy directors responsible for operation of NPP units and preparation of Flamanville unit 3 for operation.

The Nuclear Inspectorate performs regular independent assessments at sites and in corporate functions in 13 functional areas. Each plant is assessed every four years for a three week period. The 13 functional areas of Overall Safety Excellence Assessment (EGE) performed by the corporate Nuclear Inspectorate are as follows: Operation, Maintenance, Engineering/fuel reliability, Environmental safety, Chemistry, Industrial Safety and Radiation Protection, Fire protection, Emergency preparedness, Training, Nuclear Safety and site management (this area includes behaviours and performance of local site line management in safety culture, independent assessment units including Safety Engineers and overall assessment of actions to promote safety culture), Outage management, Long term planning, Material condition and Housekeeping.

The corporate independent assessment team, which conducts regular reviews consists of at least 35 staff from Nuclear Inspectorate (1 Team leader, 1 Deputy TL, 23 inspectors and 10 peers from other units or plants as needed). Nuclear Inspectorate has implemented a modified methodology from INPO. Team reviews of functional areas are well structured in order to cover both: at corporate level and reviews at plant level.

All other divisions within the EDF corporate structure have a similar independent assessment line as described above for the Nuclear Generation Division (DPN).

During the review the team was informed about well-structured independent assessments of 12 areas conducted in Engineering Division (DIN). Independent assessments conducted in DIN are well coordinated with other assessments within EDF and results are discussed in DIN annual Safety Review. The effectiveness of EGCI self-assessment is reviewed on an annual basis during DIN management review process.

All EGCI independent assessments are regularly updated and modified after significant regulatory change of requirements etc. The reference document for EGCI assessment consists of some 220 basic requirements and team identified as strength of this assessment methodology its focus on performance and risk management. All engineering centres are systematically assessed by independent reviewers every three years.

The EGCI methodology ensures that all plant modifications are performed in order to support safety as the overriding priority, thus strengthening the role of Design Authority.

The team considers the EGE and EGCI independent assessment process in DPN and DIN as a good practice, performed by highly qualified staff with adequate experience, well respected by line management.

Nuclear Power Plant level - an independent assessment at plant level is performed by the Nuclear Safety Advisor who reports to the corporate Nuclear Safety Director and Plant Director with assigned authority to escalate safety issues to corporate level in case of Plant Director disagreement with findings or recommendations. Nuclear Safety Advisor is supported by 5 Safety Engineers and a Safety and Quality department.

The independent function of NPP oversight consists of three main components or units:

1. Senior Nuclear Safety Advisor (NSA) – link to corporate level on independent oversight function and issues and part of escalation process if needed. NSA reports to Site Director and is supported by:
2. Safety and Quality department responsible for audits and monitoring station data and 23 safety indicators and
3. Nuclear Safety Engineer on each morning shift reporting to NSA and the Head of Safety and Quality Division

Independent assessment at plant level is coordinated by NSA and all three components of oversight have authority to independently monitor the plant status based on the following activities:

- A daily basis through Safety Engineers and daily safety challenge meetings with shift supervisors.
- A weekly basis through meetings and reports from NSA to station director and corporate Nuclear Safety Director. Nuclear Safety Engineer submits weekly reports to Plant Director and NSA. Weekly reports are made available for all staff through intranet too.
- A monthly Technical Safety Operational Meetings through participation of the Nuclear Safety Advisor monthly contact corporate and also participate in the Operational Safety Committee (NSA is the only assigned link to corporate).

Nuclear Safety Engineers have the authority to escalate (in case of disagreement with the shift supervisor or station director) their safety concerns to the Nuclear Safety Advisor who reviews and could escalate issues to corporate level.

During a review and visit to Saint Laurent NPP, no cases were provided by any counterparts to confirm that the escalation process has been applied or used to raise awareness of safety issues at a higher level.

The independent assessment processes on all three levels are well structured and coordinated. The IGSNR also has a role to assess safety culture and effectiveness of corporate and plant level assessment processes and effectiveness of their implementation.

2.3. ORGANIZATION AND STAFFING

EDF has a mobility programme which is widely used within the Group to assure that all staff in independent oversight groups are well trained and have experience at more than one NPP.

Independent oversight skills are developed through structured training recruitment requirements and career path management between line management and the independent assessment line.

At the plant level all Nuclear Safety Engineers and Nuclear Safety Advisors working on NPPs are well qualified and trained. This allows them to be well respected and have the right level of independence in their duties when performing assessments or conducting challenge meetings with shift supervisors or Plant Directors.

The Nuclear Inspectorate at corporate level is resourced by 40 staff members possessing specific expertise with acquired experience and training to perform all assigned duties in an effective manner. The Nuclear Inspectorate's management system procedure on qualification

requires that inspectors, have a minimum of five years of operational experience on nuclear power plants. Team leaders, are required to have held a senior managerial position on an NPP and there is a requirement in place for a maximum four year term for inspectors in the independent assessment group.

The team recognized the qualification requirements and rotation system ensuring highly competent staff for independent assessment performed by Nuclear Inspectorate in broad range of functional areas covering both NPP operation and corporate functions as a good performance.

2.4. REPORTING

The team observed that on each of the three levels in the EDF independent oversight line, there is a regular reporting system in place on results from assessment activities and audits. At site level the Nuclear Safety Engineer provides weekly reports to the Senior Safety Advisor who reports to the Station Director on a monthly during Technical Safety Committee meetings, and to the corporate function, Nuclear Safety Director.

At corporate level, all independent assessment reports and outputs from reviews are available to respective line managers. Nuclear Inspectorate reports from regular reviews of functional areas are submitted to the Nuclear Generation Division Director and are discussed at Operational Safety Review Committee (CSNE) meetings. Annual reports of the Nuclear Inspectorate summarize outputs from independent assessments of functional areas within the EDF fleet.

The IGSNR annual report is submitted to EDF Ethical Committee and to the EDF BOD. General Inspector Annual Report is available for all managers and used as an input for further improvement actions. This report is sent to ASN and is also available to the public.

The reporting system in EDF ensures openness and direct reporting to all management levels including CEO.

DETAILED INDEPENDENT OVERSIGHT FINDINGS

2.2. ORGANIZATION OF INDEPENDENT OVERSIGHT

2.2(a) Good practice: The independent function IGSNR (General Inspectorate for Nuclear Safety and Radiation Protection) reports directly to CEO.

Description:

The IGSNR comprises a team of five independent members, including the General Inspector. This team uses its own methods for independent assessment of corporate functions, nuclear sites and other EDF nuclear assets. The General Inspector reports to CEO and EDF Board of Directors (BOD). The annual report on independent assessment of EDF nuclear assets is submitted to CEO, BOD, French regulator (ASN) and also to the public.

A CEO decision establishing the IGSNR office and assigning its authorities and letters of CEO of EDF dated 30 July 1999, and 15 July 2014, empowered the General inspector to perform permanent independent assessments of all areas of EDF activities in nuclear and radiation protection areas.

The Inspector General is always selected from outside the EDF utility for 5-6 years term in order to bring independent views and fresh look to EDF nuclear safety processes.

The IGSNR team is highly qualified and has relevant experience from design to operational safety with broad experience in nuclear power operation and international practices.

The IGSNR is an autonomous role with a high level of authority and reports to the CEO (the legally assigned license holder).

Benefits:

The Annual Report of General Inspector for 2013 clearly confirms independence of this function. The report is submitted to the EDF senior management to challenge EDF line management in continuous improvement of the fleet.

This oversight function provides a link between corporate and group level to raise any safety concerns.

Line management at all three management levels uses this report for implementation of improvement actions which are tracked.

The IGSNR is a key component of continuous improvement of safety in all areas within both line management and independent assessment line of EDF.

2.2(b) Good practice: Nuclear Inspectorate in DPN and overall review process EGCI in DIN provide independent assessment by a highly competent and experienced staff, whose insights are acted upon by line management.

Nuclear Inspectorate (NI) conducts a full-scope Overall Excellence Assessments (EGE) covering a broad scope of 13 functional areas. This function is resourced by 40 staff members of specific expertise with acquired experience and training. NI conducts EGEs on a 4-year cycle on all NPPs, and the EGEs are coordinated with WANO PRs and are conducted with highly competent staff experienced in operation Assessors are highly respected by both Station Managers and corporate senior managers.

NI authorities laid down in DPN Quality Management document, sub process for “Risk Management and Internal Control “- NL PIL 90 N, N PIL 100 N, and MP1 defines duties, responsibilities and authorities for on escalation process with NI.

NI management manual procedure on qualification of all NI staff requires:

Maximum four years term for inspectors in independent assessment group of NI,

Minimum requirements for NI staff include at least 5 years of operational experience on nuclear power plants, and Team Leaders are required to have held a senior managerial position on an NPP,

The annual review of the nuclear inspectorate's human resource process documents the effectiveness of the recruitment process (HR process review of 20 October 2014, ref. D4008.26.14147CR).

Administrative measures are in place to assist with the relocation of senior employees recruited from NPPs to join the nuclear inspectorate.

Independent assessment of all engineering centres is carried out within engineering division (DIN). Independent verification process ensures that all plant modifications are well defined and performed in a way that ensures safety is the overriding priority, thus strengthening the role of Design Authority. Significant design changes and modifications are evaluated and approved in CSNC.

All engineering centres are systematically reviewed by independent assessors every three years using overall review process (EGCI). The EGCI external independent assessment team focuses on safety issues in engineering activities. The team consists of well qualified and experienced staff with experience in plant operation as well as engineering. Independent audits are also performed as topical inspections based on management request. The effectiveness of EGCI independent assessments are reviewed on an annual basis during DIN Nuclear Safety Management Review process and during analysis of events.

Benefits:

Highly competent staff whose independent assessments are regarded by line managers and this provide value to operational safety improvement.

The DPN, DIN, CSNE are provided with diverse information by independent assessment line on safety issues as needed.

The EDF structure and arrangements ensure that corporate independent assessment line has a duty to raise significant safety issues to IGSNR and thus escalate any safety concern.

The EGE functional areas reviews are well coordinated with WANO Peer reviews in four year cycles and EGCI reviews are performed every three years.

The EDF mobility program and rotation of experience staff between corporate assessment units and line management promotes self-assessment activities and ensures highly competent assessors for EGE and EGCI reviews.

3. CORPORATE SUPPORT TO PROVIDE HUMAN RESOURCES

3.1 HR POLICY IDENTIFYING KEY COMPETENCES THAT HAVE TO BE KEPT INTERNALIZED TO ENSURE CONTROL OF ALL SAFETY RELATED ACTIVITIES.

The EDF human resources are structured in 4 levels:

1. The Group HR Department;
2. The Department of Production Engineering HR (DPI);
3. The Divisions HR Departments; and
4. The sites HR Departments.

Activities under the responsibility of the human resources department of DPI include: implementation of HR policies and strategies defined at the Group level; definition of DPI HR policies and support divisions in the implementation of those policies; preparation and tracking DPI staffing plans; overseeing payroll; preparation of knowledge transfer guidelines; promotion of quality of life in the work place.

The OSART team assessment of human resources activities was mainly concentrated at the Nuclear Generation Division (DPN). Other divisions (DIN, DAIP) were assessed in the context of the support they provide to DPN.

The human resources department of DPN translates and implements Group and DPI policies and strategies and manages its activities through an integrated management system structured in one macro-process MP6 and 4 sub-processes (1- Manage resources and manager career development, 2- Define specialization skills of today and tomorrow, 3- Develop and assess skills, 4- Drive social development). Through its integrated management system, the DPN provides guidance and support to the sites for a consistent and harmonized implementation of HR activities.

At the sites level, each human resources department defines its activities in accordance with the priorities and guidance provided by DPN. At Saint Laurent NPP human resources activities are implemented under an integrated management system formed by one macro-process (MP6) and 4 sub-processes (1- Proactive management of jobs and skills, 2- Motivation, recognition and change management, 3- Coordination of labor relations, 4- Job contract management). There is good consistency between the integrated management system at the corporate and the site level.

At Group level a policy was issued in 2012 on HR vision for 2020 and an action plan established for the period 2013-2015. The policy identifies the need for an individual and collective commitment to human resources development due to the high staff turnover within the Group. At DPI level the HR vision for 2020 is translated in a roadmap.

The DPN general policy and DPN HR policy in particular, emphasize the role of managers in developing and assessing individual and collective competencies that are required for the proper execution of operation activities. This concerns also the role of managers in planning for the required renewal of those competencies.

Competencies considered critical for the organization are kept internalized through a robust system of training, tutoring and knowledge management.

3.2 ENSURING AVAILABILITY OF APPROPRIATE NUMBER OF COMPETENT STAFF THROUGH RECRUITMENT, SELECTION AND HIRING

An unprecedented recruitment process is in place to cope with the large number of retirements that is currently taking place. It is expected that 50% of the overall DPN staff will be replaced in a time frame of 10 years, and a similar recruitment trend is observed in other divisions.

Currently more than 1,500 people are recruited per year at DPN. The intent is to rebalance the age pyramid and avoid a similar situation of massive retirements in a short period of time in the future. This was made possible thanks to the recruitment process established by the DHR Group.

As a result of these recruitments, training has become one of the main priorities for DPN, in an area where the required skills cannot be found in the job market. The annual volume of training has increased from one million hours to nearly three million hours. This was made possible by recruiting new trainers, building new infrastructures, and support from operational staff, etc.

Training of new staff covers both common knowledge and specific knowledge. Common knowledge training at DPN lasts 12 to 13 weeks and is addressed to all staff joining the organization, including administrative staff. Technical staff must complete job-specific knowledge training before joining their working teams. Assessments are performed at the end of each module.

Since 2011 the DPN has been working to strengthen its skills assessment and training programmes based on best practices from other nuclear operators. Existing programmes in some areas are being revised according to the Systematic Approach to Training (SAT). This activity is not yet complete: trade reference standards must still be finalized and a performance-based evaluation system for job-specific training be established. The team issued a suggestion in this area.

Training sessions are organized by several DPN entities together with the training unit (UFPI) through the so-called “Academies of Common Knowledge” and “Academies of Specific Knowledge”. In this structure the management of DPN at corporate level and at site level is responsible to define training needs. Site-level managers are responsible for following up the development of the trainees, assessing the trainee in the field and finally qualifying the trainee for his/her job position. The UFPI is responsible for conducting the training, testing after each training module and evaluating the academic performance of the trainee and transmitting the results to the trainee manager. This is considered a good practice.

Group DRH, DPI and DPN maintains a good relationship with the academic system both at corporate and at site level. Partnerships are established with certain schools and corporate level seminars are organized in engineering schools to promote nuclear engineering careers and campaigns are organized on a regular basis to present job opportunities in EDF.

DPN trains more than 1000 students a year at all levels (vocational, technician level and engineers) under the “Sandwich Trainee Programme”. Each trainee has a tutor that is responsible for his/her development and that interfaces with the school at least twice a year. Managers are responsible to follow-up this process and verify that the goals of the training have been achieved. The training duration is generally 2 years and during this period, trainees spend part of their time at school and part of their time at the site or at DPN corporate. At the

end of this period, part of the trainees are recruited by EDF, others are proposed to sub-contractors or continue their studies. In 2013, about 50% of trainees were recruited by the DPN. Experience shows that trainees hired by the DPN after their training programme are easily integrated into their teams. This programme is considered a good practice.

As part of the effort to improve the quality of training, in particular in the area of maintenance, every site will be equipped with a mock-up facility (valves, mechanical, electricity, I & C, chemistry, testing, logistics, etc.) by 2017. This will enable workers to carry out work practices on equipment similar to that found in the field (for reactive or just-in-time refresher training). Pending the construction of new buildings, most of the sites have set up temporary mock-up facilities. Also an innovative tool development programme for training was initiated between the DPN and the UFPI in 2012 aiming to establish a reference library that can be used to refresh knowledge in areas considered as priorities for the DPN. The programme includes the development of training videos to be used for pre-job briefs; systems simulation to provide an understanding of certain operating actions; and an augmented reality tool that simulates the working environment where workers can practice their skills in order to reduce their exposure to risks in the field. As at the end of 2013, around 100 tools were available and around 30 development tools are planned for 2014. This effort in developing pedagogical tools (mock-up facilities and innovative tools) is considered a good performance.

The recruitment process takes into account the time required for the development of staff before assuming his/her job position. For certain positions the development period can be as long as 2 years. During this period new staff will follow common and specific training and will be assigned a tutor. In several cases the tutor is a subject matter expert and the new recruit manager is involved in the process to ensure that the objectives of the programme are attained. This period is known as an “incubatory period” at EDF. To ensure the availability of subject matter experts to support new recruits, they were partially relieved of their regular duties and a programme of incentives was created. Others work full time supporting the development of the new staff. Those close to retirement are offered a salary increase. This initiative was discussed and generated an agreement at the level of DPI and DPN with the unions. This is considered a good performance.

3.3 KNOWLEDGE MANAGEMENT

The skills and advisory centre (PCC) of DPN together with the site management teams are responsible for identifying the technical skills required for the safe operation of the fleet. The PCC established skills guidelines and reference standards for the technical areas and revises them as necessary.

The site management teams are responsible for mapping existing skills and identifying gaps for the following years. In this process the sites can include specific skills they consider necessary, taking into account operating experience feedback. Based on the gaps identified, training programmes are established. On this basis, the corporate department of human resources (DRHM) plans the volume and areas of training with the training unit (UFPI).

Critical skills relates to DPN positions including safety engineers, outage safety engineers, engineers liaising with the regulatory body, outage managers, complex maintenance engineers, radiation protection engineers, environmental engineers, etc. Once a year the sites send to the corporate human resources department a summary report on the status of the critical knowledge, identifying needs for the following 3 years. This report is revised

annually and validated by DPN senior management. On this basis, the need for additional training and/or additional resources is defined.

The nuclear engineering division DIN created the knowledge management programme, RACINES, aimed at facilitating knowledge transfer between experts and the new generation entering the organization. The programme has 4 main components:

- E-checking: a questionnaire to evaluate specific knowledge and is addressed to young professionals at the end of their first contract. It is voluntary and anonymous;
- SEVE: meetings involving experts and young professionals working in the same area to discuss pre-agreed topics. SEVE is also used for team building.
- RELAIS: a process to speed-up the knowledge transfer between an expert close to retirement and a young professional. This process is controlled by the young professional manager and the expert is released of part of his/her duties to dedicate to his tutoring activity;
- BUILD'IN: web community to facilitate the exchange of experiences.

This simple and comprehensive set of tools can be customised to the context of each entity and supports DIN to develop the competency of its new recruits. This set of tools is not capital-intensive and can be replicated at other operators for whom the transfer of knowledge is a priority. This is considered a good performance.

3.4 COMPANY INCENTIVES AND COMPENSATION POLICY

Salaries comprise a fixed and a variable part. The fixed part is based on a grid that takes into account the academic background, the complexity and level of responsibility of the position, the experience in the position, and seniority. The variable part takes into account individual performance, team performance and site performance. Operations staff receives additional remuneration of 10%. All on-call staff, including safety engineers, receive additional remuneration that can be as high as 30% of the fixed part of the salary.

3.5 SUCCESSION PLANNING

A succession plan is prepared at site level by the technical departments in association with skills mapping. It covers natural flows (retirements, transfers to other sites) and considers human resources needs for future projects. The information from all sites is consolidated annually by the DRHM at corporate level. A medium-term plan is prepared by the DPN which is discussed with the DPI, which finally allocates the resources in line with HR EDF Group directives. Thereafter, the DRHM distributes the resources among the sites in accordance with DPN management agreement.

The DPN has a system dedicated to managing the careers of managers and advisors supporting the site directors (Safety Director, Generation Director, Maintenance Director, Radiation Protection and Environmental Monitoring Director, etc.). At corporate level the career development committee (COCAR) identifies the candidates and discusses transfers. The DPN Safety Director is a member of the COCAR committee and provides views on the candidates from a safety-related perspective.

The appointment of site Department Heads and Outage Managers is discussed at regular intervals among site directors and coordinated by the Career Development Manager at DPN

corporate level. All other positions are examined at the site committee, comprising the site director, deputy directors and a professional belonging to the career development advisory team (professional project mobility counsellor).

There is a strong programme of staff rotation at managerial level. This includes rotation among sites, between a site and DPN corporate or between divisions. The standard duration of a position is around 5 years and crossover career paths are fostered and coordinated (programme Gateway). As an example, several instructors at UFPI (DAIP division) come from the DPN and are expected to move back to DPN after 4 to 5 years. About 300 manager transfers per year are covered by this programme.

Special attention is given to identify high-potential managers who are expected to occupy senior management positions at corporate level (group talent policy). For those managers, a dedicated career path and training are prepared. The overall process of succession planning and career management is considered a good performance.

