IAEA-TECDOC-1446

# *OSART mission highlights 2001–2003*

*Operational safety practices in nuclear power plants*

IAEA
International Atomic Energy Agency

May 2005

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The originating Section of this publication in the IAEA was:

Operational Safety Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
A-1400 Vienna, Austria

OSART MISSION HIGHLIGHTS 2001–2003
OPERATIONAL SAFETY PRACTICES IN
NUCLEAR POWER PLANTS
IAEA, VIENNA, 2005
IAEA-TECDOC-1446
ISBN 92–0–102205–0
ISSN 1011–4289



Printed by the IAEA in Austria
May 2005

# FOREWORD

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States in enhancing the operational safety of nuclear power plants (NPPs). Careful design and high quality of construction are prerequisites for a safe nuclear power plant. However, a plant's safety depends ultimately on the ability and conscientiousness of the operating personnel and on the plant programmes, processes and working methods. An OSART mission compares a facility's operational performance with IAEA Safety Standards and proven good international practices.

The OSART reviews are available to all countries with nuclear power plants in operation, but also approaching operation, commissioning or in earlier stages of construction (Pre-OSART). Most countries have participated in the programme by hosting one or more OSART missions or by making experts available to participate in missions. Operational safety missions can also be part of the design review missions of nuclear power plants and are known as Safety Review Missions (SRMs). Teams that review only a few specific areas or a specific issue are called Expert missions. Follow-up visits are a standard part of the OSART programme and are conducted between 12 to 18 months following the OSART mission.

This report continues the practice of summarizing mission results so that all the aspects of OSART missions, Pre-OSART missions and OSART good practices are to be found in one document. It also includes the results of follow-up visits. Attempts have been made in this report to highlight the most significant findings while retaining as much of the vital background information as possible. This report is in three parts: Part I summarizes the most significant observations made during the missions and follow-up visits between 2001 and 2003; Part II, in chronological order, reviews the major strengths and opportunities for improvement identified during each OSART mission and summarizes the follow-up visits performed; Part III lists the good practices that were identified in the period covered. At the end of Part III is a summary of the good practices that were observed in the different review areas and of the contributions of individual NPPs to good practices for the period covered.

Each part of the report is intended for different levels of management in the operating and regulatory organizations, but not exclusively so. Part I is primarily directed at the executive management level; Part II at middle managers and Part III at those involved in operational experience feedback. Individual findings varied considerably in scope and significance. However, the findings do reflect some common strengths and opportunities for improvement.

Appendix I presents information on the database which collects the results of OSART missions (OSMIR), which can be valuable for user programmes that deal with operational experience feedback. Appendix II reviews the IAEA programme on education and training in nuclear safety. Appendix III covers the IAEA programme on education and training in radiation protection, transport and waste safety. Finally, Appendix IV presents the IAEA programme on ageing and long term operation which aim to increase the qualification of NPPs' specialists in different areas of nuclear and radiation safety and needs for long term operation.

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## *EDITORIAL NOTE*

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# BACKGROUND

Many of the challenges faced by those responsible for ensuring the safe operation of nuclear power plants are common throughout the world. The results of an OSART mission are, therefore, of interest and possible application to many nuclear power plants and not solely to the plant in which they were originally identified. The primary objective of this report is to enable organizations that are constructing, commissioning, operating or regulating nuclear power stations to benefit from experience gained in the course of missions conducted under the OSART programme during the period January 2001 to December 2003.

In 1983, the IAEA set up the Operational Safety Review Team (OSART) programme to assist Member States in the enhancement of safe operation of nuclear power plants. The service is available upon Agency request by Member Sates to all countries with nuclear power plants under construction, commissioning or in operation. 121 missions had been conducted at 84 nuclear power plants in 31 countries by the end of 2003. There had also been 64 follow-up visits to review the implementation of previous OSART results. Twenty-three OSART missions and follow-up visits were conducted during 2001–2003 (Tables 1 and 2).

OSART teams consist of senior expert reviewers from NPPs and regulatory authorities in the various disciplines relevant to the mission. In the course of technical discussions between reviewers and plant staff, operational safety programs are examined in detail and their performance checked; strengths are identified and listed as good practices and possible solutions to weaknesses listed as recommendations or suggestions. The criteria used by the teams as they formulate their conclusions are based on IAEA Safety Standards and the best prevailing international practices, and, therefore, may be more stringent than national requirements. OSART reviews should not be regarded neither for regulatory inspections nor design reviews. Rather, OSART reviews consider the effectiveness of operational safety programs and are more orientated to program, process and management issues than to hardware. The performance or outcome of the various programs is given particular attention. OSART teams neither assess the adequacy of plant design nor compare or rank the safety performance of different plants.

The OSART missions consist of three basic types: missions to operating power reactors (OSART); missions to power reactors under construction or at the pre-commissioning stage (Pre-OSART); and Expert missions which cover a limited range of topics or which differ in character from review missions. In addition, operational safety reviews when combined with design reviews are known as Safety Review Missions (SRMs).

The results of OSART missions completed by the end of 1996 have been summarized in OSART Results, IAEA-TECDOC-458; OSART Results II, IAEA-TECDOC-497; OSART Mission Highlights, 1988–1989. IAEA-TECDOC-570; OSART Good Practices, 1986–1989, IAEA-TECDOC-605; OSART Mission Highlights, 1989–1990, IAEA-TECDOC-681; Pre-OSART Mission Highlights, 1988–1990. IAEA-TECDOC-763; OSART Mission Highlights 1991–1992, IAEA-TECDOC-797; OSART Programme Highlights 1993–1994, IAEA-TECDOC-874; and OSART Programme Highlights 1995–1996, IAEA-TECDOC-1018. Since 1996 the results of OSART missions have been made available to Member States on OSMIR. (See Appendix I).

The OSART reviews normally cover eight areas, namely: management, organization and administration; training and qualification; operation; maintenance; technical support; chemistry; radiation protection; and emergency planning and preparedness.

Formal guidelines and criteria for evaluating safety culture were formulated and made available to the industry in the form of INSAG-4 in 1991 and then INSAG-15, IAEA-TECDOC-1329 (December 2002) which provides guidelines for self assessment of safety culture as a tool for safety culture improvement. However, OSART review guidelines and criteria have, from the beginning, included most of the fundamental characteristics of safety culture. Thus, OSART teams have reviewed safety culture in each review area in an integrated manner, as an important part of effective nuclear power plant management. Since October 1992, however, safety culture has been specifically assessed in all OSART missions and follow-up visits, both overall and in each of the eight major review areas.

An important area of plant operation is the proper development and implementation of an Operation Experience Feedback (OEF) Programme. Therefore an enhanced OEF Programme review is evaluated as a part of Technical support review. Most recently, a dedicated OEF reviewer has been added to the OART team composition.

The OSART Guidelines were revised in June 1999 and have been pilot tested since then, making all necessary improvements. The revision of the OSART Guidelines will be completed in 2004. During the review guidance of recent INSAG Reports (INSAG-13: Management of Operational Safety in Nuclear Power Plants, INSAG-15: Key Practical Issues in Strengthening Safety Culture, INSAG-18: Managing Change in the Nuclear Industry, INSAG-19: Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life) and requirements of some recent Safety Guides (e.g. NS-G-2.4: The Operating Organization for Nuclear Power Plants, NS-G-1.1: Software for Computer Based Systems Important to Safety in NPPs) are incorporated. The Agency Safety Review Services were evaluated by an external audit, which recommended to promote the integrated approach to safety assessment. This is also taken into account.

Over the twenty-years experience of the OSART programme, significant changes have occurred in OSART methodology, nuclear industry transparency and power plant operational safety practices for in-depth reviews of operational safety. Over this period, the guidelines and experience of OSART team members have also evolved to reflect the higher standards for operational safety practices now being adopted worldwide.

Definitions currently in use by OSART for recommendations, suggestions and good practices are as follows:

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

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

**Good practice**
A good practice is an outstanding and proven performance, programme, activity or use of equipment markedly superior to that observed elsewhere, not just a fulfilment of current requirements or expectations. It should be superior enough and have broad application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence.

During follow-up visits the team ranks the actions taken by the plant and the effectiveness of their implementation as follows:

**Issue resolved — Recommendation**
All necessary actions have been taken to deal with the root causes of the issue rather than to just eliminate the examples identified by the team. Management review has been carried out to ensure that actions taken have eliminated the issue. Actions have also been taken to check that it does not recur. Alternatively, the issue is no longer valid due to, for example, changes in the plant organization.

**Satisfactory progress to date — Recommendation**
Actions have been taken, including root cause determination, which lead to a high level of confidence that the issue will be resolved in a reasonable time frame. These actions might include budget commitments, staffing, document preparation, increased or modified training, equipment purchase, etc. This category implies that the recommendation could not reasonably have been resolved prior to the follow-up visit, either due to its complexity or the need for long-term actions to resolve it. This category also includes recommendations, which have been resolved using temporary or informal methods, or when their resolution has only recently taken place and its effectiveness has not been fully assessed.

**Insufficient progress to date — Recommendation**
Actions taken or planned do not lead to the conclusion that the issue will be resolved in a reasonable time frame. This category includes recommendations on which no action has been taken, unless this recommendation has been withdrawn.

**Withdrawn — Recommendation**
The recommendation is not appropriate due, for example, to poor or incorrect definition of the original finding or its having minimal impact on safety.

**Issue resolved — Suggestion**
Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been fully implemented or the plant has rejected the suggestion for reasons acceptable to the follow-up team.

**Satisfactory progress to date — Suggestion**
Consideration of the suggestion has been sufficiently thorough. Action plans for improvement have been developed but not yet fully implemented.

**Insufficient progress to date — Suggestion**
Consideration of the suggestion has not been sufficiently thorough. Additional consideration of the suggestion or the strengthening of improvement plans is necessary, as described in the IAEA comment.

**Withdrawn — Suggestion**
The suggestion is not appropriate due, for example, to poor or incorrect definition of the original suggestion or its having minimal impact on safety.

# PART I
# SUMMARY

The summary below reflects the perspective on operational safety performance resulting from the 23 OSART, Pre-OSART, Expert missions and follow-up visits conducted in the period 2001–2003. They took place in Asia (2), Central and eastern Europe (9), western Europe (9), North America (1) and South America (2).

Operational safety highlights from 2001 to 2003 missions were systematically compared to the previous ones in 1995–1996, and sometimes even before, in order to confirm, or not, trends which were observed on the 2001–2003 period in a long term evolution.

**Issues and trends in operational safety**

Review of the OSART reports for the 2001–2003 revealed some issues and trends that might turn into the serious operational problems if not removed timely.

At some nuclear utilities human related factors are not properly addressed in the management programme. Despite that some power plants experience serious problems with human resources there are no perspective plans to resolve these problems. The additional trend is insufficient operations management oversight. Managers and supervisors are not identifying some deficiencies and are missing opportunities for improvement and reinforcement of expectations or correct attitudes during plant activities.

Many power plants are not gaining full benefit from the operational experience feedback (OEF) programme. Systematic programme and procedures for analysis of low-level events and near misses are not accommodated to capture properly human factor related issues. At some power plants the poor material conditions are a result of an inadequate reporting system that does not require plant defects to be formally reported.

It was discovered in OSART missions that at some nuclear power plants fire prevention and protection standards are not rigorously applied and enforced to prevent the origin and spread of a fire.

The common issue is the management of temporary modifications. Temporary modifications to plant equipment are not adequately evaluated, approved, installed and controlled. The quality of some temporary modifications is not always consistent with the good international practices.

Although the majority of nuclear power plants have Foreign Material Exclusion (FME) programs or some elements of such programs, these programs are not always rigorously applied for permanent FME areas.

All mentioned issues are consequences of the safety standards violations. Hence permanent need for strong respect and emphasis on safety standards is necessary.

The key observations in different operational areas that may characterize the status of operational safety in nuclear industry are presented in the following sections.

## 1. Management, organization and administration

Corporate visions are usually clearly stated and sufficient resources for safe operation are provided. Also nuclear safety and industrial safety policy on corporate level used to be developed adequately. Safe and reliable operation is declared everywhere as a corporate goal, however the gap between expectation of management and employees performance is still visible at some of NPPs.

Safety culture becomes a practical phenomenon in some NPPs (e.g. Angra), and several safety-culture-self-assessment surveys were performed, however some NPPs have not made steps toward to safety culture enhancement, yet. Therefore the OSART teams several times recommended developing long-term safety culture programs with periodic evaluation of the plant safety culture level.

Positive findings at NPPs, where the safety culture is well understood is that plant staff has not been allowed to become complacent. Safety culture, teamwork and plant ownership belong to prioritizing concepts. Some NPPs conduct "The days of quality" as a part of periodical self-assessment of QA activities. Programs are in place to strive to meet or exceed international nuclear industry performance goals and standards. They include membership in international organizations, studying of industry experience from elsewhere and conduct necessary training. Nevertheless the goals of some NPPs are not challenging enough when the goals and targets are based on averages. Management expectations are not always communicated to the staff.

Good tools for management in some of NPPs (e.g. Nogent, Krsko) are "Medium-term Business plans" (for three or five years, but updated each year), which cover all areas of the operating organization. The management objectives and goals, including set of indicators, are usually given to departments via "Manager Contracts".

The aging management programme is developed in some NPPs (e.g. Krsko) and management is taking steps to manage the issue by hiring and training new, younger employees, and providing more detailed procedure guidance to the less experienced personnel. Nevertheless the "aging crew" issue is not being resolved in some of older NPPs, yet.

EdF established the process of staff rotation and implemented it at it's own plants. This allows a significant degree of training and interaction to be obtained prior to the candidate taking the plant position.

In some NPPs a relatively complicated organization was found, which lead to overloading of some managers (e.g. DG with high number of people reporting to him).

The partnership between similar NPPs for mutual transfer of knowledge and feedback was found as a good performance. Some NPPs have established strong programme of international assessments and support missions (INPO, WANO, OSART) as a tool of permanent effort to improvement.

The OSART missions noted that in some NPPs with more units prepared just one unit for the mission (e.g. level of housekeeping), but rest of units remains outstanding. It was also indicated by some staff that some improvements were only as a result of the "OSART effect". The field people do not expect to see managers in the field in some of NPPs.

Some difficulties were observed within the QA departments of new NPPs. Not enough number of experienced specialists, limited involvement of managers in QA and the weaknesses identified in different areas.

QA audits and reports were not always effective enough in providing management an accurate and in depth assessment of the plants.

Contacts and communications between NPPs and regulatory bodies were found generally effective.

The international industry practices were recommended by OSART teams to provide an effective barrier to a potential decline in plant performance. There is still space for improvement in the industrial safety area in most of NPPs. Violations of industrial safety requirements by employees or contractors were observed practically in all NPPs.

The OSART teams noted 16 good practices in the Corporate or plant organization and management (1.1, 1.2) and industrial safety areas (1.5).

**2. Training and qualification**

Regardless of differences in approach to training and qualification, practically all NPPs understand importance of this area. The lack of systematic approach to training (SAT) is an exception among NPPs, but it still exists. Therefore the OSART teams pointed out the necessity to realize all steps to the retention and enhancement of plant skills and competences.

There are also corporate human resources and training policies in companies with more units and sites, and training is subject to internal company audits and audits from regulatory body. Appropriate attention is paid to the training of licensed personnel. Training of non-licensed personnel is not always without deficiencies (effective means missing, low attention of management to attendance of examinations, etc.). OSART teams noted not full attendance of trainings.

Except one, rest of NPPs has either their own full scope simulator, or possibilities to use simulator of an identical plant.

Some NPPs have computer systems for visualization of plant transients and emergencies. Such tool allows for online demonstration of plant scenarios with flow of parameters that are usually not visible for operators.

Job-specific training is generally provided by line organization just under supervision on the training centres (such as tutoring, shadow training, cross-functional training, coaching and individual project development), however the experts are not always instructed how to conduct the training and asses the trainees. There is an approach in some NPPs, according to which the line manager is responsible for training of his/her own employee (fully, or partially e.g. training in fire safety, or/and emergency planning is performed by a different section) or is involved at least into definitions of training needs — with support of Training centre.

Some NPPs have well equipped Maintenance Training Centre with mockups of reactor, steam generator, reactor cooling pump, all types of valves (e.g. to train packing), control rod drives, rotating machines. This allows effective preparation of most maintenance activities, however in some NPPs such equipment is missing. Maintenance organization in older NPPs is facing loss of skilled personnel due to retirement.

The OSART teams noted 14 good practices in the Training and qualification area (2.1, 2.2, 2.3, 2.5 and 2.6).

**3. Operations**

Operation of a nuclear power plant is clearly considered by all managers of visited plants as the core activity and hence operators are generally well qualified and well trained. Most of NPPs' line management is involved in the training of the shift crews, Operation Superintendent is an evaluator and Production Manager attends at least post-training briefings to reinforce the feedback to the shifts. However the field operators stated at some plants, that they seldom see managers of operations department in the field. The managers have not always established even the plant-walk-downs-programme.

Not all NPPs' operational documentation (e.g. Technical Specifications = Limits and Conditions of Safe Operation) is translated into the language of operator's staff. There were reported events related to unclear instructions and therefore operators' mother language is recommended for documentation.

Operating history shows that even the plants with long commercial operation can continuously improve the performance (e.g. Santa Maria de Garona after 31 years of operation).

Human performance training includes several significant industrial accidents (sometimes even space shuttle, ferry), however more timely and/or in-depth review was recommended by OSART. The OSART noted that the low-level and near miss events are frequently not reported. The OSART pointed out that the low-level events and near miss history is an important part of event analysis.

Some of NPPs have comprehensive computerized shutdown and on-line risk assessment programme (using combination of deterministic and probabilistic risk assessment techniques) as a predictive support for shift engineers.

The OSART noted that several MCRs have annunciators in the "dark board concept" to minimize the number of lit annunciators, however not all NPPs adopted such industry practice, yet.

Effective labelling system is used in some of NPPs. Nevertheless different kinds of deficiencies were found practically at all NPPs.

There were not always regular reviews of operation documentation in accordance with requirements (2 years for safety related documents, 5 years for non safety related documents).

Some NPPs (e.g. Krsko, Dukovany) use an integrated computer generated tagging system for both work authorization clearances and system line-ups. Such system is capable to perform a conflict check and assist in recognizing of potential problems that could occur with an isolation point.

Different kinds of fire-brigades combinations are used: professional site fire brigade either standalone or in combination with public fire brigades or/and with shift staff assigned and trained as the fire fighters with support of off-site fire brigade. The fire fighting plans in some NPPs give information to MCR operators what response for each area is necessary and what equipment is likely to be involved in a fire.

All NPPs have symptom based Emergency Operating Procedures (EOP) either fully, or on some level of development, however they have not always the plant-specific Accident Management procedures. Not all NPPs have a Technical Support Centre with available information on a Plant Information System.

The OSART teams noted 14 good practices in the Operations area (3.1, 3.2, 3.5).

## 4. Maintenance

Organization of maintenance activities is similar in all of visited NPPs: mechanical (sometimes divided into primary and secondary parts), electrical, I&C and civil structures. Only a few NPPs have a predictive maintenance group. The performance indicators are not always used in maintenance plans and schedules.

All NPPs have cold and hot workshops and many (not all) NPPs have mockups of main equipment (SG, loop, RCP) and several items of equipment dedicated for use in training. Tools and equipment are usually well maintained, consumable supplies are adequate and available if needed, however electrical hand tools are frequently not labelled as equipment under special control (e.g. no evidence of calibration, etc.).

There remains a tolerance for material deficiencies in some plants. Maintenance practices integrate some important safety principles such as the STAR ('Stop-Think-Act-Review') principle and a systematic hazard assessment technique that are implemented by some plants for any operational activity. Almost all plants have effective programme for preventive and several for predictive maintenance. The predictive maintenance programme includes a vibration-monitoring programme for pumps, turbines, generators and diesel generators and lubricating oil analysis, acoustic emission and thermography.

Erosion–corrosion programme are implemented in frame of ISI by most of NPPs for secondary side and some times for primary side. Also several programs for lifetime management have been established in different departments of NPPs. However degradation processes are not always comprehensively identified. The list of components susceptible to ageing degradation that could affect plant safety is established as part of Ageing Management Programs.

Maintenance departments frequently, but not always, use all industrial experiences from elsewhere and root causes evaluation is used to improve maintenance.

Repeated finding of inadequate isolation of stainless from carbon steel is a 'never-ending story' in many NPPs. Also control system of scaffolding is often underestimated.

Work planning is based on the maintenance types. If preventive and predictive maintenance is used, less corrective works are necessary. Post maintenance tests and surveillance programs are usually part of work planning. The OSART teams noted tendency to minimize number of temporary repairs.

Outage management is being significantly improved by effective organizations. In some cases, well-adapted Technical specifications (Limits and conditions) for particular status of the plant were observed. Some NPPs use PSA calculations through the outages with possibility to recalculate ΔCDF if needed. Such approach leads to enhancing the operational safety, while reducing the shutdown duration.

The OSART teams noted 13 good practices in the Maintenance area (4.1, 4.2, 4.3, 4.4, 4.5, 4.8, 4.9).

## 5. Technical support

Technical support activities in all NPPs are usually concentrated into engineering departments responsible for design modifications, safety analysis, documentation and configuration control, reactor engineering, licensing and emergency preparedness. Maintenance or operational departments with limited supervision of engineering group frequently assure (coordination, scheduling, revision) surveillance programs.

Surveillance programs are at present generally comprehensive at all NPPs and regulatory bodies are interested in the results of it. In well-operated NPPs the trending of the results is routinely performed as well as the use of surveillance indicators for early identification of deterioration of the component behaviour.

Operational experience feedback includes in-house and mostly also external operating events. Some NPPs have already OEF programme also for low-level events and near misses, all type of deviations, failures, malfunctions and deficiencies. Such approach is important for improvement of safety and work efficiency, and results are visible even if the whole programme is not fully implemented. For significant events usually root cause analysis is provided including graphics. Trending of low level and near misses events shows inadequate work practices, not following procedures, inattention to detail and component ageing. Analysis of such trends helps to identify precursors of declining performance and prompt implementation of corrective actions. Performance indicators (IAEA, WANO) are usually (but still not always) used and corrective actions are implemented in case of inappropriate value or trend (e.g. Unplanned Capability Loss Factor, Fuel reliability, Primary System Leakage, Number of planned and unplanned Containment entries, Unplanned Area Contamination, Safety Systems Actuation demands, Corrective to Preventive and Predictive Work Order Ratio, Industrial Safety Accident Rate, Number of Corrective Overdue actions, Ratio between number of reworks and all work orders). However there are still deficiencies in OEF in some of NPPs.

Plant modification system for design modification control is established in most of NPPs with understanding of responsibility for the modification process. There are usually defined roles and responsibilities, guidance describing steps to be taken (from request, prioritization, safety screening, preparation of design package, review, preparation of installation package, evaluation of impact, testing/commissioning requirements, documentation revision and modification hand over), criteria for safety evaluation, documentation review and approval in well managed NPPs. Assignment of one responsible engineer and clear ownership from conception to hand over of the modification was noted as an effective method. The fulfilment of the programme requirements and associated set of procedures ensures the configuration control of the plant. Correction of technical documentation is treated as an activity important for design configuration control and is ranked high in priority in the request prioritization system. There was found significant number of temporary modifications in some of NPPs.

Both Reactor engineering and Fuel handling belong to areas in which no deficiencies were found except:

- Missing fuel integrity monitoring system at NPP in process of commissioning where the system was in beginning of implementation;
- Foreign material exclusion control and using of transparent foils for protection of equipment.

Computer applications important to safety are usually well developed, but validation of them does not always exist. There is standard practice that the computer applications dedicated for essential functions are classified with relation to safety and their importance to the NPP. Such classification provides bases for the quality standards for operation, maintenance and modification of computer applications. The QA programmes include organization and responsibilities, computer's documentation, recovery procedures, back-up routines, modification procedures, security requirements. At some NPPs comprehensive and powerful surveillance applications are used (e.g. Civaux) for control of the essential systems and parameters. Most of NPPs use their own full scope simulators for testing of procedures modifications.

The OSART teams noted 13 good practices in the Technical support area (in 5.1, 5.2, 5.3, 5.4, 5.5, 5.7).

**6. Radiation protection**

Many plants have a satisfactory radiation protection situation, some of them even very good, with an effective ALARA programme, hence low collective dose below the ICRP-60 recommendation (around 1Sv/Unit.year for the best plants). However other plants have relatively high collective dose and an excessive number of workers receiving unnecessary radiation doses, and also, not all NPPs have fully implemented ALARA programme, yet. One NPP had no own analysis of tritium, the samples were sent for analysis to another NPP. OSART noted some deficiencies in radioactive waste management and discharge (missing programmes, lack of storage spaces). Different violations of correct behaviour in RCA were noted in some NPPs (smoking, shaking hands, improper process when cleaning, contaminated equipment and tools not covered). Nevertheless overall level of radiation protection at visited NPPs was good, number of issues is not high and is comparable with number of good practices.

The OSART teams noted 9 good practices in the Radiation protection area (in 6.1, 6.2, 6.4, 6.5, 6.7).

**7. Chemistry**

Working practices and chemistry performance are generally satisfactory; role of chemistry departments is well understood. Besides the necessity to replace obsolete equipment in some of older NPPs the OSART noted remarkable deficiencies in corrosion monitoring programme or improper accuracy of boron concentration analysis in some NPPs. The others were just smaller deficiencies e.g. in quality control of chemicals. Not all NPPs have continuous measurement of chemistry parameters for reactor coolant and secondary condensate/feed water, yet.

The OSART teams noted 13 good practices in the Chemistry area (in 7.1, 7.2, 7.3, 7.4, 7.5, 7.6).

**8. Emergency planning and preparedness**

The emergency response organization on and off the site is generally adequately addressed in visited countries with a well-developed nuclear programme. Organization is very similar in all NPPs. Emergency plans differ by dimension of the urgent protective zones, but contents are similar.

Emergency procedures calculate with assessment of radioactive source for possible release mainly based on plant data: core temperature, containment dose monitoring, and other radiological sampling data if available. (Not all plants are equipped with post-accident sampling systems). Specific assessment tools for calculation of radiological consequences in the metrological environment are developed in all NPPs.

The emergency plans of NPPs use different emergency response facilities in addition to main control room: e.g. Technical support centre, Operational support centre, Emergency response facilities and Plant medical centre and periodic exercises (1 to 3 times per year) are performed. The emergency procedures are usually well prepared however OSART noted deficiencies in implementation of procedures and in communication with offsite organizations and authorities in some of NPPs in spite of repeated exercises.

The OSART teams noted 19 good practices in the Emergency planning and preparedness area (in 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7).

**9. Safety culture**

The safety culture was generally not reviewed independently as an OSART specific area. Within period 2001–2003 there was just one mission (NPP Krsko), with an independent safety culture review. In that plant the OSART noted strong safety culture driven from top with conscious effort to inculcate the safety thinking among employees from very start, the sharing of vision, long partnership with contractors and open and good relationship with local community. However safety culture becomes a practical phenomenon in some NPPs (e.g. Angra), and safety-culture-self-assessment surveys were performed at several NPPs. Positive finding at NPPs, where the safety culture is well understood, that plant staff has not been allowed to become complacent and safety culture, teamwork and plant ownership belong to prioritizing concepts. Nevertheless some NPPs did not make steps toward safety culture enhancement, yet. Therefore the OSART teams several times recommended developing long-term safety culture programmes with periodic evaluation of the plant safety culture level.

# PART II
# OVERVIEW OF OSART (ALSO PRE-OSART AND EXPERT) MISSIONS AND FOLLOW-UP VISITS DURING 2001 TO 2003

## INTRODUCTION

The second part of this TECDOC presents a summary of each OSART (Pre-OSART and EXPERT) mission (in Part II-A) and of each follow-up visit (in Part II-B).

The summary is extracted from the OSART mission report; it is generally the introduction written by the mission team leader and incorporates comments on the follow-up visit. Follow-up visits are now a complete part of the OSART process. It is very gratifying to note that in the period 1995–1996, for 98% and in period 2001 to 2003 also 98% of recommendations and suggestions, corrective actions have, been taken and corresponding issues are either resolved or in satisfactory progress. This reflects a commitment by the nuclear industry to self-improvement.

## PART II-A
## OVERVIEW OF OSART MISSIONS

### TEMELÍN (Czech Republic)

**Scope of the mission**
A full scope OSART mission with the purpose to review also the actions taken on the recommendations for improvements indicated during the IAEA Operational Preparedness and Plant Commissioning Review Mission, February 2000. The team reviewed also the status of the selected recommendations contained in the document IAEA-EBP-WWER-05, Safety Issues and their Ranking for WWER-1000 Model 320 Nuclear Power Plants (NPPs) which were reviewed during the above IAEA Operational Preparedness and Plant Commissioning Review Mission, February 2000.

The team was composed of experts from France, Germany, Hungary, Romania, Russia, the United Kingdom and the United States of America, together with the IAEA staff members and observers from Austria and France.

**Duration:** 12 February to 01 March 2001

**Brief plant description**
The plant consists of two identical pressurized water reactor (VVER 1000 V 312 type) units each with 1000 MW output. The two units designed by EGP Prague (Nuclear island Atomenergoproekt Moscow) and supplied by SKODA Prague as General supplier. The units were in different status of commissioning. The plant is located 30 km north of Ceske Budejovice and 120 km south of Prague.

**Main conclusion**
The OSART team concluded that the managers of Temelin NPP are committed to improving the operational safety and reliability of their plant. In addition, during discussions and interviews, plant staff consistently quoted safety as the highest priority. The team found several areas of good performance, including the following:

– In general, plant staff was found highly professional and open for discussions and new ideas.
– Plant material condition and housekeeping were generally in accordance with good international practices. The team members who also participated in the IAEA Operational Preparedness and Plant Commissioning Review Mission, February 2000 were impressed with the improvements made by plant management in several of the operational aspects of the plant, notably in housekeeping and material conditions.
– Several of the plant technical processes were noted to be of good quality. This include, the secondary erosion corrosion monitoring system, and the on-line monitoring of electrical components.
– The emergency response programmes are highly developed.
– Safety culture at the plant is evolving. The team identified that several initiatives are in place to stimulate this evolution, and the team encourages plant management to continue the search for ways to further improve safety culture. The team offered a number of proposals for improvements in operational safety that once implemented would assist in this evolution.

The most significant proposals include the following:

- The plant should further develop the safety management overview of the plant through an enhanced self assessment at all plant levels, the effective implementation of the Quality Assurance programme, and a wider and effective use of safety performance indicators. In addition, corporate independent overview of plant safety should be improved.
- The team found most of the programmes and management processes in place, but identified opportunities for improvement in several of them. Examples are plant surveillance and temporary modifications programmes. Continuous assessment and consequent improvement of plant programmes and processes is essential for an effective transition from commissioning to the operational phases of the plant.
- Content and format of some plant procedures were identified in need of improvement; to make them more user friendly, usable in a step by step fashion, and consistently recording important results. Some new procedures are drafted but not yet issued. In addition, document management deserves more attention of plant staff.

Temelin 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.

Overview of the follow-up visit at NPP is in Part II-B.

**LING AO (China)**

**Scope of the mission**
Pre-Operational Safety Review Team (Pre-OSART) purpose was to review operating practices in the areas of Management, Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry and Emergency Planning and Preparedness. The plant is under commissioning and the review was focused on the operational organization, including commissioning activities influencing on the safe operation of Ling Ao NPP.

The team was composed of experts from Slovakia, the United Kingdom, Japan, Sweden, Belgium and the Republic of Korea, together with the IAEA staff members from Brazil, the United States of America, Sweden and observers from Pakistan and Ukraine.

**Duration:** 6 to 23 August, 2001

**Brief plant description**
The plant consists of 2 Framatome 990 MWe units. The plant is located 1 km northeast of Daya Bay NPP with two similar units. During pre-OSART mission both units were in different status of completion with planned synchronization of U1 in 2002. Ling Ao A is in commercial operation from 05/2002 and Ling Ao B from 01/2003.

**Main conclusion**
The Pre-OSART team concluded that the management of LNPS has adopted the safety messages "Safety First, Quality First" as a tool to continuously improve the operational safety, as well as the reliability of the plant. Senior management and staff of LNPS have a clear vision to be among the worlds best performers in 2008. The team found several strengths at LNPS, including the following:

– A large number of experienced staff members have been transferred from the Daya Bay NPP, all licensed operators were previously licensed at Daya Bay and gained operating skill from working at the Daya Bay NPP.
– A multi-reactor management organization gives common support to both LNPS and Daya Bay NPPs.
– The quality of many programmes and processes are excellent. They are comparable to the best international practices. Several, well developed computer applications support the processes.
– The development of performance indicators of different kinds for each branch of the operating organization is encouraged by management and stimulates progress. They are good tools for monitoring the development of the new operating organization.
– Enthusiastic management and staff who are open to learning and with a desire to achieve excellence.

The Pre-OSART team observed several other good initiatives taken by the management and staff of the LNPS. Several of them qualified as good practices in the teams review.

The team offered a number of proposals for improvement in operational safety. The most significant proposals included the following:

– The need for general management (i.e. senior corporate management) to take actions to consistently enforce high operational safety standards for all personnel at the LNPS;
– The need for general management to implement methods to give the plant operators the authority to ensure operational safety during the commissioning process;
– The need for general management to take actions to ensure adherence with company industrial safety standards by all personnel at the LNPS;
– The need to strengthen Quality Assurance programme activities to ensure that commissioning activities are accomplished in a safe and competent manner.

Some of the management initiatives designed to increase manager and supervisor presence in the field have not been fully effective. This appears to be due to the difficulties of managers to communicate to the staff the importance of each and every individual working at the plant, including contractors, to achieve a sense of ownership for the safety and quality of the activity. The team found personnel ready to take this ownership and apply the questioning attitude and attention to detail to identify deficient conditions at the plant and provide suggested improvements in plant operations. It is then up to the management to provide the leadership to enforce it's safety standards and to give priority to resolving concerns as well as needed feedback to individuals.

The LNPS management expressed a determination to address the areas identified for improvement and indicated a willingness to accept a follow-up OSART visit in an agreed upon appropriate time.

SAFETY CULTURE PRELIMINARY REVIEW CONCLUSION

A Safety Culture review has been integrated in the Pre-OSART review of LNPS, which included the following steps:

– A Safety Culture questionnaire was sent to the plant by the IAEA and a response received from the LNPS in May, 2001.
– After evaluation of received information additional information was requested from the plant by the IAEA.
– In June, 2001, an IAEA Safety Culture specialist visited Daya Bay/Ling Ao NPPs to conduct a Safety Culture Seminar; at that time some additional information was received.
– During the Pre-OSART, interviews were performed with LNPS staff from different organizational levels.
– IAEA Safety Culture specialists in Vienna have been informed of interview results and team observations during the mission.
– At the completion of the Pre-OSART mission, the information sent to the IAEA in Vienna was being evaluated.

LNPS has taken several important initiatives toward strengthening their safety culture development work. These efforts have included both the creation of an infrastructure and a programme of activities to support the development of a sound safety culture. They have formed a Safety Culture Development Group, assigned Safety Culture Facilitators for each department and have defined the roles and responsibilities for safety culture from the plant management level to the employees and contractors in a separate procedure (Chapter 8) in their Production Quality Operation Manual (PQOM). However, the team noted that the provisions of the PQOM are not applied to the projects organization.

An action plan for the Safety Culture Development Programme is also included in this separate procedure of the PQOM, and a more detailed schedule of activities is updated on a yearly basis. The action plan covers several activities, e.g. regularly occurring safety culture training for all employees, self-assessments of safety culture, development of safety culture indicators, and a management site patrol system. They base their approach to safety culture largely on the IAEA documents INSAG-4 and the Safety Reports Series No 11 and have as one of their main goals to become a learning organization striving for continuous improvement.

The creation of a strong safety culture rests on the commitment of the general and senior management. It is therefore crucial that the safety culture initiatives taken so far receive the full support and active involvement of the general and senior management team of LNPS. Based on the observations made by the team, the following issues need the attention of the general management:

– Safety Culture should encompass the entire organization. The safety culture infrastructure and programmes have mainly been defined for the operating organization. Observations show signs of a difference in the safety standards that have developed between the operating and the project organization indicating a development of two subcultures of safety culture. It is the role of the general management to assure that a strong safety culture permeates the entire LNPS organization as it is taken into the operation phase.
– The inclusion of a separate procedure on Safety Culture Development in the PQOM is very good. However, despite training given to all employees of the operating organization on the PQOM interviews showed that not all employees were familiar with this procedure. LNPS is encouraged to assure that the document is properly disseminated and understood in the entire organization, address the effectiveness of the training activities and the managers role in promoting a widespread understanding of the safety culture development programme at LNPS.
– The goal of becoming a learning organization rests on an openness to learn from experiences gained. The performance goals of "five zeros" include events caused by human error. Self-reporting of human errors is an essential element in creating a learning culture and a strong safety culture. At the same time the encouragement of openness and self-reporting of errors or mistakes constitutes a special management and leadership challenge. LNPS should therefore guard against the risk of suppressing reporting and/or misreporting human error related events in order to achieve the zero-event goal, which would counteract the development of a learning organization.
– Leaders create cultures. It is therefore essential that a systematic approach to the development of leadership skills is introduced as suggested from the observations made in the training area.

The general and senior corporate management are encouraged to continue with their initiative to develop the safety culture and in their work follow the further development done in this area by IAEA and other organizations.

Overview of the follow-up visit at NPP is in Part II-B.

**PAKS (Hungary)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of Management organization and administration; Training and qualification; Operations; Maintenance; Technical support; Radiation protection; Chemistry; and Emergency planning and preparedness. In addition, an exchange of technical experience and knowledge took place between the experts and their plant counterparts on how the common goal of excellence in operational safety could be further pursued.

The team was composed of experts from the United Kingdom, Switzerland, Sweden, Bulgaria, France, Germany, Slovakia, Finland and the United States of America, together with IAEA staff and observers from Lithuania and Iran.

**Duration:** 8 to 25 October 2001

**Brief plant description**
The Paks nuclear power plant (NPP), in Hungary has four WWER 440 MWe reactors that supply about 40% of the electricity to the country. Units 1–4 went into commercial operation between 1983 and 1987. The plant is located about 80 km south of Budapest.

**Main conclusion**
The OSART team concluded that Paks NPP has several good features that form the basis for future safe operation of the plant, like a well educated, highly motivated, professional and experienced staff.

The senior management of Paks NPP is committed to improving the operational safety and reliability of their plant in a long-term perspective. The team found that Paks NPP has taken several good initiatives to improve, including the following examples:

- Recent upgrading of plant standards in material condition and housekeeping throughout the whole plant. The standards of cleanliness, painting and labelling have been improved.
- A “Pool of talents” programme that has been designed and put into operation to ensure continuity in succession management and to ensure nuclear safety through timely actions by developing future managerial and technical potential from its workforce.
- An extensive technical safety upgrade programme has been implemented and several of the projects in this programme have already been completed. The effects of these upgrade programmes have not only technical aspects, but also motivate the staff by the long-term perspective of a secure work place.

However, although Paks NPP has showed good signs of operational safety improvements, the team observed that implementation of some recent initiatives have fallen short of success. These initiatives should be promptly corrected if all the staff will take management’s expectations for continuous improvement seriously. Communication of management’s expectations for continuous improvement must come from the highest level in the organization and the workers at Paks NPP must share in the same commitment.

Management has not effectively utilized some management tools, like self-assessment and management tours to assess the progress of their initiatives, resulting in an inconsistent approach among the different departments and only partly covering the organization or parts of the plant.

During the review, the team identified programmes and processes that could benefit from further improvements. Although Paks NPP has done much to improve the cleanliness and material condition of the plant, the team found areas where further improvements are needed such as; industrial safety, standards of electrical installations, labelling, radiation protection practices and closing maintenance work sites.

The OSART team observed that several other good initiatives to improve operational safety were taken during the last year. The timely preparation for the OSART has engaged management and staff to improve in several areas. The team raised a concern, however, that these activities may not continue when the prospective of the visit is no longer a feature. Although the team believes that there is a firm commitment by management for continuous improvements, the entire staff, especially at all the lower levels in the organization may not share that belief. The team suggested that the plant consider extending the content of the OSART preparation project into the established normal line organization and management processes.

Some other good initiatives taken by management (like near miss reporting), have not yet shown results in the field and some of these were not fully understood by the staff. Closing the communication gap between staff and management, by finding more effective communication means, should hasten the achievement of targets for these initiatives.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13 and IAEA Safety Reports Series No. 11 to assess various organizational and technological aspects of operational safety culture at the Paks NPP.

The team recognized that the management and staff felt the good pride of their nuclear power plant and was impressed with the staffs' professionalism and their desire to improve. Senior management should continue to encourage and reward the staff's behaviour in this area.

The team identified programmes and processes that could benefit from the improvements mentioned above, however, observed that senior management's expectations are not fully communicated or well understood at all levels in the organization. The team also observed that questioning attitudes and standards of behaviour are not consistent at all levels in the organization.

Paks NPP management expressed a determination to address the areas identified for improvement and indicated a willingness to accept a follow-up visit within twenty-four months.

**DUKOVANY (Czech Republic)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of Management Organization and Administration, Training and Qualification, Operations, Maintenance, Technical Support, Radiation Protection, Chemistry and Emergency Planning and Preparedness.

The team was composed of experts from Brazil, Canada, France, Slovakia, Sweden and the United Kingdom, together with IAEA staff members and observers from France and the Ukraine.

**Duration:** 5 to 22 November 2001

**Brief plant description**
The plant consists of four identical units WWER 440 MWe (V-213) in operation from 1985-1987. The plant is located in southern part of South-Moravian region 40 km west of Brno.

**Main conclusion**
The OSART team concluded that the managers and workers of Dukovany NPP are enthusiastic in their commitment to a strong programme for operational safety and reliability at their plant. The team found good areas of performance, including the following:

– In general, the management and plant staff are highly professional, dedicated and well experienced. They were open to discussion and new ideas about ways to improve performance.
– The housekeeping, cleanliness and plant material condition were very good. Clearly, the plant has been diligent in maintaining structures and equipment at the facility.
– The knowledge and professionalism of the staff bear witness to the high quality of the training programmes and the excellent state of the training facilities.
– The plant programmes and processes, which provide computerized information and documentation, were noted to be of high quality.

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

– Although the plant has a programme for reporting near miss events, some plant personnel do not have a good understanding of this programme.
– Some deficiencies exist in emergency planning and preparedness.
– There are also deficiencies in the area of fire protection that the plant should address.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13 and IAEA Safety Reports Series No. 11 to assess various organizational and technological aspects of operational safety culture at the Dukovany NPP. The team members were very impressed with the number of positive safety culture aspects observed in Dukovany NPP, mainly with:

– Open minded and enthusiastic staff with good emphasis in human performance;
– Obvious signs of ownership, that resulted in very good housekeeping in most of the plant areas;

– Processing, handling and control of plant standards, procedures and working documents;
– Good co-operation between plant staff and contractors.

The team also identified several areas where management and staff of the plant are encouraged to enhance the performance. Although the plant staff is not generally complacent, there were a few early signs that complacency could come in the future as good performance continues. The relatively large number of accepted fire protection deficiencies should be also improved. Management's presence in the field, with an objective for improving these deficiencies is a good way to set an example for the staff in this area.

The Dukovany NPP 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.

Overview of the follow-up visit at NPP is in Part II-B.

**TRICASTIN (France)**

**Scope of the mission**
The OSART purpose was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry; and Emergency Planning and Preparedness.

The team was composed of experts from Canada, the Czech Republic, Germany, Mexico, Spain, Sweden, the United Kingdom, the United States of America, and France the host plant peer, together with the IAEA staff members and observers from China, Pakistan and the IAEA.

**Duration:** 14 to 31 January 2002

**Brief plant description**
The plant consists from four 3-loops units PWR 900 MWe. Primary circuit manufactured by Framatome, turbines by Alsthom. First connection to grid: U1 – 05/1980, U2 – 08/1980, U3 – 02/1981, U4 – 06/1981. The plant uses MOX fuel from 1996. The plant is located in Rhone valley, mid-way between LYON and Marseille.

**Main conclusion**
The OSART team concluded that the managers of Tricastin NPP are committed to improving the operational safety and reliability of their plant. This commitment was clear when observing the improvements in plant conditions, work being performed and discussions with plant staff. The team found good areas of performance, including the following:

– The professionalism of the staff which is enhanced by a strong training programme;
– The management initiatives and tools to achieve rapid and broad improvements in a number of areas has significantly improved over the last few years;
– Strong leadership and control of safety related activities coupled with a sense of management planning is communicated professionally and consistently by the management team and now showing positive results in key areas;
– The material condition of Units 1 and 2 and the housekeeping have dramatically improved, with thorough plans to improve unit 3 and 4 at least to the same standards.

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

– Despite the improvements at the plant in the last two years, there continues to be problems associated with adherence to policies, procedures and instructions. Although workers are trained to know what is required of them, individuals sometimes feel free to determine for themselves when rules should be followed. Some managers do not always intervene to correct such performance.
– The foreign material exclusion practices at the plant are weak.
– EDF has not developed a clear corporate policy that prohibits the consumption of alcohol prior to work or during the workday in accordance with good international practice and IAEA safety guidance.

The Tricastin plant is going through a period of widespread transition. Three years ago the performance indicators for the plant showed weaknesses in many areas. Today the indicators show much better performance. In other cases it is too soon to see improvement. Because of this transition period, the team provided recommendations in some areas where the plant has already embarked on aggressive improvement activities. The team encourage the plant to maintain a long term and tenacious attitude as it pursues improvements and also periodically assess the success and make necessary corrections.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13 and IAEA Safety Reports Series No. 11 to assess various organizational and technological aspects of operational safety culture at the Tricastin NPP. The team concluded the following:

- The staff members are not always the drivers of change, the expectation is often that the change is always from the top down. Common feeling is not yet that some change comes from the bottom up, although management aims at involving people through Total Quality Management.
- Some standards are not clearly set and not adopted by some staff and managers. Cultural issues may hinder future development in this area and needs to be accounted for.
- There appears to be an insular environment with little knowledge of industry best practice outside of EDF.
- In some areas there appears to be a culture of compliance rather than a culture of striving for excellence.

On the other hand, the team recognized the good pride of their nuclear power plant that the management and staff felt and was impressed with the staffs professionalism and their desire to improve. Senior management should continue to encourage and reward the staff's behaviour in this area.

Overview of the follow-up visit at NPP is in Part II-B.

**SANTA MARIA DE GAROÑA (Spain)**

**Scope of the mission**
The OSART purpose was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance, Technical Support, Radiation Protection; Chemistry; and Emergency Planning and Preparedness.

The team was composed of experts from Brazil, Canada, France, Germany, Romania, Sweden, and Switzerland, together with IAEA staff members and an observer from France.

**Duration:** 18 February to 7 March, 2002

**Brief plant description**
The Santa Maria de Garoña NPP is single unit of BWR-3 reactor designed and constructed by General Electric. The plant is located within the province of Burgos (north of Spain), close to the townships of Garoña and Santa Maria de Garoña, Tobalina Valley on the Ebro river.

**Main conclusion**
The Santa María de Garoña NPP started operation in 1971. Despite being in operation for over thirty years the plant is in excellent condition. The OSART team concluded that the managers and workers of Santa María de Garoña NPP are enthusiastic in their commitment to a strong programme for operational safety and reliability at their plant. The team found good areas of performance, including the following:

- The housekeeping and material condition of the plant are very good.
- The responsibility for safe operation and the feeling of ownership demonstrated by managers and workers are high.
- The plant has developed and uses an extensive set of good equipment mock-ups.
- The chemistry programme and practices are strong.

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

- Because the average age of the workforce is high, succession planning will be an issue in the coming years. Additional effort should be taken to ensure that the processes and practices used by the present staff are preserved for future workers and managers.
- There are some weaknesses in the plant’s processes for fighting fires.

An important element of the OSART Review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13 and IAEA Safety Reports Series N0 11 “Developing Safety Culture in Nuclear Activities”, to assess various organizational and technological aspects of operational safety culture at Santa María de Garoña NPP. The team was impressed with a good number of positive safety culture aspects, mainly with:

- The material condition of the plant and its cleanness;
- The ageing control management program;

- Ownership, accountability and team-work; all with great pride, were commonly observed throughout the organization;
- Very good communication and interaction with the regulator.

The team also identified some areas where management and staff is encouraged to enhance their performance:

- Some important plant processes need a more formal approach. This includes some procedures and other written guidance.
- At times managers and supervisors do not correct workers regarding industrial safety rules.
- The time spent in the full scope simulator and the comprehensiveness of the requalification training programme could be enhanced.

The Santa María de Garoña NPP 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.

Overview of the follow-up visit at NPP is in Part II-B.

**ANGRA 2 (Brazil)**

**Scope of the mission**
The OSART purpose was to review operating practices in the areas of Management organization and administration; Training and qualification; Operations; Maintenance; Technical support; Radiation protection; Chemistry; and Emergency planning and preparedness.

The team was composed of experts from France, Germany, Bulgaria, Canada, United States of America, Sweden, United Kingdom, Hungary, Slovak Republic and a Host Plant Peer from Angra 2, together with the IAEA staff members and observers from Argentina and Mexico.

**Duration:** 12–31 October 2002

**Brief plant description**
The plant Angra 2 is 4-loops PWR 1350 MWe designed by Siemens-KWU and constructed by Brazilian companies under supervision of Siemens-KWU. The begin of commercial operation 02/2001. The plant is located on the coast of Atlantic Ocean in province Angra about 200 km south of Rio de Janeiro.

**Main conclusion**
The OSART team concluded that the management of Eletronuclear has adopted the safety message “To Strive for Nuclear Excellence” as a tool to continuously improve the operational safety as well as the reliability of the plant. Managers at Angra 2 were found to be committed to improve the operational safety of their plant. The team found several good areas of performance, including the following:

– The cleanliness inside the plant impressed the team;
– The competent and knowledgeable staff;
– The openness to external evaluations and invitations for international assessment and support;
– The good overall performance during the initial period of operation.

The team offered a number of proposals for improvements in operational safety. The most significant proposals includes the following:

– Although the overall staff size is adequate, Eletronuclear and the plant, in close cooperation, should develop and implement a comprehensive staffing program, including anticipation of staff changes and future needs in personnel.
– The need of strengthening the link between the training organization and line management to avoid missed training opportunities and to ensure adequate and effective training. Furthermore both organizations should enhance their ownership for a common training process covering all steps from specification of needs to follow-up of achieved improvements of skills and knowledge.
– The need of further enhancement in development and implementation of practices in the areas of operation, maintenance and technical support; such as conduct of operator rounds, completion of the work control system and trending and monitoring of performance parameters.

- The need to simplify the procedure review process and make the plant documentation translation process more productive to provide adequate instructions for operators in a timely manner.
- Angra 2 is a new plant with most processes in place, nevertheless there is a need to use more of the managerial and supervisory resources, at all levels, to drive the quality and completion of implemented programs and processes in a reasonable time frame.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13 and IAEA Safety Reports Series No. 11 to assess various organizational and technological aspects of operational safety culture at the Angra 2 nuclear power plant. The team members were very impressed with a number of positive safety culture aspects observed in Angra 2 plant, including:

- The plant staff is proud of the plant and feels a great deal of ownership of the plant.
- The general housekeeping is impressive.
- The plant has instituted a enhancement programme in the area of safety culture.
- The plant has a self-evaluation process in progress.

The team also identified several areas where management and staff are encouraged to enhance performance:

- The plant should enhance its questioning attitude and be less tolerant of the deficiencies they identify.
- Although it is not the general situation today, there are some signs of self-satisfaction and too much trust in the design.

The Angra 2 NPP 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.

**NOGENT (France)**

**Scope of the mission**
The OSART purpose was to review operating practices in the areas of Management Organization and Administration, Training and Qualification, Operations, Maintenance, Technical Support, Radiation Protection, Chemistry and Emergency Planning and Preparedness.

The team was composed of experts from Brazil, Germany, Japan, Slovakia, Slovenia, Spain, Sweden and the United Kingdom, together with IAEA staff members and observers from China and Iran.

**Duration:** 20 January to 6 February 2003

**Brief plant description**
The plant consists from two units of standard 1300 MWe PWR (Nuclear island supplied by Framatome, turbines Alshom). First connection to the grid was in 1987 (U1) and 1988 (U2). The plant is located near city Nogant-sur-Seine.

**Main conclusion**
The OSART team concluded that the managers and workers of Nogent-sur-Seine NPP have initiated many new programs to enhance operational safety and reliability at their plant. In concept, these programs appear beneficial but they will require continued effort before they are fully effective at the plant. In particular, the new matrix management system will promote managers and workers to hold a broader view of activities performed at the plant.

The team found good areas of performance, including the following:

- The management and plant staff are professional, dedicated and energetic. They are open to discussion and new ways to improve performance.
- The plant has developed a simple deterministic method of risk analysis that is widely used throughout the plant.
- The plant has the benefit of strong technical support at the corporate level.

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

- Following recent outages on both units, material condition and cleanliness have improved. However, housekeeping and material condition in both units are below IAEA standards.
- The team observed many places where materials and waste are temporarily stored inside and outside the radiological area. This material increases the fire loading. And unnecessary material introduced into the radiological area contributes to the amount of radioactive waste.
- The plant should take advantage of opportunities to enhance the self-assessment programme by increasing the amount of monitoring done in the field. Managers, operators and other workers should do more self-critical monitoring of actual plant conditions.

SAFETY CULTURE REVIEW CONCLUSION

An important element of the OSART review is the identification of those findings that exhibit positive and negative aspect of safety culture. The OSART team used the guidance provided in INSAG-4, INSAG-13, INSAG-15, IAEA Safety Reports Series No. 11, IAEA-TECDOC-1321 and 1329 and draft SCART Guideline to assess various aspects of safety culture at the Nogent-sur-Seine nuclear power plant. A safety culture review was integrated in the OSART review of Nogent-sur-Seine NPP, which included the following steps:

– Safety culture training for mission experts, based on IAEA safety standards.
– Safety culture observations were part of daily review reported during team meetings.
– During the OSART, 57 interviews on safety culture were performed with Nogent staff from different organizational levels.
– A questionnaire was filled out by all team members.
– The safety culture programme evaluation was part of Management, Organization and Administration review.
– The IAEA assistant team leader was responsible for co-ordination and evaluation of observations and interviews.

**Interviews evaluation**

Interviews were conducted with various levels of workers, including senior managers, middle managers, line managers, control room staff, technicians and field workers.

All interviewed consider safety a high priority which is most visible in; the risk assessment activities, safety assessments and safety decision making, safety policies, organizational aspects of the plant and various safety committees, behaviour and attitude of workers and their adherence to procedures, and training and qualification of staff. These were the responses of 90% of interviewed workers.

As to the question, “what are the major strengths of Nogent-sur-Seine plant”, the following answers were given: Management policies, including the corporate EDF level, safety committees and safety meetings, training of staff, skill development and integration of the younger generation, risk assessment and safety analysis, safety culture and attitude of workers, management supervision and control, role of the shifts and shift managers, adherence to procedures and use of operational experience feedback. These were also the responses of 90% of interviewed workers. Nearly all workers felt personal responsibility for safety.