3.6 EFFECTIVENESS OF HR SUPPORT TO OPERATIONAL MANAGEMENT BASED ON PLANT FEEDBACK

The DPN corporate human resources department (DRHM) together with the human resources department at site level provide support to the sites for matters relating to recruitment, legislative issues, relation with unions, succession planning, management of the remuneration system, skills management, etc.

Networks of peers run by the corporate are established in several areas with the objective of harmonizing the implementation of DPN guidelines, sharing good practices and discussing issues faced by the sites. These groups meet on a regular basis and in several cases have executive powers.

3.7 INDIVIDUAL PERFORMANCE ASSESSMENT

A unified methodology for assessing employees is applied at EDF. At the beginning of each year, employees are evaluated in terms of their performance of the previous year's objectives and in terms of their professional behaviour. This assessment is done by the direct supervisor, and has a direct link to the variable part of the remuneration. Career development, training plans and objectives for the following year are also discussed. This interview provides feedback for both participants (employee and supervisor), and the direct supervisor and the employee sign the completed appraisal form.

3.8 LABOUR RELATIONSHIP, UNION AFFAIRS

EDF has a long tradition of social dialogue and major changes are always discussed with the unions. Meetings at different levels are held on a regular basis with the unions. This activity represents a significant investment of time and is deemed necessary to allow the company to adapt to the required organisational changes. Examples include the Nuclear Generation Division (DPN) agreement of 2 August 2013 concerning the extensive fleet refurbishment programme for life extension, as well as the organisation and working conditions for the new Nuclear Rapid Response Task Force (FARN).

The Human Resources department carries out a weekly survey on the social climate of the plants in order to detect any potential difficulties via a designated local correspondent. Moreover, the EDF Group holds an annual survey (my-EDF) targeting all employees. The

results of this survey are analysed and presented to employees, and form the basis of an action plan for continuous improvement of the social climate at all levels.

Trade unions are required to give 5 days' notice prior to any strike. Negotiations are held between the unions and the human resources department to avoid a strike. In the event of a strike, known and respected business rules allow the company to ensure the safety of the nuclear fleet and of the grid. The DPN and the Nuclear Engineering Division (DIN) managers are trained on labour relations and on strike management rules for the nuclear industry. The relationship with the unions and related activities are considered a good practice.

DETAILED CORPORATE SUPPORT TO PROVIDE HUMAN RESOURCES FINDINGS

3.2 ENSURING AVAILABILITY OF APPROPRIATE NUMBER OF COMPETENT STAFF THROUGH RECRUITMENT, SELECTION AND HIRING

3.2(1) Issue: Implementation of Systematic Approach to Training is not completed at the EDF Nuclear Generation Division in the areas identified necessary.

The team has noted the following facts:

- Since 2011 the EDF Nuclear Generation Division has been working to improve its training programmes according to the Systematic Approach to Training (SAT) for job positions in the areas of nuclear safety and operation, however this activity is not yet complete.
- For the standard 50 job positions where SAT will be applied, 10 reference standards have been developed and 40 are under development.
- The implementation of a performance-based evaluation system for job-specific training (level 4 of the Kirkpatrick model) is not yet complete at the present time, although this is planned for the future.

Without completing the implementation of SAT the quality and effectiveness of the training may not be guaranteed.

Suggestion: The EDF Nuclear Generation Division should consider the implementation of SAT in the areas identified as necessary to ensure that the training being provided attains its objectives.

IAEA basis:

NS-G-2.4

6.17. Training programmes, based on the specific needs of the organization and the individual, should be established to develop and maintain the technical knowledge and skills of all personnel. A systematic approach to training should be used which will enable a training programme for nuclear power plant personnel to be prepared, analysed, designed, developed and implemented on the basis of an analysis of the responsibilities and tasks of a job.

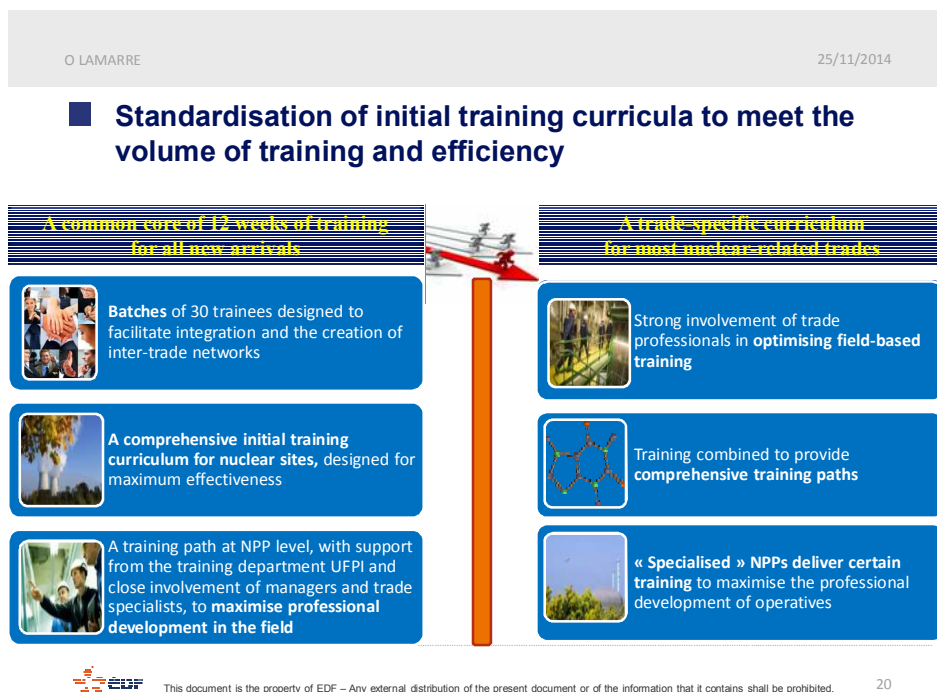
3.2(a) Good Practice: Academies of Common Knowledge and Specific Knowledge

Description:

Academies of Common Knowledge” and “Academies of Specific Knowledge” are designed to meet the training needs of new recruits entering the EDF Nuclear Generation Division.

To increase effectiveness and reduce the training time of new recruits and in a period of unprecedented staff renewal, in 2007 EDF started implementing an integrated approach to organize and conduct training through the concept of so-called “Academies” that places emphasis on the role of management in the overall training process.

To ensure extensive skills renewal and efficiency gains, training sessions for new recruits are organized at national level and conducted at site level involving several EDF Nuclear Generation Division entities together with the training unit (UFPI) through the so-called “Academies of Common Knowledge” and “Academies of Specific Knowledge”. These academies are designed to meet the training needs of new recruits entering the Nuclear Generation Division, and to facilitate and accelerate their integration into a given NPP. They are also intended to instil recruits with a common Nuclear Safety Culture and interdisciplinary knowledge in the interest of future cooperation. These academies also give rise to greater managerial involvement. In this structure, Nuclear Generation Division management at corporate level and at site level is responsible for defining training needs. Site-level managers are responsible for following up the development of the trainee, assessing the trainee in the field and, finally, qualifying the trainee for his/her job position. The UFPI is responsible for conducting the training, testing after each training module and evaluating the academic performance of the trainee and transmitting the results to the trainee manager.



Advantages:

- Strengthening managerial involvement in the training of new recruits
- Increased effectiveness of training
- Standardisation of training for the entire fleet
- Creating solidarity and a common nuclear safety culture among new recruits

Results:

For several years, between 1,000 and 1,600 new recruits per year have successfully completed this training and integrated into the EDF nuclear generation division.

3.2(b) Good Practice: Sandwich Trainee Programme

Description:

The Sandwich Training Programme supports the development of technical skills for potential EDF staff and sub-contractors. It also facilitates the integration of new recruits into EDF.

EDF Group has implemented a “sandwich training programme” to offer training to students of all levels (vocational, technician level and engineers). Under this programme, the Nuclear Generation Division trains more than 1000 students a year. Each trainee has a tutor that is responsible for his/her development and that interfaces with the school at least twice a year. Managers are responsible to follow-up this process and verify that the goals of the training have been achieved. The training duration is on average 2 years and during this period the trainees spend part of their time at school and part of their time at EDF. At the end of this period, part of the trainees are recruited by EDF, others are proposed to sub-contractors or continue their studies. In 2013, about 50% of trainees were recruited by Nuclear Generation Division.

Advantages:

- This type of training is also a way to attract students to technical areas.
- This initiative benefits EDF and EDF sub-contractors that can hire staff that have already been trained in the EDF practices related to nuclear safety.

Benefits:

Experience shows that the integration in EDF activities of new recruits that have passed training through the Sandwich Trainee Programme is much more effective.

3.8 LABOUR RELATIONSHIP, UNION AFFAIRS

3.8(a) Good Practice: Relationship with Unions

Description:

EDF has a strong culture of social dialogue and major changes are always discussed with the unions. Meetings at different levels are held on a regular basis with the unions. This activity represents a significant investment of time and is deemed necessary to allow the company to adapt to the required organisational changes. Examples include the Nuclear Generation Division (DPN) agreement of 2 August 2013 concerning the extensive fleet refurbishment programme for life extension, as well as the organisation and working conditions for the new Nuclear Rapid Response Task Force (FARN).

The Human Resources department carries out a weekly survey on the social climate of the plants in order to detect any potential difficulties via a designated local correspondent. Moreover, the EDF Group holds an annual survey (my-EDF) targeting all employees. The results of this survey are analysed and presented to employees, and form the basis of an action plan.

In the event of social unrest, trade unions are required to give 5 days' notice. Negotiations are held between the unions and the human resources department to avoid a strike. In the event of a strike, known and respected business rules allow the company to ensure the safety of the nuclear fleet and of the grid. The DPN and the Nuclear Engineering Division (DIN) managers are trained on labour relations and on strike management rules for the nuclear industry.

Advantages:

Major developments are discussed extensively at early stages to explain the priorities and receive feedback from union representatives. This allows the necessary changes to take place in smooth conditions, thereby favoring nuclear safety.

Benefits:

These discussions allow the unions to understand the need for change and facilitate implementation.

4. COMMUNICATIONS

4.1 INTERNAL COMMUNICATION

Nuclear communications falls under the Generation and Engineering Branch (DPI) which manages EDF's French power generation. It has been a management expectation since the 1990's that EDF's communication staff maintains awareness of national societal energy issues and the transformative catalysts, such as regulatory and political, to enable them to be strategic partners in the utility's business goals and growing global outreach. This expectation is written into the main communication management policy for DPI, and is acted upon on a regular basis. For example, at a recent communication manager seminar, speakers discussed the societal transitions (including the changing energy policy) and the power of people, such as politicians and leaders.

EDF's expectation that the communication team have insight into the societal affairs in the energy sector has produced a seemingly inherent regenerative dynamic communication flow which runs reverse: external to internal. Rather than making the exporting of information its sole priority, the creative communication team strives to find new channels of current information to feed into its group so as to keep the utility's information products up-to-date and its image contemporary. External information is continually coming into EDF through such means as outside experts, surveys, and international exchanges. There is a continual information assessment and revamping, and thus consistently improved messages are exported.

As part of the communication team's ongoing information assessment for improvement, DPI communications recently created the position of Editorial and Digital Communication to audit the internal publications, the content, and the means of communication for a more cohesive information package, and a more adaptive style to the new digital communications age. The communication staff recognized that society has evolved such that internal publications quickly become external ones, and that there needs to be a more targeted cross-sharing of information within the utility.

As a result of the longtime management belief in the importance of societal awareness, communication strength of EDF is its skill at networking, both internally and externally. Due to its size and long experience in international relations, EDF uses networks as an organizational management tool for communication. Internal networks within the organization cross-share best practices and facilitate the exchange of information. Through its relationships with outside experts and stakeholders, the utility has channels that ensure France's energy issues are incorporated into the utility's policies, and that the global picture is factored into the strategy for research and development. Outside experts frequently articulate the corporate vision to employees during internal activities and in EDF publications, making the utility's drive for progress and innovation applicable to real life for the employees, thus helping to motivate them.

Communications Corporate Structure

DPI has its own Communication Division. Establishing a Communications Division within DPI ensures communication is an integral part of EDF's business activities. The communications organization is well-structured with specific positions for such duties as

editorial manager, event manager, internal communication manager, environmental communication, etc.

Many of the DPI corporate communication staff's career paths have involved positions within EDF's nuclear fleet, and this knowledge and experience by corporate communication management of the organization and reality out in the field has enhanced the strategic effectiveness of internal and external communication projects. The team considers the utility practice of facilitating mobility of EDF employees from the nuclear fleet to headquarters communication function a good performance.

There are two sections within the DPI Communications Division: News and Media and Information and Image. The News and Media Section manages the communication "hotline", a dedicated phone line to the NPP sites. This responsive support system enables the News and Media Section to provide immediate internal and external communication guidance on the handling of events or media inquiries. A guide and checklist is part of the hotline system ensuring EDF's corporate policies are followed and all pertinent stakeholders are informed. The team considers this a good practice.

The Information and Image Section is in charge of internal communications (Intranet, publications, safety campaigns). This section also supports the 19 NPP sites in updating their individual websites and materials and activities for the Information Centers.

NPP Site Communication Staff

Each NPP site has at least three communication specialists. As with corporate, communications is recognized as an integral part of the management team, and the NPP Communication Manager is part of the Site Director's Steering Committee and participates in the daily morning conference call on plant status.

The Division of Nuclear Generation (DPN) Head of Communication visits at least two NPP sites a month to review corporate communication policy implementation with the site communicators. He also meets with the NPP Site Director to provide feedback from his visit. Following his visit, the DPN communication head sends a feedback letter to the NPP site. The team considers this a good performance.

Communication Policies

There is a policy guide for NPP on-call communication staff. It includes: target audiences; a communication template; criteria (thresholds) for a National Information Message (a written statement); a comprehensive listing of potential situations that may occur and procedures to follow for each one; and a sampling of formats to follow for write-ups. The team recognizes this as a good performance.

Communication Plans

The DPN Head of Communication works closely with senior management on development of the annual communication plan. Divisional communication plans are shared amongst division communication heads for collaboration on potential projects. Based on the corporate divisional plan, each of the NPP sites develop an annual site communication plan.

Methods to Assess the Effectiveness of Communication Strategies

Sophisticated studies and surveys are conducted by the EDF's Studies and Monitoring Division on the local, national and European levels. These studies are conducted annually and the results are shared with the communication staff for assessment on EDF's communication strategy and to improve action in this area. Based on the results of a local survey one year, the communication team realized the public needed more information on health issues related to nuclear power and subsequently hosted a conference with health professionals and developed a health professional network to continue the education program. Besides community relationship assessment, the surveys provide comprehensive information to the NPP site directors, especially for new ones. One of the benefits of the European "Opinion Leaders" survey of this survey is that EDF managers go to the utility's subsidiaries to present the results, thus assisting these companies in improving their communication strategies. In addition, once year, a seminar is held with the communication management team on the effectiveness of the current communication strategy and to discuss a forward looking vision.

Corporate Internal Communication

The main tool used for internal communication is the intranet. Over 28,000 employees are registered users of the intranet's nuclear communities. A social media style is used for the intranet to encourage employee use. Employees have profiles and can "like" stories and articles. EDF's intranet is impressive. WebTV is used both for live and taped programs. Six programs were broadcast featuring managers discussing such things as: lifetime extension; industrial safety; human resources; and nuclear safety.

In addition to monthly divisional publications issued by DPI, the corporate Communications Division produces a very good bimonthly news magazine (VIVRE EDF The Mag) for all EDF group employees. In a recent edition, it is mentioned several times in various articles the importance of motivating employees and engaging them in the future success of the organization. The magazine highlighted various employees and their positions, and it featured wide-ranging articles on the various facets of the utility's business. There was an informative article providing background on NPP site directors.

The communication staff demonstrated good ownership of their respective areas when the team observed a weekly internal communications meeting.

Cross-sharing and Information Exchange Vehicles

EDF has instituted information exchange and oversight committees to facilitate the cross-sharing of information. The corporate communication managers are part of the senior management team, and participate in management meetings at all levels. For example, the DPN communication head is part of the Nuclear Investments Review Board.

In the News and Media Section, there is a staff position for environmental communication. Because of her overarching coordination of all NPP sites, she is able to have a global vision on all environmental issues and share best practices with the communication team.

A popular area for the communication staff is DPI's intranet area called, "MyCom", which shares information, especially best practices, for use by corporate and the NPPs.

There is sharing of good practices between corporate and the utility companies. Annually, benchmarking visits are conducted with EDF Energy in the UK for the purpose of identifying ways to improve across EDF's nuclear fleet.

In a new initiative, the first joint EDF French-British Nuclear Communications Seminar was held in 2013. Forty communication staff from EDF France and EDF Energy (UK) participated in the information exchange seminar to cross-share best practices and further develop internal communications. The topics they discussed included communication approaches to information planning and community relations. It was beneficial to the communicators and successful in that a new online intranet community for the heads of communication in France and UK was established for the purpose of sharing documents and other professional material. The team considers this a good performance.

Strategies for Utility Challenges

EDF has been publicly transparent about its challenges as a utility related to its size and continued technological advancement. On the website is a future-focused publication, “Challenges and Commitments”, which discusses the utility’s vision and projects in the context of the overall current energy environment. Goal oriented strategic projects were developed to address EDF’s identified challenges for the three nuclear business divisions, and corporate communication plans were designed and implemented to support them: “Generation 2020” (Nuclear generation: DPN), “DIN’amic 2020” (Engineering Division: DIN) and “Ensemble vers 2020” (Fuel Division: DCN). These three projects are blueprints for divisional management direction and key improvement focus areas. They were developed to keep nuclear safety a top focus. The projects drive the Communication Division’s activities.

One of the consistent utility challenges is its NPP outages. Both the corporate and NPP communicators have been developing a variety of strategies for information dissemination to employees on the status of the outages. Twice a year, there is a live question and answer broadcast on WebTV where corporate managers discuss priorities with NPP managers. One of the topics is outages. The nuclear generation division has a blog devoted to outages for employees.

Feedback Process

Utility-wide, there is an annual internal questionnaire, “My EDF”, which is used for employee feedback and internal relations assessment. For the three years the utility has been performing the survey, the results have been fairly consistent and positive indicators on the rise. Employees state they are proud to be in the employment of EDF, and they are proud of the industry. Weaknesses the employees mentioned include that they desire more training and want better organization at the utility. The survey is designed so that the results are targeted so that each NPP gets its own assessment of internal relations. The questionnaire is revised annually.

An example of this NPP targeting is the Chooz plant. The 2012 “My EDF” survey indicated that plant employees felt there was a lack of visibility of the NPP status and activities. The communication staff responded to the survey results by setting up a working group of managers to develop a system to provide information to the employees. The result is a monthly publication which covers NPP indicators in: nuclear safety; industrial safety; environmental; radiation protection; human resources; and budget.

At the NPPs there are communication pathways for employees to provide direct feedback. Pathways include email and a “continuous improvement practice” box in the access building for comments. The box at the sites is monitored by the Safety, Quality and Audit function of the Nuclear Safety Department. Additionally, there is a phone number that all employees can

call if they wish counselling with a trained psychologist on professional or personal issues. Human resources have several staff members who track cases and there is a staff person at each NPP who monitors internal relations.

Collaboration between Communication and Human Resources

EDF recognizes that social awareness is an important element in assessing internal relations and has increased its focus on the social awareness and monitoring dimension through utilizing human resources management. Human resources monitors the issues involving social tensions at the NPPs and assists in measuring internal relations with survey initiatives. Support is provided to NPP management by human resources with a psychological risk assessment when communications are to be done at a time of organizational change. For example, in support of management's plan to move to a shift system for outages in 2009, Human resources conducted a survey to assess the organizational, social and human impact this change would have. Doctors were contacted on the occupational impact of working on the night shift. Communicating the reasons management wanted this organizational change assisted in acceptance by employees.

Communicating Safety Messages at NPPs

In 2011, the chairman of EDF requested that an industrial safety project be launched. With over 20,000 employees involved in activities related to EDF's nuclear fleet, worker safety is one of the most important components of safety management, and the utility management recognizes the constant need to keep employees in a safety-conscious "risk prevention" mindset. A campaign was developed, "Sécurité, Tous Contre La Seconde De Trop" ("Safety everyone together against that second too late"). The campaign's priorities were related to the importance of safety precautions around heights, electricity, heavy load and radiation. But instead of just statements and reminders on safety, the posters feature real NPP employees with quotes about their personal safety experience. The communication staff realized after assessing their strategy, there was a greater response from employees to their fellow workers' sharing of their personal safety experience. The team recognizes this safety campaign as a good performance.