The team members were very impressed with a number of positive safety culture aspects observed in Nogent-sur-Seine plant mainly with:

– everybody feels that safety is first priority,
– good team work,
– risk analyses is done prior to work.

The team also identified several areas where management and staff of the plant are encouraged to enhance safety culture:

– Development of a greater understanding of corporate instructions;
– Consideration of near misses and low-level events as potential precursors;
– Enhancing ownership of the plant and plant processes.

During the review, the team observed that while safety culture requirements are incorporated in several guidelines; a systematic programme for safety culture evaluation and enhancement needs to be developed. In general, senior managers are encouraged to continue with the initiative to develop safety culture in accordance with developments identified in this area by IAEA and other organizations.

In conclusion, there is a commitment to nuclear safety at Nogent as well as a willingness to make improvements. The implementation of the OSART recommendations and suggestions will contribute to management's intention to improve safe operation of the plant.

**CIVAUX (France)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry; and Emergency Planning and Preparedness. This OSART mission also included an enhanced review of Operating Experience Feedback, which is documented in the area of Technical Support.

The team was composed of experts from the United States of America, Germany, Finland, Canada, Sweden, United Kingdom and Belgium together with the IAEA staff members and observers from Brazil and IAEA.

**Duration:** 12–28 May 2003

**Brief plant description**
The Civaux power plant is composed of two 1450 MW generation units (N4 series) on Vienne river 2 km from the village Civaux and 35 km south-east of Poitiers in the Vienne department. First synchronization was of U1 in 1997 and U2 in 1999.

**Main conclusion**
The OSART team concluded that the managers of Civaux NPP are committed to improving the operational safety and reliability of their plant. The team identified a number of commendable features at Civaux NPP, including the following:

- A well motivated staff who work together as a team with shared responsibility;
- A culture of openness and honesty in identifying potential areas for improvement;
- Good support for the operations department in their central role;
- Management willingness to involve all levels of the staff in programs for improvements is evident in most of the areas.

Civaux NPP is a new plant and the present material condition of the plant is good. However, the team observed early signs of decline in housekeeping and material condition. The plant is encouraged to further it's efforts to maintain housekeeping and material condition.

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

- Enhance the attention to detail and adherence to rules in several areas of human performance, e.g. industrial safety and several other areas.
- Civaux NPP should accelerate the implementation of corrective actions.
- Greater attention should be paid to low level and near miss events.

Although not the subject of a specific proposal in the report, the plant should consider benchmarking its performance against the best international plants.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety culture aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13, INSAG-15 and the IAEA Safety Reports Series No 11 to assess various organizational and technological aspects of operational

Safety Culture at Civaux NPP. The team concluded the following positive aspects of safety culture exist:

– The plant has a strong commitment to being open minded to new ideas.
– Good communication has been established between departments.
– Teams are motivated and work effectively with a desire to improve.

The team also recognized the pride of the workers and managers in their nuclear power plant and was impressed with the staff's professionalism. Senior management should continue to encourage and reward the staff's behaviour in this area.

The team also recognized some areas of safety culture where Civaux should seek a higher level of performance. These were:

– Enhance a culture of following rules, as needed in the area of Industrial Safety;
– Managers and supervisors should increase their oversight of field conditions and spend more time in the plant coaching and listening to workers;
– The plant should set uniformly high standards for performance for all departments.

The team recognized that several actions are already in place to address some of the above proposals. The Civaux management expressed a determination to improve in the areas identified by the team and indicated a willingness to accept a follow-up visit in about eighteen months.

Interviews were conducted with various levels of workers, including senior managers, middle managers, line managers, control room staff, technicians and field workers.

Those interviewed consider safety a high priority which is most visible in:

– OTF structure (organization to support operations),
– well integrated Operating Experience from other French plants and technical exchanges,
– training,
– short management hierarchy,
– safety and QA organization.

Nearly all workers felt personal responsibility for safety.

**PAKS (Hungary)**
**Expert mission to the fuel cleaning accident**

**Scope of the mission**
At the request of the Government of Hungary and within the framework of Technical Co-operation (TC) project HUN/9/022, the International Atomic Energy Agency (IAEA) conducted an independent expert mission at the Hungarian Atomic Energy Authority (HAEA) and Paks Nuclear Power Plant (NPP) to assess the results of HAEA's investigation of the 10 April 2003 fuel cleaning incident at the Paks NPP.

The team was composed of nuclear and radiation experts from the IAEA, Austria, Canada, Finland, Czech Republic, the United Kingdom and the United States of America. The team composition consisted of a team leader, co-team leader and eight (8) experts who reviewed the following six areas: (1) Management Systems including QA/QC, (2) Regulatory Oversight/Interface, (3) Root Cause Analysis/Risk Analysis, (4) WWER Fuel Performance Characteristics, Thermo hydraulics and Chemistry (two experts), (5) Radiological Dose Assessment/Radiation Protection (two experts) and (6) Emergency Planning and Preparedness. The co-team leader assisted in reviewing the legislative aspects of the incident and assisted each expert in the evaluation of overall operational safety performance.

**Objectives of the mission**
- To assist the Hungarian authorities with advice on the applicable international safety standards to this particular event and on the Agency's possibilities to provide for the applications of these standards at the request of the Hungarian Government;
- To present to the President of Hungarian Atomic Energy Commission, Mr. Istvan Csillag, an authoritative and factual overview of HAEA's review of the consequences and aftermath of the fuel cleaning incident at the Paks NPP as well as the available information on its originating causes;
- To produce a comprehensive report, with appropriate recommendations, detailing the IAEA's independent and objective analysis of the actions taken by HAEA and Paks NPP prior to, during and after the incident.

The following were areas of emphasis for the review:

- Evaluation of the root cause of the incident including an analysis of Paks NPP and HAEA's root cause analysis;
- Evaluation of the effectiveness, by Paks NPP and HAEA, of the risk analysis performed to conduct the fuel cleaning operation;
- A review of the classification (category 3) criteria for the fuel cleaning activity as compared to IAEA safety standards;
- Evaluation of the assessment and approval process for modifications made to the fuel cleaning equipment and subsequent operations at both the Paks NPP plant level and at HAEA;
- Evaluation of operational safety performance during the fuel cleaning operation and subsequent identification of the problems leading to the incident;
- Adequacy of the procedures being used to conduct the fuel cleaning activity, including prerequisites and precautions;
- Adequacy of clearly defined roles and responsibilities for the conduct and supervision of the fuel cleaning activity;

- HAEA’s effectiveness for licensing the fuel cleaning activity, with emphasis on HAEA’s role for licensing NPP activities falling outside of the licensing basis of the plant;
- Adequacy of the training provided to Paks NPP operation, maintenance and radiation protection personnel on the fuel cleaning operation, precautions and possible indications of problems;
- Evaluation of emergency response capability and criteria for this incident;
- Evaluation of the radiological release and worker dose for this incident;
- Assessment of the adequacy and timeliness of the corrective actions proposed to prevent recurrence of a similar event.

**Duration:** 16 to 25 June 2003

**Brief description of plant**
The Paks nuclear power plant (NPP), in Hungary has four WWER 440 MWe reactors that supply about 40% of the electricity to the country. Units 1–4 went into commercial operation between 1983 and 1987.

**Main conclusions**

**Management of safety:** the team noted that the responsibility for operation of the fuel cleaning system was turned over to the contractor. The plant operations organization was more in the mode of a service provider to the contractor (FANP) than in having responsibility for the safe operation of this system. Neither HAEA nor Paks NPP used conservative decision making in the rigor of safety assessment given to this unproven fuel cleaning system.

The aggressive schedule for design, fabrication, installation, testing and operation of the fuel cleaning system contributed to a sense of urgency that influenced decisions regarding the rigor of nuclear safety assessment and design review. The team also noted that communications between organizational units at Paks NPP are not encouraged except through Department or Division managers. Thus, opportunities to share information among personnel in different organizational units are reduced.

The team concluded that the top management of HAEA and Paks NPP are committed to improving the safety of the plant. Both Director Generals said they would welcome further IAEA assistance as they continue to review and manage this incident and improve safety at the facility. An interview with the Paks NPP Director General has shown that he is a responsible, competent and knowledgeable professional, dedicated to improving the safety of the Paks NPP. He made the right steps to mitigate the incident.

The willingness to consider new ideas and implement necessary changes is a positive indicator of the potential for further improvement of the operational safety at the plant.

**Regulatory oversight:** the team concluded that the Hungarian Atomic Energy Authority underestimated the safety significance of the proposed design for the fuel cleaning system, which resulted in a less than rigorous review and assessment than should have been necessary. The issuance of a ‘license in principle’ lacked the requirement for an expanded and independent review and assessment.

**Design deficiencies:** the design of the cleaning system was deficient in several respects:

(1) The submersible pump provided for mode B was inadequately sized and had inadequate redundancy/back up.
(2) The bypass flows around the fuel assemblies were not fully taken into account in the thermo-hydraulic analysis of the design.
(3) Potential additional bypass flows around the fuel assemblies, because they may not be correctly seated, was recognized but ineffectively dealt with.
(4) The simple thermo-hydraulic analysis of the design that was performed, even though over simplistic, did indicate unacceptable margins in fault conditions (time to boiling) but this was not effectively recognized.
(5) The provision for lifting the cleaning vessel head in mode B or in fault scenarios was inadequate.
(6) Changes in the configuration of the cleaning tank design (outlet pipe position and inlet plenum chamber) going from a seven assembly cleaning tank to a thirty assembly cleaning tank was not recognized to be significant.
(7) Inadequate instrumentation, trend recording and alarm systems were provided to detect off normal conditions during cleaning.
(8) Possible fuel assembly seating misalignment due to only one fuel guide plate utilized in the cleaning tank to align the bottom of the fuel assembly in its correct seating location. Slight misalignment will reduce cooling flow. Normally, two guide plates are used for fuel pool storage of fuel assemblies.

**Fuel cleaning operation:** the roots of 10 April 2003 fuel cleaning incident at Paks NPP are in 2000 and 2001 when the extensive steam generators decontamination process was performed at Units1–3. In the beginning of 2002 Paks NPP management determined that additional actions were needed to deal with the accumulation of magnetite deposits on the fuel. A contract was signed with FANP to perform out-of core fuel cleaning. The team found that the contractor worked without proper supervision of the Paks NPP plant. In general, personnel involved did not receive adequate training in the nuclear safety aspects of this specific operation. Additionally, operating and emergency procedures were not adequately developed nor was the plant operations department sufficiently engaged in the supervision of the operation.

**Radiation protection:** the IAEA team found that the Paks NPP undertook appropriate monitoring and assessments of the radiation exposure to staff. Based upon the data and dose assessments provided by Paks NPP and other authorities, the team found no indication that the annual dose limits for occupational exposure as specified in IAEA Basic Safety Standards had been exceeded. The team also agreed with the Paks NPP and HAEA’s assessment that the annual dose limits for the general public resulting from the release specified in IAEA Basic Safety Standards had not been exceeded.

**Emergency planning and preparedness:** the team noted that the emergency responses of the HAEA and Paks NPP were well coordinated and consistent with the information available to the emergency manager at the time. However, the lack of an emergency threat assessment for this activity affected the ability to recognize the potential severity of the situation, and some aspects of the emergency response procedures introduced delays and confusion in the implementation of the emergency response plan.

**ANGRA 1 (Brazil)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance; Technical support; Radiation protection; and Chemistry. The scope of the mission did not include Emergency Planning and Preparedness as this area was reviewed less then one year ago during the OSART mission to Angra 2. Also the scope of review for Radiation Protection and Chemistry was reduced as some activities in these areas are performed in the similar way as those reviewed during the Angra 2 OSART. One reviewer was, therefore, assigned to these two areas. A similar approach was applied to the Training and Qualification area allowing more time to be devoted to information exchange.

The team was composed of experts from the United States of America, Germany, France, Bulgaria, the United Kingdom, and the Czech Republic together with three IAEA staff members and a host plant peer from Brazil.

**Duration:** 30 June to 17 July 2003.

**Brief plant description**
The plant Angra 1 is 2-loops Westinghouse PWR 657 MWe. The begin of commercial operation in 1985. The plant is located on the coast of Atlantic Ocean in province Angra about 200 km south of Rio de Janeiro.

**Main conclusion**
The OSART team concluded that the managers of Angra 1 NPP are committed to improving the operational safety and reliability of their plant. The team identified a number of commendable features at Angra 1 NPP, including the following:

– The people working at the plant are very dedicated, experienced, and professional.
– The team was impressed by the cleanliness of the plant and the good housekeeping.
– The plant is open to international and external reviews, and has an impressive plan that confirms that the plant will continue this approach.

Furthermore, the team identified a number of good practices.

The team also offered a number of proposals for improvement in operational safety. The most significant proposals include the following:

– The plant should more clearly define their long-term staffing programme, reduce the reliance on contractors, and ensure that vital plant knowledge is transmitted to new staff.
– The plant should more aggressively reduce its backlog of all kinds and in all domains.
– The plant should improve their standards in installing temporary modifications and enhance the control of temporary modifications.
– Some programs and policies need to be more formalized to ensure continuity and consistency, especially as newer staff will replace experienced retired contracted staff.

Although not the subject of a specific proposal in the report, several observations by the team could be addressed by a stronger questioning attitude. These include; identifying and reporting deficiencies, following implemented processes for foreign material exclusion and temporary modifications, and improving plant material conditions, as well as taking care of ageing equipment.

## SAFETY CULTURE REVIEW CONCLUSION

An important element of the OSART review is the identification of those findings that exhibit positive and negative aspect of safety culture. The OSART team used the guidance provided in INSAG-4, INSAG-13, INSAG-15, IAEA Safety Reports Series No. 11, IAEA-TECDOC-1321 and 1329 and draft SCART Guideline to assess various aspects of safety culture at the Angra 1 nuclear power plant. A safety culture review has been integrated in the OSART review of Angra 1 NPP, which included the following steps:

- Safety culture training for mission experts, based on IAEA safety standards.
- Safety culture observations were part of daily reviews reported during team meetings.
- During the OSART, 31 interviews on safety culture were performed with Angra 1 staff from different organizational levels.
- A questionnaire was filled out by all team members.
- The safety culture programme evaluation was part of Management, Organization and Administration review.
- The IAEA assistant team leader was responsible for co-ordination and evaluation of observations and interviews.

*Interviews evaluation:*
Interviews were conducted with various levels of workers, including senior managers, middle managers, line managers, control room staff, technicians and field workers.

All interviewees considered safety a high priority which is most visible in; communication and commitment, training, good safety performance and procedure adherence.

As to the question, “what do you think could be improved at the Angra 1 plant”, the staff suggested several areas where more training could be provided and they listed a variety of other desires for new equipment and information.

*Team members evaluation:*
The team members were very impressed with a number of positive safety culture aspects observed in the Angra 1 plant. Most often mentioned were:

- the openness to new ideas and desire to exchange international experience,
- their self assessment exercises and process,
- cleanliness and housekeeping,
- communications and training.

The team also recognized the pride of the workers and managers in their nuclear power plant and was impressed with the staff’s professionalism.

The team also identified several areas where management and staff of the plant are encouraged to enhance safety culture:

- improving the questioning attitude and striving for excellence,
- decrease the acceptance of deficiencies,
- provide greater detail in the analysis of human performance.

During the review, the team observed that safety culture requirements are incorporated in several guidelines and the plant is encouraged to continue this effort in accordance with developments identified in this area by IAEA and other organizations.

**ROVNO (Ukraine)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of management, organization and administration, training and qualification, operations, maintenance, technical support, radiation protection, chemistry and emergency planning.

The team was composed of experts from Brazil, Bulgaria, Japan, Slovakia, South Korea, United Kingdom and United States of America, together with four IAEA staff members and a host plant peer from Ukraine. In addition one observer from IAEA and one from Zaporozhye NPP were part of the team.

**Duration:** 19 September to 9 October 2003

**Brief plant description**
The plant is located in Vladimirets district of Rovno region, 80 km to the north of Rovno city on the Styr river. The site contains two WWER 440 (units 1 and 2) type reactors, one WWER 1000 type reactor in operation and one more WWER 1000 type reactor under construction with planned commissioning in 2004. The operating units were first connected to the grid in 1980, 1981 and 1986 respectively.

**Main conclusion**
The OSART team concluded that the managers and staff at Rovno NPP are enthusiastic in their commitment to improve the operational safety of the plant. The team found many good areas of performance, including the following:

– In general plant staff are knowledgeable, competent and well experienced.
– There is strong support of Energoatom and plant management to establish higher levels of operational safety, and plant staff are motivated to continue the progress already achieved.
– There is open and good relationship and communication between management and workers.
– Housekeeping and material conditions have been significantly improved and are noted to be of very good quality.
– The plant has well structured and detailed procedures.

The plant has embarked in a serious programme to improve operational safety. The team encourages Energoatom and plant management to continue to give high priority and adequate resources for the continuation of these improvements. With this purpose, the team offered proposals for further improvements in operational safety. The most significant proposals include the following:

– The training programs and training evaluation need improvement.
– The fire protection and fire fighting equipment should be improved.
– The predictive maintenance programme needs improvement.
– The effective preventive internal dose control measures need improvement.

Rovno NPP management expressed a determination to address the areas identified for improvement and indicated a wiliness to accept a follow-up visit in about eighteen months.

## SAFETY CULTURE REVIEW

An important element of the OSART review is the identification of those findings that exhibit positive and negative attributes of safety culture. The OSART team used the guidance provided in INSAG-4, INSAG-13, INSAG-15, IAEA Safety Reports Series No. 11, IAEA-TECDOC-1321 and 1329 and draft SCART Guidelines to assess various aspects of safety culture at the Rovno nuclear power plant.

The safety culture review was integrated on a daily basis into the OSART review process. The results of the safety culture review are based on the team member's daily observations and interviews with the Rovno NPP staff, review of the material condition and housekeeping of the plant and evaluation of the programs, processes and procedures used at the plant.

The Safety Culture review included the following steps:

– Safety culture training for mission experts, based on IAEA safety standards and other IAEA documents;
– Safety culture observations by team members discussed at each daily team meeting;
– A questioner, at the completion of the review, asking each team member to prioritize the most significant plant and staff strengths, weaknesses and safety culture indications observed during the review;
– Consensus by the team on the results of the safety culture review.

The safety culture programme evaluation was done as part of the Management, Organization and Administration review. The IAEA Deputy Team Leader was responsible for co-ordination and evaluation of observations by the team.

**Evaluation and conclusion**
Observations and interviews were conducted with various levels of workers, including senior managers, middle managers, line managers, control room staff, technicians and field workers.

It was evident to the team from the beginning of the review that nuclear safety is a high priority that filters down from the highest level in the corporate utility and is embedded into the procedures, work controls and daily activities of all plant staff. The most significant attributes visible to the team were observed in; management involvement in routine tasks and modifications, the staff's adherence to procedures, the open relationship and communication between management and workers, the motivation of all personnel and the technical competence of the staff. The team also observed a work pattern by line management that reinforced the safety message during all pre-job briefings.

The team also identified several areas where management and staff of the plant are encouraged to continue to enhance safety culture. These include: development of a greater use of world performance indicators and international contacts; improving the interest and ownership of the staff across departmental lines; adherence and attention to personal protection principles and improving the media for reinforcing safety culture.

The team concluded that there is a commitment to nuclear safety by the management and staff at the Rovno NPP. The Rovno team who contributed to the excellent preparation for the OSART mission is encouraged to continue with their efforts for sustaining the momentum to make continuous plant improvements. Senior managers are also encouraged to continue with their initiative to develop a strong safety culture environment in accordance with developments identified in this area by IAEA and other world organizations. The implementation of the OSART recommendations and suggestions will contribute to management's support to improve the safe operation of the plant.

**KRŠKO (Slovenia)**

**Scope of the mission**
The purpose of the mission was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry; and Emergency Planning and Preparedness. Also an enhanced review of Safety Culture was performed.

The team was composed of experts from Canada, Brazil, United Kingdom, Sweden, France, Slovakia, and United States of America, together with the IAEA staff members and an observer from Ukraine.

**Duration:** 20 October to 6 November 2003

**Brief plant description**
The plant is located on the left bank of the Sava River approximately 2 km southeast of the town of Krško in the east southeast part of the Republic of Slovenia.

The Krško NPP was built jointly by the Republic of Slovenia and by the Republic of Croatia. Net electrical output of the plant is 676 MWe. The plant is equipped with the Westinghouse 2-loops PWR with the thermal output of 1994 MW. Nominal power has been reached in 08/1082.

**Main conclusion**
The OSART team concluded that the Krško NPP has several good features that form the basis for future safe operation of the plant; most significantly, a well educated, highly motivated, professional and experienced staff.

The senior management of Krško NPP is committed to improving the operational safety and reliability of their plant in a long-term perspective. The team found that Krško NPP has several strong attributes and programs, including the following:

- There is priority on nuclear safety at all levels of the organization.
- As a whole, the management of the plant has a depth of technical knowledge and a good background in nuclear plant operation.
- The plant has made effective use of computer technology to plan work, track activities and communicate within the plant.

However, although the Krško NPP has many good operational safety features, the team observed some areas for improvement. The most significant were:

- The industrial safety policy, practice and management involvement should improve.
- The plant should further address the volume and storage of low level waste.
- The plant should enhance the use and adherence to procedures in the field.

An important element of the OSART review is the identification of those findings that exhibit positive and negative safety cultural aspects of operational safety performance. The OSART team used the guidance provided in INSAG-4, INSAG-13, INSAG-15 and IAEA Safety Reports Series No. 11 to assess various organizational and technological aspects of operational safety culture at the Krško NPP.

The overall impression by the team is that the plant has a strong safety culture, driven from the top with conscious efforts to inculcate the safety thinking in employees from the very start, the sharing of vision and standards in long-term partnership with subcontractors and by fostering an open and good relationship with the local community. A stable work force with long experience in the plant has facilitated these developments.

Although a strong safety culture is evident in many ways, the term safety culture has only recently been more systematically introduced in the company together with efforts focused at assessing the safety culture of the organization. The development of the codex of safety and business ethics, together with the training given, has been the main means of introducing the safety culture concept.

The plant is in a transition phase with many future challenges in terms of aging plant, aging work force with soon to come retirements, increased economic pressures from owners and operating in a competitive market. A strong safety culture is paramount in being able the meet these challenges.

Krško NPP management expressed a determination to address the areas identified for improvement and indicated a willingness to accept a follow-up visit.

## PART II-B
## OVERVIEW OF FOLLOW-UP VISITS

### KOZLODUY (Bulgaria)

**Scope of the mission**
The purpose of the follow-up visit was to see progress in fulfilment of issues from OSART mission held in January 1999.

The follow-up-visit team consisted from representatives from Spain, France, Czech Republic and IAEA.

**Duration:** 15 to 19 January 2001

**Brief plant description**
The plant is located in east Bulgaria on the Danube river, which is the border with Romania. The site contains two WWER 1000 (units 5 and 6) type reactors and four WWER 440-230 type reactors (units 1 to 4). The units were first connected to the grid from July 1974 to May 1982.

**Main conclusion**
The IAEA follow-up team was pleased to find the great majority of the recommendations and suggestions offered by the team in 1999 resolved by the plant, a few had satisfactory progress to date, and only one suggestion was classified as insufficient progress to date.

In 1999 the OSART team stated that the managers and staff at Kozloduy NPP were committed to improving operational safety at the plant, and that can be restated during this follow-up visit. The results of this review indicate that corporate and plant management continue to give priority for the continuous improvement of operational safety of Kozloduy, and this has supported an evolving safety culture at the site.

Several of the actions taken by the plant went beyond the intention of the recommendations and suggestions offered by the team. Examples of these are the improvements in the main control rooms and the actions taken to test the efficiency of the plant iodine filters.

The team encourages the plant to continue in the path of continuous improvement. This is essential to meet the demands of a safety culture that do not comply with complacency or decline in performance. With this purpose, a number of indications for further improvements in operational safety were offered by the team and are indicated in the follow-up part of this report, notably in the areas where the issues were not totally resolved. Examples of these are the completion of the symptom based procedures and the further improvement in plant reporting system, including root cause analysis.

## GOESGEN (Switzerland)

### Scope of the mission

The purpose of the visit was to discuss the action taken in response to the findings (recommendations and suggestions) given in the official report of the Goesgen OSART mission held from 8 to 25 November 1999.

The team comprised of four members, one from UK and three from the IAEA, all of whom had been members of the original OSART team.

**Duration:** 11 to 15 March 2002

### Brief plant description

The plant consists from single unit with 3-loop PWR supplied by Siemens KWU. The plant is located on Aare river between cities of Olten and Aarau. The commercial operation from November 1979. The plant had twice increased power (originally 2808 MWt – until 1985, 2900 MWt – until 1992, now 3002 MWt).

### Main conclusion

The team received excellent cooperation from the Goesgen NPP staff and was impressed with the actions taken in most areas to resolve the findings in the original OSART mission. The willingness of plant management to consider new ideas and implement necessary changes is a positive indicator of the potential for further improvements of the operational safety at the plant.

The plant management has now clearly stated in plant documents that safety has an overriding priority and furthermore strengthened this message by restructuring the morning meeting to have a clearer focus on safety. A set of measurable goals has been established and in all plant communications, safety is stated to have the highest priority.

A special Safety Culture Commission with representatives from the different departments has been set up to further develop safety culture initiatives. A set of measures has been presented to the management for their decision and prioritization.

In the original OSART mission the team identified the plant's succession planning as a good practice. To be even better prepared for the future transition from heavy reliance on knowledgeable staff with long experience to a reliance on more documented guidance to new staff, the plant has developed a common approach in documenting its processes. Some processes defined in this new way have already been deemed to contribute to the plant's effectiveness.

The improvements that the plant has implemented to strengthen its QA system during the last two years are impressive and shows clearly the ambition to develop this area towards its objectives during a total time frame of 4 to 5 years. A new QA organization has been set up and an audit process developed as well as a clear system for document management. An audit programme has been set up and 22 audits performed so far. In addition, tailored training has been given to different categories of staff.

Industrial safety is another area where impressive improvements have been implemented as improved guidance in procedures, training and new training materials means, work site safety analyses for the whole plant, as well as clearer instruction on what personnel protection equipment should be used.

The team has designated 11 of the original 31 recommendations and suggestions as fully resolved. Satisfactory progress has been made in 18 of them. One recommendation and one suggestion were found to have progressed insufficiently.

The team encourages the plant to continue on their path of continuous improvement. This will ensure that operational safety will be kept on the highest level and that the plant can meet the challenges in the competitive environment.

**Belleville (FRANCE)**

**Scope of the mission**

The purpose of the visit was to discuss the action taken in response to the findings of the OSART mission held from 9 to 26 October 2000.

The team comprised of four members, one from the United States of America, one from the United Kingdom and two from the IAEA. Three of the four reviewers in the team had been members of the original OSART team.

**Duration:** 13 to 17 May 2002

**Brief plant description**
The plant is located in northwest of the Cher administrative department on the left bank of the Loire and on the boundary of the Loiret, Nièvre and Yonne departments. The site contains two PWR type reactors of 1300MWe. The units were first connected to the grid in October 1987 and July 1988.

**Main conclusion**
The follow-up team received excellent co-operation from the Belleville staff and was impressed by the progress that the plant has made since the OSART mission in October 2000. In all discussions the Belleville staff were open and straightforward, and exhibited a desire to move forward and further develop their plant. The willingness of plant management to consider new ideas and implement operational safety changes are a positive indicator of the high potential of this plant to achieve continued future success. In all cases, agreement was reached with the Belleville management on the assessment of the actions implemented.

The plant has done a thorough analysis of all the recommendations and suggestions offered by the original OSART team and has effectively responded and implemented operational safety improvements that will further enhance the safety of the plant. The team would like to highlight some of the areas where good progress was observed, as follows:

Key to the Belleville management's response to the OSART recommendations and to the successful response in many areas is the Strategic plan and Business plan arrangements adopted into the normal "way they do business" at the plant.