At Chooz NPP, the team saw upon entering several colourful signs hanging from the ceiling which states simple, but important safety messages, such as: "I am transparent, I am reporting any deviation"; "Nuclear safety is at the very heart of excellence"; and "I am responsible for my own safety and that of others." The communications team at Chooz NPP are enthusiastic and committed to finding creative ways to support management's safety culture goals. A badge attachment for lanyards was developed with the safety culture and teamwork saying "I care for you and you care for me." There is a good relationship between the communications manager and the nuclear safety director.

Nuclear Safety Corporate Communications Strategy

EDF's management recognizes the communications link to nuclear safety. The EDF Group Director of Communication is a member of the Nuclear Safety Council.

The utility's Nuclear Safety policy is published on the corporate website. Additionally, there are three impressive informative reports published on the website which highlight various aspects of nuclear safety: "Nuclear Safety: Our Overriding Priority"; the annual Inspector General for Nuclear Safety and Radiation Protection report; and the 2013 Sustainable Development report.

“Safety Day” programs are held utility-wide. The fuel division (DCN) holds “Safety Days” three times a year. The “Safety Days” discuss the results of the annual Inspector General Report, present the division’s nuclear safety and radiation protection priorities, and a real example of an activity related to safety challenges. Across the nuclear fleet, “Nuclear Safety Day” activities include booths, games and activities to facilitate dialogue on such topics as error reduction practices and improvements between plant operators. Outside technical industries—aviation for example—are invited for information exchanges. At Chooz NPP, a “Nuclear Safety Day” is held annually in January to start the New Year with the right focus, to paraphrase the nuclear safety director.

Part of EDF’s nuclear safety strategy is the very popular “Innovation Challenge” held across the nuclear fleet. This event rewards production sites based on their annual performance. There is an “innovation” challenge category which is open to foreign power plants affiliated with EDF, and DPI divisions for presenting their own good practices. This challenge aims to reward employees who implement innovative ideas in their unit and recognition is given to employees during a trophy presentation at the event in front of their managers. In addition to the recognition NPP employees receive with their awards, EDF employees are invited to vote on the submissions. The team considers the “Innovation Challenge” a good performance.

There is a meeting of 300 DIN managers held every 18 months called TOP DIN. At this meeting, managers recognized the employee winners of the innovation challenge by presenting them with the awards in front of the management group.

Communicators’ Training

Pride is expressed by the communications staff when they discuss their ongoing training opportunities, and potential career paths at EDF. There is a formalized structure within the Communications Division for the purpose of professional development and succession planning of the communication staff in the form of a Skills Management Committee which meets every two months.

Summary

Communications is an integral part of EDFs strategic management and vision. EDF’s communication staff is well-trained professionals and business savvy. There is excellent support and interface between corporate communications and the NPP site communicators.

4.2 EXTERNAL COMMUNICATION

Website and Social Media

On EDF’s France website there is a “Live from our plant” link devoted to its nuclear facilities which has comprehensive information. In addition to EDF’s company websites, the utility has websites targeted to stakeholders, such as researchers, students, and teachers. Accessed through the corporate website, EDF’s WebTV, thematically presents videos the utility’s services, employees and activities on different channels to the public.

For the nuclear fleet, EDF has 21 Twitter accounts. The NPPs have 11,000 Twitter followers. The followers on the NPP Twitter sites are growing 5-6% a month. There is a cross-sharing of information between NPPs on Twitter. Saint-Alban NPP retweeted Gravelines’ NPP newsletter and a photo of new apprentices for Penly NPP. The NPP Tricastin retweeted a photo of Cruas-Meysses NPP employees involved in a community activity.

There are a variety of videos on YouTube. The “saga of Eric Judor” public service videos are popular. Two of them have had over 600,000 views. EDF’s annual Pulse Award projects also draw interest.

EDF has “L’énergie en question” a blog that was developed to present EDF’s position during a national debate on energy transition.

Nuclear Safety Symposium

EDF held a Nuclear Safety Symposium in Paris in 2014 that was attended by more than 200 experts following the World Nuclear Exhibition.

Nuclear Safety Media Commercials

EDF communications developed a series of television spots with the aims of humanizing the nuclear power technology and showing the pride the plant workers have related to their nuclear safety work. The subjects of the nine television spots included: independent oversight; the environment; radiation protection; management of fuel; and outage safety. They were broadcast on primetime on television. The nuclear safety television spot is linked to one of the major French news websites giving it extensive coverage. The team considers this a good practice.

Stakeholder Involvement

EDF has active relations with stakeholders and experts through its local, national and international outreach. In addition to its ongoing communications with the High Committee for Transparency and Information on Nuclear Safety and the Local Information Commissions, EDF has established information exchange opportunities with stakeholders and experts through the sustainable development panel and councils and Health & Energy Scientific Council.

Also, EDF has relations with a large number of international, national and local experts—not only in the technical fields, but also in the arts, academics, medical, economic, and media. Parts of the expert roster are international and national judges for the Pulse Awards who share their expertise and vision on the future of electrical technology for the betterment of society. The team considers EDF’s strong stakeholder involvement a good practice.

International Relations

Through technical and stakeholder relationships, and initiatives, such as its Pulse Awards, EDF has an ongoing global information exchange at several levels. There are many international technical and training exchanges through EDF’s active involvement with IAEA, INPO, WANO, and organizations such as EPRI and VGB. EDF also has cooperation agreements with numerous utilities around the world. Noteworthy, the utility annually arranges international benchmarking visits to utilities in other countries.

Shareholder Relations

There is a strong channel of communication between EDF senior management and shareholders. Under French law, shareholders elect two-thirds of EDF’s Board of Directors. EDF holds a meeting every six months detailing the utility’s financial status and operations. These meetings are viewable live on the utility’s social media sites. On EDF’s website is a comprehensive web page devoted to shareholders that includes, among other things, dates

and locations of meetings, video webcasts of annual financial presentations, real-time tracking of shares price, and management and financial publications.

NPP Communications

An Annual Report on Nuclear Safety and Radiation Protection is published by each NPP. It is distributed to The High Commission for Transparency and Information on Nuclear Safety; the regulator (ASN); public authorities; Local Information Commissions; the general public through the NPP website; and Information Centers.

EDF is transparent in event reporting. There is a NPP event information section on each of the 19 NPP websites. The event reports consistently provided clear explanations in lay terms of the technical terminology and complex systems, but not in instances where radiation terms were used in personal contamination events. Putting such events in perspective, for example, on how dose received is less than a medical x-ray, would be helpful in lessening confusion and anxiety to the reader not familiar with the subject. There is an INES explanatory diagram on the NPP websites. The team encourages EDF to consider adding a similar diagram for placing radiation doses in perspective.

One of the publications available on the NPP websites is a monthly environmental report. This publication has a widespread distribution. The NPP communicators tweet an announcement when it is out and provide a link to it in the tweet.

The NPPs are a part of the life of the local communities. There are many examples of educational activities which integrate the community with the NPP. At the Saint-Laurent NPP, for example, the Canoe Club signed a partnership agreement with the power plant resulting in kayak instructors being able to discuss the purpose of the Loire intake, the releases, and environmental monitoring. This is a positive indicator of EDF's awareness of the importance of having an ongoing engagement and relationship with the community surrounding its nuclear sites.

Local Information Commissions

Established as part of French legislation, Local Information Commissions are located at every NPP. They are an independent body that assists in providing a framework for debates and information dissemination between EDF, commission members and civil society. The local commissions have been effective as ensuring a credible information flow between EDF and the local community. In particular, the commissions have assisted in facilitating information exchange between EDF and anti-nuclear groups. For example, meetings are in progress with the Local Information Commissions to discuss the "Helinuc mapping" a radiation mapping around the nuclear facilities that was done over a decade ago. Recently this mapping was requested by an anti-nuclear group and the meetings provide an opportunity for the NPP site directors to discuss in more detail the activities related to the NPP sites.

Public Communications

EDF hosts "Open Days" (Also called: "Electric and Industry Days") over two weekends at all of its NPPs. These open days offer tours of the simulator and turbine hall. Corporate provides support to the NPPs for these events by providing promotional items and an internet registration site for the public. A total of 113,000 people in 2013 visited the NPP sites.

EDF hosts a variety of programs for youth and families, and the Information Centres are open to the public during such events. The Saint-Laurent NPP Information Centre advertises an activity in which members of the public can follow for free for three hours an environmental laboratory technician during his daily rounds, covering 10km radius around the plant. In 2013, 42,000 people visited the NPP Information Centres.

Journalist Educational Seminars

Each year trips are arranged for journalists on different topics. Recently, journalists visited Saint-Laurent NPP and discussed the environment and met the new Rapid Emergency Response Force (FARN). A future journalist program is being considered on outages.

Summary

Transparent and innovative communication strategies and the skilful use of its social media platform (Twitter, YouTube, Facebook, and websites) have assisted EDF in positioning themselves on the global stage as a credible leader in energy issues.

EDF's first annual Pulse Awards in 2013 is an example. These awards recognized international innovative research projects and inventions related to electricity. The awards competition generated the interest of students, young professionals, employees, and the general public who became actively involved in the competition by voting on EDF's Twitter and Facebook sites. EDF received 260,000 votes from the public through its social media platform. The corporate communications strategy of the Pulse Awards has generated technological excitement at the future possibilities, and the award projects focused worldwide attention onto France. This program has also assisted the utility in not only building positive credible relationships with the public (customers) outside of normal business matters who engaged in voting on the projects, but has also enhanced outreach to potential recruits (one of the challenges discussed by the utility) through awareness of utility technology on social media, the information channels of choice for society's younger generations. EDF's comedic public service announcement, "saga of Eric Judor", cleverly presents electricity issues in a practical way. The ads are popular with the French public.

4.3 CRISIS COMMUNICATION

Communication teams are integrated at all levels within EDF's internal crisis communication plan. It is commendable that there is a technical liaison position in the plan with the purpose of assisting the communication staff. There is also a government liaison position for communicating with authorities.

The utility established a designated emergency response taskforce. The Director of Communications is a member of this taskforce. After the emergency plans have been activated there are conference calls. The first call is a technical exchange and analysis with the regulator and public authorities. At the end of the technical conference call, a summary message is produced and actions decided. The second call follows with the communication staff of organization that would be involved in a crisis (public authorities, regulator, operator, etc) and they discuss and agree on the public information messages. The frequency of these calls and the production of summary messages are every 90 minutes. The conference call technique with the spokespersons has been practiced in exercises for two years with positive results.

There are two major exercises a year conducted with journalists, public authorities and the regulator involving an NPP. Journalists also observe exercises. Social media and a crisis

website is used in the exercises. The designated spokespersons (DPN director and deputy and NPP Site Director and deputy) participate in these exercises. It is commendable that EDF uses real journalists in their exercises. This is one of the IAEA recommendations following the Fukushima accident.

EDF has a state-of-the-art media studio with direct links to news stations, and the utility's press conference facilities at headquarters can accommodate up to 100 journalists. Communication tools such as a crisis website, press kits, and background supporting materials are updated annually. There is a database of written supporting messages based on real events to draw from. A very good book of visuals and background information has been prepared that is focused on possible accident scenarios. The communication team is well-prepared in a crisis to support the spokespersons in delivering a timely response.

Information Sharing Agreements

Information agreements have been developed with the three neighbouring governments of EDF's nuclear sites (Belgium, Luxembourg, and Germany). Belgium authorities participated in an exercise in 2014

Crisis training

The designated spokespersons have undergone the required communications training held three to four times a year. The utility has journalists available to provide additional media training if needed during a crisis. In addition, ongoing training is provided to these senior managers by the News and Media Section in response to the periodic events related to the nuclear facilities that result in the need for public interviews and discussions. Once every three years all the potential spokespersons from across the nuclear fleet receive refresher crisis media training.

Public Emergency Response Information

The local population surrounding EDF's 19 NPP sites in France are provided a publication detailing actions to be taken in case of an emergency at their nearby nuclear facility, and public notification regarding emergency response training exercises conducted at the sites is done. However, only five of the nineteen NPP sites post the publication on their individual websites. Also, emergency response information on EDF's "Live from our plant" page on its website is contained under the heading "Safety Culture" and within two lengthy publications ("Nuclear Safety: Our Overriding Priority" and the 2013 Sustainable Development Report). There is no separate section on emergency response. The team has developed a suggestion in this area.

Summary

EDF has a well-thought out crisis communications structure to ensure all key responders are involved in the development of a public statement and accurate and credible information is shared and released uniformly in a timely basis. In addition, there are clear and comprehensive guidelines for media relations and crisis communications.

DETAILED COMMUNICATIONS FINDINGS

4.1 INTERNAL COMMUNICATION

4.1(a) Good practice: Communications 'Hotline' to NPP sites

Description:

For the last ten years, corporate communications has implemented a real-time support and advice system for the NPPs. It consists of a dedicated phone hotline between corporate and the NPPs, and an on-call support outside of working hours. Part of this effective system is the Nuclear Activity Management Guide, a detailed procedural document specifying criteria for communications, providing checklists, and logging/tracking data. Complementing this system is required training for new hires and refresher training every three years.

Benefits:

1. This dedicated hotline promotes the quick and direct information flow to corporate when an event occurs at the NPP site, enabling a timely dissemination of information from corporate or the NPP site to the public and media.
2. The hotline also facilitates corporate communication support and action for the NPP sites, as the site communication staff are encouraged to use the hotline for advice and guidance.
3. The rapid information flow between corporate and the NPP sites via the direct hotline ensures the communication team are an additional source of information for DPI management.

Results:

The partnership of the dedicated phone line and the Nuclear Activity Management Guide create a systematic channel for clear, consistent and regular information dissemination from EDF to the public and media. The surveys carried out in the local communities around the NPP sites show that EDF is perceived as being a source of trusted information.

4.2 EXTERNAL COMMUNICATION

4.2(a) Good practice: Media Information Campaign: ‘At the Heart of Nuclear’

Description:

EDF launched a television educational information campaign centered on nuclear power plants (NPPs). The campaign, ‘At the Heart of Nuclear’, consisted of nine television short spots spotlighting nuclear safety and the actions done at NPPs to protect workers, the public and the environment. The topics included: independent oversight; environmental measures taken at NPPs; radiation protection; management of fuel; professional excellence through training (simulator onsite); the seismic safety of NPPs; and outage safety actions.

The campaign spots had prime time coverage on television and then replayed on a major news website, where viewers had the opportunity to discuss the topics of the television spots.

Benefits:

The campaign ‘humanized’ the technology and the industry by visually featuring people who could be neighbors or friends who work at an NPP. The television spots opened up the doors of the nuclear plant to the general public to see what goes on behind the security blockades inside the ‘heart’ of the plant. EDF, through the television ads, dispelled the stereotypes on nuclear power, and promoted careers in the nuclear sector.

Shown on the major French media outlets, the campaign generated enthusiasm and pride in EDF employees at the spotlight shown on their work at the NPPs, and the emphasis placed on the importance of their work. The NPP workers featured in the television spots clearly are proud about what they do. The campaign was also broadcast on internal EDF Media.

Results:

The television campaign was seen by more than 54 million people.

4.2(b) Good practice: Strong Stakeholder Involvement

Description:

EDF has built strong relationships with stakeholders and experts through its local, national and international outreach. The utility has a multi-layered stakeholder involvement. On the government level, the utility is actively engaged in stakeholder dialogue with the High Committee for Transparency and Information on Nuclear Safety and the Local Information Commissions surrounding its nuclear facilities.

Within its organization, EDF established regular opportunities for consultation and feedback with international and national stakeholders on its corporate policies and utility activities through panels and councils.

The utility's corporate policy is shaped by national and international energy issues and EDF has reached out to a range of experts to share their perspectives in utility publications and at utility activities. This outreach to an external roster of experts and holding of public discourse has assisted EDF in communicating its corporate vision with its employees. The utility also has an ongoing consultation with the French Nuclear Energy Society, a group of experts familiar with EDF's nuclear facilities.

Benefits:

1. The utility is transparent at every level, from local to global.
2. EDF's stakeholder councils and panels provide the utility with expert consultation on key corporate policies.
3. Discussion by experts on such issues as the European energy policy, electric utilities transition, energy strategy for local communities, climate change, innovation and research.

Results:

As a result of the High Committee for Transparency and Information on Nuclear Safety and Local Information Commission dialogues, the government and the local community is kept informed of the activities of EDF's nuclear facilities.

Additional information reporting pathways (external to internal; corporate and company) are created that promotes discussion of policy on such issues as lifetime extension and decommissioning.

The utility's Health and Energy Scientific Council reached 1.5 million radio listeners in 2013 and 39 million television viewers in 2014 with programs on placing radiation in perspective.

As part of the corporate Health Communication Plan, two NPPs (Chooz and Civaux) are part of a network of health professionals. The two NPPs held health conferences on radioactivity. Over 100 people attended each one.

4.3 CRISIS COMMUNICATION

4.3(1) Issue: EDF does not consistently post the public emergency response publication on all NPP websites and there is not a separate section on emergency preparedness and response on the websites.

The local population surrounding EDF's 19 NPP sites are provided a publication detailing actions to be taken in case of an emergency and emergency response training exercises are done at the sites.

Nevertheless, the team noted during the review:

- Only five of the nineteen NPP sites post the publication on their individual websites.
- Emergency response information on EDF's individual NPP websites "Live from our central" is contained under the heading "Safety Culture".
- On EDF's corporate webpage emergency response information is located within two lengthy publications ("Nuclear Safety: Our Overriding Priority" and the 2013 Sustainable Development Report).
- There is no separate section on emergency preparedness and response on the websites.

For the average person, emergency preparedness response information and the related publication are hard to find. Without clear and easily available information on what the public should do in an emergency, the implementation of emergency response plans could be jeopardized.

Suggestion: EDF should consider providing a link to the public emergency action plan (where to go, who to contact, how to prepare) on each NPP site's web page, and providing emergency preparedness its own separate section to facilitate the clear and rapid transmission of instructions for the public in an event of an emergency, and to provide more clarity in public information on emergency preparedness.

IAEA Basis:

GS-R-2

4.83. Arrangements shall be made for: providing useful, timely, truthful, consistent and appropriate information to the public in the event of a nuclear or radiological emergency; responding to incorrect information and rumours; and responding to requests for information from the public and from the news and information media.

EPR-PUBLIC COMMUNICATIONS 2012

11. Communicating effectively with the public about radiation emergencies is key to successful emergency management. It will help mitigate the risks, support the implementation of protective actions, and contribute to minimizing negative psychological impacts.

IAEA international experts meeting; IAEA report on enhancing transparency and communication effectiveness in the event of a nuclear or radiological emergency 2012

3.1. Media of all types (i.e. traditional print, broadcast and social media) are essential vehicles for nuclear officials to communicate with the public.”

3.2. Nuclear emergency communicators need to be aware that public communication channels such as telephone call centers, email and social media are often the public’s media choice during emergencies.

Annex A.

There is a clear link between routine and crisis communications.

5. MAINTENANCE

5.1. ORGANIZATION AND FUNCTIONS

Maintenance is covered by three DPN main macro-processes:

- Maintenance (MP8),
- Production (MP2),
- Contractor policy (MP9).

Sub-processes are prepared based on international known programmes for maintenance activities.

Indicators are reported monthly to the corporate management and a summary is prepared for the top management. Indicators include nuclear safety aspects from plants and strategic aspects for EDF.

5.2. MAINTENANCE FACILITIES AND EQUIPMENT

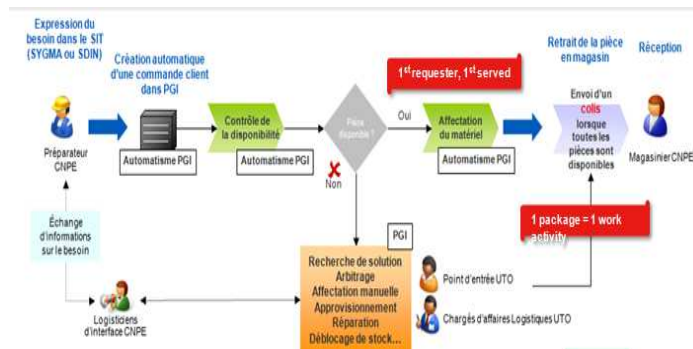
Warehouse and spare parts

The centralization of the spares holdings and their management in EDF has led to improvements in the availability of spare parts for the NPPs. Clear supplying rules and structures were implemented with the new build of a centralized warehouse.

Stocks are concentrated in two locations in order to optimize the flows. Spare parts are categorized by requirement type (routine maintenance, coverage of unplanned industrial risks, part on order for multi-annual programs) to be able to define the level of stocks and the buying modalities corresponding to the plant needs. The flow of the supply chain and the traceability of spare parts and their documentation are supported with an information system and bar codes.