Operating first of all top down the senior management team set strategic direction for Belleville aimed at the plant being in the top 20 in the world by 2005. The management team took into account all factual information from stakeholders in providing key goals in three specific areas, Operational Safety, Competitive Strength and the Environment. Communication at all stages of the process ensured staff were aware of the key issues.

Help from staff in natural work teams was requested in a bottom up approach to provide the tactics or actions to achieve the strategic goals. All suggestions were considered and most were adopted, reasons being given for those that were not. The strategic aim of incorporating many small victories to achieve the goals was the approach adopted. Communication of these "victories" has been an important part of the recognition of staff involvement.

Ownership of the actions is evident in staff interviews. It is estimated that of the order of 85% of the staff are very supportive of the management approach for Belleville.

This activity has been instrumental in improving motivation and commitment on the site, which in part will have contributed to the significant improvement observed in many areas of the operation of Belleville since the OSART mission. The adoption of this structured approach to the future of Belleville and the involvement of the management team and site staff deserves to be recognized.

Senior plant management is demonstrating a significant overall commitment to raise the standards in the working processes as well as in the plant material condition. Several commendable initiatives have been either implemented or strengthening to better coordinate the work process through the TEM organization, reduce the low-level defects through setting up an effective organization for reporting, allocating resources and effectively deal with the defects. The follow-up team's discussions and field inspections confirm that Belleville has reached good results and some of the success factors are the broad involvement of staff in developing the initiatives and their adoption of the new standards.

The further development of the risk assessment process since the OSART mission and specifically its integration into one organization with radiological protection, nuclear safety, industrial safety and quality has contributed to this important methodology becoming part of every day work. Several examples of risk assessments reviewed were considered to be comprehensive and owned at the worker level. Many of the risk assessments are undertaken by the craft personnel and only reviewed by management if the risks are considered to be significant. The risk assessment process is seen as a significant contributor to improvements in Belleville's performance indicators in areas such as industrial safety and contamination control.

Following the OSART mission, EDF approved the building of a full scope simulator at Belleville. The full scope simulator is scheduled to be complete in October of 2002 followed by a testing programme with training starting in early 2003. The full scope simulator will provide additional training opportunities and realism. The follow-up team was impressed by the effectiveness in realizing this decision, giving the possibilities for the Belleville staff to further improve their professionalism and the operational safety at the plant.

The follow-up team also likes to highlight some areas where the plant needs to pay more attention on the way to reaching it's vision:

The plant has implemented several activities to improve its FME approach. The follow-up team recognized several of these to be in line with plant's expectations, such as performed risk analyses, procedural instructions and precaution signs at areas as the fuel pool area unit 1, which also was set up as a model area. However, during inspection of the pool area, five small objects (two small lamps, a loose padlock, small stainless steel hook and a small plastic cover) were found close to the fuel pool on unit 1. Thoroughness in implementation and common understanding of the FME approach is essential to reach success.

Although standards at Belleville have improved since the OSART mission, given the target of being in the top twenty of world plants, there is a need to expose staff to those higher standards to which the plant aspires. Linked to this, if further benefits are to be gained from the adoption of a questioning attitude there is a need to ensure that staff recognize and have internalized the high standards as the basis of their questions. Exposure of staff to these standards is best achieved by benchmarking with plants which operate to these standards as the norm. International benchmarking provides the optimum way to remove this potential limiting factor to further improvements for Belleville in the future.

While there are many benefits from EDF being the largest nuclear organizational structure in the world, there are also specific challenges to progress at a individual site like Belleville. The OSART team and the follow-up team observed several instances of corporate inertia slowing progress toward resolution of issues or implementation of new good ideas and modifications. The team believes that Belleville must take into account the potential of delays that accompany a large corporate structure like EDF.

In order to establish effective monitoring of the surveillance programme the plant started to trend some of the surveillance test results. However, the percentage of the trended results of surveillance tests is still limited and clear policy on increase of trended results was not yet displayed. Because the trending is one of the basic effectiveness monitoring tools, the team encourages the plant to achieve further sustainable progress in this area, which will enhance plant staff confidence in their reliance on performed surveillance tests when taken out one of the safety trains of any reason.

A statistical analysis of the status of the 24 recommendations and 9 suggestions identified in the OSART mission in October 2000 shows that 39% were resolved, 58% were making satisfactory progress and 3% (one issue) were making insufficient progress. Several of the resolved issues were category specific and limited in scope. The remaining issues are in many cases related to needed cultural changes and will need more effort and attention to be resolved.

**MÜHLEBERG (Switzerland)**

**Scope of the mission**
The follow-up visit to the Mühleberg purpose was to discuss the action taken in response to the findings of the OSART mission held from 6 to 23 November 2000.

The team comprised of four members, one from Brazil, one from Sweden and two from the IAEA. Three of the four reviewers in the team had been members of the original OSART team.

**Duration:** 9 to 14 June 2002

**Brief plant description**
The plant is single unit of General Electric BWR-4 plant with electrical output 355 MWe, in operation since 1973. The plant is located on river Aare 14 km west of Bern and is owned and operated by BKW FMB Energie AG.

**Main conclusion**
The team received excellent co-operation and support from the Mühleberg staff during the follow-up visit. The team concluded that Mühleberg has done an outstanding job analysing the OSART issues and taking prudent actions to deal with the significant elements within each issue that would be the most benefit to improving the operational safety of the plant.

The Governing Board and the management of BKW FMB Energy Ltd., the sole owner of the Mühleberg nuclear power plant (NPP), has stated on several occasions it's topmost priority on nuclear safety. This is clearly reflected in the plant regulation manual (Kraftwerksreglement), which is mandatory for the entire staff of the Mühleberg NPP. The willingness of plant management to look broadly into each of the OSART issues shows the characteristics of a strong self-assessment approach and a desire to achieve operational excellence. In all cases, there was agreement between the IAEA team and Mühleberg on the evaluation and conclusions of the actions taken to improve operational safety.

The team noted the following areas where good progress was observed:

Significant effort has been placed on the development of safety performance indicators. The restructuring of the plant regulation manual together with the goals and requirements of the plant Quality Management system has led to the development of a hierarchy of good safety performance indicators. There was a significant effort by the Swiss plant manager organization (GSKL) to develop the structure that led to the development of these safety indicators, thus, demonstrating the ownership and support from upper level management from all Swiss nuclear plants. IAEA-TECDOC-1141 was used as the basis for developing the hierarchy structure for these safety indicators.

Further enhancements were made to improve management expectations for the reporting of events and near misses. A marked increase in the reporting of events, near misses and injuries as well as malfunction and critical situation notifications showed that management expectations for this effort is being understood at all levels in the organization. The team viewed the actions taken in this area as a significant cultural change that, with the plant's efforts already underway for a strong self-assessment program, will continue over time to improve the operational safety at Mühleberg.

The team recognized the good progress taken by the plant to address and improve industrial safety at Mühleberg. A significant amount of effort has been placed on taking advantage of existing controls and training activities in place to further improve industrial safety standards. Some examples of the plants efforts in this area are; the eye wash packages have been made more user friendly, swing range of automatic doors are clearly marked, performance testing in industrial safety training has been improved, work preparation for industrial safety aspects has been enhanced and improved management oversight for identification of industrial safety hazards has been increased in the field. The team also noted improvement in oversight activities by the plant safety officer. The team concluded that with sustained management attention in these areas, industrial safety practices at KKM would continue to improve.

The team was impressed with the actions taken to remove un-needed material that was stored in and around the plant. All levels in the turbine and reactor buildings showed significant improvement. Also of significance, was the clear identification of lifting slings, ladders and mechanical eyebolts that were approved for use.

The plant has taken action to improve many aspects of training in all departments. Industrial safety training has been improved, training for radiation protection workers has been enhanced and plant specific simulator training and testing for all operations personnel has been significantly improved. The team concluded that the training for personnel at Mühleberg meets good international and IAEA safety standards.

The team noted that satisfactory progress to resolve some of the issues identified by the OSART team continues. Specifically:

– The actions taken to date to enhance the reporting of near misses and potential accidents;
– The control of operations documents;
– The analysis and control of temporary modifications.

The team encouraged the plant to continue work in these and other areas so as not to loose the good momentum that the staff has exhibited. Plant management at Mühleberg acknowledged the team’s conclusions during the follow-up visit and showed a determination to continue to strive for excellence in operational safety at Mühleberg.

**NORTH ANNA (United States of America)**

**Scope of the mission**
The follow-up visit to the North Anna purpose was to discuss the action taken in response to the findings of the OSART mission held from 22 January to 10 February 2000.

The team comprised of four members, one from Belgium and one from Brazil and two from the IAEA, three of the four reviewers in the team had been members of the original OSART team.

**Duration:** 8 to 12 April 2002

**Brief plant description**

The plant is located on the southern shore of Lake Anna in Louisa County Virginia, United States of America. The site comprises of two PWR reactors, Unit 1 was first connected to the grid in 1978 and Unit 2 in 1980.

**Main conclusion**
The team received excellent cooperation from the North Anna Power Station staff and was impressed with the actions taken in most areas to resolve the findings in the original OSART mission. The willingness of plant management to consider new ideas and implement necessary changes is a positive indicator of the potential for further improvements of the operational safety at the plant.

The corporate decision-makers have considered the vulnerability of the plant identified during the OSART mission and added further economical and personnel recourses to the plant budget. The willingness to give good conditions to the plant for meeting the future challenges on the competitive market and the structure and appliance of the new business plan give the basis for that decisions are taken with safety as the highest priority.

Administrative procedures are under revision with the objective to remove unnecessary detail and improve user friendliness. The staff is more familiar with the structure of the plants procedural system as well as the procedures that affect them.

Several initiatives have been taken to reinforce the importance of industrial safety and the need for a questioning attitude and attention to detail in the area of industrial safety. This resulted in the reduction of the industrial safety accident rate.

The debriefing process for the operator’s simulator sessions has been considerably modified to achieve consistency from one simulator session to another. Human related aspects and the expectations of management for Control Room conduct are now better covered.

Several initiatives have been taken to refocus on managers and supervisors oversight, coaching, and supervising and observation skills. The importance of attention to detail has been highlighted, resulting in, among others, improved material conditions in the plant.

Contamination control awareness has been raised significantly and an effective waste reduction programme has been put in place, leading already to reduced production of radioactive waste.

However, some findings in the original OSART mission were extensively discussed during the follow-up mission. At the time of the follow-up visit, the team noted that these findings had not been given the same high attention as all the others, mostly due to lack of information on the findings. Such findings were the adoption of ICRP 60 and some issues in Emergency Planning and Preparedness. After the follow-up mission, the IAEA received additional information, from mainly NRC, which explains the background and the discussion behind why NRC has not adopted the ICRP 60 and why some practices in Emergency Planning and Preparedness are not adopted in NRC regulations. In all the questioned cases, clear information has been given from NRC that North Anna NPP is in the compliance with the current NRC regulations. North Anna NNP is also following accepted good practices in the United States of America.

The team has designated 14 of the original 28 recommendations and suggestions as fully resolved. Satisfactory progress has been made in 13 of them. One suggestion was found to have progressed insufficiently.

The team encourages the plant to continue striving for excellence in operational safety.

**LING AO (China)**

**Scope of the mission**
The follow-up visit to the Ling Ao NPP purpose was to discuss the action taken in response to the findings of the OSART mission held from 6 to 23 August, 2001.

The team comprised of four members, one from Sweden, one from UK and two from the IAEA. All of the reviewers in the team had been members of the original Pre-OSART team.

**Duration**: 18 to 22 November 2002

**Brief plant description**
The plant consists of 2 Framatome 990 MWe units. The plant is located 1 km northeast of Daya Bay NPP with two similar units. Ling Ao A is in commercial operation from 05/2002 and Ling Ao B from 01/2003.

**Main conclusion**

The team received excellent co-operation from the LNPS management and staff and was impressed with the progress that had been made to resolve the findings in the original Pre-OSART mission. In addition the team was very much appreciative of the openness, frankness and desire for continuous improvement displayed by Ling Ao personnel during the Follow-up visit. These are positive indicators of the potential for further improvements of operational safety at the plant.

LNPS management has taken significant actions in different areas to enforce management requirements, expectations and safety standards. An important milestone for these achievements was that the safety management has been transferred from the project department to the power plant. A series of actions have been taken in the area of industrial safety, fire protection, operation, documentation and maintenance. These actions have significantly contributed to effectively enforce high safety standards. The implemented measures have been very effective and have contributed to safe fuel loading and commissioning of both units.

In the area of quality assurance the plant management and project department management have initiated several improvements in their internal power plant and project department auditing programme and in prioritizing the criteria regarding the resolution of QA findings. The actions taken by the power plant will also be used during commercial operation.

LNPS management clearly place a high priority on quality training and is prepared to invest resources, both money and man-hours, in continuously improving this area. They have demonstrated that the issues raised during the Pre-OSART mission have been understood and their remedial actions have exceeded the scope of the original concern.

The Operators demonstrate strong ownership of the plant. There is clearly a high level of determination and commitment shown by the management to maintain (and improve) the high standards which have already been achieved.

The plant re-assessed their original policies advocating on-line maintenance, and additional procedural controls, and requirements to conduct risk and safety analysis, will be used to support judgments when implementation of on-line maintenance is to be performed at the plant.

Enhancements to the plant’s Ageing Management Programme (AMP) have been achieved. The plant’s management of its predictive maintenance programs was enhanced.

Very good response was identified to address the need to effectively establish a site wide Foreign material exclusion (FME) program, which used a structured approach that comprehensively addressed lessons learned from industry experience and the resulting international practices.

A comprehensive set of corrective measures were identified and implemented to respond to significant performance weaknesses in the areas of plant material conditions and the conduct of maintenance.

There is an ambitious programme for a complete probabilistic safety assessment study for LNPS. Two areas where PSA can provide useful information in order to control work, “outage/no power” and “fire” will be analysed by the end of 2003. In order to meet the time schedule, this work should have necessary management attention and support.

Surveillance test programs are intended to verify the operability of different types of equipment. Industrial experience shows that any test not carried out accurately could cause damage to the tested equipment. The revised diesel generator surveillance testing programme will take this into account, and the plant is encouraged to complete this work.

Radiation dose control is essential to meet ALARA objectives. It can be broken down into parts such as radiation work permits, surveys, use of TLD and electronic dosimeters and so forth. Procedures and other appropriate actions have been implemented in this area. The completeness and effectiveness of all actions taken will be verified during the first refuelling outage.

The radiation monitoring system, KRT, has been put into operation as part of the commissioning. Test procedures and alarm sheets are in place, but validation of the various alarm setpoints is not present.

The power plant has carried out an extensive analysis of the impurities that can lead to increased corrosion in the reactor coolant system and spent fuel pool.

A special project group has been established to analyse issues and implement corrective actions for steam generator primary-secondary leakage monitoring. Because of associated complexities, not all measures are implemented yet, but schedule and budget have been allocated to this issue.

The team concluded that a site wide comprehensive programme for chemical control has not been sufficiently developed and managed on an integrated basis. In addition, sufficient training has not been provided for plant personnel in order to ensure the use of only approved chemicals and other substances in plant systems, and that practices involving chemicals at the site are not sufficient. The team is of the view that additional management attention is necessary to better focus the Ling Ao management and staff in making good future progress for resolving this issue.

The team noted strong performance due to the very good progress on resolving the issues on Emergency Planning and Preparedness.

The effort of plant and off-site officials involved in emergency planning and preparedness activities to work co-operatively contributed to the successful meeting of the goal to minimize the time to perform the process of notification of off-site officials and activation of the on-site response.

Significant improvements were made in the preparations for managing the treatment of injured, contaminated individuals or severely overexposed individuals to ensure that appropriate medical treatment is provided.

A statistical analysis of the status of the 33 recommendations and 11 suggestions identified in the Pre OSART mission in August 2001 shows that 71% were resolved, 25% were making satisfactory progress, 2% (one issue) was designated as insufficient progress to date and 2% was withdrawn. The issues with satisfactory progress were not fully implemented due to their complexity or the need for long term action or their effectiveness could not be fully assessed.

During the Pre OSART mission and the Follow-up visit, the team has observed a high quality of operation preparation, commissioning and normal full power operational activities at LNPS. Most of the aspects are comparable with recently revised IAEA Safety Standards and Ling Ao results will be a valuable reference to the nuclear industry worldwide.

## SANTA MARIA DE GAROÑA (Spain)

**Scope of the mission**
The follow-up visit to the Santa Maria de Garona NPP purpose was to discuss the action taken in response to the findings of the OSART mission held from 18 February – 7 March 2002.

The team comprised of four members, one from France, one from Romania and two from the IAEA. Three of the four reviewers in the team had been members of the original OSART team.

**Duration:** 21 to 28 November 2003

**Brief plant description**
The Santa Maria de Garoña NPP is single unit of BWR-3 reactor designed and constructed by General Electric. The plant is located within the province of Burgos (north of Spain), close to the townships of Garoña and Santa Maria de Garoña, Tobalina Valley on the Ebro river.

**Main conclusion**
The follow-up team received excellent co-operation from the Santa Maria de Garoña staff and was impressed by the progress that had been made. The willingness of the plant management to consider the recommendations and suggestions made by the OSART team in February/March, 2002, and to implement operational safety changes is a positive indicator of the potential of the plant to achieve continued future success. In all cases, agreement was reached with the Santa Maria de Garona management on the assessment of actions implemented.

The plant has made thorough analysis of the recommendations and suggestions and implemented several different programs that support the resolution of many of the issues. Examples of such programs are self-assessment, corrective actions programs, “Programme for the improvement of safety in organization and human factors and Safety culture and work quality improvement plan”, to mention but a few. The implementation of these programs is starting to show results and the majority of the issues were found to be resolved.

The expectations of plant management have been clearly defined in several areas and clear responsibilities are included in the programs implemented. The new programs or changes in existing programs have been communicated to all staff.

Santa Maria de Garoña is the first site in Spain that has implemented a comprehensive “Fitness for duty” programme. The medical staff and risk prevention staffs have led the development of the programme.

A detailed succession plan for 2003 – 2006 has been developed, with the names of the people who are expected to retire, defined actions to be taken to either substitute with staff from the existing organization or recruit new staff and how to prepare them for their new positions. Nuclenor management sees the succession plan as very important to ensure the right number of knowledgeable staff when entering a life extension of the plant.

The work management system is significantly improving with a new specific software programme and revision of related procedures and a more comprehensive approach on pre-job briefings has been developed.

At the beginning of next year, additional professionals will be contracted for the fire brigade and security staff is currently in training to add to the number of staff involved in fire fighting. These actions will release operation staff from a significant part of their present involvement.

The plant is committed to using the information from low-level events more effectively. Continuing effort is still required to carefully develop processes to capture near misses and precursors.

**DUKOVANY (Czech Republic)**

**Scope of the mission**
The purpose of the follow-up visit to the Dukovany NPP was to discuss the action taken in response to the findings of the OSART mission held from 5 to 22 November 2001.

The team was composed of experts from Slovakia, UK, two from IAEA and one IAEA observer.

**Duration:** 6 to 10 October 2003

**Brief plant description**
The plant consists of four identical units WWER 440 MWe (V-213) in operation from 1985–1987. The plant is located in southern part of South-Moravian region 40 km west of Brno.

**Main conclusion**
The IAEA follow-up team received excellent co-operation from the Dukovany staff and there were frank and open discussions of all the issues. The team observed that the staff of Dukovany NPP thoroughly analysed the issues and in many cases developed solutions, which achieved enhancements in operational safety beyond the recommendations of the original team. Sometimes this was done by creatively integrating the responses to two or more issues in a way that provided a better response than simply addressing each issue individually.

The team was particularly impressed with the management decisions to perform hanger replacements in the primary system and the replacement of many fire doors. These investment decisions indicate a strong commitment to operational safety.

Dukovany NPP has done a fine job in improving the technical review of minor modifications installed in the plant.

The enhancements to practical fire fighting training have improved the capability of the fire fighters to respond to a wider range of fires. The people working in this area indicated that they appreciate the opportunity to participate in this training.

The new procedures and precautions taken with the transportation of hazardous material are well designed to enhance the safe handling and control of these materials.

The overall impression of the team is that the plant has aggressively moved forward to address the issues raised in the initial report. The team found many of those issues fully resolved.

The final statistical analysis of the status of the recommendations and suggestions identified during the OSART mission of November 2001 showed that 70% were resolved and 30% were making satisfactory progress.

**TRICASTIN (France)**

**Scope of the mission**
The follow-up visit to the Tricastin NPP purpose was to discuss the action taken in response to the findings of the OSART mission held from 14 to 31 January 2002.

The team comprised of four members, one from Spain, one from UK and two from the IAEA. All four reviewers in the team had been members of the original OSART team.

**Duration:** 17 to 21 November 2003

**Brief plant description**
The plant consists from four 3-loops units PWR 900 MWe. Primary circuit manufactured by Framatome, turbines by Alsthom. First connection to grid: U1 – 05/1980, U2 – 08/1980, U3 – 02/1981, U4 – 06/1981. The plant uses MOX fuel from 1996. The plant is located in Rhone valley, mid-way between Lyon and Marseille.

**Main conclusion**
During the OSART mission in the beginning of 2002 there were several observations that supported the fact that plant staff as well as contractors did not always follow policies, procedures and instructions, although they have been trained to know what was required of them. There were also observations that staff members were seldom drivers of change and most improvement initiatives were coming top down. Furthermore, it was clear that the plant was in an insular environment with little knowledge of best practice outside of EDF. On the other hand the OSART team also recognized the staff's willingness to improve.

After the OSART mission, the Tricastin management adopted an approach of trying to define the root causes to their issues in all areas rather than simply working on the individual issues. This approach created a management oversight view, that was used to develop strategies for how to work with the outcome of the OSART. This had the integrated effect that work with some of the issues in the MOA area widely contributed to the work on resolution of issues in other areas.

With the above mentioned approach, the plant identified the need for several common activities, for example:

- Clarify reference standards for several areas and also to create simplified communication means to get all concerned aware of what's expected from them;
- Strengthening thoroughness in performance of activities as well as a questioning attitude;
- Widespread use of cross functional groups with the involvement of staff and managers have developed new reference standards and simplified them to make communication effective;
- Strengthening the supervision, coaching and monitoring in the field by supervisors and managers;
- Extensive benchmarking to learn and understand how others approach similar problems as defined by the OSART team.

The plant has developed a systematic process for working with the OSART issues, where the above activities are included.

The OSART follow-up team found considerable improvements in several areas.

For example:

Housekeeping and material condition has continued to improve, still more remains to be done and the plant is well aware of this and has reserved the necessary resources for doing this in 2004.

Enhanced field observation in operation, maintenance and radiation protection has led to improvements in these areas that is clearly seen in indicator trends.

Industrial safety posting has improved and the staff is more consistent in following the rules.

The plant's solution on seismic constraints for lead shielding is excellent and could serve as a model for the industry.

The Fyrquel issue has been approached in an exemplary way, which makes Tricastin a leading plant in the EDF nuclear fleet.

The plant has made notable improvements in many other areas and is well aware that there is always room for more, in their adopted continuous improvement approach. An important enabler to assure continuity is the involvement of field workers in Tricastin.

**TEMELIN (Czech Republic)**

**Scope of the mission**
The follow-up visit to the Temelín was to discuss the action taken in response to the findings of the OSART mission held from 12 February to 1 March 2001.

The team was composed from expert from Romania, three experts of IAEA and one observer from China.

**Duration:** 8 – 12 December 2003

**Brief plant description**
The plant is located in south Bohemia, 30 km north of town České Budějovice and 120 km south of Prague. The plant consists of two identical pressurized water reactor (VVER 1000 V 312 type) units each with 1000 MW output. The plant was placed in commercial operation from 06/2002 (U1), 04/2003 (U2).

**Main conclusion**
The team received excellent cooperation from the Temelin NPP staff and was impressed with the actions taken in most areas to resolve the findings of the original OSART mission. The willingness of plant management to consider new ideas and implement necessary changes is a positive indicator of the potential for further improvements in the operational safety at the plant.

Several processes at the plant have become highly developed and are now strengths. The plant has enhanced the audit programme. Audits of contractors and suppliers as well as internal audits are performed according to schedule. Audits are structured so that a technical expert in the area being audited is placed on the team.

Temelin has developed a procedure which prescribes the content, format, and style of procedures for use in the plant. This high level procedure is being used as the guidance for the preparation of procedures in the plant. Many of the original procedures were provided by the contracting organizations and the style and content varied. The plant has embarked on a programme to convert these procedures so they conform completely to the content, format and style now required. Nearly all procedures for Unit 1 are completed or are awaiting approval. Because of the recent completion of Unit 2, its procedures are not at the same level of development; however adequate resources are being devoted to this task.

The surveillance procedures are going through a process of transformation to the new format, which meets the recommendations provided by the OSART team. Qualifications for those performing the tests or analysing test results are given. For unit 1 about 80 percent of the procedures are finished and the remainder are in the approval process. For unit 2 about 20 percent are finished.

The plant has extended the number of personnel trained in OEF practices. And new procedures have been developed. These procedures use root cause analysis methodology like fault-tree analyses, change analyses, and barrier analysis. In addition, events are prioritized by severity so that the more significant receive more detailed analysis. Events and the analysis of events are presented to management in a timely manner and the corrective actions are closely tracked.

The temporary modification system has been significantly improved. The new policy defines the method of initiation, the development of the technical solution, preparation and implementation. This includes assessment of impacts of the change, the labelling of the temporary changes, definition of its impact on nuclear safety, and the release conditions for initiation of the implementation.

In order to strengthen corporate overview of safety activities, the corporation has taken several steps: it has instituted a safety review committee, chaired by the CEO, whose membership includes several senior managers with strong nuclear experience and there is a high level internal audit function to review safety issues and report to the board of directors.

At the first of the year, a new organization will go into effect. Under the new organization the senior manager at the site will be the production manager. This position will have responsibility for operations and chemistry. The responsibility for maintenance, maintenance planning, engineering, safety analysis and other functions will report to managers who support both Temelín and Dukovany. Essentially the plant manager for both sites will be the Director of the Nuclear Energy Department.

Since this organization has not been implemented, it cannot be determined now if the new organization will provide a positive or negative result. The team encourages the plant to have a knowledgeable, independent review of the impact on operational safety after the plant has some experience with the new organization.

The nuclear energy division has developed a document, which details the management expectations for the division. Indicators and goals for the division and specifically for Temelin complement this document.

Not all the elements of self-assessment have been developed for Temelin and the plant should work to learn of the self-assessment programmes, which have been developed at other facilities during the last several years. The team encourages the plant to visit other facilities that are leaders in the use of self-assessment to see first hand the techniques now being used in the industry. Since construction and commissioning is finished, the time is ripe for the best of these techniques to be implemented at Temelin.

# PART III
# GOOD PRACTICES IDENTIFIED DURING OSART MISSIONS CONDUCTED IN 2001, 2002 AND 2003

## 1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

### 1.1. Corporate organization and management

*Ling Ao*

**A safety culture pocket manual was distributed to all staff of the company.**

In order to promote a good understanding of the safety culture, the plant has published a safety culture pocket manual for all staff. The basic concepts of safety culture in INSAG-3/4, the principles of operational safety management of plant, the safety culture factors analysis, the requirements for leaders, organization and staff on the safety culture point of view, the comparison of good behaviour  and bad behaviour of staff etc. are included in this pocket manual. It is very useful and helpful for plant staff to understand the safety culture, specially for the newcomers. Associated with that, a mouse pad, containing the fundamental principles of the safety culture basics was also furnished to everyone in the staff organization.