Responsibilities, requirements and expected performances from warehouse processes are written down, quantified, and managed in the Integrated Management System.



The new process, developed five years ago under SAP, is fully interfaced with the technical information system of the nuclear plants (SYGMA or SDIN and EAM) supports the outage preparation phase of units. Management requirements and involved corporate departments (CNPE, UTO, Velaines) support NPPs in supply chain improvements.

OSART team considers the centralization of stock and the management of spare parts as a good performance.

Training facilities

Mock up and new training facilities at NPPs were built up over the last years.

5.3. MAINTENANCE PROGRAMMES

Preventive maintenance program

Standard documents were established at corporate level including overhaul scope and frequency. These documents are stored in a database. The experience reviews of the documents by network/expert groups over the fleet should guarantee the completeness of the program.

The following KPI's are used: loss of availability, failures in safety related systems, number of scrams, rework. These indicators have shown an improvement on the last years as a result, among other things, of the implementation of the AP913 process in 2005.

The preventive maintenance program includes all aspects of industrial standards.

Predictive maintenance program

For safety related equipment e.g. reactor vessel, steam generators, reactor coolant pumps, turbo generator, special predictive techniques are used to proactively detect defects or weaknesses in performance. Oil analysis, thermo-graphic monitoring and vibration monitoring are some of the predictive maintenance techniques used at NPPs. All predictive maintenance activities are performed by plant personal, corporate personal or contractor personal, depending on the predictive technique.

Predictive maintenance results are used to adjust the maintenance program.

Risk assessment

Risk assessments within maintenance work packages are supported at corporate level for planned and unplanned maintenance activities. It considers the need for the measure, duration

of work, need for spare parts, chemical and radioactive hazards, etc. The maintenance program for the overall fleet takes into account the results of the risk assessment.

Corrective maintenance

In 2010, the Nuclear Generation Division implemented rules guiding the equipment anomaly processing by issuing work requests, addressing proactively work requests and performance of activity scheduling. This led to a reduction of backlog by 50%.

However at November 2014 the current status is still a backlog of 20000 online CM tasks across the fleet, an average of 345 backlogs per unit (~208 on safety related equipment; Oct. 2014) and 11600 outage CM tasks across the fleet, an average of 200 backlogs per unit (117 on safety related equipment; Oct. 2014).

The OSART team encourages EDF to enforce this process to further reduce these backlogs especially at those plants with higher than fleet average corrective maintenance backlogs.

Lifetime management (ageing management)

The ageing management program at corporate level follows the requirements of IAEA NS-G. 2.12. Scoping of Systems, Structures and Components (SSC), defining ageing mechanisms and deep analysis of ageing phenomena are done at corporate level. The allocating of components and ageing mechanisms are done by sites. EDF takes part in international experience exchanges with IAEA, WANO, EPRI and the utility ESKOM. This process includes clear roles and responsibilities and provides a systematic approach concerning to safety related equipment.

In-service inspection

In service inspections are managed in accordance with French legislation. Pressure equipment follows the Decree 99-1046:

- nuclear pressure equipment ministerial order from 12. Dec. 1999
- conventional pressure equipment ministerial order from 15. March 2000

The qualification for in-service inspections follows the memorandum D4550.32-06/1601. EDF personnel are trained as ISI Inspectors. Contractors are qualified and tested and test equipment is available. In service inspections are performed in accordance with industry standards.

5.4. PROCEDURES, RECORDS AND HISTORIES

Corporate provides around 100 technical and organizational documents to the NPPs per week. At NPP level received documents are classified in three implementation levels:

- Level 1: implementation after 2 months (safety and availability aspects)
- Level 2: implementation at a fixed deadline in the same year (1. Nov. of the same year)
- Level 3: implementation at a fixed deadline in the following year (1. Nov)

Corporate provides maintenance instructions for components under its responsibility (related to nuclear safety and availability). All of these documents are structured in the same way

following industry standards. The advantage in this model is that plants can transfer easily corporate documents to plant documents.

5.5. CONDUCT OF MAINTENANCE

In Macro Process MP2, sub process “equipment condition” covers foreign material exclusion. Implementation at the plant is driven by a responsible person from corporate with assistance from the plant (expert/network group). For progress monitoring a dashboard with significant KPI's is in place. On site there are lockers containing FME-protection material (e.g. turbine hall).

5.6. MATERIAL CONDITION

INPO AP913 process “equipment reliability” has been implemented. This program was started in 2007 at corporate, the plants have followed the implementation after project wrap up. (e.g. St. Laurent NPP in 2009). Because the plants have adapted the structure of the corporate program the interfaces work effectively. Scope and screening is about 150 systems per plant, 90 systems per plant for health reports and 68 component families per plant.

Corporate level is staffed for a strong lead on safety related equipment and projects. The process INPO AP913 is applied to ensure robust equipment reliability. The derivative measures of that process are stored in an IT-Database, available the whole fleet.

The OSART Team recognized the EDF implementation of the INPO AP913 “equipment reliability” process under strong leadership from corporate in all NPPs as a good practice.

5.7. WORK CONTROL

The flow of work orders is managed according to corporate procedures using IT-systems called SYGMA or SDIN. The prioritizing of equipment failures is a required part of the workflow and is in line with the corporate standards.

The new IT-program SDIN provides more transparency and is more connected via interfaces to other IT-solutions and will be implemented by the end of 2017 in all plants of EDF.

Corporate has designed a visual aid with wheel and slider where the tasks required for the preparation phase, performance phase and experience feedback phase (online and outage) and equipment groups to be worked on during online mode is visually shown in a simple way.

The OSART Team recognized this visual aid as a good practice

5.8. SPARE PARTS AND MATERIALS

The policy for spare parts and material from corporate level is: Right spare part, in the right place, at the right time. The Corporate departments for spare parts and material understand themselves as a supplier for the Customer Plant.

Program “Amelie” ran between 2006 and 2013 to strengthen processes in warehouses and to raise quality of spares using a systematic approach. Therefore corporate adopted a centralized warehouse model, from where the plants are supplied as a customer.

A new central warehouse was put in operation in 2012 with main storage building and electric “ESD” building. Also local warehouses are provided under the responsibility of the plants.

Spare parts for planned activities have to be reserved in the preparation phase before the outage, in 98% the delivery will be on time. Planned modifications have a longer lead time (up to two years) that takes the quality aspects of Category 1 components into account. Spares holdings for unplanned activities are calculated using a risk analyses.

Min and Max Levels for spare parts are set by specialists from UTO supported by DIN department (modifications) based on experience and taking the fleet synergies into account. There are continuous analyses ongoing over the movement from spares to use the results for the new set up.

Obsolescence is covered inside a separate department inside UTO; an information system to show which parts are affected by obsolescence, management of spare part substitutes, alert system with addressing to responsible departments, forecast and control of the coming load from obsolescence.

5.9. OUTAGE MANAGEMENT

Corporate plans the LTO-strategy for outages. They schedule big projects and the essential maintenance and modification tasks that affect to the outage type and duration.

EDF corporate has a department for the organization outages. Standards for expectations and interactions from corporate and plants are described in document DT396 for Long Term planning from 1 to 10 years before outage and in document DT196 for the duration of one year before the outage and the execution of the outage and the Operating Experience.

Control of adherence to the recommendations is done with dashboards and milestones and regular meetings/audio conferences, increasing as each outage approaches and leading to daily reports during outages.

To drive continuous outage improvement for 2014 management has defined more challenging targets.

Additionally, DPN requested an industry Technical Support Mission on outages in October 2014 to identify supplementary actions and to consolidate the reached results.

A new review for the outage campaign 2015 was held in November 2014 with all the site managers and corporate departments to stabilize the improving trends from 2014.

Current status of outage management KPI's are:

- Average outage extension reduced from 20 days in 2013 to 8.3 days in 2014.
- In the 2014 outage campaign 62.5% of units achieved the corporate targets for planning, 27.5% reached medium corporate estimations and 10% of units were under performance to the corporate estimations. The corporate targets concerning outage preparation planning were enhanced between 2013 and 2014.
- In the 2014 outage campaign 72% of units which met the corporate requirements for to outage preparation planning (45% of all units) overran the estimated outage

length by 4.2 days, comparing to the underperformance units where the average overrun was 12.9 days.

- In the 2014 outage campaign 85% of the identified risks during the outage preparation phase concerning outage extension could be managed with countermeasures and did not lead to outage prolongations. The corporate estimations to risk management improved from 2013 to 2014.
- Corporate prepares the outage forecast with planned maintenance and modifications for the next 10 years, although the forecast from 5 to 10 years is not fully precise.

OSART team encourages EDF to stabilize outage planning and outage performance fleet wide to eliminate unplanned outage extensions. (See also suggestion in TS area)

DETAILED MAINTANANCE FINDINGS

5.6. MATERIAL CONDITION

5.6(a) Good Practice Maintenance

Implementation of INPO AP913 Equipment Reliability at EDF

Description:

With strong leadership from the corporate organization EDF has implemented the INPO AP913 Equipment Reliability process at all its nuclear plants in a consistent manner. All requirements and aspects of the process are embedded in the maintenance process.

Advantages:

At the end of 2007, the DPN management decided to implement the AP 913 approach in order to reduce the rate of unavailable equipment for units in operation. This INPO methodology relies on the rigorous implementation of assessments, events analyses and a senior management decision making process for error reduction actions and modifications of the maintenance programmes. This approach was incorporated within the integrated management system (IMS) of EDF.

The roll-out of the method and the technical coordination by corporate provides EDF a system to meet the performance objectives in terms of nuclear safety and availability, and guarantee appropriate future planning stability.

A monitoring system was also implemented by corporate across the nuclear fleet. This system provides EDF with a better overview of the results and improvement in the NPP's of the fleet.

Regular analyses of system and equipment conditions by corporate and units represent knowledge management about the improvement in reliability.

The AP 913 process is supported by expert networks to improve the technical grade of the fleet (sharing of issues, development of common technical solutions, training of young engineers). With these groups, upcoming problems are identified more effectively and relayed to the Corporate Error Reduction Committee.

Operating results:

Progress with the rate of unavailable equipment, strong increase of the Fleet Equipment Reliability index of the fleet, improved engineering skills and better control of the technical condition of equipment provides the NPP management with more opportunities to modify corporate strategies.

Rework: Reduced by 50% from 2013 to 2014

Backlogs: Reduced by 50% from 2010 to 2014

Outage extension: fleet average reduced from 20 days to 8.3 days between 2013 and 2014

5.7. WORK CONTROL

5.7(a) Good Practice Maintenance

Simple visual aid to assist preparation of NPP on-line and outage maintenance schedules.

Description:

In 2009, EDF corporate management validated a new process for on-line activities and in 2013 for outage preparation, inspired by the AP928 approach and described in corporate document DT296 for online and DT196 for outage. This model supports the everyday site organization and performance, and the preparation of the implementation of the new nuclear information system (SDIN).

To reduce the component unavailability, equipment is grouped by category (GEF) to support preventive maintenance tasks to be carried out simultaneously. A central component e.g. pumps, or cooler, with auxiliary components identified as belonging to the same equipment category is created.

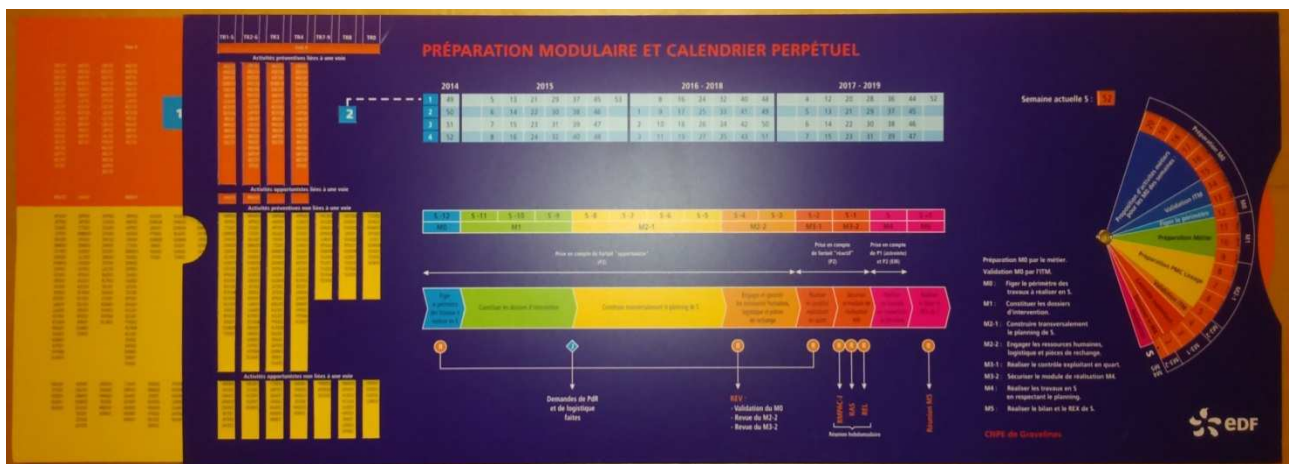
For outage preparation 7 modules are used and easily visualized on this disk.

Advantages:

Every eight weeks, maintenance windows are planned for each GEF. With the adjustable wheel for given week, all open GEF for maintenance are located on the same safety train, while work lasting less than a week is scheduled during these maintenance windows. The eight week periodicity also incorporates safety-related surveillance testing from technical specification requirements. Longer work activities are linked to operating windows that depend on the time period in the operating cycle or on environmental conditions (winter, summer, etc.)

For each reactor series (CP0, CPY, 1300, N4) and based on this model, a reference schedule was built jointly between the corporate departments (UTO, UNIE) and the NPP's. The work management system (SYGMA or SDIN) is updated accordingly via a network and yearly approved by DPN senior management.

Gravelines NPP has developed a simple tool to display GEF scheduling as it is not easy to mentally display a time period eight weeks ahead of time, dealing with multiple units on a single site.



6. TECHNICAL SUPPORT

6.1 ORGANIZATION AND FUNCTIONS

The EDF organisation is based on an integrated “Architecte-Ensemble-Exploitant” (design, build and operate) model in order to monitor and manage the balance of design, operation and equipment suppliers. It guarantees cost control, integration of operating experience and thus continuous improvement, which is unified based on reactor design series. The DPN division has prime responsibility for safety. There is a clear distribution of responsibility between DPN (nuclear safety and NPP operation), DIN (design and construction division) and DCN (nuclear fuel division).

The technical support organisation is defined in a structured GIOp (Guide de l’Ingénierie Operationnelle GIOp) document. It assigns clear responsibilities and roles within the technical support and modification process including workflow charts and regulatory activities. Employees perceive this guide as a useful and powerful tool; the team recognised this as a good performance.

The DIN has a clearly defined structure. Roles and responsibilities are described.

CNEN	- new reactors construction
CNEPE	- conventional island design
CIPN	- nuclear island design for operating plants
CEIDRE	- NDT, materials and chemistry expertise
CIDEN	- decommissioning and environment
SEPTEN	- safety studies, conceptual design

The departmental organisation is described with line responsibilities and also supports a project management approach. For major modifications, a DIN-DPN Protocol is signed to commit resources and specify the interface 18 months prior to start of the activity. It is evaluated every 6 months. The Paluel NPP – CIPN Protocol (standardised DIN-DPN Protocol) has been signed to commit relevant resources and interfaces in order to prepare for the 10-yearly outage of Paluel NPP unit 2. The team considered this a good performance.

The DIN Integrated Safety Policy is in compliance with French NPP legislation (BNI Order) and it is consistent with EDF Group’s Nuclear Safety Policy. National Nuclear Transparency and Safety law and subsequent Decrees – Orders – Decisions are incorporated into internal company procedures. The enhancement program called DINamic2020 has been initiated. Several tools for communication on the goals of DINamic2020 are used: internal computer distribution to everybody in the company, objective-based seminars for personnel, video programs/twitter, innovation awards. This system ensures the conditions for regulatory compliance. The team considered this as a good performance.

Nuclear engineering management states that nuclear safety is an overriding priority – there is a set of KPIs/ goals, which are tracked and evaluated at relevant levels. Furthermore, the internal DIN-driven audits are performed on a 3-yearly basis and annual assessment by the Nuclear Safety Review Committee is performed. The outputs are focused on all related potential areas for improvement including safety issues, training, implementation issues, etc.

Since 2008, 2500 young engineers have been recruited into the DIN, which has a total staff of 6200 employees. A part of the DINamic2020 project is focused on newly hired staff

integration. The DIN-specific “Skills development plan” has been launched to ensure resources and skills as required and to ensure skills/knowledge retention and development. Relevant sources are identified, which is supported by periodic tracking and also using annual “Safety Review Meeting” evaluation. A plan is in place to introduce additional 3-year Skill Area Health Reports. Nevertheless, only 3 out of 12 “3-year Skill Area Health Reports” have been completed to date. Several hundred newly hired employees are due to enter the engineering division by 2016. There is an internal pipeline to hire experienced people from within EDF, from external nuclear organizations and also to hire nuclear newcomers to balance the need to maintain the proper level of knowledge. Several activities to maintain the level of knowledge were introduced and a knowledge transfer method is formalized and described. Nevertheless, knowledge transfer is required only within current staff and shadowing is not consistently used at all corporate support departments (CIPN) as the organization promotes team expertise rather than individual. In addition, the training compliance checks to ensure that vital or safety related activities are performed by personnel with desired level of knowledge and full scope of mandatory skills are not consistently used. This fact, together with a large number of newly hired employees and 12-month deadline to pass the initial Nuclear Safety training may jeopardize the quality of work performance. EDF management is encouraged to consider implementation of a systematic approach in order to assure mandatory training within the DIN in a timely manner.

A digital CIPN engineering simulator has been introduced in order to adjust plant simulators to be in compliance with plant modifications, validate modifications and the associated training procedures before the modifications are implemented on the plants, which was not possible with the hardware full scope simulators. It captures feedback from instructors, operators and maintenance prior to on-site implementation. The team considered this a good practice.

Personnel performance reviews are undertaken on an annual basis between managers and subordinates. It provides a sufficient period to set personal development plans and to perform annual appraisal of expertise and goals setting. Team performance is annually assessed by Nuclear Safety review meetings; additionally, challenges may be raised at project boards on different levels.

6.2 PERIODIC SAFETY REVIEW

There is a strong and clearly structured PSR (periodic safety review) process in compliance with TSN (Nuclear safety and transparency) law and subsequent BNI order. The process is effectively structured at corporate level based on reactor series generic plant design and at NPP level based on site/ unit specifics.

PSR is synchronized with the 10-year outage cycle with focus to implement relevant modification to get the next 10-year ASN approval – the activities are overseen by ASN. The scope of modification and evaluation is discussed at Standing Committee meetings (ASN, NGOs, DPN, DIN, IRSN) and requested by ASN using regulatory dossiers.

Even though EDF PSR scope is in compliance with national legislation and ASN requirements, it is focused mainly on technical issues and modifications. This is not in compliance with the 14 safety factors recommended in the IAEA Safety Guide SSG-25 (2.13 Safety factors relating to the plant). The safety factors not addressed within the scope of PSR are. Human factors and Emergency planning. These factors are evaluated on an annual basis independently of PSR. The General Operating Rules and Procedures are updated according to the PSR associated modifications batch. The team has made a suggestion in this area.

6.3 PROGRAMME FOR LONG TERM OPERATION

The company has implemented a comprehensive and effectively structured fleet-wide LTO (long term operation) programme. It consists of ageing management, in-service inspections and obsolescence control. The LTO programme is in correlation with VD4 for 900 MW units and VD3 for 1300 MW units (VD 10-yearly outage) preparation and long term operation with the vision of 60 years of plant service life. These programs are based on international authorities' recommendations (IAEA, etc.). Internal operating experience, R&D and international inputs and experience are taken into account (International Generic Ageing Lessons Learned - IGALL, EPRI, INPO, etc.).

6.4 SURVEILLANCE PROGRAMME

There is a clear description of responsibilities within the surveillance program, which is perceived as robust and comprehensive. Surveillance testing procedures (Chapter IX of General operating rules) are produced in conjunction DIN (CIPN) and DPN (UNIE) based on GIOp rules, which provide cross validation.

Power operation surveillance implementation and data tracking is the DPN's (plant) responsibility, CIPN (DIN) provides support on request. The surveillance tests are planned using work orders and SYGMA and SDIN software support.

Procurement, manufacturing, installation and pre-service inspections are performed by DIN (CEIDRE oversight based on CIPN specification) based on AP913 and using national (AFCEN RCC series) and international (ISO, IEEE, IEC60780) codes. A graded approach is used with the focus on supplier level, EDF level and safety authority level. Processes such as "Contractual and functional checks" and "Supplier monitoring" have been introduced in order to ensure adequate scope of surveillance based on the level of supplier qualification. EDF has implemented a comprehensive process with clear responsibilities and proper indicator tracking with effective feedback. There is a strong system of inspector training and authorisation. The team considered this as a good performance.