*Angra 1*

**The plant has a creative and stimulating training module in its General Employee Training programme dedicated to safety culture.**

It consists of a 2 hours lecture and discussion on actual interesting events that involve safety culture aspects. This applies to all employees and contractors. The subjects of the lectures include: a national navigator who navigated between the North and South Poles — a risky journey, in a very well planned and courageous manner, well supported by a competent group of workers — a positive example of safety culture; the climbing of the Mount Everest, when the aim of production overcame safety and resulted on serious accidents — negative example of safety culture: the performance of the Brazilian samba school parades and a symphonic orchestra concert, examples of good planning and team work leading to success: an oil submarine platform incident, a serious fire event where lack of recognition of high risk, lack of prevention, knowledge and leadership led to a disaster, a negative example of safety culture. These lectures include the principles of safety culture, and bring to discussion positive and negative contributors and signs of improving and declining safety culture. It also provokes comparison with the plant work environment. The lecture themes change each year. The lecture, obligatory to all employees and contractors at the plant site, is repeated several times at the company head office.

### 1.2. Plant organization and management

*Ling Ao*

**A self-assessment guideline was prepared to effectively evaluate the operations preparation work before fuel loading.**

This guideline is based on the WANO peer view guideline and OSART guideline for regularly assessing the operations preparation works before fuel loading and a yearly self-assessment programme is also implemented according to this guideline. The quality assurance staff from Operations is involved in the self-assessment as auditor.

***Paks***

**A ‘Pool of Talents’ programme has been designed and implemented to ensure continuity in succession management and to ensure nuclear safety through timely actions by developing future managerial and technical potential from its workforce.**

The Human Resources department at Paks NPP has identified, in view of the plant’s potential life extension, the need to plan for the future to ensure adequate replacement of technical and management staff as the workforce ages and retirement in key positions takes place. This is to ensure the continuity of safe and reliable plant operation. The initiative is called a ‘Pool of Talents’.

Applicants to this pool are by either recommendation from supervisors or by volunteers from motivated personnel. Comprehensive testing has been carried out of the candidates and feedback has been prepared and this will be given to the candidates. Opportunities will be given to them for continuous and planned skill and competence enhancement.

With this programme in place the talents and gifts of the plants personnel will be uncovered helping the station meet its current and future human resource challenges to produce electricity safely and reliably.

***Dukovany***

**A system of performance indicators, which was developed for the purpose of support of management of all areas of the power plant is used directly by the Dukovany managers for management of their areas.**

The indicators are structured and it is possible to monitor performance down to the individual units. The indicators consist of main, partial and supporting indicators for each area and these are monitored and guaranteed by the individual managers. What makes the use of this system most important is its inclusion in the system of Dukovany management, i.e. the annual plan of Dukovany NPP and the Harmonizing Program. Criteria and acceptance criteria are determined for the indicators and their actual values are assessed monthly. The actual values are displayed directly for the specified objectives in the Dukovany information system.

This method of use of indicators makes it possible to provide motivation for managers on all levels and monitor trends in graphic form. This supports managers when preparing proposals of measures leading to improvements and thus, system of continuous improvement is formed. Information notice-boards are located around the power plant where each power plant department can see its performance indicators and at the same time, all employees of Dukovany are informed and motivated. This system also enables direct inter-link of data (charts) facilitating the work of managers during their presentation of indicators.

In Maintenance Division the indicators are established on the division level, cascaded to specific indicators for maintenance sections and cover a wide range of goals and objectives. It has been demonstrated how the performance indicators gives the management the possibility to take corrective measures based on the trends given by the indicators, for example to improve availability on diesel generators and cut pumps maintenance costs.

The team noticed that another very important step is the inclusion of the whole system of indicators into the system of assignment of tasks from the side of ÈEZ, a.s. corporate management and at the same time, it is used as part of the annual evaluating reports covering the relevant areas of Dukovany management, from which the evaluating report of Dukovany is then prepared for the corporate management of CEZ, a.s.

This application receives all elements of protection, which assure safety of data. Only authorized individuals who proceed according to the user's manual can modify the source data for each indicator. Parts of assurance of safety of data are measures, which makes it possible to recover data from back-up copies.

This application will be replaced by a more modern, which was developed as part of an IAEA project and it may be used also at other nuclear power plants. At this moment, it is already used in the department of safety.

***Dukovany***

**A Civic Safety Committee has been formed to involve the local community in plant activities.**

External communication at Dukovany NPP has tremendously positive results which has resulted in the 80% of the population supporting operation of the plant. The Civic Safety Committee composed both of civic members, such as local town majors, and professional employees of NPP are active in releasing publications (ZPRAVODAJ) and technical information in the region.

The unique features of this committee are:

- The committee members have received detailed training about the plant;
- They are allowed to participate in safety evaluations;
- They are informed about plant events and the corrective actions taken following those events;
- All the members are qualified and have permanent badges, which allow permanent and unescorted access.

In addition, safety culture is the main message transmitted to the public by an excellently equipped Information Centre.

***Tricastin***

**Management initiative to improve plant performance.**

Tricastin NPP has achieved Rapid and broad improvement in a number of areas over the last few years. The management tools used to achieve these results collectively are an effective means to achieve rapid improvement.

Strong leadership and control of safety related the management team communicates activities coupled with a sense of management planning professionally and consistently.

The programmes that make up this good practice are:

The forward thinking management lead strategy formulated approximately 2 years ago has been supported by an effective integrated information system which links all the key business objectives such as, business plans, action tracking, training, documentation updates, performance indicators which are accessible to all users.

The anticipated loss of competencies over the next 10 to 12 years has been recognized as a major future issue and the replenishment programme is ongoing. Both corporate and plant management are fully supporting this programme.

It was recognized that the interface between human resources department, training department management teams and specific training representatives within each department has become a means of improvement at Tricastin NPP.

Operation department training is supported by committed management involvement, such as attending and evaluating of training in classroom and on the simulator including the observations and operator assessments.

Managers and supervisors are also involved in the design of new training courses within the operation department.

In order to unite staff across all departments, Operations developed a document entitled “Operations Nuclear Safety Requirement”. All departments shared in these straightforward requirements to improve the performance of the plant in terms of nuclear safety, industrial safety and radiological protection and availability. The document aids other departments to understand what is essential to safe and reliable operations.

A contractor monitoring programme has been implemented that directly contributes to the improvement of safety practices at the job site. The review team recognizes the deployment of the “Industrial safety challenge” supported by management inspections in the field, as an important mechanism to stimulate improvements in this area.

Tricastin NPP is the first plant in the EDF fleet to implement the status-oriented approach in the emergency planning area. The staff took a leading role to develop and to implement the procedures in co-operation with the Bugey training centre. Some of the improvements included procedures to improve on site protection of staff and the issuing of potassium iodine tablets. Improvements in information transfer and communication between the “Poste de Commandement (PC)” have improved exercise performance.

Significant improvements in procedures, supply and use of equipment, training regimes plus a substantial increase in the number of on-site formal emergency exercises per year, have raised the standards of emergency preparedness markedly.

The development of the Human Factors Network provides for training one or two human factors evaluators in each plant group. These people will lead the human factors development within their group, they will ensure that the needs of their group are represented in the development of the human factors programme, and they will report and analyse human factors issues.

These programmes support the achievement of overall improvements towards higher standards and encourage the plant to continue to move forward with the same determination as has been demonstrated over the past 2 years.

***Nogent***

**The Nogent NPP Management launched an action generalizing the supervisory inspection programme to improve management process in compliance with ISO 9000/2000 Standard in May 2001.**

All managers and directors have implemented the inspection policy and programme. This approach provides a record of the delegations granted in technical and non-technical field and constructive input to in-house experience feedback.

An action plan is established for all subjects — responsible personnel and activities that are important for all the departments. This provides a record of the delegations granted in technical and non-technical areas-activities. Standard charts dedicated to each type of activity check are available for easy comparisons. Fast feedback information for correction is available in real time. Inspection activities are scheduled and followed-up on a monthly basis. A global yearly status review is conducted by the communication department at the end of the year to provide experience feedback for the following year. The department performance indicator charts supplement it. The whole process provides a constructive input to in-house experience feedback.

***Civaux***

**Enhancing first line managers' professional standards in shortened management lines.**

The plant programme designed to enhance first line managers' professional standards is based on a "mirror" group comprising ten percent of the first line managers working in the various departments. They express and evaluate their needs so that these can be taken into account in the design of the programmes aimed at enhancing the first line manager's professional standards.

This "mirror" group allows for the involvement of first line management in a continuous approach focused on improving professionalism and fostering a high level of autonomy. They are first to take part in the developed training sessions and permanently check and collect the comments expressed by their colleagues who follow in the training so as to further improve the programme.

The first stage in the programme focuses on team management, industrial policy, managing contractors and labour law. The second stage focuses on the economic culture and skills development.

This good practice involves first line managers in developing their own professionalism and empowers them to become more autonomous while fostering continuous progress.

***Civaux***

**Newcomer's report in order to convey and make use of the experience and professional background of all newcomers to Civaux, a so-called "newcomer's report" is drawn-up 6 months after the newcomer's arrival.**

The reception process aims at speeding up the integration of a newcomer, whether he used to work on another plant or in another company. The "newcomer's report" is part of a reception process for newcomers aiming at allowing him to express his thoughts as regards plant practices and status. The newcomer arrives with his own professional background, which is used in order to draw the lessons from his past experiences. He has a "fresh vision", and all the items he finds surprising — whether at an operational or functional level — raise questions.

This document must be written and will be used as a basis for the plant answers.

The newcomer's report must be drawn up 6 months after arrival. It is a summary of what the individual considers as strengths and the questions derived from the aspects which surprised him. This report is presented to the department management's team in order to be used as return on experience. When the newcomer's report mentions aspects which are of interest to all, it is presented in a meeting where all departments are represented, in order to discuss them with the other department Managers and the plant management.

Every 6 months, a meeting is organized with all newcomers and allows them to share their “newcomer’s report”, discuss specific items and even question some processes.

This programme is set up for all new members of the plant, including the management team’s members who are responsible for handing a “newcomer’s report” to the plant manager.

***Civaux***
**Computer system provides all workers in the plant access to key information from anywhere in the plant.**
In order to carry out their daily tasks and assignments, workers must be able to access reliable and available information and documents in real time and close to their work station. The Civaux units have implemented a computer system which allows all workers in the plant to have access to any information from anywhere in the plant.

The following is available to workers:

- Working documents including procedures in compliance with quality assurance rules;
- Department commitment plans (contracts);
- Performance indicators and goals for the unit and all departments;
- Monthly reports on progress to achieving the goals;
- Technical information pertaining to the state of units in operation and/or units in outage;
- Meeting agendas, minutes and decisions made;
- Follow-up of commitments;
- A database of temporary operating instructions that manages temporary operating instructions including writing review, electronic signature approval and fitting.

This good practice fosters a high level of operational and quality communication for all workers.

***Civaux***
**Site transport arrangements to limit accident risks.**
The plant has introduced arrangements to limit the risks of dangerous material transport accidents. Dangerous products or materials are conveyed in accordance with the site’s load dependent routing plan in compliance with signs and rules for sensitive areas. These arrangements provide standardized routes, limit the number of oncoming vehicles passing each other and reduce the risks for the plant and storage or warehousing areas located on the route.

At the site entrance, a routing plan based on the type of transport (sludge, chemicals, fuel oil, etc.) is given to the driver. It provides the route for the vehicle on the site plan, general road use instructions as well as what to do in the event of an accident.

The overall analysis was carried out with all the participants including the departments, contractors and drivers. The risks addressed are:

- Pollution by chemical spillage on the road;

– Contamination during conveying of equipment, material or waste from the controlled area;
– Explosion and fire during the conveying of petroleum products;
– Accidents of a staff shuttle bus.

These hazardous material transport arrangements give a good guarantee that the consequences of a transport accident on the plant will be limited.

***Angra 1***
**The plant has established an effective way to familiarize the staff, appointed for "on call" support to operation during the next week, with the plant's current status and expected events** by conducting the so called "On call staff" meeting.
The meeting is conducted regularly with the goal to prepare proper conducting of the duty from the "on call' staff, appointed for the next week. It takes place every Friday at 04:30pm, and is leaded by the Unit 1 Emergency Group Coordinator (GEU-1) that is the Plant Manager or his representative according to the On Call list. The Operation Manager, the Shift Supervisor, Technical Support, Reactors Physics, Maintenance, Materials (warehouse), Radiological Protection and Chemistry takes part of the meeting where all groups, part of the on call team are represented by their heads-on-duty for the next week. This meeting has objective to discuss the last events in the Plant, important maintenance that was in progress during the day, the current operational status of the plant, plans for the days off, if there is some important task to be accomplished during the weekend, any problem that needs some special attention or some special instruction. Efficiently conducted in a short time, the meeting plays important role in assuring the coordination between the different teams appointed for on call readiness.

***Krško***
**The team has determined that the quality of the 5 Year Business Plan and the rigorous process that created it strength.**
The 5 Year Business Plan provides a clear tool to chart a course of action to maintain the plant in a safe and efficient condition into the future.

The Maintenance Rule and System Health Reports are a major input to the investment decisions covered by the 5 Year Business Plan.

The replace vs. repair strategy on certain components promotes high safety and reliability and the most efficient overall use of resources.

The Business Planning process provides good strategic alignment among managers.

The 5 Year Business Plan supports the morale of the station personnel by demonstrating that senior management is interested in the long-term operation of the plant.

**1.3. Quality assurance programme**
No one

**1.4. Regulatory and other statutory requirements**
No one

### 1.5. Industrial safety programme

*Nogent*

**A global risk analysis method has been elaborated and implemented to improve performances related to nuclear safety, plant capacity, industrial safety, radiation protection, chemistry, housekeeping and the environment in the areas of maintenance and operations.**

The method is applied during all operation, maintenance and technical support activities, ranging from basic operations to interfaced activities. It is divided up into two steps:

- Search for risk and related countermeasures.
- Possible formalization of risk analysis. A common support, available on-line, provides consistency through the site, regardless of the author and the area(s) involved. If no specific risk is identified, the work package will contain a note: “no formal risk analysis”.

A practical pocket manual was edited in order to help out risk analysis set-up and control. This manual down some possible risks covering areas mentioned above. Risk analysis is performed when preparing the work package. Risk analysis data sheet includes all risk-related areas and various countermeasures to be implemented for a given risk associated with planned work and execution conditions. During performance of risk analysis procedure there are different levels and department representatives are involved. The method allows the analysis to be completed with additional items, from the preparatory phase of the work package up to the work on the field by taking into account possible context- related changes.

*Rovno*

**The Labour protection division organizes lessons of labour safety on work at home, garage, and hobbies for all employees.**

Because injuries of NPP employees that occur outside of the NPP are many times more frequent compared to on-the-job injuries, the Labour protection division organizes lessons of labour safety on work at home, garage, and hobbies for all employees. Every week the labour protection division conducts a training workshop with safety industrial specialists related to events analyses as well as injuries that have occurred on personnel during sports activities, hobbies and everyday work at home. On the basis of the analysis, corrective measures to improve the work of the social facilities in the town are elaborated.

### 1.6. Document and records management

No one

### 1.7. Site access control (optional)

No one

## 2. TRAINING AND QUALIFICATION

### 2.1. Organization and functions

*Temelin*

**Evaluation of training effectiveness takes place by means of three different kinds of evaluation sheets to be filled out.**

- by training participants immediately after training,

– by training participants after some months of experiences on-the-job,
– by supervisors who participated in training.

Beside other relevant determinants the training participants evaluate indicators of safety culture.

***Ling Ao***
**LNPS has conducted comprehensive job and task analyses for positions important to safe and reliable operations.** The LNPS has undertaken an effort to reinforce existing training programs through use of the Systematic Approach to Training (SAT). The five production departments each have their own approach to analysis of training needs, based upon IAEA guidance on the Systematic Approach to Training (SAT). Comprehensive job and task analysis have been completed for almost all LNPS positions except for managers and some supervisors. The results of these analyses are being used to upgrade job descriptions, selection criteria, performance appraisals, training programs and plant procedures. Particular positions were selected as pilot projects for design, development and implementation of SAT-based training. The LPH Branch initiated the first LNPS SAT pilot project. In the case of operations, the blocking manager (assistant shift supervisor) position was selected for a pilot project. There has been broad participation in the analysis phase which has helped to create an atmosphere of learning. At LNPS, SAT is no longer regarded as a job for a few experts, but instead is a practice participated by each person, with benefits for all.

***Tricastin***
**Part Time Trainers Club**
Since 1992, Tricastin NPP has been implementing a programme of trainer support to the NPP identified as the "Club des Formateurs à Temps Partiel" or the Part Time Trainers Club. This group of individuals is specially chosen from volunteers, provides training for all the training departments at the site, which allows the trainers to share their plant technical knowledge and experience. This programme also provides a mechanism for strong operating experience feedback. There are currently seventy-six (76) part-time trainers in the club coming from all the departments within Tricastin NPP. They cover the fields of nuclear safety, first aid, environment, emergency plan, radiation protection, information systems and fire fighting. A "club" coordinator within the training □enter manages the scheduling of the part time trainers, relations with the managers and training skills development. Although many personnel volunteer for the programme only those demonstrating the appropriate skills and attitudes are chosen. The part time trainers use their training skills to enhance their career development at Tricastin NPP as possible future managers and supervisors, future full time instructors, future experts and advisors. In the year of 2001 three hundred and eighty (380) man-days of training was provided to the training departments at the plant. The programme is controlled, proceduralized, monitored and assessed on a routine basis to ensure the highest level of implementation. Each trainer has a personnel file maintained within the department and evaluations are performed. Plant management supports the programme and as mentioned above this provides many days of training for plant staff through the use of their staff. At the present time this programme is specifically implemented at Tricastin.

***Tricastin***
**Since the Tricastin NPP has focused their attention on the improvement of training and established and implemented a monitored action plan, multiple methods are in use to ensure skills attached to tasks are met and maintained.**

During the review process it was noted that the maintenance of job functions are not based entirely on traditional type training courses. A specific policy implemented in Tricastin NPP is to offer a variety of methods to trainees to maintain their skills and competencies. The plant supports its new recruits with a formalized tutoring and shadow training programme based on trained tutors and shadow training booklets. Immersion programmes are proposed and implemented to improve cross-functional experience and skills. A project-based training method has been developed where there is theory input followed by the development of a project for each trainee to develop and implement based on course work completed. This project is then presented, discussed and assessed by the training centre and management. Situational team training is then used for practicing action sheets for all field staff. The strength of this system lies in the fact that team management follows the field staff and completes observation sheets during the training. Afterwards well-constructed debriefing sessions use methods of active trainee participation to prod and encourage response focused toward improvement. Newly appointed managers are provided with coaching to ensure they are able to perform the oversight function of this process. As a part of this programme the operational departments monitor infrequently performed and other unusual activities so that these skills are constantly maintained by task assignment rotation and by including the tasks into scenarios for simulator training. The networks set up for key functions such as human factor specialists, contractor monitoring supervisors and team leaders enable the participants to identify training needs, share their experience, brainstorm and solve problems.

## 2.2. Training facilities, equipment and material

***Rovno***

**Full scope simulator is not just used for training of control room staff training but also for electricians responsible to conduct the manipulation in electrical scheme of NPP.** This leads to upgrading of electricians' skills and better co-operation between control room staff and an electrician on duty.

***Krško***

**Construction of instructor guides for Field operator practical training.**

The field operator (non-licensed operator) continuing training is conducted in accordance with annual plan and two-year program. Each year, four training segments / weeks of training are conducted for each operations crew. During one week of training there are some common topics that are attended by field and licensed operators together, but only field operators attend some topics.

The basic topics conducted for field operators are practical exercises to perform field operator duties in accordance with system operating procedures. During one week of training up to four practical exercises are performed on different systems from different field operator work positions.

Each practical exercise is conducted in three parts:

– Short review about system design and functions (1 h);
– Classroom overview of procedure and section that is subject of training (1 h);
– Demonstration and practice of system operation activity on field (2 h).

Training is conducted by two field operator instructors in accordance with previously approved lesson plan/practical exercise guide.

The instructor guide consists of instructor-based information that is used during each part of training. The main portion of the instructor guide is developed on the left part of the document to support the training. Rules of procedure use are detailed and content of specific procedure section is covered step by step. To better support instructor needs, the instructor notes are prepared in colours, to mark steps that are performed by field operators (blue) and are the topic of training, and those that are performed by main control room (gray). Important steps to be discussed in detail are coloured red.

On the right side of the guide are objectives, important instructor notes, questions, and remarks that are used during the training delivery and comments about proposed procedure changes if needed. Operating Experience (OE) given by trainees, addressed by SME or by experienced operation workers, or complement to the procedure developed through the international OE are also written to support applicable portions of the course. Through the official process, the instructor guides are prepared by Field operator instructor, validated by other Field operator instructor, verified by Operations superintendent and approved by Training manager. Finally the instructor guide explains the objective and the timing of the practical evaluation on-site and provide a checking list on last page to perform the evaluation of the work performed.

The goal of Krško NPP is to continue development of this kind of instructor training guides and to make them available to Shift supervisors for use during the On-the-job training.

### 2.3. Control room operators and shift supervisors

***Angra 2***

**The training programme for licensed operators at Angra-2 includes the requirement for candidates to complete an intensive 3-week programme at a Research Reactor in Brazil.** This programme includes both classroom sessions on Reactor Physics, Radiation Protection, and, Thermodynamics, as well as, practical experience at manipulating the research reactors reactivity controls. Aside from giving students a solid grounding in reactor core behaviour , it gives candidates some feel for the effects of reactivity movements in a Nuclear Reactor and respect for the need to adequately control reactivity.

***Nogent***

**Setting up of a professionalism programme specific to trainees supplemented by the use of expertise follow-up logs in the operations department A member of the shift staff is seconded onto days and assigned as a shadow trainer to support the training of new recruits.**

The operations department training manager acts as a tutor for trainees. Meetings are organized periodically between the trainee and the shadow trainer and tutor to take stock of the experience the trainee has acquired in terms of professionalism. To enable the trainee to take ownership of their training a logbook has also been developed.

The log contains three sections:

– A list of infrequently performed activities due to be carried out at fixed intervals;
– A less restricted part in which the trainee keeps a record of the activities carried out that he considers as “noteworthy” or “significant”;
– A section containing generic performance based objectives.

The manager then validates the trainees completion of these activities. The log is also being incorporated into the qualified staffs continuing training programme and may form the basis for dialogue between the staff member and his manager during annual authorization interviews.

### 2.4. Field operators

No one

### 2.5. Maintenance personnel

*Ling Ao*

**Improving knowledge and skills during commissioning.**

LNPS can share technical information with the Daya Bay plant, upon which its design was based. There are some technical differences between the two plants, especially with respect to Instrumentation and Control. In order to improve maintenance skills during commissioning, a database was created on technical differences in I&C for the two plants. A total of 27 technicians participated in the start up team of 14 systems. Each participant was assigned for his areas a task sheet that included 3 topics:

– commissioning and maintenance knowledge,
– details on technical differences,
– training materials for the system.

Each Friday training sessions are held on different systems, in order to extend the knowledge gained within the I&C team. Additionally, a follow-up database is created from this information on special tools and equipment, software backup and spare parts.

Similar approaches were also implemented for personnel in the operations, technical support and radiation protection organizations.

*Dukovany*

**The contractor/supplier training and qualification process at Dukovany ensures that technical competence is assured by both pre-qualification and further specific training relevant to the task to be performed on the plant.**

The training arrangements for site access and general plant knowledge, including appropriate standards and expectations, ensures staff are well prepared for their duties on site.

### 2.6. Technical support personnel

*Nogent*

**The uses of initial training guides to support shadow training in the technical department, testing and chemistry sections.**

The initial training guides used in the sections provide a record of the steps taken to issue authorizations to the staff. These guides list all the skills that must be acquired for each work activities with a view to authorization:

Situational and professional training based on shadow training. A shadow-training programme is established for the department. Each shadow training activity is defined with its expected training objectives, which are given in the operating documents necessary for carrying out the activity. The tutor or shadow trainer assesses each shadow training activity. A staff member responsible for the project supports the programme.

Individual know-how acquired from training, publications, and observations in the field.
This structured approach allows work to be delegated in a traceable way and is supported by the daily assessment by foremen in the field. For authorizations to be issued, management confirms all these skills have been acquired.

### 2.7. Radiation protection personnel

No one

### 2.8. Chemistry personnel

No one

### 2.9. Management personnel

***Angra 2***

**The training organization, with the support of the Human Resource Department (HPD) and line management, has developed and conducted a series of training courses aimed at raising awareness of all staff (both internal and contractors) in safety culture.**
This training was part of a comprehensive plan produced from a cultural survey commissioned by the leadership of "Eletronuclear" done for all staff in 2000. The delivered programme focuses on:

- overview of overall company direction,
- teamwork skills,
- conflict management,
- self awareness,
- trade-offs between safety and production,
- knowledge transfer.

Senior Plant and Utility Managers are directly involved with the programme delivery. The programme is ongoing and new areas are being added to reflect areas identified as needing improvement from the staff surveys. Feedback has been extremely positive and an assessment of the current state will be done with revisions to the overall plan to follow.

***Rovno***

**The training organization with the support of line managers has developed and conducts a series of training courses aimed at promoting safety culture.**
The training addresses all aspects of safety culture and managers are directly involved in the programme delivery. This should help with the application of safety culture principles at NPP.

***Krsko***

**Management Personnel training**

Training for managers at various levels of plant organization is organized commensurate to their position. The programs span from executive positions to supervisory level. Various national and international institutions are involved in these training programs. Some programs are of general management nature while some are specifically linked to nuclear field.

Being an international member of WANO/INPO organization, Krško NPP uses this opportunity to send senior and supervisory level managers to INPO courses for senior NPP management and development seminars for supervisors on particular work positions. Specifically, the Senior Nuclear Plant Manager course and professional development seminars for Shift Manager, Maintenance Supervisor, Engineering Supervisor, Radiological Protection and Chemistry Supervisor, Training Supervisor and Liaison Engineer Programme are used.

Standard management development programs, organized at specialized institutions, are used for different managerial levels. International MBA programs are used for executive management, general management programme of approximate five-week duration is used for higher management positions and two-week programme is used for young managers.

The MBA programme for executive management is a professional degree programme of approximate one-year duration. A faculty drawn from the leading European and North American business schools teaches a curriculum, focused on general management in an international environment. The objective of the programme is to provide a solid foundation in managerial knowledge and skills. Dedication to integrative role of general management and fostering the attitudes and personal characteristic required for effective leadership, are also topics of this programme.

The General Management Programme is a five-week seminar that provides a thorough coverage of managerial knowledge, skills and attitudes, and is aimed at managers who have the potential to take over strategic responsibilities. It covers a set of topics from main business areas ranging from fundamental concepts to the latest trends.

The Young Managers Programme is a two-week course that provides an overview of the main fields of management and managerial skills. It targets beginners in management positions who need to complement their educational background in order to enhance their management knowledge, skills and practices, and to support applying newly learned concepts to practical business situations.

Management development seminar on developing leadership competencies and teamwork skills, tailored to Krško NPP needs, is periodically conducted and is intended for all division directors, line managers and key staff. The topics are selected and customized by direct communication with the selected lecturer and organizing business school.

In addition to above described formal forms of management training, a team building event in nature is organized each year for all division directors, line managers and key staff. Such event is designed to promote achieving results as teamwork efforts and to foster good interpersonal relationships.

### 2.10. General employees training

No one

## 3. OPERATIONS

### 3.1. Organization and functions

*Civaux*

**As part of the self-assessment activities carried out by the operations department, a formalized control programme has been introduced.**

This programme monitors the performance of key safety-related operations activities.

Key safety-related operations activities such as surveillance test scheduling, temporary procedures, administrative lock-outs, alarm management, operating documents in the control room, etc. are formally monitored on control sheets.

Seventeen types of check targeting key operating activities have been introduced and are identified by a letter of the alphabet. These internal checks monitor the effectiveness of operations department activities and assess their performance. They are tracked in independent, stand-alone control sheets including:

- control points,
- the person responsible for carrying out the check,
- frequency,
- processing of deficiencies.

The various checks are systematically discussed at the week-end and during the Monday operations meeting to ensure proper implementation of the process. A comprehensive report is drafted twice a year and presented to operations management.

This control programme has improved performance of key operations activities. In particular, it has helped to reduce the number of temporary operating instructions and the number of alarms in the main control room. Another aspect is that the programme has been effective in ensuring that operations staff complete their required training in due time.

***Civaux***

**NPP has developed an innovative support and expertise structure for the on-line process.**

This unique structure has the advantage of providing a direct link between the shift team and maintenance work planners and placing the shift-manager at the heart of the decision-making process.

Two shift supervisors support the shift manager. The CTTD or deferred-time shift supervisor plans and schedules weekly activities. He provides a direct link between operations staff and maintenance work planners. He relieves the shift manager of planning activities, thereby enabling the latter to focus on operational safety. Unlike other French plants, this position is incorporated into the shift structure.

Thanks to this structure, the CTTR or real-time shift supervisor can focus more closely on daily operations activities, both in the control-room and in the field. He ensures that the interface with maintenance runs smoothly at all times, and has enough time at his disposal to provide the shift team with hands-on support.

This system has proved to be so effective that it has been tested and adopted by other French plants.

With this organization in place, the shift team is truly at the centre of the process.

***Krsko***

**Establishment of a comprehensive shutdown-risk-program.**

Administrative Procedure ADP-1.3.030, Plant Safety during Shutdown, provides instructions for safe plant operation during different shutdown states. It defines the required equipment to be available to ensure defence-in-depth of shutdown safety functions. A combination of deterministic and probabilistic risk assessment techniques is used.

There are seven shutdown safety functions defined:

- reactivity control,
- shutdown cooling,
- inventory control,
- spent fuel pit cooling,
- electric power availability,
- cooling water and other vital support systems,
- containment integrity and cooling.

The outage is divided into nine shutdown states according to the status of the reactor coolant system and the methods used to ensure shutdown safety functions. Required equipment operability is defined for each shutdown state to ensure each shutdown safety function.

The requirements for shutdown safety are built into the outage plan, where the outage schedule is composed of several phases that are directly related to shutdown states. Each activity and each work order within system windows used in the scheduling programme are assigned a shutdown safety function code for the ORAM® computer application that is used in the outage schedule preparation phase and during the outage execution phase to recognize the impact on shutdown safety functions.

In addition, the shutdown safety requirements are assessed in the MCR by the Shift Foreman and by the Shift Engineer using a detailed checklist each shift and before each transition to the next Shutdown State. Simplified composite system schematics are developed in advance for each outage phase. System and equipment requirements are designated in each outage phase by highlighting the required equipment for the specific outage phase in red. These diagrams give the operator a very good overview to control the protected equipment and to recognize the impact of any outage activity on the operability of the equipment required to provide the safety functions. These diagrams are also used by other plant personnel who are directly involved in outage activities such as outage coordinators, tagging coordinators and supervisory personnel.

### 3.2. Operations facilities and operator aids

***Paks***

**Plant Control Centre**

Considering the fact that plant shift supervisor controls the operation of several units it seemed to be necessary to establish a centre where the unit's main parameters, the national grid connection can be monitored and the appropriate communication is available for the plant control. The plant control centre (PCC) is a workplace for plant shift supervisor, dispatcher and plant chief electric. They are provided with dispatch phone system allowing a direct phone contact with operational personnel of all units in conference mode.

The present role and functions of the PCC in normal operation condition are:

- The PCC shall monitor the operation of units, and some common systems like electric and cooling water systems, heating and other auxiliary systems and the fire alarm systems;

– Two-way communication with National Dispatch Centre;
– Coordinating the work of shift operation personnel monitoring the units and the related process systems;
– Handling of installed emergency preparedness communication devices and completion of tests with specified frequency.

In case of an accident, PCC is the centre from where control the process parameters and operational condition at the location of emergency situation is performed to provide conditions of accident prevention including required notifications and information preparation.

PCC information system is constructed from modular elements suitable for displaying analogue and dual-state signals. Information to the scheme board is supplied by microprocessor data acquisition system from the units, 400/120 KV substation and water in-take plant. PCC computer system includes two VAX type microcomputers and the relevant peripheral devices. The system shall process data received from the units and the dosimeter system.

In case of any potential accident on the plant the personnel will be immediately alerted and informed by the computerized (computer controlled) acoustic safety alarm and information system in accordance with the emergency preparedness plan (including activation of civil defence sirens and public alarm). The pannon-courier of pannon GSM system is used for a fast, easy-to-handle and at the same time reliable alarm system by sending short textual messages (SMS) by cell (mobile) phones, by monitoring the messages sent, and by processing the reception of the messages.

***Dukovany***

**Effective operator aids have been provided for Control Room staff to enhance their capability to monitor and respond to changes in plant condition.**

In addition, good human factors methods were used to develop Safety system surveillance test sheets that are colour-coded to clearly designate which work groups are responsible for the execution of each test section. The unique features of these operator aids are as follows:

A computer based alarm response programme has been developed that is simple to use and readily accepted by operations staff. It is a graphical replica of each annunciator panel in the control room. The operator simply selects the panel, and then clicks on the corresponding alarm window on the computer, and the alarm response procedure is then immediately visible on the screen. A backup paper copy is also maintained in the control room.

Each section of the Safety system surveillance test procedures is highlighted in a different colour code according to which work group is responsible to execute that section. For example, the steps for Field Operators are highlighted in red, Instrumentation & Control are highlighted in yellow, Electrical in green and Control Room operators are purple.

The computer based alarm response programme allows rapid access to control room alarms and the colour-coded surveillance test procedures reduce the risk of human errors. Both of these operator aids can result in an overall increase in operational safety.

*Santa Maria de Garona*

**Field operators take field data with hand held computers in which the trending of the parameters taken over the last six days is available. This helps the field operator to enhance surveillance of plant equipment.**

Field data are taken with hand-held computers, which have the data from the last six daily walk-downs. For each parameter there are maximum, minimum and variation limits, which warn the operator when surpassed. In this situation the evolution of the parameter over the last 6 days can be immediately observed either graphically or in data. The comments from previous walk-downs can also be seen.

Therefore this tool enables the personnel, who perform the walk-downs, to obtain important information about the evolution of the parameter, to help in decision-making and to anticipate responses in order to prevent the degradation of equipment or inadmissible parameter values.

This improves surveillance of equipment performance and contributes to an increase in plant operational safety.

*Angra 2*

**Safety Function Determination Programme (SFDP)**

In addition to the plant computer information system and SPDS system the plant developed a Safety Function Determination Programme that supports the operators in the Control Room in identification of plant safety status.

This programme is a tool that helps the staff of the control room ensure that any loss of Safety Function is detected and that the appropriate actions are taken. In the case that two or more Limits Conditions of Operation (LCO)are not fulfilled, simultaneously, an evaluation will have to be made, to determine if there is a loss of Safety Function. Additionally, other appropriate actions must be taken as result of the inoperability of auxiliary systems.

The SFDP is capable of:

- Crossed verifications in trains, to assure that the loss of the capacity to execute Safety Function, assumed in the accident analysis, will be detected;
- Evaluate that the plant is kept in a safe condition, if there is an inoperable system or function;
- To assure that the Conclusion Time of an inoperable system is not improperly extended as resulted of the inoperability of auxiliary systems;
- Other appropriate limitations;
- The SFDP identifies where there is a loss of Safety Function;
- If the loss of the safety function exists, it is necessary that the corresponding actions and technical specifications imposed limitations are applied. The updating of the programme is assured by a long-term contract with the supplier of the software.

### 3.3. Operating rules and procedures

*Paks*

**Technical Specifications are under development to be fully computerized with connection in the plant process signals.**

On-line evaluation and presentation of Operational Limits and Conditions (OLC) or Technical Specification (TS) will be in the reconstructed Paks process computer.

The main function of the TS evaluation and presentation module integrated into the new process computer is follows:

- On-line evaluation of TS algorithms and logic diagrams;
- Interactive displaying of evaluation results in form of alarms;
- Displaying of those analogue and discrete measured signals;
- Intelligent and structured displaying of text of the TS document and browser.

One of the most important parameters in the TS is the “reactor operation mode “ which gives information about the actual reactor status. The signal is also determined on-line, based on the main reactor and primary system parameters.

TS displays can be either called from the process computer workstation header or from the display selection menu. This system can illustrate about ten different displays.

The advantage is that the system will give the operator a warning when TS is violated. This will reduce the delay time to take action.

There is just now a demonstration of the system on Intranet.

### 3.4. Operating histories

No one

### 3.5. Conduct of operations

***Tricastin***

**The site has a very effective programme for minimizing liquid effluent releases.**
The operations department has been a driving force behind a site programme for minimizing liquid effluent releases. It was observed by the team that Tricastin NPP has moved from a very poor position among other EDF plants to the third best position. The amount of released liquid effluents has dropped from 5.5 GBq (1990) to 1.5 GBq (2001). At the end of 2001, the release rates were less than 50.0 MBq/month. Tricastin’s goal is to become ISO 14001 certified by 2003 and this accomplishment will help achieve this aim.

Site management has emphasized the involvement of all plant stakeholders in this initiative. An effluents team, consisting of seconded technicians from the operations, chemistry, radiation protection and maintenance departments, has been formed and manages the overall programme. This methodical involvement of seconded technicians from all of the departments that can influence either the production or processing of effluents has been the single most influential factor to the success of this initiative. Most notably, the auxiliary operators from the Operations department have assumed a personal ownership for and commitment to the success of this initiative. They have become the driving force in the results that have been achieved.

First, the auxiliary operators have dealt with the production pathways for liquid effluents. They have worked with the reactive maintenance team to identify and eliminate the sources of liquid effluents (e.g., primary coolant leaks). Their success can be measured by the fact that over the past 2 years, the input volume has been decreased by 90%.

Second, on a daily basis the auxiliary technicians record the volumes in the various tanks. They then enter this data into a dedicated effluent computer application (TEU), developed by the plant. This application, allows for the accurate tracking of the activity and volumes of all liquids in storage. More importantly, it provides the means to segregate longer lived radionuclides, such as Co-60, thereby minimizing the cross-contamination of tanks and the associated increased releases that would occur.

A third improvement has been the addition of a special filter to trap AG110m. This improvement was made as a continuing improvement effort, possible once the initially high release rates had been remedied.

Finally, the programme has been assisted by the categorization of liquid effluents into four "families." This simple categorization enables all levels of the staff to appreciate the importance of reducing liquid radioactive waste quantities and to understand how best to dispose of them.

***Santa Maria de Garona***

**The process of naming and activating the on-call personnel for operations is very simple and efficient, as it is automatically linked to the shift schedule.**

The on-call personnel have a pager, which can be easily and quickly activated in case of emergency by calling all on-call crew members at the same time. Therefore it is not necessary to have a list of people, who are on-call at that moment.

***Angra2***

**Administrative management of reactivity**

To allow strict and conservative approach for reactivity control the plant has developed and implemented an administrative procedure for management of these issues.

The procedure 2PA-OG013 established the following tasks:

– Discussions and formal classroom dissemination of administrative reactivity precautions and concepts to all Licensed Reactor Operators and Shift Supervisors;
– Controls over behaviour of personnel in control room during infrequent reactor reactivity evolutions, such as criticality;
– Establishment of a natural communications standard between licensed operators, operations manager and reactor physicists;
– Conservative attitudes related to reactivity variations in reactor operations as well in refuelling operations;
– Definition of responsibilities for reactivity related activities;
– Provision of a suggested checklist of items to be used in case of necessity of root cause search for reactivity related issues.

The procedure is included in the re-training programme of the personnel, with good acceptance by the instructors (Reactor Physicists) and the trainees (Licensed Operators).

***Nogent***

**Shift manager safety assessment tasks**

Nogent NPP operational department has a shift organization with one supervisor on each unit and one shift manager for both units. The shift managers are dedicated to safety assessment tasks.

The set of tools and methods described below allow the shift manager to carrying out a complete, traceable safety assessment and are detailed in a department memorandum.

- A safety assessment charts adapted to power operation and outage conditions;
- A safety management chart filled in by the shift manager and networked with operational management committee reported and used in the weekly safety report from safety and quality department;
- An inspection plan integrated in the safety assessment via the shift manager shift log (temporary modification, fire areas, administrative lockouts, etc.);
- Use of the ORLI-system as a complement for assessment of safety-system within safety-margins

***Nogent***

**Unit operating trend monitoring**

A specific follow-up procedure for certain safety criteria parameters on the basis of periodic tests has been developed. The aim is to detect malfunctions before reaching the critical thresholds defined in the normal operating range or in the general operating rules. Some criteria currently monitored during operations are for instance: primary leakage rate, opening time of automatic shutdown switches, clogging of IPS absolute filters, recirculation flow rates of SAG pumps and motor-driven pumps, actuating times of TPA steam valves. This monitoring is principally organized by the Unit operating off-shift structure, in the form of a read-only computer tool that can be accessed by teams. The outage off-shift structure has also implemented for several years the follow-up of safety criteria of periodic tests carried-out on outage

***Angra 1***

**Three-Way Communication Training Tool**

The 3-way Communication computer based training tool reproduces through software some actions that nuclear operators need to take in the Control Room (CR). Pushbuttons and control switches were captured from control room digitally and integrated to a software developed by the Computer Process Monitoring Group (part of Operation Department) reflecting the main control board, each one with 32 control switches and 160 actuators total.
As soon the operator receives the command he will confirm at first, and then manipulate the controls. The system will do a mimic for the actuation and will record on a file for each operator. The expectation is that the operator will use the STAR (Stop, Think, Act and Review), performing the command without mistake. The whole process is recorded, to be analysed in a post-job critique section and was proven to be extremely effective from the operators point of view.

### 3.6. Work authorizations

No one

### 3.7. Accident management

No one

### 3.8. Fire protection programme

No one

## 4. MAINTENANCE

### 4.1. Organization and functions

***Dukovany***

**The different tasks of the maintenance groups are co-coordinated via the administrators and the planning and maintenance information systems.**

The maintenance information system provides excellent information on Technical issues, schedules, failure trends, status of jobs ongoing, contractors, costs and other relevant information used in maintenance. In the system information of jobs already performed is recorded in such a way that a cost benefit assessment can be performed. The information system also keeps track of individuals skills to assure that only qualified people are used.

The architecture of the system and the way the information system is used in the Maintenance Division is as a good practice for the industry.

***Nogent***

**Implementation of outage working time follow-up and self-check system within the MMCR department (maintenance-mechanics-boiler work-valves department) designed to prevent any deviation from employment regulations.**

During plant unit outage periods, work monitors are provided with a paper chart for logging their activity providing them with a simple means of ascertaining that they comply with employment regulations (daily and weekly working time, rest time). This is stand alone chart that provides a reminder of the rules to be followed and allows the working periods assigned to the work inspector to be formalized by the project manager at management level. System provides: rapid simple to use self-check, trace ability provided between the worker and his functional supervisor and than his hierarchical manager, a remainder of employment regulations and system for anticipating the working time margins available for weekend on-call work.

***Krsko***

**The use of the contractors' self-assessment and correction action plans in assuring the continued development of contractors.**

In conjunction with long-term contracts or long term relationships, allow high standards in contractors` performance to be established in particular for a country with a limited market.

The enhancement of the contractor performance quality through technical specification of procurement request is implemented as follows: QA programs, qualification and training of personnel, documentation, procedures, standards, history tracking, special tool and remote control equipment, reports, and self assessment and correction action plans as a tool for development. These obligations are evaluated by maintenance and officially checked by QA department. Moreover common training of involved personnel is used to improve cooperation between utility and contractor

### 4.2. Maintenance facilities and equipment

***Temelin***

**The plant has established for its operating phase a method to monitor and analyse electrical disturbances and equipment performance.** The operating organization arranged to leave in service the start-up commissioning electrical monitoring system (MOSAD-4) to provide continuous on-line monitoring capabilities as a way to record important event information for assessment of electrical disturbances. The capability for electrical system monitoring consists of inputs from 112 analogue and 3264 binary signals of Unit 1 Temelin. An external time standard source for correct time marking of the events and flexibility in setting sample rates set for both analog and digital inputs are features of the system. This allows for the analysis of electrical related events to be explained as the large number of binary signals and correct time makes it possible to determine the sequence of events and make determinations that the equipment is performing correctly.

Since the system is capable of high speed sensing and analysing electrical parameters during transient conditions, it is being used to monitor most of the electrical tests performed at the plant. The range of testing being monitored is from relatively simple activities like motor starts, to very complex tests such as the loss of offsite power and start of the 5 diesel generators with simultaneous back-up energization of all 6 kV switchgears. The plant is now recording routine tests performed during operations, for example the diesel load sequence test or back-up energizing of a switchgear, to analyse and compare the results with previous or other similar tests as a method for detecting deficiencies.

Data from the monitoring activities is saved in the computer and subsequently stored on CD media for subsequent use.

### 4.3. Maintenance programmes

***Santa Maria de Garona***

**The plant has been innovative in the development of new designs, tools, and technical processes.**

Much of this innovation has been focused on the reactor vessel and reactor vessel internals.
To ensure that the innovation works properly the first time, the plant has made extensive use of mock-ups to verify the design, test the tooling and validate the new processes.

A comprehensive variety of reactor vessel mock-ups and remote handling tools are available for testing the performance of equipment and also for training maintenance personnel in reactor vessel inspection and repair activities. Mock-ups can be flooded with water and include realistic flaws to simulate similar conditions to what will be met on the plant.

Employee rehearsals of such activities create the conditions where repairs and inspections can be carried out more efficiently anticipating potential problems and shortening critical path time that otherwise would not be possible.

Examples of these are:

- Equipment development and mock-up training for inspection and repair of control rod drive penetrations and jet pump restrain restrainer brackets;
- Tooling developed for core spray piping as-built measurements prior to replacement, material surveillance test specimens insertion and removal, recirculation nozzle and jet pump nozzle plugging for decontamination purposes, etc.;
- Mock-up development and personnel training for feedwater spargers replacement, core shroud repair and core spray piping replacement;
- Blind testing of contractors’ ultrasonic inspection equipment prior to use for vessel inspection during outages.

### 4.4. Procedures, records and histories

***Temelin***

**The development of a set of Process System Ownership and Maintenance Guidelines (PSO&MGs) represents the stored knowledge of how the plant's systems should be operated, maintained and tested.**

It is the intent of the plant to have this set of documents represent a legacy of knowledge that is being obtained by the System Engineers as part of ownership of their assigned systems. The content of the guidelines consists of:

- Process system description functions and boundaries, including the connected and supporting process systems;
- List of important equipment including the safety categories (provides priorities);
- Safety and availability requirements for the system and its equipment;
- Process load characteristics, constraints and media used in the system;
- Degradation mechanism, its consequences and parameters to measure them;
- System surveillances, evaluation and parameter trending;
- List of periodic maintenance, ISI, and IST;
- List of predictive maintenance and methods of use predictions, and the evaluation of operational;
- Maintenance, testing and inspection results.

Once the entire set of PSO&MGs is developed, the set will represent collectively, the important databases of components and requirements for such programmes as preventive maintenance, ISI, Surveillance, and outage planning.

As a result of the start-up and commissioning operation, the System Engineer is using the development of the PSO&MGs as the collection vehicle for important operating, maintenance and testing information.

***Ling Ao***

**The utility developed a maintenance procedure modification follow-up sheet that is used for validation of used procedures prior to their initial use.**

The utility is developing 4462 new procedures. The work started in June 1999 and will be accomplished at the end of 2002. At initial release of a procedure its status is considered preliminary. Prior to the first use of the procedure, the users must observe if the procedure suits the actual conditions of maintenance and offer appropriate feedback or practical experiences and recommendations. This information is documented on the Modification Follow-up Sheet that is contained in the Maintenance Procedure Writing Guideline, IP/DOC/014-C. The responsible manager of the procedure reviews the feedback and comments and updates the procedure to a certified for use status.

The benefits of this approach are that there is timely feedback of user comments; the clarifications or correcting of inaccurate information that was incorporated in the procedure at the procedure writing stage will be identified early-on in the use of the procedure; and expand the responsibilities for procedural accuracy and quality to the personnel conducting procedural implementation instead of just the procedure writers. The features of this process will aide in achieving the development and use of effective maintenance procedures.

***Temelin***

**A process suitable for predetermining the appropriate torque to be applied when tightening the bolts was established when state-of-the-art gasket material is used.**

This action was necessary because asbestos containing gaskets were replaced in a large number of valves with gaskets of other materials, like expanded graphite and other state-of-the-art materials. By using dedicated, validated and certified software developed by the CVUT Praha, the Czech Technical University of Prague, the process to establish reliable quantification for all application cases was introduced successfully. The Czech Technical University of Prague was consulted, and acted as the Technical Support Organization for this project, and also provided the required training for the plant personnel to demonstrate their competence.

### 4.5. Conduct and control of maintenance work

***Angra 1***

**Managers and supervisors monitor important maintenance activities in the field based on expectations to objective established in a formal procedure, PA-ME 10.**

The objective of the observations is to identify weakness in human performance. The expectations are summarized on a blue card that is filled out by each observer with a numerical grade. The expectations on the card cover Attitude, Communication Material Condition, Supervision, Procedural Adherence, Industrial Safety, Radiation Protection, and Qualifications.

The results of these evaluations are used to get quantitative data on human performance and make corrections where necessary. The results are compiled in a monthly report.
The evaluator also discusses the results of each observation with the workers observed.

***Rovno***

**The plant has performed maintenance works under a slogan of the motto “Prevent rather than Correct”.**

It is well understood by all affected personnel. Under this slogan, the plan aggressively traces the in-service inspection records, root cause analysis results, and maintenance histories of equipment using the database KUDO to strengthen the predictive and preventive maintenance programs and the life extension program.

After the plant management sloganeered the motto in 1996, the trends of increasing quality of maintenance and of decreasing troubles of equipments are evident in the records such as number of incidents, unit load factor, availability factor and time factor. The slogan encourages good safety culture and leads the personnel to maintain the plant equipment in such a way that it is safe, reliable and efficient.

### 4.6.Material conditions

No one

### 4.7. In-service inspection

No one

### 4.8. Stores and warehouses

***Civaux***

**High standards of stock control and good warehouse management contribute towards effective and efficient environmental practices and reduce the likelihood of contamination spread.**

Examples of how this was highlighted include the following:

In order to minimize traffic flow on site and to control the entrance and exit of goods and equipment a buffer store is located at the site perimeter. Thus delivery vehicles are not required to enter the site. All the deliveries and shipments are recorded. The store management personnel then take the parcels to the work sites.

There are gamma radiation monitors at the entrance and exit to the buffer store constituting an additional barrier to minimize the risk of contamination spread on and off site.

In order to optimize the preservation of all the spare parts in the general stores, climate control is provided, thus reducing packaging, waste, inspection time and hence cost. Temperature and humidity are strictly regulated to maximize shelf life.

All chemicals are segregated. Thus in the unlikely event of a chemical leak the consequences to other stored chemicals and equipment are limited and the impact on the environment is minimized.

**4.9. Outage management**

***Temelin***
**The Utility developed and issued to personnel involved in outage activities a pocket sized outage information guide describing the objectives of the outage, health and safety protection of personnel, fire protection principles, foreign material exclusion provisions of the open main coolant systems, and other outage related item related to the expectations of behaviour of personnel**.
The guide was produced in Czech and English to allow for a wider distribution and understanding of the important information needed to be adhered to during a plant outage. As a result of the issuance of the booklet, issues arising out of co-coordinating activities were being rapidly and frequently communicated by working level contractor personnel to the outage management organization. This condition prevented waiting for the next daily meeting to be the forum to raise the issue or concern. The team noted that it was unusual in the industry for plants to be using such a communication tool while it is still in a start-up phase of operation.

***Civau*x**
**Civaux has adopted a project-based approach to the management of outages.**
The organization structure is well defined with team members seconded from various departments to ensure appropriate knowledge and skills are available in the preparation phases of the outage. Integrated information and planning systems are also provided thus enabling the plant to make continued progress in the areas of operational safety, quality, radiation protection, environmental safety and overall outage performance.

Outages are managed by plant senior management, with a high level of support provided by specialist departments. Responsibilities are clearly defined in terms of operational safety, risk prevention, environmental safety and performance.

A multidisciplinary team whose members are assigned from the following areas coordinates outages: maintenance, operations, safety-quality, chemistry, scheduling and industrial safety/radiation protection, as well as nuclear and conventional logistics.

The outage project is divided into a number of modules with effective monitoring, review and follow-up at each stage of the project.

The ten-year project group provides the link between the outage and power operations project teams. It is a cross-functional team in charge of scheduling inspection and maintenance activities. It gives a ten-year strategic vision to site management, support functions and major contract organizations. Hence it provides a clear understanding of:

– Scenarios adopted and outage content for coming years to the outage project team;
– Competencies and skills need to be acquired and developed internal and external to the organization;
– Outage strategy and effective transfer into medium and short term planning;
– Workload balanced out for EDF and contract staff;
– Activities to be carried out during power operations to the power operations project team.

Computer tools are used to ensure national and international operating experience feedback is incorporated into the planning process.

A rigorous configuration management tool (SIAT) has been developed on-site to control the change in reactor states during outage periods. This ensures compliance with operations and maintenance requirements during outages and hence safeguards nuclear safety.

Results:
Operational and industrial safety results during outages have been improving constantly since 2000. Excellent results are being achieved in the areas of radiation exposure and the environmental safety.

Reduced number of significant operating events for which the outage structure is responsible.
No safety-significant events reported as a result of deficiencies in the planning of activities.
Reduction in the number of industrial accidents.

Lowest integrated exposure levels during outage, compared with all other French plants.
Compliance with radioactive effluent production targets.

## 5. TECHNICAL SUPPORT

### 5.1. Organization and functions

*Ling Ao*

**A detailed analysis was performed and made widely available to help engineers understand the differences between the twin plants LNPS and Daya Bay units.**

Though the LNPS is based on the Daya Bay units, there are a lot of differences of systems and equipment. Technical and maintenance departments are shared between the twins. In order to help engineers understand the differences between the two plants, the Equipment branch has performed an analysis. Important systems and equipment with differences were selected and the system engineer wrote a detailed report on the subject. Lectures were given and the reports were published on the web.

The benefit of this approach is higher quality of work, as the staff being more familiar with the differences between the plants at an early stage. Another benefit is that maintenance strategies can be developed as soon as possible for all equipment, which saves costs.

***Angra 2***

**Regular presentation programme for procedures and experience feedback.**

The Plant Technical Support organization has found a simple and effective way to illustrate the Plant administrative procedures content, a weekly presentations program. This program, started in Sep. 2001, is now on its second cycle. Based on a schedule prepared in advance, every Tuesday, at least one administrative procedure is presented to Technical Support personnel. These presentations are conducted by the Technical Support personnel and, when applicable, by the Plant Managers. This programme is also used to promptly discuss procedure updates. A similar presentation programme is used to disseminate the Internal Operational Experience.

For each presentation, an attendance list is filled out. This initiative has helped the Technical Support organization to speed up the personnel understanding of plant policies and procedures and to have information about experience feedback.