When a modification package is produced, it is documented in an e-Dim file and the impact assessment including Risk Analysis, Work Monitoring Program, etc. is performed by the Plant Joint Team ("Joint" meaning teams from both DPN and DIN) and is validated by the Plant Technical Director. This provides an input to the training, documentation and modification preparation and safety sensitive activities are treated with special focus. "Joint teams' Framework Manual" has been developed to describe the responsibilities and assign the hold points to ensure proper readiness in each phase of modification.

DIN (CIPN) provides a 24/7 HOT LINE to support plants encountering difficulties during surveillance tests. The requests and solution are tracked. Safety significant items are sufficiently documented and communicated to the Safety Authority as appropriate.

6.5 AGEING MANAGEMENT

There is a robust ageing management process in place with reference to international programs (IGALL, research programs, EPRI, etc.). Ageing management is based on the fleet approach and grouping of equipment based on the functional characteristics in compliance with IAEA safety standard NS-G-2.12.

Ageing management process ownership is distributed at corporate level based on generic reactor series and plant level in relation with site specifics. UNIE and SEPTEN are responsible for systems, structures and components screening and for completing of Ageing Analysis Sheets (AAS) and Detailed Ageing Analysis Reports (DAAR). DPN (plant) is responsible for Unit ageing analysis report (UAAR) for each unit.

DMAT (equipment management board) is a decision-making body dealing with maintenance strategy, ageing and obsolescence issues and cross-functional aspects based on AP913, taking into account site specifics and impact on availability, workload and budgetary issues. Special attention is paid to spare parts replacement and obsolescence (UTO responsibility). DMAT outputs are coordinated by ICT (technical coordination committee) and the final decision to start a new project is made by DEN or CECEG boards based on the level of expenditure.

6.6 PLANT MODIFICATION SYSTEM

Major modification projects (e.g. Post-Fukushima project, VD4-900 Review project, VD2-N4 Review project, steam generator replacement, etc.) are prepared based on a standardized project management process and are synchronized with 10-yearly outages as much as possible.

Projects are treated at three levels. The project committee agenda covers key points, safety issues, TCDI- review (technical, cost, delay, industrial procurement strategy), project agenda and difficulties/problem solving. In the event of documentation modification, the analogical TRD (technical, resources, delay) method is used. This provides several decision-making levels and also additional challenge meetings, allowing emergent issues to be resolved.

This system ensures a graded approach and delegation of authority from CEO/division directors down to the organization with respect of process model, as described in GIOp and processes description. Project milestones are tracked and reported. EDF has made an effort to introduce activities in order to improve major modification preparation either in 10-yearly outage or at units in power operation. The team has recognized an improving trend, nevertheless, the quality and timeliness of preparation of major modifications is not being consistently met. The team has made a suggestion in this area – see also MA 5.9 part of the report.

Several attributes are assessed during Modification Package preparation (challenge meetings at appropriate phase of preparation). Furthermore achievable outage scope and outage schedule are discussed. There are several attributes assessed as follows: workload, OE feedback, budget, duration; scope of valves maintenance, NDT, mechanical maintenance; compliance with the Technical Specifications.

Safety related issues are sufficiently documented in “deviation documents”. Cumulative impact of conformity deviations is assessed and corrective actions are taken. Safety related deviations (with relation to postulated initiating events) are challenged on monthly/ quarterly and annual bases and reported to the regulator.

Low level deviations are treated, listed and reported at Plant level with internal safety supervision. COMSAT (safety in outage committee) checks the status prior to unit restart.

Nevertheless, PSA2 is still not being fully used (it is used for internal hazards assessment and seismic events). Even though the deterministic approach is a regulatory requirement and the probabilistic approach is understood as a complementary tool, Living PSA is not used on a regular basis to evaluate the current risk, it is also not used during outage preparation and execution to evaluate the risk based on actual configuration. The management of EDF is

encouraged to implement the full scope of PSA2 and consider systematic use of PSA for further risk optimization.

6.7 REACTOR CORE MANAGEMENT (REACTOR ENGINEERING)

DCN is responsible for corporate level nuclear fuel management. DCN annually proposes fresh fuel objectives and is responsible for specific fuel activities and/or surveillance. The main goals at the corporate level are fuel security (enrichment, nuclear fuel and control rod procurement), off-site logistics, regulatory compliance and storage (fuel cycle coherence) and radioactive waste management.

There is a clear DCN structure, the roles and responsibilities are described in “3-year protocol”. DCN activities are performed by operational departments:

- PUCE - Uranium Conversion-Enrichment
- PAC - Fuel assemblies
- PEL - Operation and logistics
- PAD - Back-end, Waste Management

DIN (CEIDRE) performs manufacturing process overview and documentation checks for the fleet. The interfaces and cooperation are perceived as beneficial and at appropriate level.

DCN coordinates and oversees all fuel cycle activities. Front end and back end operations are performed by contractors on multi-year contract bases with the focus on maintaining security of supply, cycle coherence and fuel quality & performance. Diversification contributes to the objective of security of supply.

DCN (PAC) performs supplier audits and oversees the safety and quality with DIN contribution: SEPTEN – design safety, CEIDRE – fabrication.

Fuel supply, off-site transport and fuel repairs are organized by PEL in accordance with “Transport regulation” – overseen by ASN. Safety issues are identified and addressed.

There is fleet approach to ensure the quality of fuel/core components supply. The process includes CEIDRE surveillance and support (control rods examination and fuel defects support) and UFPI (training facility) cooperation.

Appropriate KPIs (e.g. fuel defects, noble gases presence, etc.) are tracked to monitor fuel leakages and defects. Fuel activities are then prepared (out of an average of 50 activities a year, only average 5% are emergent activities). Several generic issues regarding fretting or cladding fabrication have been identified and resolved since 2002. The team considered this as a good performance.

On-site fuel handling, core loads and safety justification are DPN (plant) responsibility. UNIE (GECC department) provides an effective technical support and is responsible for test procedures and specific logistic procedures including core loading plan. Reloading work package is issued by UNIE and submitted to the regulator. The surveillance test system is described in Chapter X (GOR). Tests are performed based on work requests (SYGMA computerised system) at weekly, monthly (flux mapping) and 3-month (Xenon oscillation test) frequencies. Test results are reviewed by UNIE, DCN tracks the top level indicators to get timely feedback.

DETAILED TECHNICAL SUPPORT FINDINGS

6.1 ORGANIZATION AND FUNCTIONS

6.1(a) Good practice: Digital engineering simulator to prepare and validate the modifications and training procedures.

Description:

Given the number, the new character and the strong impact on operation of the changes that will be implemented for the third 10 yearly outages (VD3) for 1300MW plant series, it is necessary to train operators more quickly to anticipate these changes. This is made possible thanks to this innovation that provides a digital (touch screen) simulator, whose technical data are compliant with the design stage of the third 10 yearly outage. Digital CIPN training control room has been launched to focus on safety issues and proper site full scope simulators upgrade in order to comply with plant status after modifications – it facilitates feedback from instructors, operators and maintenance prior to site implementation.

This simulator will be deployed on all the NPPs of the EDF fleet. It will then be available in French or English.

The system will have two configurations: VD2 and VD3. It will represent a complementary training means to the existing VD2 hardware full scale conventional simulator.

A digital simulator provides for flexible use:

It is able to reproduce different configurations (VD2 and VD3 and, later on, VD4) and thus facilitates training of operators working on the units in different configuration situations (VD2 and VD3);

Advantages:

1. It is a state of the art device: desks are fitted with digital, touch and haptic (sensorial feedback when handling IT tools) screens. They make conduct of operation activities more realistic (handling of a command system, reading of information, recording...).

2. With its full scale design, the simulator reproduces exactly the lay-out of a real control room: the lay-out of the facilities, the size of the equipment, and even the surrounding acoustics.

3. Through a simple software modification, this customized device can be updated rapidly and easily, to simulate configurations, in line with the modifications implemented on the units;

It offers new teaching functions (image wall, access to files, films and presentations projection);

It requires limited and simplified remote maintenance.

4. The construction time of a digital simulator is half that of a conventional « hardware » simulator.

Operating results:

The CIPN simulator provides a facility that anticipates plant modifications. Instructors, operators and maintenance staff support the simulator modifications in order to validate the plant modifications and also the training procedures.

Based on this the local NPPs' simulator adjustment is very effective and allows operators' timely training.

6.2 PERIODIC SAFETY REVIEW

6.2(1) Issue: The scope of EDF Periodic Safety Review (PSR) is technically oriented and does not take into account safety factors relating to management and environment.

Even though EDF PSR scope is in compliance with national legislation and ASN requirements, it is focused only on technical issues and modifications. This is not in compliance with the 14 safety factors recommended in the recently issued IAEA Safety Guide.

The safety factors not addressed within the scope of PSR are Human factors; Emergency Planning. These factors are evaluated on annual basis independently of PSR. The General Operating Rules and Procedures are updated according to the PSR associated modifications batch.

Not taking into account safety factors relating to management and environment within the systematic 10-year period assessment has a potential to dilute corporate focus on these areas, even if corporate performs internal management review.

Suggestion: The corporate organisation should consider focussing on the newly published IAEA safety guide and enhancing the scope of the PSR process to cover the full range of important safety factors.

IAEA Bases:

SSR-2/2

4.44. Safety reviews shall be carried out at regular intervals. Safety reviews shall address, in an appropriate manner, the consequences of the cumulative effects of plant ageing and plant modification, equipment requalification, operating experience, current standards, technical developments, and organizational and management issues, as well as siting aspects. Safety reviews shall be aimed at ensuring a high level of safety throughout the operating lifetime of the plant.

SSG-25 (2.13)

2.13. The 14 safety factors recommended in this Safety Guide are listed in the following and described in detail in Section 5:

Safety factors relating to the plant

- (1) Plant design;
- (2) Actual condition of structures, systems and components (SSCs) important to safety;
- (3) Equipment qualification;
- (4) Ageing.

Safety factors relating to safety analysis

- (5) Deterministic safety analysis;
- (6) Probabilistic safety assessment;
- (7) Hazard analysis.

Safety factors relating to performance and feedback of experience

- (8) Safety performance;
- (9) Use of experience from other plants and research findings.

Safety factors relating to management

- (10) Organization, the management system and safety culture;
- (11) Procedures;
- (12) Human factors;
- (13) Emergency planning.

Safety factors relating to the environment

- (14) Radiological impact on the environment.

6.6 PLANT MODIFICATION SYSTEM

6.6(1) Issue: Major modification preparation process does not assure meeting the modification and outage milestones as expected

- The goal to meet “-4 months readiness deadline” has been reached only at 64% of pre-outage activities related to major outage modifications (summary CIPN data). An outage planning process has been revised recently to improve preparation of outage related modifications.
- The goal to meet “-3 months readiness deadline for power operation modifications” (modifications possible to implement at the unit in operation) are only rarely being met.
- The average outage overrun in 2013 was 20 days (2014 outage overdue has been reduced by an average of 8.3 days).
- In addition to the IAEA team findings,
 - The plants’ Joint Team has identified the need for more detailed scheduling of preparatory activities to ensure readiness as expected and to enhance its involvement in power operation modifications preparation with the focus on better scheduling.
 - The plants’ Joint Team has also identified the need to simplify the modification package content to streamline the preparation of relevant NPP maintenance teams documentation.

Without detailed planning of sub-sequential steps and tracking the internal hold points, the ability to react on emerging issues might be compromised. Also the clear and timely documentation preparation could prevent mismatches or potential difficulties to in executing all the modification steps in a safe and timely manner.

Suggestion: The corporate organisation should consider continuing its efforts to reinforce modification preparation activities to ensure the modification and outage quality and time milestones are met as expected.

IAEA Bases:

NS-G-2.3

3.6. The operating organization should ensure that modifications are carried out in the correct sequence, since subsequent modifications may be dependent upon the completion of previous modifications in a particular sequence.

3.9. The operating organization should ensure that the appropriate revisions to plant procedures, personnel training and plant simulators necessitated by the modifications are implemented in a complete, correct and timely manner as part of the implementation process.

4.23. Any modifications to the operating procedures should be made in accordance with the plant procedures governing their preparation. Modified operating procedures should be verified and validated before use. Any other operating procedures affected by the modifications should be revised and operators should be trained in the revised procedures.

NS-G-2.6

5.18. Management of the work should be recognized as a cross-functional process, not exclusive to any one work group but integrating the important activities of all work groups. Consequently, for the work control process to be fully effective, all needs and concerns in relation to operations, maintenance, technical support, radiation protection, procurement and stores, contractors and other matters should be considered and should be accommodated wherever appropriate, consistent with the long term operating strategy for the plant.

7. OPERATING EXPERIENCE

7.1 ORGANIZATION AND FUNCTIONS

The corporate operational experience feedback (OEF) system is undergoing a reorganization process that started in 2010 when a comprehensive review (diagnosis) of the OEF system was conducted. The improvement process utilizes the following basic principles of the corporate OEF programme:

- benefit for workers
- prevention of events
- nuclear safety is an overriding priority
- management support with back-up from corporate engineering entities
- results oriented
- closed feedback loop with response time frames adapted to the importance of the issues
- outward looking

Targets for the NPP OEF system have been redefined with the main focus on corrective action programme implementation to address deviations, contribute to operational coordination on a daily basis, provide operating experience for use in functional groups and ensure that the system is firmly anchored in the continuous improvement programme. A system providing operating experience (OE) to workers was rearranged to ensure debriefs are firmly entrenched at the heart of the operational experience system. This comprises actions to develop a briefing-debriefing culture with a software application to assist data entry on debriefs, a database for use of worker OE and a respective OE search engine. The corporate OE system has also been reconsidered and revised in order to be consistent with the site system. Finally, the DPN corporate OE system is organized in a manner similar to the fleet sites in two dimensions involving:

- a site short term feedback loop known as corrective action programme and a corporate short term feedback loop as event-based OE system;
- a medium term OE feedback loop

The corporate OE system comprises a number of attributes required to manage operational experience data:

- screening, weighting, distribution and processing of collected events on a weekly basis, known as immediate OE or “Hot OE”
- analysis and validation of proposed actions known as deferred OE or “Cold OE”
- trending of data and identification of emerging trends known as “TENDEM”

These activities cover a range of cross-functional areas including nuclear safety, radiation protection, industrial safety and production. Corporate management are involved in the process via different corporate OE committees.

7.2 REPORTING OF OPERATING EXPERIENCE

Within the scope of the corporate event based OE system, EDF plants report to the corporate organization on a weekly basis via “Weekly reports” that comprise events important for safety, radiation protection, environment and transport. This information is handled via the corporate “Hot” and “Cold OE” loops. In turn, the corporate organization produces a report encompassing vital operational experience from all sites and distributes it to the plants for consideration and application where appropriate.

EDF deliberately opted to organise the capturing of worker specific OPEX, both internally and with contractors, using an intranet platform called BIP (data base for fleet workers). The data base includes simple and short A4 data sheets (with pictures) describing good practices, useful data for pre and post-job briefings that can be used for future similar tasks, practical advice to avoid repeat deficiencies. The team has recognized this as a good practice.

7.3 SCREENING OF OPERATING EXPERIENCE INFORMATION

Screening of events at corporate level is carried out systematically on a weekly basis, with a view to determining potential generic fleet safety implications. The screening group (DCREX) evaluates events by classifying, weighting, coding and proposing set of events for validation by corporate management committees.

Screening of external events at corporate level (international operating experience) is coordinated by a dedicated group of experts. Selected information is sent for review to the “Hot OE” loop for prompt processing (weighting, coding, allocation) and then respectively to “Cold OE” for analysis and identification of respective actions.

7.4 INVESTIGATION AND ANALYSIS

Investigation and analysis of significant events is carried out by relevant plant personnel utilising enhanced methods provided by the corporate organization known as simplified analysis (apparent cause analysis) and root cause analysis (RCA). One fourth of the fleet does not yet utilize the enhanced method for investigating safety related events owing other business priorities. Full implementation is planned for June 2015.

The corporate organization has expertise in carrying out RCA. About 30 specialists have been trained. The corporate organization does not perform RCAs, but evaluates analyses performed by the plants. Several corporate groups may be involved in the review of events at the initial stage – “hot OE” and later when RCA (cold OE) is completed, if necessary. Some significant events are selected by the corporate organization for review of performed root cause analyses.

EDF has developed an enhanced event analysis method, which is gradually rolled out throughout the EDF sites. This method is simple and makes it possible to easily come up with a root cause of an event. Application of an enhanced corporate guide for the analysis of safety related events at sites does not always meet corporate expectations presented in the new guide for the review of significant events in terms of utilization of the following significant attributes of investigation: identification of repeat events and external events, determination of extent of cause and extent of conditions, consideration of assessments that should be focused on the safety consequences and implications of the event, application of a concept of contributing causes, prioritization and assessment of corrective action effectiveness. Safety

related event analysis performed at the corporate organization for identification of generic safety implications for the fleet, does not always provide clear indication of identified causes and corrective actions generated during this analyses are not prioritized for importance

The team has made a suggestion for the corporate organization in this area.

7.5 CORRECTIVE ACTIONS

Validation of corrective actions for significant events takes place during the corporate management meetings at different levels of the corporate organization. Decisions for extension of overdue corrective actions important to safety may take place at a lower level in the corporate organization than initial validation and approval of a scope and a period of implementation. Senior management periodically review the status of actions decided and, if necessary will address adverse trends.

Effectiveness of each particular corrective action is not individually assessed but there are indicators at fleet level, for example “2-0” (no repeat events), control of technical decisions, control programme of nuclear inspectorate and annual safety report. The system for the assessment of effectiveness of corrective actions for the plants and the corporate organization is planned to be developed and implemented at the end of 2015. Weaknesses in the processing of corrective actions are reflected in the team’s suggestion mentioned in the chapter 7.4.

7.6 TRENDING AND REVIEW OF OPERATING EXPERIENCE

The corporate organization trends a wide range of recorded events, in addition to detailed analysis of significant events. This helps to identify developing, generic, emergent issues or to identify precursors for more significant events. On recognizing developing issues, proactive measures are taken to prevent negative trends in plants performance. A database (SDA) is developed and implemented at the corporate organization to manage a wide range of collected data from the fleet. The corporate trending process uses a specific coding system that is identical for the plants and the corporate organization. The corporate trending process includes tracking of corporate corrective actions for implementation. Results of trending are demonstrated regularly and discussed during the corporate specific management meetings.

7.7 UTILIZATION AND DISSEMINATION OF OPERATING EXPERIENCE

External operating experience from different sources is analysed and handled at corporate level and distributed to the plants for implementation. The proportion of internal and external OE analyses conducted at corporate level and provided to the plants is 95% and 5% respectively. There are no clear screening criteria identified at corporate level for the selection of external operating experience. For this purpose, the approach of engineering judgment and personnel knowledge is utilized at corporate level.

The corporate organization has established a number of specialist groups and expert networks. These networks bring together various specialists on common topics to support the sites in multiple areas such as nuclear safety, operations, maintenance, fuel/core, industrial safety, environment and radiological protection, and to share and transfer knowledge and skills. These networks therefore support adherence to nuclear safety requirements. The team has recognized this as a good practice.

7.8 EFFECTIVENESS REVIEW OF OPERATING EXPERIENCE PROGRAMME

Effectiveness of operating experience feedback is assessed at corporal level on repeat events analyses. Causes of repeat events are analysed in order to launch improvement actions. As the IMS is based on continuous improvement, operating experience and its utilization are input data for each process review. Consequently, their effectiveness is assessed in each of the processes.

Following this global approach for assessment of effectiveness, some specific deficiencies of the elements constituting the OEF system may not be captured in a timely manner and may become latent organizational weaknesses. See also the Corporate Management part of this report.

DETAILED OPERATING EXPERIENCE FINDINGS

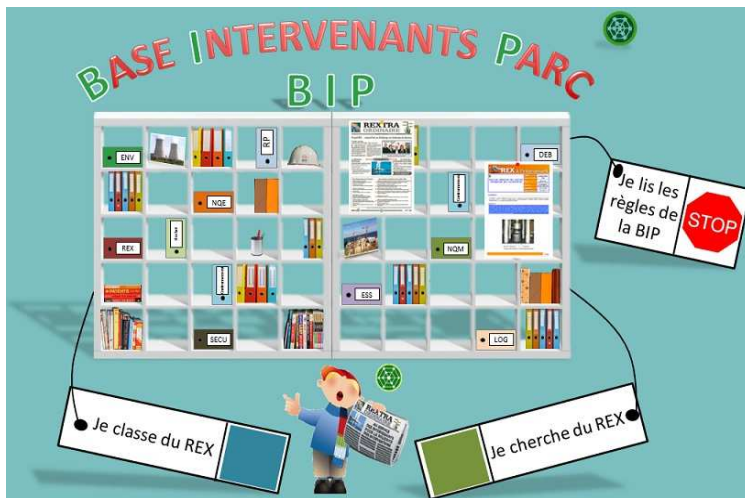
7.2 REPORTING OF OPERATING EXPERIENCE

7.2(a) Good practice: Capture of worker operational experience in a shared data base

Description:

Generation of worker focused OPEX (both in maintenance and operations areas) including sharing between workers, are items that contribute to improved task quality and ultimately operational safety.

EDF made a deliberate choice to organise the capture of worker specific OPEX, both internally and with contractors, using an intranet platform called BIP (data base for fleet workers).



Benefits:

The data base includes simple and short A4 data sheets (with pictures) describing good practices, useful data for pre and post-job briefings that can be used for future similar tasks, practical advice to avoid repeat deviations.

The data captured in the data base are routinely used during pre-job briefs for sensitive jobs.

This tool was developed in 2011 at a low cost, for widespread use in the fleet. Awareness of experience from previous tasks makes it possible to improve the quality level of future jobs (which is one of the improvement actions in the EDF action plan on enhanced work quality).

The data in the BIP data base are used more and more frequently during worker training. It is a highly relevant tool to be used in view of the increasing flow of incoming newcomers.

Results:

Workers have expressed their satisfaction with this new tool. The data sheets included in the data base are contributing to reducing substandard maintenance and operations practices.

7.4 INVESTIGATION AND ANALYSIS

7.4(1) Issue: Implementation and application of the enhanced method of analyses of events important to safety in EDF and handling of associated corrective actions do not always ensure adequate depth of investigations, appropriate prioritization and effectiveness of implemented corrective actions.

EDF has developed an enhanced event analysis method, which is being gradually rolled out throughout the EDF sites. This method is simple and makes it possible to easily identify the root cause of an event.

However during the review the team noted:

- Implementation of the enhanced method of analysis of events important to safety is not complete throughout the EDF fleet. One quarter of the fleet plants do not yet utilize the enhanced method of investigation of events important to safety due to other priorities. Full implementation is planned for June 2015.
- Application of an enhanced corporate guide for the analysis of events important to safety does not always meet corporate expectations in terms of utilization of such attributes of investigation, specified by new analysis method, as:
 - identification of repeat events and external events,
 - determination of extent of cause and extent of conditions,
 - consideration of assessments that should be focused on the safety consequences and implications of the event - whether it would have been more severe under reasonable and credible alternative conditions, for example at different power levels or in different operating modes,
 - application of a concept of contributing causes,
 - Prioritization and assessment of effectiveness of corrective actions.
(Reference to the results of recent OSARTs at Chooz and Flamenville NPPs).
- Analysis of events important to safety that are performed at the corporate organization for identification of generic safety implications for the fleet, does not always provide clear indication of identified causes and respective corrective actions.
- Effectiveness of each particular corrective action is not individually assessed but with overall indicators at fleet level, for example “2-0” (no repeat events), control of technical decisions, control programme of nuclear inspectorate and annual safety report.
- The corporate organization does not have a requirement for refresher training of staff who might take part in an investigation of events important to safety.
- Decisions to extend overdue corrective actions important to safety may take place at the lower level in the corporate organization than initial validation and approval of a scope and a date of implementation.
- There are no screening criteria for international OE established at the corporate organisation.

Without a formal approach to processes within the corporate operational experience and corrective action programmes there may be inconsistencies in the investigation and analysis of events important to safety and handling of associated corrective actions that may lead to significant causes not being identified properly and subsequently corrected.

Suggestion: The corporate organization should consider completing implementation and enhancement of the practice for the analysis of events important for safety and handling of associated corrective actions to ensure adequate depth of investigations, appropriate prioritization and effectiveness of implemented corrective actions.

IAEA bases:

SSR-2/2

5.30. As a result of the investigation of events, clear recommendations shall be developed for the responsible managers, who shall take appropriate corrective actions in due time to avoid any recurrence of the events. Corrective actions shall be prioritized, scheduled and effectively implemented and shall be reviewed for their effectiveness. Operating personnel shall be briefed on events of relevance and shall take the necessary corrective actions to make their recurrence less likely.

NS-G-2.11

4.7. Event analysis should be conducted on a timescale consistent with the safety significance of the event. The main phases of event analysis can be summarized as follows:

- Establishment of the complete event sequence (what happened);
- Determination of the deviations (how it happened);
- Cause analysis:
 - Direct cause (why it happened);
 - Root cause (why it was possible);
- Assessment of the safety significance (what could have happened);
- Identification of corrective actions.

4.8. At the plant level, as well as at the level of the regulatory body, several follow-up activities should be undertaken after the analysis of an event. These activities comprise documentation of the analysis of the event and storage of the documentation, dissemination of significant results, and monitoring of the implementation of corrective actions and assessment of their effectiveness.

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

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

5.7. A tracking process should be implemented to ensure that all approved corrective actions are completed in a timely manner and that those actions with long lead times to completion remain valid at the time of their implementation in the light of later experience or more recent developments. A periodic evaluation should be carried out to constantly review the need for items in the pending corrective actions list and separately to check the effectiveness of actions implemented. Primarily, the implementation and tracking of corrective actions should be performed by the plant management. The regulatory body may monitor the progress of certain recommended actions. This may be done by requiring nuclear facilities and/or operating organizations to provide periodic progress reports.

II.8. The *safety assessment* should be focused on the safety consequences and implications of the event. The primary aim of this review is to ascertain why the event occurred and whether it would have been more severe under reasonable and credible alternative conditions, such as at different power levels or in different operating modes. The safety significance of the event should be indicated.

II.12. *Corrective actions*. Corrective actions taken or planned owing to equipment failures or human errors should be reported. Some corrective actions are more important than others, and those that are desirable but not essential should be listed as such or even omitted to avoid making excessive demands on an organization's resources. All corrective actions should be listed and described in sufficient detail, primarily to allow their applicability to other plants to be determined. Inclusion of details of the following aspects is good practice and should be considered:

- The nature of the corrective action (recovery, short term or long term) and any target dates set for its implementation;
- The authority taking the action (the operating organization);
- The personnel group responsible for implementing the action (e.g. operations group, maintenance group or analysis group);
- For each corrective action, cross-references to the identified causes that gave rise to it, to allow an assessment of the adequacy of the corrective action.

II.13. *Lessons learned*. The report should clearly identify learning points. The communication of lessons learned can lead to enhanced safety, positive changes in working practices, increased reliability of equipment and improvements in procedures. The sharing of lessons learned from operational experience is one of the most valuable parts of the process of feedback of operational experience.

Appendix III.3. Training (both initial and refresher) should be provided for the staff who might take part in an investigation. This should include training in investigation techniques, documentation needs, witness interviews, conflict resolution and dealing with confidentiality issues.....

Whereas all investigators should receive some basic training in event investigation, including root cause analysis, for more difficult and complex investigations there may need to be at least one expert facilitator who is familiar with such methods of investigation.

III.9. Investigators should prepare a written report and should present it to the management group that commissioned the investigation. In some cases there will be a request for corrective actions to be taken that are commensurate with the identified root causes.

III.13.Very often the notions of immediate (direct, observed) causes, root causes and contributing factors are used in the cause analysis. Cause identification should be carried out for the formulation of corrective actions. The depth of the causal analysis should be adequate for ensuring the determination of appropriate corrective actions.

IV.4. The plan for corrective action should include a provision for verification of the effectiveness of the actions.

7.7 UTILIZATION AND DISSEMINATION OF OPERATING EXPERIENCE

7.7(a) Good practice: Crafts and expertise networks

The networks assemble various actors on common topics to support the sites in multiple areas such as nuclear safety, operations, maintenance, fuel/core, industrial safety, environment and radiological protection, and to share and transfer knowledge and skills. Thus, these networks contribute to the adherence to nuclear safety requirements.

Description:

To take better account of the characteristics of its nuclear fleet, EDF has created several types of networks:

- Systems Reliability (i.e., primary systems, feedwater systems, heat sink, I&C, etc.) and Components (i.e. valves, rotating machines, boiler making, I&C, etc.).
- Expert Networks in specialised areas:
 - Assistance on analysis of measurements, quick diagnostic and prognosis in case of detection of a risk situation via monitoring (i.e., generators, transformers, pumps monitoring)
- Post-maintenance testing of equipment and systems
- Networks on more general topics: chemistry, units production, external leaks (Housekeeping), Rules concerning conventional and nuclear pressurised vessels, the fuel/core area (physical tests at start-up, criticality follow-up at refuelling, reactivity management, fuel handling), industrial safety (lifting,...), environment, radiological protection (ALARA, X-ray tests, work sites)

Crafts networks: nuclear safety engineers, shift managers, heads of maintenance department, engineering/reliability department and fuel department, industrial safety engineers, radiological protection engineer, SME managers

Regular meetings are organised by the network coordinator. Requests to the network are initiated by a site or by Corporate. Networks can gather the competencies of experts in generation, engineering, R&D and manufacturers.

Benefits:

Networks allow sharing of OPEX and identifying and sharing good practices. In new risk situations, requests to networks are initiated to facilitate diagnosis and prognosis and provide a guide on actions to be implemented in the short and medium term. Recommendations on the process to process to follow technical issues are formalised in the “Fiches de position.”

The networks contribute strongly to the professionalization of their members and orientate staff on how to anticipate and deal with emerging situations.

For OPEX, the networks are in charge of writing guides “how to”.

Results:

There are 18 Systems and Components Reliability Networks in the reliability area.

Some examples of results achieved by the networks: in 2013, the Corporate Fleet Engineering Support issued 231 position statements and 211 in 2014.

The networks have produced several guides on:

- Post-maintenance test, diagnostic help for the generators, transient analyses, etc.
- The reference guide on physics tests performance at zero power, the good practices guides to optimise up-powering.

Networks have participated in:

- The reduction of unavailabilities. The ASG-LLS network participated in the reduction of LLS turbine generators (2013: 3,7 JEPP; 2014: 1,32 JEPP) and ASG pumps (2013: 4,75 JEPP; 2014: 0 JEPP) unavailabilities.
- The improvement of NPPs performances on collective and individual dose rates and on the management of X-ray test.

8. CHEMISTRY

8.1 ORGANIZATION AND FUNCTIONS

Functions and Responsibilities

Corporate organization and plant management understand the importance of sound plant chemistry to the integrity of structures, systems and components especially with regard to life time extension. Plant management appreciates the high level of competence in the corporate chemistry units.

Chemistry processes were implemented with a senior plant manager as the responsible person.

Corporate office has included plant chemistry as separate area to be regularly reviewed and assessed during DPN NI inspections.

At the beginning of 2014 corporate level has introduced an “EDF Chemistry Indicator“, that compiles safety relevant chemical and radiochemical parameters of a plant and allows ranking of the nuclear fleet. The indicator is brought to the attention of upper management. The team considers this as a good performance.

To avoid gaps of knowledge between corporate chemistry units and plant chemistry sections, regular meetings are organized. Meetings are held on operating experience, experience exchanges within the EDF fleet are done and discussions on new developments take place regularly. Corporate has recruited one special engineer at each site who is assigned to keep contact with DPN and to support the implementation of directives from corporate. Corporate provides an intranet platform to post questions (FQR FAQ) on chemical issues to the whole fleet and to the corporate units. The team regards this as good practice.

The organization of the chemistry section is developed on the site; a corporate project is underway to harmonize the organization of plants.

Interfaces with other plant groups and other organizations

The corporate research and development (R&D) function runs research centres with highest scientific standards near Paris and worldwide. The research activities cover relevant topics. Cooperation and information exchange exists with national, European and international bodies.

Basic research with specially designed test loops on stress corrosion cracking, general corrosion of primary systems, activity build-up, secondary side corrosion and steam generator fouling and clogging provide fundamental knowledge on these issues. The results are presented on conferences and are highly appreciated by the international scientific world.

In addition very practical and day-to-day problems of the power plants are addressed such as ageing of resins and use of chemical dispersants to control sludge formation on the secondary side.

The team considers the combination of high level basic research competence and solving of practical plant problems as a good performance.

The chemical laboratories of DIN CEIDRE (centre d'ingénierie DIN) at Chinon provide direct corporate support to the plant sites' chemistry sections. They provide expertise on chemical, radiochemical, metallographic and microbiological issues. Cold labs, hot labs and hot cells with manipulators with modern analytical instruments are available. The most demanding project of the near future is the examination of two steam generators. These steam generators were in service more than 30 years. The objective of this project ("Sherlock") is to establish basic understanding on ageing mechanisms and the impact of the chemistry regime on activity built up (e.g. zinc injection). The team regards this as a good performance.

Corporate laboratories develop analytical methods to be implemented on the sites in close cooperation with the plants. They select after thorough evaluation the appropriate analytical instruments to be purchased (laboratory instruments and online instruments). A test lab, with sample lines that are connected to Chinon B, is used to test online instruments "in the field". The team regards this as a good practice.

Corporate chemistry units are closely involved in the programme DDF 60, the life time extension of the fleet. The impact of the chemistry regime of the primary cycle and the secondary cycle on the integrity of systems and structures are thoroughly evaluated. National and international experience are integrated. Of special concern for the primary side is the susceptibility of Inconel 600 containing components to primary water stress corrosion cracking.

Site chemistry is intensively involved in the development and implementation of new specifications, procedures and analytical techniques whereas the corporate organization has the governance. This iterative approach may take some one year for normal processes like development analytical methods (e.g. measurement of boric acid) and it can take several years for more complex processes that might impact the integrity of systems and components and/or that will be deployed to the whole fleet like the zinc injection. However the process can be accelerated in urgent circumstances.

Qualification of Personnel

The training plans for chemists will be harmonized on the corporate level.

Line management is accountable for training of individual skills of staff.

The corporate training unit (PCC) regularly meets with plant management to discuss and develop training plans that are rolled out over the whole fleet. PCC is involved early in projects to be launched to evaluate if training needs have to be developed.

The effectiveness of on the job training is evaluated using a check list provided by PCC that can be adapted at the site as required.

8.2 CHEMISTRY CONTROL IN PLANT SYSTEMS

Chemical control programme

Corporate office has governance over the technical (STE) and chemistry specifications to comply with material concept and design assumptions.

With these specifications corporate office defines limit values, measurement frequencies and measures to be taken when values are out of margins.

Corporate office has the governance over the shutdown procedures. It provides a set of indicators on the corrosion product situation and the fuel integrity situation of the plant to prepare the shutdown process and to support other departments. These indicators are updated every quarter and raise the awareness of other departments to chemistry issues. Based on these indicators corporate provides recommendations and adapts the shutdown programme. Operating experience from other plants of the fleet is implemented. In most plants during shutdown chemistry personnel is on shift, although there is no requirement from corporate office for this service.

Corporate office supports the plants in real time. If problems are expected experts are available round the clock. The same applies to start-up of plants, when more stringent limit values may apply, e.g. oxygen concentration in the primary coolant. Although corporate provides strong support, the plant has the first responsibility to respond to unexpected events.

Substitution of boric acid and hydrazine, which are of certain concern for the environment, and health of people has been checked thoroughly but there are no satisfactory substitutes currently available.

The nuclear authority has set limiting values for the release of chemicals like boric acid and hydrazine to the environment. Corporate units lowered these values even further to set challenging goals for the plants. As the plants are technically different, the values are also different. Indicators are available and show favourable trends: Due to improved waste management and implementation of hardware modifications the release of radioactivity, boric acid and hydrazine to the environment has continuously decreased during the last years. Boric acid can be discharged as liquid waste or as solid waste. As the storage capacities for solid waste are limited, the amount of boric acid released as liquid will now stay more or less constant. Hydrazine can be destroyed chemically; therefore its release can theoretically go to zero. The team encourages EDF to further reduce the amount of chemical and radiochemical releases and thus reduce impact on the environment.

Chemistry control for primary circuit

In compliance with the structural materials used in the primary circuit the plants are operated according to the coordinated lithium-boron-chemistry; hydrogen is injected to suppress radiolysis and to reduce the electrochemical potential. Under close surveillance of corporate chemistry unit CEIDRE fifteen plants of the fleet are injecting zinc to mitigate stress corrosion cracking and to reduce activity built up. At the time of the mission the injection of zinc and an adaption of the hydrogen concentration are the only scientifically proven measures to mitigate stress corrosion cracking. The extension of this strategy to the whole nuclear fleet is currently being evaluated.

As already mentioned some parts of the primary circuit are made of Inconel 600 which is susceptible to primary water stress corrosion cracking. Of special concern are welds and penetration tubes in the reactor pressure vessel at the lower plenum (bottom mount instrumentation, BMI). EDF has implemented an ultrasonic and visual test programme to complement chemical measures especially with regard to stress corrosion cracking. In the past the tubes of the BMI were visually inspected and 10 % of the tubes were ultrasonically tested. The test programme is annually evaluated, incorporating national and international operating experience and results of latest research from EPRI and EDF on crack growth rate. Now all tubes (100%) are regularly ultrasonically tested. However the welds themselves are not ultrasonically tested. The team encourages EDF to keep track on further national and international operating experience and adapt its strategy as appropriate.

A review of the results from OSART missions to EDF sites showed that, since 2003, more detailed analysis of the corrosion product situation in the primary and secondary coolant were regularly suggested. In 2010 a working group was established to review international practices to monitor corrosion products. An appropriate analytical programme comprising relevant species like iron, nickel, cobalt and chromium has been prepared; it will be implemented in the chemical specifications and deployed to the whole fleet. Few analysis have been done so far by offsite labs. It is only since 2014 that the corporate office has provided the necessary equipment, it will be installed next year. The team encourages EDF to pursue the programme stringently and to hold tight to the scheduled plan.

Corporate evaluates regularly the fuel defect situation of all plants and reports to relevant parties and the authority. If the activity concentrations of the fission products exceed certain values different measures like constant load instead of load follow operation or plant shut down are required. At the moment 7 out of 58 units have some fuel defects. Corporate is working to improve the programme for foreign material exclusion. Together with the manufacturer EDF is seeking more reliable fuel designs. An international benchmark reviewed that EDF fleet has a higher fuel defect rate than some other operators.

Chemistry control for secondary and condensate polishing circuits

The secondary side chemistry seeks to minimize all forms of corrosion and to minimize transport of corrosion products to the steam generator, thus reducing clogging and fouling. To demonstrate that the applied chemistry regime is successful relevant parameters like iron, copper and suspended solids are regularly measured in the feed water and in the blow down from the steam generators. The team encourages EDF to keep on optimizing the secondary side chemistry.

The performance of the steam generators is evaluated periodically by thermo hydraulic measurements. Primary to secondary leakages are monitored, timely measures are taken when certain criteria are met to prevent tube rupture. However, as long as the allowed leakage rate is not exceeded, there are no additional measures foreseen during the next planned outage.

8.3 CHEMICAL SURVEILLANCE PROGRAMME

Procedures, schedules, and analysis methods

All chemical parameters to be measured are defined by corporate level CEIDRE and implemented in a data base (“Merlin”) and thus transferred to the sites. In this database the parameters, limit values, measurement frequencies etc. are defined. Corporate level has access to the data. However, at corporate data are arrives in from 58 plants, too much to be analyzed and evaluated in a reasonable time. The quality programme is also implemented in the Merlin system. Merlin indicates if limit values are violated on plant side and on corporate level. The data can be trended and evaluated, are recorded and are easily retrievable.

Results of analysis

During the development of analytical methods and after their implementation “round robin” test are performed to evaluate the quality of the method.

Technical specifications and chemical specifications describe detailed measures to be taken, when limits are violated. For relevant parameters maximum time for these actions are defined. However, in Chooz B NPP leakage from the primary coolant to an intermediate

cooling system was detected in May 2013 and it was not until November 2013 that corporate was requested to deploy a task force for further support as plant action was not not effective.

The team provides a suggestion in the corporate management area.

8.4 CHEMISTRY OPERATIONAL HISTORY

Operational experience feedback

The first steam generator tubes were made of Inconel 600 MA, as well as some other components of the primary circuit like control rod drive mechanism, partition plate of the steam generator and instrumentation tubes at the pressurizer and some welds. Since the 1970s cracks in the steam generators were observed. Since then steam generators as well as other components (e.g. control rod drive mechanism) were replaced due to stress corrosion cracking (SCC).

In 2011 a crack was detected in a penetration tube of the lower plenum of the reactor pressure vessel of Gravelines NPP unit 1.