***Nogent***

**An Operating Quality Committee, headed by Safety Quality Director and led by Human Factor Consultant was created as a proactive means to promote adequate addressing of human factor related issues at the plant.**

The plant has employed a human factor specialist to help and assist plant management in any matters relevant to human behaviour analyses or human performance. In order to facilitate the integration of this specialist in the plant team and to enhance the promotion of better understanding of human factors related matters a decision was taken to create an Operating Quality Committee. This committee comprises 22 volunteers staff members from all departments who are actively promoting good communications on human factors related matters to the plant staff. These arrangements seem to work very effectively, since the human factor analyst has proved already very useful in addressing human errors in the plant event analyses and developing several proposals for improvement of staff operational practices. This innovative approach to address human factors issues enables a better perception of human factors on the site, less focused on human error but perceived rather as an aid to understanding employee's behaviour . Additionally by involving the workforce in discussing human factor related issues, and then encouraging them by demonstrating good use of the information they have provided, “ownership” is strengthened.

### 5.2. Surveillance programme

***Civaux***

**PROSUR and SIAT Programs**

It is important that document and procedure configuration controls be managed closely to adequately promote reactor safety. The PROSUR and SIAT Programs provide important elements of this control.

**PROSUR** is a single reference programme that encompasses all plant system activities, for example: maintenance, operations, chemistry, and surveillance tests. The Prosur programme provides configuration document and procedure management controls. These controls apply to technical specifications, procedures, and governing documents for the applicable equipment.

**SIAT** is a rigorous configuration management tool especially for outages. It was developed to control the change in reactor states during outage periods. This ensures compliance with operations and maintenance requirements during outages. Prior to any change in reactor state during the outage, coordination files are prepared via SIAT, reviewed by the outage safety committee and validated by the shift operations manager. SIAT is linked with the outage work schedule i.e.: work windows, milestones and outage safety committee hold points

### 5.3. Operational experience feedback system

***Nogent***

**A plant special committee, involving staff members from all departments, was created to enhance rapid and prompt dissemination of operational experience feedback.**

By establishing of information exchange (REX) committee and using a software application FIREX the plant has implemented a very effective means to disseminate the information on safety significant and safety important operational events amongst all the departments. During the REX meetings every second week the representatives of each department are requested to comment on the recent events reported. After a brief analyses during the Committee meeting a person is appointed to be responsible for providing more detailed information on the way given events could influence plant safety and on any further analyses or corrective actions, should such be needed. FIREX application allows closely monitoring and controlling the implementation on any plant actions, which might be needed to react promptly to any particular event and to implement lessons learnt.

***Rovno***

**An information system on events in NPP's is available at Rovno and allows direct access to all event reports from Ukrainian NPP's.**

CAESAR (Classifying Abnormal Events System for Analysis and Reporting) is a database of nuclear power plants events. It contains full and structured reports on events occurred in Ukrainian NPP's from the beginning of their operation. The system is continuously supplied with fresh data and electronic exchange is performed between Ukrainian NPP's on a regular basis via NAEK "Energoatom". Specialists of main departments of Rovno NPP (83 in total) are CAESAR system users. Ease access to this information enhances the OEF process in many aspects:

- To familiarize personnel with messages about events in Ukrainian NPP's;
- To brief staff on specific issues of their activities;
- To perform quantitative and qualitative evaluation of events trends;
- Planning and supervising implementation of corrective actions and measures decreases number and severity of events.

### 5.4. Plant modification system

***Dukovany***

**A well developed computerized system is in place to monitor the modification process at the plant.**

The system includes categorization of the modifications requests in accordance with established criteria, evaluation of each modification proposal in accordance with the plant's strategic objectives of power plant, safety implications and other 29 criteria established to evaluate the priority of each new modification proposal. Analysis of the safety impacts, financial, manpower resources, various other parameters enables to assign the general strategy for the implementation of all the modifications in the modifications package including the "hard deadline" for the modifications implementation. The system works on-line, monitoring the flow of the entering modifications, evaluating and ranking each entry in such a way that the current priorities (safety is considered as one of highest priorities) are maintained. The system uses the PSA analysis to define the priorities of the safety related modifications dependent on their risk values.

***Angra 1***

**The PST (Programação Semanal de Trabalho — "Weekly Work Scheduling") is a maintenance-planning programme that uses PSA to calculate the risk rate (CDF — Core Damage Frequency) and the weekly cumulative risk (CDP — Core Damage Probability). The objective of the programme is to reduce the level of risk arising from on-line maintenance planning.**

When the maintenance and testing programme results in the plant being at an elevated ("yellow") level of risk, then additional qualitative analysis is performed to determine means by which the risk can be minimized. Examples include:

- Specific plant line-ups to reduce the requirement for operation of standby plant and for operation actors consequent upon "Loss of Off Site Power";
- Prevention of maintenance on Auxiliary Feed Water Systems when "risk of trip" activities are being performed;
- Preventing maintenance on containment protection systems during periods when the main instrument air compressor is not available, due to the risk from small LOCAs (including SGTR).

The qualitative assessments are used by work planning to ensure that the compensatory measures are planned. They are also passed to the shift supervisor who ensures that the appropriate measures are in place prior to the release of the affected equipment.

### 5.5. Reactor engineering

***Angra 2***

**Regular fuel integrity meetings. A monitoring programme was established to continuously evaluate fuel integrity.**

The programme includes regular meetings conducted on a three months frequency to discuss current cycle performance based on reactor physics, on radiochemistry, on radiation protection, on core design, and on future cycle expectations. The Plant manager chairs these meetings and attendance includes managers and technical representatives from Technical Support, Operations, Maintenance, Chemistry, Radiation Protection, Core Design Calculations, Thermal Hydraulic Calculations, Nuclear Safety Group, Systems Engineers and invited Specialists. The programme provides guidance for discussions on inspection equipment, debris control, fuel handling, radiochemistry and actions to be taken in the event of fuel failures. The meeting frequency is shortened at any sign of fuel degradation. The programme has demonstrated the corporate support capability in cases of fuel failure in support of the Plant needs.

*Nogent*

**Action plan "Optimization of fuel processes" and monitoring the activities during start-up tests after refuelling.**

The plant has developed very comprehensive complete and accurate action plan "Optimization of fuel processes", with the following objectives:

- Clarify roles and responsibilities including quality assurance (departments, plant, corporate level);
- Guarantee the quality of all activities;
- Training, skills development and ensure their sustainability;
- Implement a programme for the integration of operating experience;
- Integration of corporate activities.

The action plan includes a comprehensive set of indicators and trend analysis.

As part of this plant-wide action plan, the Testing Section of the plant Technical Department has set up an organization designed to monitor and manage all activities carried out during physical start-up tests, particularly emphasizing the right understanding and control of actions implemented by the Operations shift team.

So as to improve interface management and clarifying everybody's responsibilities, a testing manager is appointed within the Testing Section. He coordinates activities and their sequence based on a clear, efficient and rigorous document structure that integrates required check points, the comprehensive identification of risks and user-friendly testing procedures.

Combined to this, a highly innovative approach has led to the testing manager being the coordinator of and chairing the shift turnover (primary side) during tests after refuelling. (In addition to normal shift turnover). He uses a shift turnover form briefly describing the background and status of tests underway, the tests to be carried out during the next shift; a reminder to the operator of the criteria and rules to apply as part of the REPR (start-up test rules), the errors and traps to avoid and the appropriate monitoring methods. The operator can require additional input or reminder if he needs to. This system provides better sharing of knowledge with operators who, at this specific stage, act upon request by the Testing Section (which is the entity having the necessary skills in the area of physical testing).

**5.6. Fuel handling**

No one

**5.7. Safety related computer applications**

*Paks*

**Participation of the Simulator Section in plant modifications as a testing environment significantly contributes to the success of the modifications.**

In the refurbishment of the reactor protection system (RPS) in cooperation with the vendor, the simulator played significant role in the design of RPS with provision of a representative configuration. This new RPS attached to the full-scope simulator allowed for an exclusive test environment., which had a double direction, searching and fixing eventual logistic errors in the RPS and the full-scope validation prior to its commissioning as well as upgrading the simulator in parallel. On this way it was possible to reduce the failure during the implementation in the plant.

***Krsko***

**Comprehensive information management system allow direct and easy access at the workplace, to all the data needed for day to day operation, maintenance, design changes, business applications as well as Industry operating experience through MIS direct connection to INPO, WANO databases.**

The Krsko Computer System comprises two main parts: the Process Computer System (PCS) which gathers and process the plant technical information and an ORACLE based plant Management Information System(MIS), which contains the plant databases (e.g. Master Equipment Computer List), all the plant business applications, connection to external databases and the plant Intranet. The PCS and the MIS are connected through a firewall; the only allowed direction of data transfer is from PCS to MIS.

By accessing the MIS the user has available on screen the PCS information (e.g. on line plant process computer, environmental monitoring data, loose parts and vibration monitoring data, core monitoring data from BEACON, chemistry data from the CHEMNET application, etc.) as well as the above referred information contained and/or processed through the MIS. Some examples of use and applications are given below:

- Outage online activities planning, WO, projects planning (PRIMAVERA);
- Follow-up of Surveillance Schedule as well as recording of data from Operations Surveillance procedures, trending it for use as input to System Health Monitoring reports, surveillance follow-up reports, etc.;
- Preparation and follow-up of procurement packages and design modification packages;
- Plant status data (e.g. critical safety functions and plant status) monitored in Main Control Room is also available in TSC, OSC and EOF. Similar data from the plant full-scale simulator can also be made available in these emergency centres. This makes it possible during an exercise to make plant status presentation of a scenario, using the simulator as the scenario generator, very alike the real situation;
- User friendly, computer based process for Corrective Action Program, where all plant deviations to quality are identified in one system. The system review function routes the deviation to the proper supporting plant process to correct the adverse condition (WO, engineering analysis, etc.). The process makes it easy for workers to enter conditions adverse to quality and is based on the best international practice;
- Industry operating experience is made easily available to all plant personnel for use in work planning, pre-job briefings, training lesson plans, and department meetings;
- Every plant PC have direct connection to WANO, INPO and others databases through the Plant MIS through a special “tunnel” connection;
- Availability of these documents encourages personnel to keep aware of industry operating experience and performance data, and provides an easily accessible source of industry guidelines that can be used to improve performance.

***Krsko***

**Plant specific Simulator with capability to simulate the Severe Accident scenarios realistically.**

In the conception of the project of the Krsko plant specific Simulator it was decided to include the capability of simulation of Severe Accident conditions. This was a pioneering initiative developed together with CAE, FAI and EPRI. Starting from generic W SAMGs , the severe accident scenarios specific for Krsko were established based on the most probable core melt sequences identified in Krsko Level 1 PSA and evaluated utilizing the MAAP code. The MAAP model was incorporated into the Simulator modelling. In case severe accident conditions are reached in the simulation, the corresponding MAAP models replace the Design Basis reactor core, RCS and containment models. The resulting simulations are plant specific and reproduce within the uncertainties of the model, the Krsko plant behaviour in case of Severe accident conditions. These simulations are used for EP exercises, Operator training on SAMG guidelines and SAMG review and validation.

## 6. RADIATION PROTECTION

### 6.1. Organization and functions

*Ling Ao*

**A very clear and instructive video VCD-programme has been developed for training persons who are working in the Radiation Controlled Area (RCA).**

Also, an evaluation (examination) is performed by the radiation protection department (RP) of every contractor working in the RCA, based on this instructive VCD-programme. Instead of a simple and uninteresting instructional content, this training video has a scenario of an RP engineer guiding a visitor to the controlled area. A funny cartoon character presents the key knowledge points. With a vivid story, it delivers to the trainees the basic RP knowledge, the approaches of controlled area access and exit, the usage of RP instruments, the identification of safety signs, the RP materials and the prevention methods of internal and external exposures. In each section, it also contains multiple choice questions about trouble-shooting, letting the trainees find the actor‘s wrong behaviour s, thus enhancing the understanding of RP knowledge and skills.

### 6.2. Radiation work control

*Ling Ao*

**The LNPS RP department has established a radiation work control information system, which is integrated with the work request system.**

By a simple press on a button within the work request system, all necessary RP-related job information is shown, such as, exposure rates, existing contamination, pictures of equipment with indication of location (e.g. room number), hot spots, and links to experience feedback.

Further, this system also contains information on industrial safety risk. Touch screens were installed at the entrance as well as all the main passages in the RCA so that people on-site can research occupational safety risks, cautions and measures regarding their work. Information is also available at every office due to its Intranet web design. This system is called “Occupational Safety Risk Analysis Consultation System” (HPS).

***Santa Maria de Garona***

**Replacement of the drainage network in the reactor building.**

Following an incidence study on the remaining contamination in the reactor building floor drainage network on the dose rate on several levels, this was replaced with a new one, made of stainless steel, which has a better cleaning capacity.

The project started in 1993 as one of the first initiatives that would make up the Dose Reduction Plan. The level of remaining contamination in some parts of the network was a consequence of 22 years of plant operation, together with the material used in the conduits (carbon steel) which limited the effectiveness of the cleaning agents and the existence of isolation siphons which had been systematically installed in each sump. This made it impossible to insert the cleaning jets.

The location of the network (under the floor on each level and not embedded in the floor) had a general effect on the lower floor dose rates (values which could vary around 43µSv/h) and on some drainpipes in zones frequently used by personnel.

First of all the hot points were identified and which of these would have more effect due to their location. A semi-empirical method was developed to assign the specific superficial activities of the different parts of the conduits and to identify the candidate parts.

Initial cleaning tests were carried out with pressurized water. The poor effectiveness in many of the parts was a determining factor in deciding on their replacement, improving their inclination, using stainless steel conduits and implanting cleaning connections at strategic points.

Finally a procedure was written for the measurement and immediate cleaning (if necessary) of the affected parts after a contaminating practice. As a consequence of the systematic replacement of the drainage network the average dose rate has gone down from 43 µSv/h to 22 µSv/h. The general incidence has been so great that it has stimulated a “cleaner” behaviour in the use of the drainage network.

***Civaux***

**The plant developed a user-friendly software (called “EDP”) to make dose estimations and provide experience feedback for ALARA purposes.**

All departments use this software for planning, monitoring and integrating radiation exposure operating experience for all work in the radiation controlled area.

For the planning of the plant’s first outage, the management decided to introduce software designed to make optimized dose estimates for each job. Everyone can consult this user-friendly software on the computer network.

EDP is used by all departments for:

- The calculation of dose estimates which can go as far as the work order grid;
- The formalization of the ALARA approach used (ALARA check-list);
- The monitoring of the dose for the work site;
- Easy comparison between radiation exposure at the work site and the objectives for the work;
- Analyses by department, activity, work site, elementary system, etc. for monitoring, control and operating experience purposes;
- Reporting good practices or any unforeseen circumstances encountered;
- Benchmarking between units and outages;
- Optimization through consideration of operating experience from previous work.

The radiation protection department advises, approves and controls the different stages of the process. The radiation protection department analyses the results of previous outages with the other departments to optimize radiation exposure for the following outages.

The EDP file is printed out and placed in the work package file on the work site. The workers fill in the integrated doses, comparing them with dose objectives. At the end of the work, the doses, which have been recorded and entered in the computer software by the workers, are compared with the objectives and the file provides operating experience feedback on the work.

The introduction of this software has led to close involvement of each department in addressing radiation exposure at the planning stage and in monitoring their work sites.

It is a tool for operating experience feedback and progress which has resulted in better refuelling outage results for the fleet.

**6.3. Internal radiation exposure**
No one

**6.4. Radiation protection instrumentation, equipment and facilities**

***Tricastin***
**The Radiation Protection Department has assumed a leadership role in developing for EDF products and processes to improve the company's overall radiation protections practices.**
The chemistry laboratory, working with a local commercial supplier, has developed and is using radioactive sources containing a water equivalent matrix type resin. This solid phase source is considered as a sealed source. As such, its lifetime (depending on the radio element contains) is 10 years rather than the 2-year life normally specified for unsealed sources. These sources are supplied in standardized shapes, identical to those currently used for measurements, and are available in 3 different sizes (3.0 l, 0.5 l and 50 ml).

Compared to liquid sources, the advantages of this product are as follows:

– No handling of liquid radioactive sources;
– No radio element migration phenomenon within the source container;
– Source retrieval by vendor (no destruction requirement);
– Longer period of use (depending on the radio element half life);
– No spread of contamination in the event of being dropped.

***Nogent***
**As part of a French national "Radioactive Source Management" action plan, a comprehensive organization and storage facilities have been implemented to manage sealed and non-sealed radioactive sources.**
The main source storage room is a best performer with two separate rooms, each one individually monitored by an ARM with audible alarm in the outside of the rooms. In each room there are locked shelves where the sources are stored. Only an authorized person can get the key. There is one "person competent for source management" (SPR) that organizes source training courses, manages relation with the regulator, controls the inventory, checks permits of utilization and sets the procedures. The organization relays also in:

– Two persons in charge of sources (sealed and non-sealed), responsible for day to day management of sources;

– One person in charge of each storage area, responsible for the management of sources of his storage area;
– Trained users, with specific permit issued to each staff member concerned.

There is one register for each storage area. The entrance/exits are recorded in the register of the area by the end user and tracked systematically by those responsible for the storage area and sources. Computer monitoring (MANON) exists in addition to paper monitoring for all source movements with change of storage area. The source rooms and lockers locked with keys held by the person in charge. Also source safes used with a code (Medical Service). Double padlock for ARM and PRM sources (SPR + store responsible) and for contractor sources (SPR + contractor responsible). The sources on site are transported in type A cases.

Rigorous traceability (user and responsible) of the movement of each source, enables the location on the site to be known at all times and thus reduces the risk of loss or theft. The use of sources is limited to trained people who know the organization in place for the management of sources (specific permit). Transport is easier and safer (protection against knocks and falls, suitable posting and leak tightness) thanks to the use of Type A handling cases.

***Krsko***
**The plant initiated a modification that included the development of on-line monitoring capability of the Reactor Coolant Sampling line, using electrically cooled low efficiency Gamma Spectrometry.**
This facilitates prompt and enhanced detection of changing trends in the reactor coolant, such as initial fuel leakage, or crud burst detection during reactor coolant system cleaning processes. This system also contributes to good ALARA practice, because it may reduce the need to collect as many reactor coolant samples as had previously been the case. This has also reduced the potential for associated contamination events.

The analysis parameters can be adjusted to suit Plant conditions. Under normal operations the analysis is performed weekly. During shutdown and start-up, the frequency can be easily adapted to suit the Plant's specific needs. Such monitoring techniques are the normal practice in some types of reactors, although they have not been adopted at other types of Plant. The Krsko Plant has made the effort to implement this equipment. The Team considered that it deserved inclusion as a Good Practice of the Krsko Plant.

### 6.5. Personnel dosimetry

***Nogent***
**The plant has developed several innovating ways to reduce dose for specific problems in plant areas and the actual doses in the plant are very low.**

Some of these are:

- In order to reduce doses of the decontamination crew in the tasks of manual sump cleaning, this activity has been mechanized. Now, the operation is done with minimum time near the sump, by means of a mobile system that employs a pump to suck the water and a shielded filter to clean it. The results are a drop in the ambient dose rate with direct impact on the dosimetry of the operation and chemical teams. The collective dose has been reduced by a factor of two for the decontamination crew. Also, there have been gains in terms of dose reductions for operating and chemistry teams by means of eliminating hotspots and the reduction of area dose rate near the sump. Additionally, there is no production of prohibited waste (sludge) because particles are retained in the filters and these are treated as normal waste.

- In order to reduce the doses around the concrete drums of high activity waste, an additional biological shielding has been designed as a big metal container drum, where the smaller drum can be introduced. The dose rate produced by these high activity drums inside and outside the waste treatment building has been reduced by a factor of 8.

- Optimization of the cavity decontamination operation by reducing the dosimetry and the critical path. This was accomplished by changes in the cleaning method (no manual scrubbing) to low pressure water with cleaning foam, and an optimization of zones to decontaminate. The results are a reduction of outage critical path and collective dosimetry by a factor of 7 for decontamination after unloading the fuel and by a factor of 2 after refuelling.

### 6.6. Radioactive waste storage and discharge

No one

### 6.7. Radiation protection support during emergencies

***Dukovany***

**Activities carried out by the Radiation Protection Department along with the International Ecological Organizations related to mutual visits, common exercises, and exchange of technical information about external radiation instruments help to enhance public relations of the Dukovany NPP.**

Facts:

– Close cooperation with International Ecological Organizations was established in 1999.
– During December 1999–September 2001, Ecological organization people visited the Dukovany NPP, they received information on the system to prevent the release of the activity into the environment in case of incidents, they visited the Shift Emergency Centre, Radiation Control Room.
– In June 2001 radiation protection people visited the Ecological Organization in Vienna, they exchanged information on the teledosimetry system which is located in the neighbourhood of the Dukovany NPP and about the alarm team of the ecological organizations.
– Hot telephone numbers and email addresses have been exchanged for the purpose of immediate information about real-time radiation conditions.
– A mutual simulation exercise has been prepared, the aim of the exercise is to verify the response of the ecological organization and their alarm team, to verify hot telephone lines.
– Mutual communication between specialists in different languages, correct interpretation of the results measured and total response time — this established communication and cooperation has resulted in better relationships with these organizations.

## 7. CHEMISTRY

### 7.1. Organization and functions

***Tricastin***

**A very comprehensive system of chemistry performance indicators is established.**

The main chemistry performance indicators connected to chemistry, radiation protection effluents and the environment are used with short-term trend evaluation (3 weeks). Expected and limit values of indicators are also expressed. The values are upgraded once a week and are easily accessible for all the plant's employees via the electronic IT system. In the form of a weekly newsletter with pictograms, the system is used for the presentation of chemistry results for plant management and other departments.

This type of relationship has the advantage of enhancing the commitment of plant management and other departments in the chemistry area. As a result, chemistry deviation treatment is performed more rapidly.

***Santa Maria de Garona***

**System technicians connected with plant systems for which they have to take over responsibility.**

The manager of the chemistry section together with the chemistry personnel have developed a method by which every technician of the chemistry section is responsible for following up each particular system of the plant in relation to chemistry and radiochemistry items. They also have to file and record all the operative incidents to enable them to find root causes related to chemical and radiochemical condition changes. With this purpose every plant system has been associated with a particular technician who is responsible for preparing plots of different parameters, which have been previously established for the control of each particular system. Each technician also has to report about the performance of his systems in all regular meetings of the chemistry section. They also contribute to the preparation of the chemistry report, which is performed at the end of each fuel operation cycle by means of plots and by written reports in which all the comments that they have filed during the operation cycle for each particular system must be included.

The methodology established is reporting several benefits. Some of them are:

- Allows to observe, in a closer way, all analytical results;
- Improves the follow-up of the chemical and radiochemical behaviour of the plant systems;
- The personnel themselves consider that they are more useful and, in this way, they feel more motivated;
- This method engages them to follow up the performance of the systems in a much better way than before it was established.

### 7.2. Chemistry control in plant systems

***Temelin***

**Secondary side erosion/corrosion monitoring is well structured and implemented.**

The plant has installed a comprehensive corrosion monitoring programme for continuous evaluation of the corrosion state of secondary side equipment and systems especially in steam lines and feed water piping. Parts of this programme are the following:

- Continuous and periodic corrosion potential measurements are carried out using the Corrater electrodes built into different parts of the water system to determine corrosion tendencies.
- To quantify the corrosion processes, corrosion loops are also established to determine the exact corrosion and deposit formation rates in those systems.
- Using mobile and fixed corrosion monitors the same parameters can be determined for any new material type as well.
- The corrosion processes are followed by detailed wall thickness measurements and visual inspections.
- The selected locations are systematically measured and by means of the CHECKMATE programme the equipment residual lifetime is regularly predicted based on measured values. By this means the appropriate preventive actions can be implemented when necessary.

***Dukovany***
**A regular small-scale primary feed and bleed process is implemented with the following positive impacts to primary water chemistry and the environment:**

- Fluctuations of hydrogen and ammonia concentrations and consecutively pH (300) are reduced with corresponding corrosion product transport minimization.
- Oxygen ingress into primary coolant associated with large scale feed and bleed process is minimized.
- Releases of $^{41}Ar$ into atmosphere are reduced by 40%.

***Tricastin***
**The automatic injection system of lithium to the primary circuit was established in Unit 2 as a prototype.** The system uses special software for continuous calculation of lithium needed for the circuit. The on-line measurement of conductivity with the feedback loop makes it possible to comply with lithium/boron specifications during operation and during hot standby. An alarm is provided to the control room operators when a problem occurs with the injection system.

This system is especially useful for power plants operating in load following mode with very frequent variation of power (up to the hot standby), which are always accompanied by boration and dilution operations. This phenomenon is compensated by an automatic lithium injection system, which is used to compensate in real time whenever the limit of the lithium-boron diagram is exceeded, and to prevent excursion at low pH. 25 load reduction transients were carried out, which qualified the prototype and the lithium concentration was constantly maintained with a deviation below 0.05 mg/kg relative to the reference value.

***Santa Maria de Garona***
**To optimize hydrogen water chemistry (HWC) the plant has carried out some experiments at different hydrogen injection levels based on sophisticated and extensive measurements of the electrical corrosion potential in the bottom plenum of the reactor pressure vessel.**
The plant has taken the decision to protect the bottom plenum of the reactor vessel and its internals against Intergranular Stress Corrosion Cracking (IGSCC) phenomena. It was necessary to carry out a special minitest, maybe unique in the world. hydrogen water chemistry was implemented for the first time at the plant in 1986. The first goal was to protect the recirculation loops against IGSCC. With the results coming from the minitest, it was

determined that the feed water hydrogen concentration necessary was 0,3 ppm to reach -230 mV, which is considered good enough. Afterwards, in 1996 the plant took the decision to protect the bottom plenum of the reactor vessel and its internals. It was necessary to install a total of 13 electrodes in four different positions of the bottom plenum, nine of them were mounted in three modified LPRMs, which were installed in their normal positions, and the fourth one was mounted in the bottom head drain line flange. The reference electrodes used were Pt and $Fe/Fe_3O_4$ and the measurement electrodes were stainless steel. During this minitest many other parameters different from ECP were measured, such as hydrogen concentration, oxygen concentration, conductivity, ionic analysis, metallic analysis, activity etc, in waters coming from reactor and from the feed water system and dose rates were also measured in different plant areas. In most other NPPs it is usual to calculate the feed water hydrogen concentration necessary to protect any zone of the vessel using radiolitic models, which are much less reliable. The experimental method used at the plant has also been used to adjust the radiolitic models mentioned before. But, as it is known, the response to hydrogen injection is different in each plant.

The magnitude of the work related to the experiment performed at the plant, technically and economically speaking, has been very big but the effort made has been extensively compensated by the success obtained. This experience has allowed the plant people to know exactly that 0.9 ppm is the feed water hydrogen concentration necessary to reduce the ECP below –230 mV in the bottom plenum, mitigating by this way the IGSCC phenomena with no more hydrogen than necessary and optimizing, at the same time, the dose rate at the plant.

***Santa Maria de Garona***

**The plant saves money, radioactive waste and minimizes sulphates ions input in the reactor vessel by optimizing treatment of condensate demineralizer filters.**

In all plants, which have deep bed resins in their condensate demineralizer systems, it is usual, when the resins are exhausted, to remove them and to install new ones. Many years ago there was the practice to regenerate all the condensate demineralizer system resins but later, in many plants, it was decided not to regenerate any more because the sulphates limits in the reactor water were reduced very much. The first regeneration step is to carefully separate the anionic and cationic resins but some small amount of resins of each class always remains with the other resin. In such a case when the cationic resin is regenerated with sulphuric acid some small amount of anionic resins are regenerated too, but in the form of $SO_4^{=}$ instead of being in the form of $OH^-$ which is normal. This contamination of the anionic resins produce some leaching of $SO_4^{=}$ when the bed is put into service. This is very undesirable because they contribute to increasing the sulphate concentration in the reactor water. As is well known, sulphates are one of the most detrimental substances for reactor because they enhance the intergranular stress corrosion attack in sensitized materials.