Flow accelerated corrosion in two phase components (water and steam) was first observed in 1982, fouling of steam generators in 2000 and clogging of steam generators in 2006. After thorough evaluation the chemistry regime was adapted several times. First measures to mitigate the situation were increasing the pH after replacing copper containing components. In addition to ammonia, morpholine and/or ethanoltriamine (ETA) were applied. Since 2012 dispersants have been injected at Golfech NPP to mobilise iron so that it can be removed using the steam generator blow down system.

8.5 LABORATORIES, EQUIPMENT AND INSTRUMENTS

Post-accident sampling system

Post-accident sampling system (PASS) is designed to sample liquid and gaseous samples from the containment. Sampling is performed with the support of corporate staff from DIN CEIDRE using corporate procedures for sampling and plant procedures for measuring chemical and radiological parameters.

There is no additional shielding against radiation at the PASS. This means that samples can only be taken when radiation levels at the sampling station allow. During this period an online dose rate measurement in the containment is available. The systems are regularly tested.

8.6 QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

Corporate has defined specifications for chemical operational products (Procod) and other chemical substances to minimize any negative impact on safety related plant systems. Both groups are summarized as PMUC-substances (Products and Materials to be used in Plants). All these substances are delivered with a certificate of analysis from the supplier. The supplier must have a quality control system and point out any change in composition to EDF. Corporate laboratories perform regular sampling on Procod substances by external contractors.

All chemical substances that are allowed to be used on safety related plant systems are labelled with a PMUC sticker. Allowed substances are listed on intranet platforms. During the OSART mission to Nogent in 2003 this system was recognized as a good practice

The plants do not perform identity checks for substances that are delivered with certificate of conformance as required by IAEA Safety Standards (SSG 13, chapter 9.8), as there is no requirement by corporate.

During previous OSART missions several issues in handling and managing of auxiliary and operational chemicals have been identified (Civaux 2003, St. Laurent 2006, Cattenom 2011).

Material safety data sheets are available on the EDF intranet platform.

DETAILED CHEMISTRY FINDINGS

8.1 ORGANIZATION AND FUNCTIONS

8.1(a) Good Practice: Intranet Platform for Information Exchange on Chemistry related issues in EDF nuclear fleet

Description:

The chemistry Frequently Asked Questions (FAQ) system assists exchange of information between NPPs and the corporate organization. Corporate commits to provide an answer to any given query within a month. Twenty-four hours a day, the on-call system in place at corporate makes it possible to respond to a chemistry related query (chemical specifications, chemical contamination, shutdown transient, chemical clean-up, etc.).

A form is completed by the site and corporate enabling searches for the relevant answers from their own operating experience data bank, or in existing studies. This has made it possible to avoid many days unavailability every year.

There are over 1400 data sheets in the data base, which can be browsed using key words. In this manner, the site or corporate can check whether the question has already been raised by one of the other EDF sites of the nuclear fleet. The data sheets represent an ideal basis for development of responses by corporate.

Advantages:

There is a very good responsiveness on chemistry related issues, whatever the area (normal operations, outage, cleaning, waste, effluents etc.). The data sheets are resources for site decisions when preparing chemistry activities that require optimized chemistry parameters and/or operations activities.

Benefits:

The FAQ sheets have been in use since 2004. They are popular and the sites have easy access to official information from the corporate organization. The regulator has recognized the process as a positive one, and also uses these FAQ sheets in their day-to-day monitoring of the fleet.

The FAQ sheets deals with over 40 different areas. Approximately 140 such sheets are developed every year, i.e. three per week. This is a practice that can be easily replicated by any other engineering structure in charge of support to unit chemistry.

8.1(b) Good Practice: Chemistry Laboratory to test chemistry instruments “in the field”.

Description:

The corporate chemistry laboratory CEIDRE runs a test laboratory, with sample lines that are connected to the systems of the secondary circuit of the Chinon NPP. The sample lines thus provide “real” samples and online instruments and other chemical techniques can be tested “in the field”. In addition these water samples can be modified by injecting conditioning chemicals for the secondary circuit (e.g. ethanolamine) to simulate alternative chemical treatment of the systems. Only when these substances can be measured reliably they can be potential candidates as alternative treatment substances. This is an important prerequisite factor to improve plant chemistry with regard to several corrosion processes like general corrosion or flow assisted corrosion (erosion-corrosion in two-phase-systems). Suppliers are provided with relevant experience feedback to modify their instruments.

Technicians are trained on how to operate these instruments and to maintain them. These technicians act as trainers in the plant. In addition students receive their basic training according their training plan in sampling and instrument maintenance.

Advantages:

Performance checks of instruments over several months, these tests help NPPs to avoid inevitable malfunctions when installing new instruments.

Benefits:

Out of the hundred or more new instruments installed across the fleet, no analysers have had to be changed, thanks to the use of this testing facility.



9. EMERGENCY PREPAREDNESS AND RESPONSE & ACCIDENT MANAGEMENT

The resilience management within EDF Corporate was reviewed in the areas of the emergency preparedness and planning and severe accident management.

9.1. EMERGENCY PREPAREDNESS AND PLANNING

Roles, responsibilities and authorities

The emergency response organization (ERO) is based on the emergency plans that involve separately EDF as the operator and the public authorities. The on-site emergency plan (PUI) is under EDF responsibility. The off-site emergency plan (PPI) is the responsibility of public authorities

The bodies of the EDF ERO are:

PCD-L	on-site Emergency Management Command Centre
PCL	Local Command Centre (in Main Control Room)
PCM	Maintenance and local equipment Command Centre
ELC	On-site Technical Support Centre (EOPs and process supervision)
PCC-Measures	Measurements Health Protection Centre
PCC-Analyses	Analysis Health Protection Centre
PCD-N	Corporate Emergency Management Command Centre (Wagram)
ETC-N	Corporate Technical Support Center (St. Denis), assisted by SEPTEN and Areva
FARN	Nuclear Rapid Response Force

The involved public bodies and organisations are:

COD	Local Public Authorities Emergency Command Centre, assisted by local ASN representative
PCO	Local Public Authorities' Emergency Field Operations Centre
PCT-ASN	ASN Emergency Command Centre, technical assistance from IRSN
ISRN	technical support organisation of ASN

The emergency response plan has been developed taking into account all possible hazards, including non-radiological (such as chemical) and external events (natural and those caused by neighbouring industries).

Staffing

Emergency plans include the necessary staffing and resources to be assigned to emergency tasks. Sufficient resources for all foreseen emergencies, particularly for multiple unit emergencies on-site, are tested during emergency drills. There is sufficient designated staff to cover all key positions in the EROs. Availability of people to these positions is ensured with the on-call system.

Emergency response equipment, facilities and locations

On-site emergency response centre at Blayais Power station

Team members visited Blayais NPP (with four CP1 units) to review the on-site emergency arrangements. The units were commissioned starting from 1981 to 1983. Blayais NPP carries out annually five full-scope on-site drills. During the last ten years, there have been five national level drills (two to three every five years based on a corporate schedule).

The on-site emergency centre BDS is located next to the entrance gate and it has been properly equipped for the needs of the on-site ERO. There are two technical support centres LTC (for ELC) that are located near the control rooms and have the same habitability level with resistance against airborne contamination as the control rooms.

The Blayais ERO aims at a high emergency culture (as part of safety culture) and, as recommended by corporate principles, bases its strength on three vital pillars: skills - equipment - documents. A specific feature of Blayais ERO is in the training functions that are effectively incorporated into the ERO structure. Simulator trainers form a part of ERO. The members of the technical support centre (ELC) can have classroom and table-top training in the replica of the ELC space located in the simulator building. Team members valued these features as a good performance of the Blayais ERO.

Global ERO is designed to provide second line of defence to on-site ERO by corporate ERO :

- proving that the decisions taken by local ERO are appropriate,
- providing support from EDF thermal-hydraulic experts and Areva if needed,
- finding criteria for e.g. radiological alerts.

The cooperation and communication between the site and Corporate staff was found active, friendly and professional.

Visualization of CCL now under construction at Flamanville

New on-site emergency centers (CCL)

EDF has decided, based on its own initiative, to construct new on-site emergency centres (CCL) that will have a robust building protected against seismic events, flooding, explosions, extreme weather conditions, electromagnetic interference and contaminated conditions. The construction will be carried out during the next ten years at all 19 NPP sites. The first is Flamanville, where



construction is in progress and the CCL should be commissioned in the middle of 2016. The CCLs have been designed to operate autonomously for 72 hours. The team recognized the new on-site emergency centres as a good performance.

Corporate level ERO

EDF Group's emergency unit in Paris (Wagram) forms a functional emergency control centre (PCD-N) in case of nuclear and radiological emergency, and it implements action strategies and verifies the consistency of cross-functional areas. PCD-N supervises the whole emergency response process and communicates with the ASN and public authorities.

The corporate technical support centre, ETC-N (in St. Denis), advises ELC and PCD-N in all technical matters and proposes alternative strategies to the PCD-L. ETC-N gets support from internal engineering (SEPTEN) and from the nuclear island vendor Areva NP.

FARN: Nuclear Rapid Response Team

As a response to the Fukushima accident, EDF management took an initiative in 2011 to launch FARN, ensuring a skilled and properly equipped team will arrive at each site to assist in recovery actions during the emergency situations.

The criteria to be fulfilled by the FARN were set as:

- skilled and properly equipped FARN team will be available at each of the 19 EDF NPP sites within 12 hours from the onset of emergency,
- FARN has to be able to support all the units on-site (most demanding is Gravelines with six units on the same site),
- a FARN center would be available for each of the various French PWR series: CP0, CP1/2, P4 and N4.

Based on these criteria four FARN regional bases were set up and they are located on the sites of Civaux (N4), Paluel (P4), Dampierre (CPY) and Bugey (CP0). Each of these regional bases has five on-call teams consisting of 14 members ready for immediate action within an hour. The first FARN team arrives at the affected site in less than 12 hours and is fully operational within 24 hours.

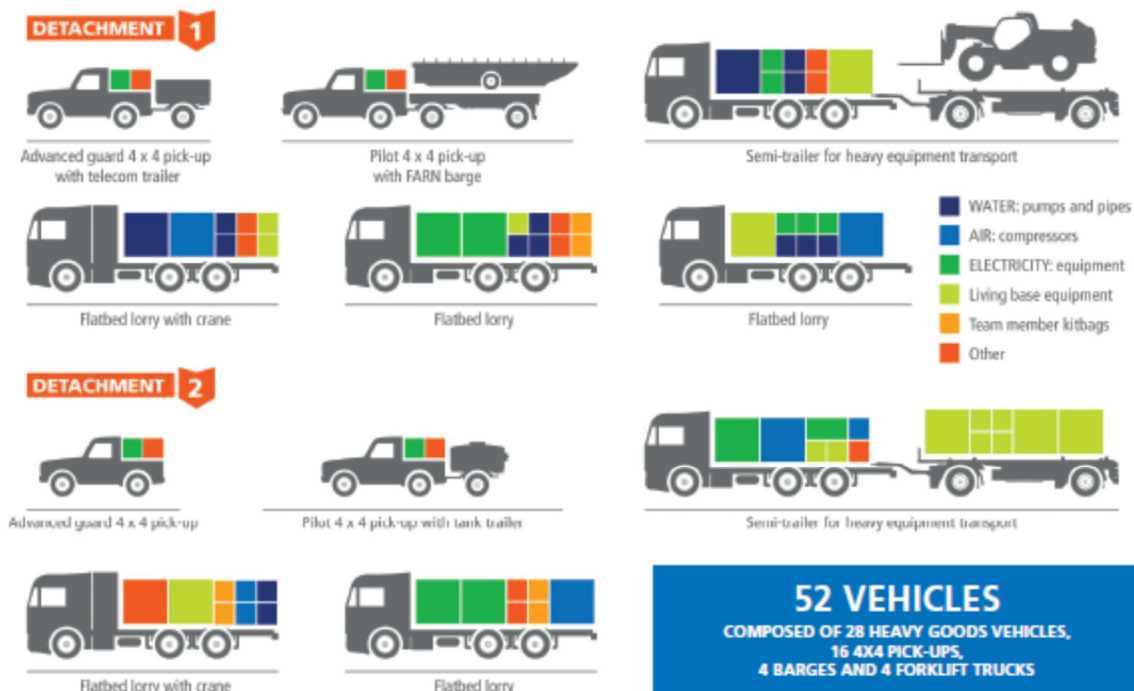
The FARN members are all nuclear workers who split their time throughout the year between their job specialisation at their NPP and activities specific to FARN. During the periods of FARN duty, the team members dedicate most of their time to training, drills and maintenance of the FARN equipment. In the event of response operations, FARN has essential skills (operational, maintenance and logistics) to assist or take over from the site team. The new FARN buildings are being constructed on-site to house both the personnel and equipment

FARN performs actions on-site under command of the local crisis manager (PCD1):

- provide and connect the emergency response equipment (pumps, emergency diesel generators, fuel tanks and air supply)
- carry out appropriate monitoring of operation of the emergency response equipment and ensure related logistics to guarantee operation, especially fuel supply
- participate in assessment of availability and condition of site equipment
- participate in maintenance of site equipment, to ensure (or restore) its operability

- support the shift team and ensure targeted handover (assessment of the situation, ongoing and forthcoming actions and status of the safety functions)
- participate in priority operating actions (in support of or to take over from the shift crew), required by the situation and especially unit safety status
- operate vital safety systems, and particularly the steam dump to atmosphere, auxiliary feed water and station blackout diesel generator (LLS)
- carry out plant alignments
- carry out plant monitoring and checking rounds
- deploy the backup means of emergency response communication.

FARN CONVOY PLAN DEPARTING FROM EVERY REGIONAL BASE



Each FARN regional base is equipped with various means such as

- robust transport vehicles: lorries and 4x4 pickups,
- all living supplies and equipment needed for 72 hours autonomous operation,
- five 100 kW diesel generator sets,
- crane, forklift truck (convertible to personnel lifting, digger, bulldozer etc), diesel driven air compressor set, high-capacity hydraulic pump and 4 km hoses, electric cabling,
- a barge for crossing waters,
- various communication means including radiophones and satellite phones.

All FARN regional bases have been established and they are operational, but the personnel is not yet complete for all teams. The bases will be fully operational by the end of 2015.

Summary of the emergency response facilities and equipment

EDF has assured that its emergency response organisations have proper facilities and various equipment available. At the same time, EDF has taken a dedicated approach that all equipment be accompanied with personnel having appropriate skills to operate these devices. The work is continuing by improving the on-site mobile equipment, completing the FARN centres, developing the INTRA remote controlled equipment and providing the site with new and robust on-site emergency centres CCL.

With these arrangements EDF is prepared to deal with even the unexpected emergency situations using a well-developed graded approach. In case of wide unavailability of the design safety systems and having simultaneously harsh on-site conditions, the on-site ERO has been trained to use on-site mobile equipment. The FARN teams will be available to assist a NPP in less than 24 hours (on site in less than 12 hours) and they are trained to manage even in harsher situations. The remotely controlled equipment of INTRA is available for further support within 24 hours, when there are locations inaccessible due to radiological or chemical contamination.

All the emergency response facilities are equipped with an extensive telecommunication system, which is based on diverse devices ensured with backup power supplies. The means include wired telephones, radiophones and satellite telecommunications. The diversity to ensure operation under all extreme conditions has been recently enhanced with autonomous satellite phones (e.g. Iridium technology) and will be completed with fixed satellite technology (VSAT technology) in 2015 for all plants.

The team noted the introduction of the equipment and personnel in multiple levels of emergency defence as a good practice.

The documentation in emergency centres is available both in electronic and paper format. Adequate personnel protection, food and water, sanitation and electricity are available to maintain habitability and operability of the personnel present for the expected duration.

EDF has contracted Areva NP to benefit from using well-equipped technical support centre that is able to advise EDF ERO on nuclear island issues and provide forecasts of severe accident progression.

Training, drills and exercises

Training for the all staff involved in the emergency response organisations is provided by corporate training unit (UPFI part of operational support division DAIP). Training includes both initial basic training and specific training for specialized members and refresher training. There are annually 12-15 corporate level drills including 4-5 full-scope drills with the authorities. Overall number is about 200 various exercises carried out per year. All staff responsible for critical response functions participate in drills and exercises at regular basis sufficient to support the staff's ability to take these functions. In certain cases as the training was found to be an essential and integral element of the emergency function, e.g. Blayais ERO, FARN and INTRA.

Systematic experience feedback is provided after the drills and exercises. The person coordinating the drill analyses all collected information. Feedback is provided e.g. during so-called Team Nuclear Safety Days among the emergency personnel. The on-site exercise experience is disseminated through networking of site emergency engineers. Experience feedback has resulted in more balanced scenario developments for the drills.

A corporate level emergency drill took place during the OSART Corporate mission on the 4th of December 2014. The scenario was a complicated accident with loss of coolant combined with loss of component cooling and heat sink and leakage from the containment at Paluel NPP. The drill was designed to test the plant level response to a complicated scenario and how the plant ERO manages to utilize the support from the corporate emergency response. The observed corporate ERO performance was found to be professional both in Wagram (PCD-N) and in St. Denis (ETC-N).

Activation of response functions

During the mission, the team observed that the plant has implemented measures to minimize the potential delays for the declaration of an emergency and provided the authority of declaration to the shift manager after consultation with the manager on duty (PCD1) or without consultation if the PCD1 is not available. At the time of the OSART review, the IAEA standards still required a person on-site at all times with the authority to declare an emergency without consultation. However, a new revision of GSR Part 7 Preparedness and Response for a Nuclear Radiological Emergency is to be published soon. The team encourages the plant to review its compliance with the new IAEA standard on this issue.

The decision to switching from the EOP domain to the SAM guidelines (GIAG) is done during the emergency by the PDC-L, based on measurable parameters.

Deciding the appropriate protection measures in the vicinity of the plant is taken by the local authorities, normally after hearing the advice or opinion of the PDC-L.

The decision to mobilize FARN rests with the head of the PDC-N.

9.2 SEVERE ACCIDENT MANAGEMENT

Overview of SAM in EDF

EDF started the development of severe accident management program (SAMP) by working on severe accident (SA) engineering documents, which provide the technical background information for the development of SAM guidelines. The phenomenological basis has been provided by applying integral SA code MAAP and various specific analytical tools as well as from various research programs.

The new set of emergency operating procedures (EOP) based on the state-based (viz. symptom-based) approach and SAM guidelines (GIAG) were implemented at all stations in 2006. Human performance based evolution of the EOP and SAM guidelines has been going on since 2012. Corporate ETC-N uses their own set of SAM guidelines, which includes some additional features in comparison to on-site SAM guidelines.

The principal approach of EDF to SAM has been summarized as:

- The entry from the EOPs to the SAM domain is non-reversible, i.e. there is no return to EOPs once the transfer has been decided by the on-site emergency manager.
- The EOPs focus on core integrity, whereas the SAM guidelines aim at preserving containment integrity and mitigating the releases into the environment.
- The SAM actions have been subdivided into immediate actions and delayed actions. The immediate actions will be executed by Main Control Room directly

- after switching to the SAM domain without consultation to the emergency director.
- Implicit in the transfer from the EOPs to SAM guidelines is that the decision on execution of delayed actions switches from the Main Control Room to the on-site emergency response centre (PCD-L).

The ECT-N uses currently version V4B of GIAG that give guidance in case of severe accident taking place during shutdown states. Update V5 has been already developed that includes new guidance for open reactor modes, detection of reactor vessel failure and measurement of core exit temperature in station blackout conditions. V5 also includes revised guidance on low safety injection flow rates and containment depressurisation using the U5 filtered containment venting system. SAM guidelines entry criteria for shutdown modes with the reactor vessel open will also be included in the appropriate main control room procedure. Implementation of V5 has been delayed to allow for the completion of post-Fukushima modifications in the EDF fleet. Implementation is planned for 2015.

Specific SAM measures and resources

The use of the primary pressure relief (tandem-type SEBIM pressurizer safety valves) has been instructed as an immediate action in GIAG after transfer to the SAM domain in order to ensure depressurization of the primary circuit before heat up of hot legs and SG tubes and before the pressure vessel failure.

The EDF fleet has been equipped with passive autocatalytic recombiners (PAR) to recombine hydrogen in the containment. PARs are also effective for burning CO that is generated during corium-concrete interactions.

Long-term stabilization of molten core during a severe accident which is a long term operation objective of EDF, comparable to GEN3 reactors safety objective, does not have a final technical solution. EDF is continuously working on developing technical measures that would allow spreading of the corium in the instrumentation room area of 100 m² after the failure of the reactor pressure vessel. The stabilization would be sought by top cooling with water from the containment sumps. Implementation of the spreading and top cooling strategy is planned to start from 2019 pending regulatory approval of the strategy. The team encourages EDF to proceed in the matter in order to ensure the long-term stabilization of core melt before basemat penetration.

Injection of contaminated leakages back to the containment (reinjection) is a common practice in French NPPs plants for LOCAs within the design basis. Recently EDF has developed a specific system with reinforced qualification. Safety injection system and containment spray system may become operable for cooling the corium and remove decay heat and as these systems might work for a long term, leaks during the recirculation mode may not be excluded. This is why EDF has designed a reinjection system of all leaks from these systems that are collected in a dedicated sump. A pump is installed in that sump and it injects the effluent into the reactor building. A thick plate covers the sump to limit the degassing and protect the pump motor from irradiation. The pump is qualified for irradiation and debris resulting from a severe accident and it can cope with the leakage flow rate in a range of 0 to 30 t/h. A sump level sensor, also qualified for severe accident conditions can check at any time that the sump does not overflow and that all leaks are fed back into the reactor building.

The necessary severe accident equipment is being qualified for severe accident conditions. The team considers this as good performance.

The team made a suggestion on the application of PSA to support SAM and EPP programs.

SAM issues from recent plant OSART missions

OSART missions to French NPPs during past three years have repeatedly brought up two issues: first, the SAM guidelines in place do not cover all operational states of the reactors and the spent fuel pool. Secondly, the SAM guidelines do not provide effective mitigation methods for severe accidents induced by extreme conditions that may occur simultaneously on several units.

The current status is that SAM guidelines being executed on NPPs include those operational states where the primary circuit is closed. The states with an open primary circuit are managed under the guidance of corporate support centre ETC-N. The new version of SAM guidelines that will be implemented for the whole nuclear fleet during year 2015 will cover also the states with an open primary circuit.

Concerning multiple unit events, EDF considers that the introduced SAM measures are sufficient to exclude the possibility of multiple units facing a severe accident simultaneously. New version V5 of GIAG to be implemented 2015 will include survey of the radiological conditions on-site after containment filtered venting. The case of multiple units will be treated in the EDF response to Flamanville and Chooz OSART suggestions.

9.3 THE POST-FUKUSHIMA MODIFICATION PROGRAMME

Following the Fukushima accident in Japan in March 2011, ASN asked EDF to perform complementary safety assessments of its nuclear power plants.

Complementary Safety Assessment (ECS) had four main objectives:

- check plant compliance with the existing safety baseline
- better consider external hazards such as earthquake and flood with higher levels than those previously specified in the initial design;
- reinforce electrical power supply and water makeup to respond to total loss of both power and heat sink;
- reinforce emergency response management.

Although ECS confirmed that the current safety level of French nuclear fleet is appropriate, EDF proposed additional measures to further improve all EDF NPPs to an enhanced safety level.

The post-Fukushima programme was launched to be completed by the year 2030. This is a set of measures aiming at modernising and extending operating lifetime of the French NPPs. The programme is mainly incorporated in the schedule of decennial outages, covered by safety reviews enabling operation to be continued, and it fulfils requirements laid down by ASN. The key elements are organisational, equipment and human measures implemented in three phases:

- **Phase 1** by the year 2015: installation of new mobile and temporary emergency equipment (local and FARN) and reinforcement of the organisational measures of emergency response management.

- **Phase 2** by the year 2020: Deployment of new water makeup and power supply systems designed according to more restrictive hypotheses and strengthening the existing safety systems. Phase 2 modifications cover the Fukushima direct OE
- **Phase 3** from 2019 by the year 2030: the last part of the measures designed to manage extreme situations beyond the baselines in force, and to meet LTO enhanced safety objectives (related to new GEN3 reactors safety objectives).

The programme makes a total investment of around 10 billion Euros for the entire French fleet, half of which had already been planned for plant modernisation to extend operating lifetime beyond 40 years.

The team noted the post-Fukushima action program as a good performance.

DETAILED EMERGENCY PREPAREDNESS AND RESPONSE & ACCIDENT MANAGEMENT

9.1 EMERGENCY PREPAREDNESS AND PLANNING

9.1(a) Good practice: Multi-layered resources for emergency response.

EDF Corporate has provided successive levels of emergency response resources that will help the stations to succeed in unexpected situations. The material resources include local mobile equipment, Nuclear Rapid Response Force (FARN) and remote controlled equipment of “Intervention by Robotics in Accident” (INTRA). An important element of these resources is that their operation is ensured by well-trained and skilled personnel.

There is mobile equipment available on each site to support emergency functions. The hook-ups are provided and hose routings are pre-planned for water supply with mobile pumps e.g. to auxiliary feed water tanks to cool steam generators and direct line-ups to cool spent fuel pools. Plenty of other mobile equipment is available. The use of all this emergency equipment has been trained on-site. There is a plan to upgrade the current mobile pumps and hoses into fixed installations.

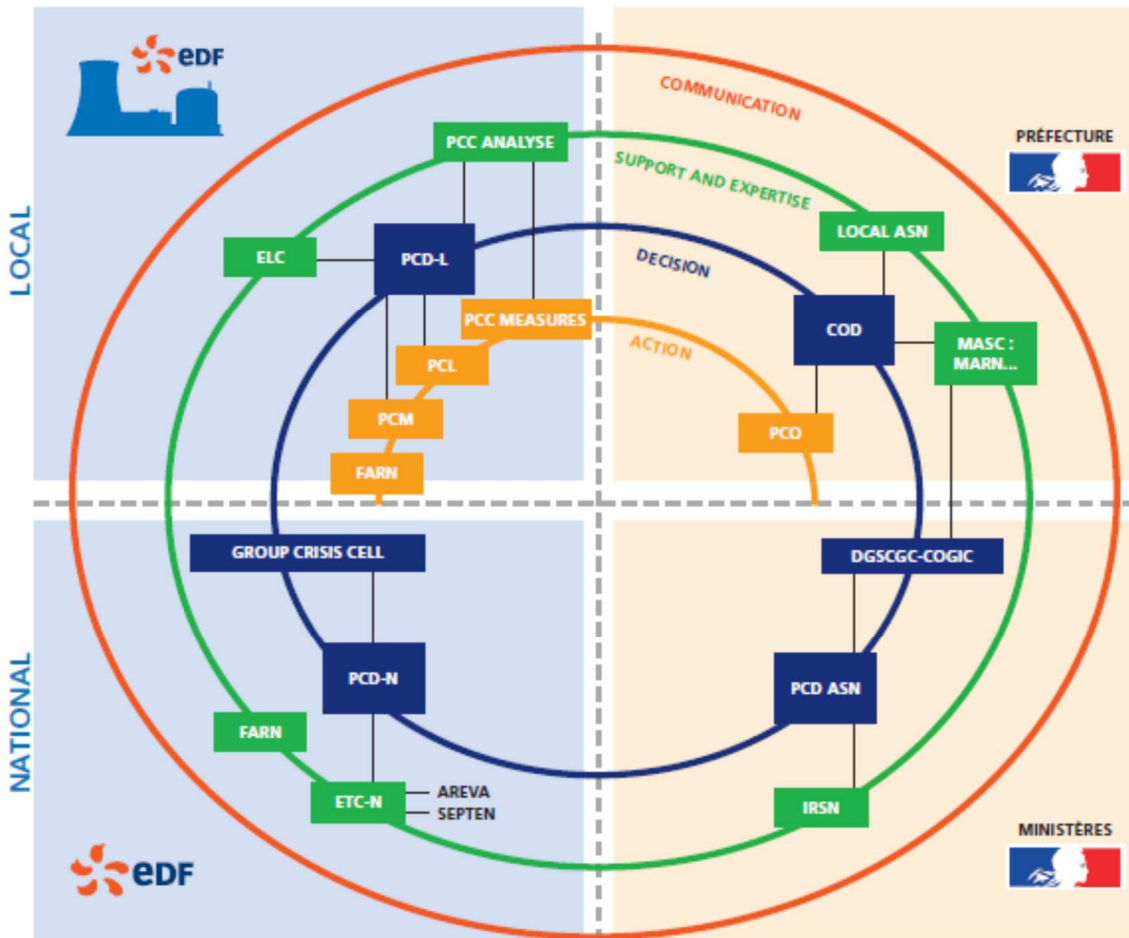
FARN is tasked with responding within 24 hours at any nuclear power plant affected by an emergency in order to limit further deterioration of the situation, prevent large off-site radioactive releases and prevent core melt if possible. FARN deploys skilled human and equipment resource to support the site shift teams. It takes action to restore water, electrical power and compressed air in order to limit worsening of the situation and if possible, prevent core meltdown. Trained and skilled FARN teams are available on-call.

EDF has founded, together with Areva and CEA, Groupe INTRA at Chinon. INTRA has developed and maintains remote controlled equipment (such as indoor robots, outdoor robots, civil machinery - bulldozer, dump truck, digger - and aerial devices for monitoring). The equipment can be sent to any site for various tasks, which cannot be performed by people due to high radiation or chemical toxicity levels.

The successful use of the equipment is ensured by the personnel and skills that are developed and maintained by training. Telecommunication is ensured under all conditions by providing diverse devices (wired telephones, radiophones, satellite telecom).

Following Fukushima accident, the diversity was further enhanced with autonomous satellite connections (e.g. Iridium).

The structure of the whole emergency response arrangements is clearly illustrated with the diagram that integrates decision making and actions both within EDF and authorities in local and national levels. The diagram also explains what support and expertise is available for the emergency response centres. The key item is successful communication among the various players and also external crisis communications through group crisis cell.



9.2 SEVERE ACCIDENT MANAGEMENT

9.2(1) Issue: The current scope of PSA is not sufficient to support the EPP and SAM developments in managing consequences of external hazards and in addressing simultaneous severe accidents in multiple units at the same site.

The team observed the following:

- The full-range of external hazards has not been included in the current PSAs for the operating nuclear fleet.
- EDF plans to include external hazards in the plant-specific PSAs to be delivered in connection to the next 10 year PSRs, e.g. for CPY in the 4th PSR in 2019-2025.
- The exclusion of multiple unit hazards has not quantitative support from PSA.

The extension of PSA is a continuous process related to internal and external hazards over many years. The continuation is proceeding with the schedule agreed with ASN. Until now the PSA level 1 covers internal hazards (fire and flood) and an external hazard (seismic) at power states.

Even though it is recognized that the gradual progress in the PSA allows inclusion of operational feedback from the first included hazards, it could be valuable to have the probabilistic support for the SAM and EPP planning included in earlier phase.

The hazards threatening multiple units are taken into account in EPP guidelines for extreme weather conditions (SACA). The quantitative results from the PSA would provide valuable insights concerning the actual risk level.

The by-pass sequences (V-LOCA and SGTR) have been already included in PSA level 1 and they will contribute to the frequency of large early releases. In addition PSA level 2 will take into account induced SGTR, containment leakages e.g. from penetrations failures, and particularly to penetration openings (personnel and material hatches) during the outages. Isolation failure rates and average duration of opening penetrations will be collected from the statistics based on the 1500 operating years of the French nuclear fleet.

The experience and results of the full-scope PSA process would be beneficial for complementing engineering basis and the next updates of EPP and SAM guidelines.

Suggestion: Consideration should be given to revalidate the schedule of the full-scope plant-specific PSAs, including all pertinent external hazards, in order to obtain the full support for planning the actions

IAEA Bases:

IAEA NS-G-2.15

3.2. For determination of the full spectrum of events, useful guidance can be obtained from the probabilistic safety assessment (PSA) Level 1 (if available), or similar studies from other plants, and operating experience from the plant and other plants. A selection of events should be sufficiently comprehensive to provide a basis for guidance for the plant personnel in any identified situation, even if the evolution of the accident would constitute a very unlikely path within the PSA or is not identified in the PSA at all.

3.4. For determination of the full spectrum of challenge mechanisms, useful guidance can be obtained from the probabilistic safety assessment (PSA) Level 2 (if available), or similar studies from other plants and insights from research on severe accidents. However, identification of potential challenge mechanisms should be sufficiently comprehensive to provide a basis for guidance for the plant personnel in any identified situation, even if the evolution of the accident would constitute a very unlikely path within the PSA or is not identified in the PSA at all.

3.5. In view of the inherent uncertainties involved in determining credible events, the PSA should not be used a priori to exclude accident scenarios from the development of severe accident management guidance. (If such use is considered, very low cut-off levels should be specified so as not to underestimate the scope and nature of scenarios to be analysed.)

3.6. After the accident management guidance has been completed, it should be verified whether indeed all important accident sequences, in particular those obtained from the PSA, are covered and whether risks are reduced accordingly.

3.120. Every categorization scheme, however, should result in a list of groups of accident sequences that address plant behaviour and response, including core degradation and melting, reactor vessel failure and containment boundary failure, and the associated severe accident phenomena. Different categorization schemes are conceivable. A typical Level 2 PSA will also contain such a categorization scheme.

IAEA SSG-3

2.29. The results of the Level 2 PSA should be used to determine if sufficient provision has been made to prevent or mitigate the effects of postulated core damage sequences. In Level 2 PSA, it should be considered whether the containment is adequately robust and whether the protection systems such as hydrogen mixing and recombining systems, containment sprays and containment venting systems provide an adequate level of protection to prevent a large release of radioactive material to the environment. Furthermore, containment bypassing events such as a loss of coolant accident in interfacing systems should be addressed. In addition, Level 2 PSA should be used to identify and optimize accident management measures that could be carried out to mitigate the effects of the damaged core. This could include determining additional measures, for example, measures that could be taken to introduce water into the reactor containment.

2.30. When available, the results of Level 2 PSA and Level 3 PSA should be provided to civil authorities as a technical input for off-site emergency planning.

IAEA SSG-3

Annex I: Example of a generic list of internal and external hazards

IAEA SSG-4

8.21. The Level 2 PSA should be used as a basis for the evaluation of the measures in place and the actions that can be carried out to mitigate the effects of a severe accident after core damage has occurred. The aim of mitigatory measures and actions should be to arrest the progression of the severe accident or mitigate its consequences by preventing the accident from leading to failure of the reactor pressure vessel or the containment, and controlling the transport and release of radioactive material with the aim of minimizing off-site consequences. Examples of mitigatory actions that could be carried out for pressurized water reactors include:

(a) Opening the pressurizer relief valves in order to reduce the primary circuit pressure and so avoid molten core material being ejected from the reactor pressure vessel under high pressure;

(b) Adding water to the containment by any available means after the molten core has exited from the primary circuit so as to provide a cooling mechanism.

8.22. The results of the Level 2 PSA should be used to determine the effectiveness of the severe accident management measures that are described in the severe accident management guidelines or procedures, whether they have been specified using the Level 2 PSA or by any other method.

8.24. The source terms and frequencies derived in the Level 2 PSA, along with calculations of the off-site dose as a function of distance, should be used as inputs into the development of off-site emergency planning. One or more reference accidents can be defined and used in this process.

8.25. An important requirement for a Level 2 PSA that is to be used for emergency planning is that the source terms should be accurately specified in terms of the quantities of radioactive material released and the additional attributes

8.26. The source terms and frequencies derived in the Level 2 PSA can be used as an input to determine the extent of the emergency planning zones and the area for the distribution of prior information (so as to meet Requirement 23 of IAEA GSR Part 4 on use of the safety assessment).

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

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

Good practice

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

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

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

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

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

- **SF-1**; Fundamental Safety Principles (Safety Fundamentals)
- **GSR Part 3**; Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Interim Edition
- **SSR-2/1**; Safety of Nuclear Power Plants: Design (Specific Safety Requirements)
- **SSR-2/2**; Safety of Nuclear Power Plants: Operation and Commissioning (Specific Safety Requirements)
- **NS-G-1.1**; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)
- **NS-G-2.1**; Fire Safety in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.2**; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)
- **NS-G-2.3**; Modifications to Nuclear Power plants (Safety Guide)
- **NS-G-2.4**; The Operating Organization for Nuclear Power Plants (Safety Guide)
- **NS-G-2.5**; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)
- **NS-G-2.6**; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)
- **NS-G-2.7**; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)
- **NS-G-2.8**; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)
- **NS-G-2.9**; Commissioning for Nuclear Power Plants (Safety Guide)
- **NS-G-2.11**; A System for the Feedback of Experience from Events in Nuclear Installations (Safety Guide)
- **NS-G-2.12**; Ageing Management for Nuclear Power Plants (Safety Guide)
- **NS-G-2.13**; Evaluation of Seismic Safety for Existing Nuclear Installations (Safety Guide)
- **NS-G-2.14**; Conduct of Operations at Nuclear Power Plants (Safety Guide)

- **NS-G-2.15**; Severe Accident Management Programmes for Nuclear Power plants Safety Guide (Safety Guide)
- **SSG-13**; Chemistry Programme for Water Cooled Nuclear Power Plants (Specific Safety Guide)
- **SSG-25**; Periodic Safety Review for Nuclear Power Plants (Specific Safety Guide)
- **GSR**; Part 1 Governmental, Legal and Regulatory Framework for Safety (General Safety Requirements)
- **GS-R-2**; Preparedness and Response for a Nuclear or Radiological Emergency (Safety Requirements)
- **GS-R-3**; The Management System for Facilities and Activities (Safety Requirements)
- **GSR Part 4**; Safety Assessment for Facilities and Activities (General Safety Requirements 2009)
- **GS-G-4.1**; Format and Content of the Safety Analysis report for Nuclear Power Plants (Safety Guide 2004)
- **SSG-2**; Deterministic Safety Analysis for Nuclear Power Utilities (Specific Safety Guide 2009)
- **SSG-3**; Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **SSG-4**; Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (Specific Safety Guide 2010)
- **GS-R Part 5**; Predisposal Management of Radioactive Waste (General Safety Requirements)
- **GS-G-2.1**; Arrangement for Preparedness for a Nuclear or Radiological Emergency (Safety Guide)
- **GSG-2**; Criteria for Use in Preparedness and Response for a Nuclear and Radiological Emergency
- **GS-G-3.1**; Application of the Management System for Facilities and Activities (Safety Guide)
- **GS-G-3.5**; The Management System for Nuclear Installations (Safety Guide)
- **RS-G-1.1**; Occupational Radiation Protection (Safety Guide)
- **RS-G-1.2**; Assessment of Occupational Exposure Due to Intakes of Radionuclides (Safety Guide)

- **RS-G-1.3**; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)
 - **RS-G-1.8**; Environmental and Source Monitoring for Purpose of Radiation Protection (Safety Guide)
 - **SSR-5**; Disposal of Radioactive Waste (Specific Safety Requirements)
 - **GSG-1** Classification of Radioactive Waste (Safety Guide 2009)
 - **WS-G-6.1**; Storage of Radioactive Waste (Safety Guide)
 - **WS-G-2.5**; Predisposal Management of Low and Intermediate Level Radioactive Waste (Safety Guide)
- ***INSAG, Safety Report Series***
- INSAG-4**; Safety Culture
- INSAG-10**; Defence in Depth in Nuclear Safety
- INSAG-12**; Basic Safety Principles for Nuclear Power Utilities, 75-INSAG-3 Rev.1
- INSAG-13**; Management of Operational Safety in Nuclear Power Utilities
- INSAG-14**; Safe Management of the Operating Lifetimes of Nuclear Power Utilities
- INSAG-15**; Key Practical Issues In Strengthening Safety Culture
- INSAG-16**; Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety
- INSAG-17**; Independence in Regulatory Decision Making
- INSAG-18**; Managing Change in the Nuclear Industry: The Effects on Safety
- INSAG-19**; Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life
- INSAG-20**; Stakeholder Involvement in Nuclear Issues
- INSAG-23**; Improving the International System for Operating Experience Feedback
- INSAG-25**; A Framework for an Integrated Risk Informed Decision Making Process
- Safety Report Series No.11**; Developing Safety Culture in Nuclear Activities Practical Suggestions to Assist Progress
- Safety Report Series No.21**; Optimization of Radiation Protection in the Control of Occupational Exposure

Safety Report Series No.48; Development and Review of Utility Specific Emergency Operating Procedures

Safety Report Series No. 57; Safe Long Term Operation of Nuclear Power Plants

▪ ***Other IAEA Publications***

- **IAEA Safety Glossary** Terminology used in nuclear safety and radiation protection 2007 Edition
- **Services series No.12;** OSART Guidelines
- **EPR-EXERCISE-2005;** Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, (Updating IAEA-TECDOC-953)
- **EPR-METHOD-2003;** Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)
- **EPR-ENATOM-2002;** Emergency Notification and Assistance Technical Operations Manual

▪ ***International Labour Office publications on industrial safety***

- **ILO-OSH 2001;** Guidelines on occupational safety and health management systems (ILO guideline)
- Safety and health in construction (ILO code of practice)

Safety in the use of chemicals at work (ILO code of practice)

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