In the plant a special procedure has been developed which allows the separation of the resins. For this reason, it was decided to regenerate only the anionic resin, which is the most expensive of the two resins. Its volume represents half of the total volume. After assuming this improvement, the chemical results in the reactor water are the same as when anionic resins were also removed. This practice represents a resin cost reduction to one third of the total price, it also reduces the volume of wastes produced and, as a consequence, a reduction is also obtained in manipulations of the wastes in the Radwaste System, which represents important dose savings.

*Santa Maria de Garona*

**To minimize personnel dose during the outage the plant has decontaminated the recirculation loops by a new method and water chemistry for minimizing recontamination has been optimized.**

To reduce the dose a chemical decontamination has been performed on the recirculation loops. The system design was unique in the world. It allowed the chemical to be circulated through the loops for better decontamination. A decontamination factor (DF) of 40 was obtained. After decontamination iron and zinc injection were implemented to avoid recontamination and a dose saving estimated to be 1.6 Sv. (160 man Rem) in the last two outages was achieved.

The decontamination process applied was CORD and it was performed using a closed circuit, which was thought to be important to obtain a good DF. To close the circuit was necessary to connect special devices inside the reactor vessel. The many tools necessary to close the circuit were designed by NUCLENOR and they allowed performing the decontamination process without dismounting the 20 jet pumps, which belong to the recirculation system. This work, performed in such a way, allowed to reduce the length of the outage by about 6 days. The decontamination process was complemented by zinc and iron dosages to avoid recontamination. The concentrations which were maintained were 5 ppb Zn in reactor water and 1 ppb iron in feed water. The recontamination found after one operation cycle was only 20%.

It is very important to perform the decontamination process using a closed circuit and at plants, which have jet pumps, it is very important to design tools avoiding jet pump dismounting. To minimize recontamination it is necessary to establish zinc injection and a control in feed water iron concentration.

### 7.3. Chemical surveillance programme

*Paks*

**On-line analysers are used to ensure that only demineralized water of accepted quality will be used.**

The demineralized water for the plant is produced on the make up water plant. In the common line from this plant to the storage tanks are an analyser for silicate and a conductivity meter installed. These two analysers control an isolation valve and it will close if a pre-set value for either one analyser is exceeded. By this procedure it is ensured that demineralized water of proper quality in any situation is fed to the storage tanks. The valve can only be opened when receiving water that fulfils the requirements. The fact that such a system is installed is above the general standard applied on power plants.

*Angra 2*

**The liquid radioactive waste storage and treatment process is well controlled by the Control System for Liquid Waste Storage and Processing (SISREJ) computer programme.**

The programme was developed with the aim to assure prompt and effective interaction between waste system operator, chemistry division managers and supervisors, control room operator and also to give information about waste system via the computer network. The safety and integrity of the programme is warranted by restricted access.

By using different tables and corresponding files in the programme the whole storage and treatment process (the volume and storage place of liquid waste, the chemical and radiochemical parameters, necessary treatments, and the authorization for release) can easily be followed, registered and controlled by authorized personnel.

### 7.4. Chemistry operational history

***Temelin***

**A well-organized and structured Chemistry Information System is used for effective control of the chemistry work.**

The Chemistry Information System (CHEMIS) serves for providing information and support to managers and shift personnel in chemistry related questions in primary, secondary and auxiliary systems, systematic assessing of chemistry processes by using its database with displaying features and for planning and checking the laboratory work.

The system is accessible via the plant computer network with all its modules, including alarm modules in different operating conditions, chemistry performance indicators, diagrams for displaying results, trending and comparing results to limit values and reporting action level. The system is extensively used by main control room personnel for displaying chemical analyses and printing protocols of chemistry conditions.

Furthermore, the system enables specification of sampling and analyses to be done and proper archiving of analytical results.

The system is a really effective tool for organizing chemistry related work.

### 7.5. Laboratories, equipment and instruments

***Dukovany***

**Comprehensive quality control information system is effectively used to plan, perform, track and evaluate quality control related laboratory activities and some other chemistry duties.**

This system allows to the performing of the following functions:

- Recording of non-standardized samples;
- Recording of analytical procedures;
- Recording of calibration results;
- Calculation of analytical errors;
- Automatic recording of calibration and check results of laboratory pipetting equipment by direct communication with analytical balances;
- Quality control charts calculation and displaying;
- Recording of issued protocols;
- Recording of standards and laboratory chemicals storage and consumption with expiration time alerts;
- Recording of instrument handbooks and logbooks;
- Recording of shift reports;
- Recording of walk down, audit and assessment inconsistencies;
- Functional dependences of different chemistry and other relevant parameters.

### 7.6. Quality control of operational chemical

*Nogent*

**The power plant uses an intranet database with approved suppliers and safety data sheets of materials and products to be used on site.**

This Intranet database, which is managed by the technical operations unit, allows Nogent NPP to share information with all NPPs of EDF.

The corporate laboratory group supplies specifications for chemical conditioning products like resins, hydrazine etc. to guarantee that these products have no negative impact on corrosion, activity build-up and safety. These products are PMUC certified (products and materials to be used on nuclear plants).

PMUC is available in the EDF Intranet database and contains chemical specifications of the products, characteristics of approved suppliers, e.g. the expiry date of the validation granted to the supplier and address of contact.

– For every product safety data sheets are kept up to date.
– The Intranet guarantees a real time information feedback e.g. if a supplier does no longer meets the expectations.
– As the database is accessible from any office, appropriate products are used systematically and traceable.

### 7.7. Radiochemical measurements

No one

## 8. EMERGENCY PLANNING AND PREPAREDNESS

### 8.1. Emergency organization and functions

*Civaux*

**Strong long-term relationships with off-site entities, especially rescue services, lead to an efficient and common response.**

Relationships with off-site entities (local authorities, medical assistance, hospitals, fire brigades) are extremely well developed and continuously maintained through regular contacts. In the case of external fire brigades, this leads to the following actions and results:

– Set-up of a common mixed commission, called “fire commission”, which meets every 2 months in order to confirm the arrangements and to initiate corrective actions if needed.
– A document has been developed jointly by Civaux and the off-site fire brigades to optimize fire fighting on the site.
– This document (“PER” in French) is used by the off-site fire brigades. It gives an accurate indication of all plant locations, including details regarding sensitive plant equipment like main and auxiliary power transformers. It also lists the main industrial safety and radiological risks encountered on the plant.
– After receiving a phone call from the plant, the relevant fire brigades simply need to refer to a detailed chart indicating the number of human and material resources required to fight a fire according to its specific conditions and location. Especially for sensitive equipment, fire-fighting plans included in the document have been drawn up by the off-

site fire brigades. Moreover, this plan has been drawn up using standard formats and wording used by the fire brigades.

– This document has the added advantage of directing fire-fighters to the location of the fire even before arrival at the plant. The document also provides a clear definition of responsibilities assigned to the fire fighters and to Civaux staff.
– The PER is an important tool for fire-fighting since it defines the resources to be used and ensures that fire fighters and the site are using the same frame of reference. It makes it easier for fire fighters to operate and meets their expectations.
– It is reviewed periodically (every 2 months) not only for updating purposes but also for raising awareness of the concerned personnel. This includes regular joint visits of the installations.
– The document is available at the main entrance building, in the vehicles of the off-site emergency services, the second response team vehicle (PCOM) and at the logistics command centre (PCM).
– The off-site fire brigades thus have a high quality, updated operational document.
– Review of on-site EPP-arrangements to involve a management function (PCD2) in the field to become Civaux interlocutor with the fire brigade officer.
– Organization of more exercises with external rescue services than required by the national doctrine (3 per year instead of 1) with effective deployment on the site.
– Organization of common training (plant staff and fire brigades) to promote mutual exchanges, discussions and common understanding.
– Organization, if needed or in function of turnover of personnel, of educational exercises with various specific objectives, such as the protection and decontamination measures to be taken in the case of interventions in RCA.
– Establishment of a training centre, located near to the Civaux site and partially funded by EDF, to perform most of the common training sessions.
– Concerning the relationships with the hospital of Poitiers, similar arrangements are in place also to perpetuate the relationships between the plant staff and the medical rescue teams.

Examples are:

– Mixed training at the plant and at the hospital of Poitiers;
– 2 of 3 exercises per year with a specific medical section;
– Management of the personal protection equipment dedicated to the Poitiers hospital personnel by the Civaux plant staff using sealed boxes, contributing to perpetuate the relationships between the plant and the hospital staffs;
– Finally, close contacts exist between the plant staff and the local authorities (prefecture, mayors of the villages within the 10 km EPZ, local information commission). In that frame, proactive communication from the Civaux NPP would limit the adverse effects of inappropriate response of the population in case of an emergency.

These relationships promote team working and common understanding of the concerned actors as part of an ongoing improvement process.

### 8.2. Emergency plans

***Ling Ao***

**While two different companies operate LNPS and GNPS there is a single integrated emergency response structure for the entire site.**

Under this structure the preparations for response at both plants have been unified to include: the emergency plan, emergency response organization, emergency implementation procedures, off-site planning, classification system, facilities, communication, emergency monitoring, consequences assessment system, emergency countermeasures, medical protection and interface with off-site emergency organizations. This concept optimizes the use of human resources, facilities and materials and simplifies the interface between the plants and with off-site emergency organizations. It also assures that the experience from GNPS is applied to planning at LNPS and assures a consistent response through unified training, drills, and exercises.

***Dukovany***

**Within the framework of the onsite emergency plan, the plant has developed a specific plan to deal with water pollution, the « Emergency deterioration of water quality — measures plan ».**

In case of an emergency situation that can affect the quality of discharged water, continuous measurement of water parameters would be available to service personnel at the central radiation protection control room to monitor the situation. Evaluation of this information will be made and the results transmitted to the Shift Emergency Staff.

The classification scheme of the water emergency plan contains a so-called „zero level„ to ensure timely identification of harmful substances before they can get to the environment. Not only radioactive substances are monitored and analysed, but also a number of other substances that can adversely affect the environment. In order to resolve extraordinary events associated with impaired quality of discharged water, there is a specialist for ECOLOGY on the Shift Emergency Staff. The « Emergency deterioration of water quality — measures plan ». is approved both by SUJB and the District Water authority.

***Angra 2***

**Innovation in Benchmarking**

As this is the only nuclear generating station in the Brazil, a considerably high level of offsite emergency response benchmarking has been performed. The programme management periodically arranges for governmental authorities to visit programs of other countries to help in defining the scope and breadth of the program. The State of Illinois, which has the most comprehensive programme at the state level within the United States, was selected as the model programme to be followed.

***Angra 2***

**Strength in Public/Private partnership**

State and municipal civil defence organizations are extremely well staffed, trained and drilled in their respective responsibilities for facilitating the implementation of public protective actions. The evacuation planning performed in support of provisions to implement public protective actions is extremely thorough and detailed. Staging areas are used to stage emergency workers already well familiarized with their respective assigned areas of concern. Main evacuation routes are computerized as are facility layouts for reception centres. Reception centres also have had an appropriateness review including pre-allocation of resources. In addition, this programme serves as a public information outreach programme on nuclear energy as well as on emergency planning programme aspects. Therefore, the public within the EPZs is informed in these areas to a much higher level than is normally found around a nuclear power plant.

Furthermore, the IRD of the CNEN possesses an extremely detailed post plume phase capability that provides a high level of assurance that ground deposition characterization, ingestion planning and public relocation and re-entry activities would be well managed should the need arise. While the capability is designed to be used generically, the provisions in place in support of the operation of Angra 2 are very detailed and well coordinated. These conditions are reflective of an extremely good working relationship between the plant and the supporting governmental authorities.

***Angra 2***
**Use of multiple Public Information Centres**
The plant has used a very aggressive public information policy that serves as an outreach programme for the public on nuclear energy as well as on emergency planning programme aspects. Eletronuclear runs two information centres. One is in Angra Dos Reis and the other is in Itaorna Beach, adjacent to the plant site. The two centres have a good mixture of displays, models and information available in both Portuguese and English. Displays are frequently changed and the participation level of community groups is high. Brochures are colourful and informative. Visits by schools, universities and the public are encouraged and indeed are conducted on a frequent basis. There were some 25 000 visitors to these centres last year, many of which were from overseas. Both centres have facilities available to support community activities. This programme stimulates a more informed and supportive public, attracts students to the industry and helps to elevate the overall level of emergency preparedness throughout the region by improving the level of understanding of the technology. It is noted that Eletronuclear has also developed public information materials for the Indian population that is indigenous to the area. Therefore, the public within the EPZs is educated in these areas to a much higher level than is normally found around other nuclear power plants.

***Rovno***
**Kuznetsovsk City Emergency Population Protection Plan**
The city of Kuznetsovsk has developed their plans and guidelines to effectively protect the health and safety of citizens of the city. Worthy of special mention, is the confirmed plans and agreements which allow families within the city to live with other families outside the 30 kilometre protection zone during potentially long accident term mitigation situations. These agreements have been verified in writing, signed and are maintained by the city.

### 8.3. Emergency procedures

***Temelin***
**To facilitate the consistent and positive identification of pre-selected monitoring points in offsite areas a detailed appendix to the procedure for field monitoring has been developed.**
There is a large scale area map with each pre-selected sampling location annotated which aids in proper orientation and sample location selection. Then for each location a detailed map is provided giving clear locating information. This is accompanied by a picture of the sample location which includes readily recognizable permanent landmarks which make each monitoring point uniquely identifiable.

***Ling Ao***
**The Emergency Operating Procedures (EOPs) used for control room operations classification, assessment of environmental releases and assessment of protective actions have been integrated to an exceptional degree.**

Each of these procedures has a simple flow-chart of the basic steps to be performed and refers to related steps in other procedures. The procedure used for classification was greatly simplified by indicating that entrance into a specific EOP warranted consideration of declaring a specified emergency class. The classification procedures also directly references the environmental criteria assessed in the monitoring procedures. The protective action assessment procedure uses and refers to the results of the classification procedure and results from the environmental assessment procedures. In addition the procedures used for classification and assessment of environmental releases and protective actions are based on the very latest international guidance. This demonstrates an exceptional effort to keep abreast of and apply international guidance.

***Dukovany***

**The plant has established a card describing actions that personnel have to accomplish should an emergency occur.**

Such card, that shows a top management signature, has been plastified and fixed behind each door of the buildings offices and workplaces to remind personnel of the actions to undertake should an emergency be declared at Dukovany. What makes these cards unique in Dukovany is the extent to which it has been communicated to the plant staff and contractors. The card recalls in an introductory paragraph how personnel would be informed of an emergency (what the warning signal would be). In a second part, the card delineates in a very straightforward and clear way the 9 steps that personnel have to complete before going to the shelters:

- Do not panic;
- Finish current activity and place equipment in a safe condition;
- Store documents in a safe place;
- Switch off unimportant devices and lights;
- Shut the doors and the windows;
- Use emergency protection aids;
- Ingest KI if instructed to do so (through the internal broadcast system);
- Leave for the corresponding shelter;
- Behave according to instructions given by the shelter teams.

***Santa Maria de Garona***

**Use of flow charts in preparedness and response for a nuclear or radiological emergency and integration of severe accident management in the internal emergency plan.**

Santa María de Garoña NPP has developed flow charts for extensive use in the below mentioned three ways of preparedness and response for emergencies. The flow charts contain clear references to the procedures they are based on.

*Flow charts for emergency identification, notification and activation.* Following four very easy understandable flow charts (one for each emergency category), operators can promptly determine the appropriate emergency category and the level of emergency response and shall initiate the appropriate on-site actions. This is possible by following the out line of the schematic flow charts.

*Area action and work centre guides*. The areas of operations, radiological control, maintenance and logistics, as well as the central offices emergency centre (CEOC), external emergency centre (CEE) and medical services, all have flow charts which give an easy-to-follow, integrated and graphic representation of the actions they should take and what competencies of the corresponding personnel needed.

*Training Sheets.* The people in charge of each area have training sheets, which have been developed in flow chart format for teaching during the training period. They explain their action in a way that is easily recognizable.

These flow charts help all personnel involved in the emergency response organization to develop and maintain a rapid and collective overview of what their responsibilities are and how they must act in each case. They were developed based on the fact that they are predominantly practical and useful as well as on the favourable acceptance on behalf of the users. The use of the flowchart increases the degree of safety by making surveillance of the emergency management more complete and simpler.

Santa Maria de Garoña NPP has also integrated the management of severe accidents into the preparedness and response for a nuclear or radiological emergency in the following manner:

*Creation of a new "General Emergency" initiating event.* The "Initial situation in the Severe Accidents Guide" event is included in the initiating events related with the "Nuclear Steam Supply System" (NSSS).

*Integration of Severe Accidents Management in the internal emergency plan together with its procedures with respect to organization and responsibilities.* When necessary, the person in charge of the Operations Area transfers the Emergency Operation Procedures to the Severe Accidents Guides. The person in charge of the Operations Area and the two Operation Evaluators from the Emergency Technical Support Centre form part of the Severe Accidents Management Team. To manage the severe accident, the team use flow chart on the same table where emergency procedures are, displayed under glass.

*Periodical training of personnel* All personnel receive periodical training in Severe Accident Management according to their position and responsibilities within the emergency organization, as part of the annual training programme for the Emergency Plan.

The integration of Severe Accident Management in the Emergency Teams means an optimization of human resources and of their knowledge in General Emergency situations originated by an event that implies a Severe Accident and an improvement in their response capacities.

***Krsko***

**A special tool for the assessment of radiological consequences in the environment has been developed.** It utilizes a more realistic dispersion model, Lagrangean particle model instead of the simple Gaussian, to calculate dispersion. This accurate modelling is very important in areas with complicated meteorological modelling environment, such as Krsko. Graphical and numerical presentation of projected data are presented in several ways, such as dose at different distances and exposure types and map containing resulting ground dose rates due to fall-out. Dispersion projection may also be viewed in a three dimensional model. Meteorological input data is automatically taken from the NPP environmental information system while input data on release source term is manually given, based on emergency procedures and automatically collected plant status data.

A comparison between the two types of models, given the same release scenario and meteorological situation, shows that inadequate advises could be given the off-site emergency organization in case of using the simpler model. A validation of the developed tool has been made using real release measurement data from a chemical plant. This approach may be a significant improvement for NPPs in equivalent siting positions as Krško.

### 8.4. Emergency response facilities

***Temelin***
**The plant initiates callout of standby response personnel and activation of emergency response facility at the first step of a three-step emergency classification scheme.** This allows for arrival of key responders early in event sequences. This promotes a clear understanding of events and response actions since response personnel are involved early on in events, and provides additional staff for evaluation and implementation of potential mitigate actions. Dedicated emergency response facilities equipped with state of the art computerized information systems enhance the functionality of the facilities and creates a condition for rapid activation of response facilities.

***Temelin***
**The plant has developed a simple and effective tag board at the common entrance for the technical support centre and emergency control centre.**
The emergency response staff for these two facilities is divided into four teams. Each team is given a unique coloured tag. Each team member has his own tag with his name and functional position in the response organization indicated. This same information is posted permanently on the tag board. When arriving at the facility a responder simply removes his tag and attaches it to his clothing. This allows clear identification of what each responders function and name is. It also allows for quick and positive indication of who has responded and assumed each response function.

Additionally, all emergency response facilities are provided with uniquely coloured vests with each functional position stenciled in bold letters on the back of the vest. This also allows for clear positive identification of who is filling which position. In TSC and ECC complex where responders may mix and mingle between areas, a clear distinction of function and response centre assignment is made possible by the unique vest colour.

***Santa Maria de Garona***
**Computerized application for evaluating category of emergency and dose evaluation off-site the plant.**

The application is composed of six interconnected modules:

- PDM Module: This module presents meteorological parameters (direction, speed and wind stability) of the last 24 hours updated in real time.
- TFUENTE Module: This module evaluates the source term (Bq/s) distributed by isotopes for four fuel degradation conditions, considering possible safeguard actions. It also enables us to evaluate a leak based on area and process radiation monitors combined with the status of the ventilation system. Finally it has the option of evaluating the source term based on parameters that are pre-calculated in NUREG-1228.
- DOSAC1 Module: This module estimates the class of emergency based on previously calculated source term data, applying meteorological and dose rate criteria from site limits. These are established in the internal emergency plan.

- IRDAM Module: This module estimates doses outside the plant based on previously calculated source term at various distances in the affected sector, following the straight line trajectory model.
- RASCAL Module: This module estimates doses outside the plant based on previously calculated source term, allowing the variation of meteorological parameters in four time intervals. It has the option of evaluating doses based on surface concentration data and/or air concentration taken from the Emergency Radiation Surveillance Plan (PVRE).
- MESORAD Module: This module is more complete than the above. It includes area topography and enables us to monitor the radioactive plume every fifteen minutes on a map of the area (30 km). The results obtained are the doses on various organs due to types of exposure and surface deposit, in each time interval and accumulated at the end of the simulation.

These computerized modules are user friendly and together they make it easier to make dose estimations and input data. They are also very useful tools for personnel training, because it is easy to visualize the results of various emission hypotheses or the progression of the accident. It is also possible to make predictions assuming that meteorological conditions are maintained.

### 8.5. Emergency equipment resources

***Tricastin***

**For Accident management measures, special shielding devices are necessary to be implemented in a controlled area in the plant.**

This needs to handle very heavy concrete block of weights ranging from 5 to 10 tons by a forklift in a very narrow area to precisely position them as radiation protection shielding. To facilitate the training of staff, the plant has prepared a special dedicated out side area to give the staff the possibility to train without interfering the operation of the plant and without the hazard of damaging equipment inside the plant during training. This area is used up to 12 times a year to get persons used in setting up the device. Using dedicated training areas for special training of accident management material will enable the staff to get more practice easily and with less effort and especially without endangering the plant. It is considered a good practice and is recommended for other plants with similar accident management provisions.

### 8.6. Training, drills and exercises

***Civaux***

**A well-developed and comprehensive exercise programme associated with a strong commitment of management and of the appointed representatives of command centres leads to a good state of preparedness of involved plant staff members.**

Five types of exercises are organized. These exercises are validated by the Technical Safety Group indicating a strong commitment of the management for these activities:

- Global exercises: technically oriented or fire/health oriented – 6 per year (3+3), of which 1 per 3 years the national crisis teams of EDF participates;
- National exercise with participation of local and national organizations and authorities: 1 per 3 years (next in December 2003);

– Mobilization exercises (with effective moving to the site): 2 per years outside working hours (criteria: full activation of the PCs in less than 1 hour);
– Assembly exercises (for all personnel): 1 per year during working hours. 1 every 3 years with activation of the back-up centre with (partial) personnel effective evacuation.

For each unit, effective test of reactor building evacuation per each outage.

Moreover, additional drills are also performed:

– Four communication tests at home (outside working hours) with acknowledgment and verification followed by immediate corrective actions, if needed;
– Six security oriented exercises (intrusion risk);
– A weekly fire oriented drill exercise for the on-site second intervention teams (supervised on field by management).

Effective participation in exercises is systematically recorded ensuring the necessary tracking in order to respect the requirement of at least 1 exercise/2 years for each of the involved people.

The number of exercises, their scope and systematic evaluation and feedback are worth being highlighted.

***Krsko***
**Severe accident management is incorporated in the scope of emergency exercises.**
This enables the Main Control Room (MCR) crew, field operators and personnel in TSC to enhance their ability to cope with such situations and the use of EOP's and Severe Accident Management Guidelines (SAMG).

Plant status data, for example status on critical safety functions and systems, monitored in MCR is also accessible in TSC, OSC, EOF and SNSA. This is what would normally be expected. Also the similar data from the plant simulator is made available to these facilities. This feature makes it possible during an exercise to assess plant status exactly the same way as during a real situation. The team notes that this significantly enhances the training effect of the exercise as well as experience gathered from the assessment procedures.

### 8.7. Liaison with public and media

***Nogent***
**NPP has instituted many unique and beneficial ways to maintain contact with the residents in the area of the plant.** Among these projects are:

– “Natural Network of Opinion” since December 2002. This kind of close contact with public by NPP staff will strengthen the liaison with public;
– One-to-one contact with residents to evaluate the image of the plant and to increase the plant staff's sensitivity to local concerns;
– A quarterly journal “L’Echo des Tours” with information on the plant and emergency actions;
– A toll free number for residents to call;
– Excellent facilities for briefing the press;

- CLI (Committee for Local Information) of Nogent-Sur-Seine plays important role for the liaison between Nogent NPP, public and media;
- Personal distribution of potassium iodine tablets by volunteers fire fighters, Red Cross, etc. which also provide an opportunity to discuss emergency activities one-to-one with residents.

## 9. COMMISSIONING

### 9.1 Organization and management of commissioning
No one

### 9.2 Commissioning programme
No one

### 9.3 Training in commissioning
No one

### 9.4 Preparation and approval of test procedures
No one

### 9.5 Control of test and measuring equipment
No one

### 9.6 Conduct of test and approval of test results
No one

### 9.7 Maintenance during commissioning
No one

### 9.8 Interface with operations

***Ling Ao***
**A pre-established plan for the participation of operating staff in commissioning has been implemented in operation branch (LPO).**
Field operators are integrated into the Start-up Team (SUT) branches of the project department for an average duration of more than three months. Each field operator is scheduled to participate in the commissioning of a chosen system until it is handed over for operation. All participants are required to share their experience with other operating staff and submit a monthly report on equipment problems that occurred during commissioning, which are then followed up by a special group from the operations side with the help of a special database on equipment reliability. In this way, operating staff are heavily involved in the commissioning of all major systems in the plant with all important equipment problems under close monitoring.

More than 30 licensed operators with clear responsibilities for procedure writing and take-over activities compose a procedure group in the LPO. They are encouraged to establish direct contact with test supervisors to validate procedures during commissioning of the concerned systems. Among these procedure writers, ten are selected and sent to the SUT as shift start-up engineers responsible for overall commissioning tests on the unit.

Before each stage of unit overall test, maximum participation of operation shift teams in commissioning activities are also discussed between LPO and SUT with consensus recorded in minutes of meetings signed by both operations and project managers. Experienced licensed operators are also assigned to assume the coordination functions. This practice facilitates good communication between the start up and operation teams during commissioning.

Full participation of operating staff in commissioning not only provides good opportunities for training of operating staff, but also gives a strong support to commissioning activities that in turn facilitates for the forthcoming operation of the plant by knowledgeable operators.

**9.9 Interface with construction**
No one

**9.10 Interface with engineering**
No one

**9.11 Initial fuel loading**
No one

**9.12 Plant handover**

***Ling Ao***
**The Liaison Office of Operations Department has established an efficient software system for take-over management known as TCS (Take-over process Control and follow-up System).**
Everyone in the plant can visit the TCS website through the internal computer network. It is tightly incorporated with the interface procedures and is widely used to control the taking-over process, follow-up the clearance of reservations and provide different information on take-over activities as EESR, TOB, TOM, and TOTO.

The TCS has been used to monitor all the important points on the process control, including the delivery time of the requests, deadline for comments following visit on site, comments from operations to project and the status on signature of certificates. Reservations found in earlier take-over stages are carefully monitored and are not taken to the next stage unless they are resolved with each reservation traceable and retrievable in the TCS.

Timely information on the overall status of system hand-over, lists of reservations, clearance ratios etc. can be produced through TCS for both management and working levels. In order to ensure good communication during the take-over process, TCS also provides notifications on site joint visits, and the status of completed, on-soling and planned take-over activities.

**9.13 Work control and equipment isolation during commissioning**
No one

**9.14 Control of temporary modifications**
No one

**Good practices in 2001-2003 summary**

| Chapter of OSART report | Number of good practices |
|---|---|
| 1 | 16 |
| 2 | 14 |
| 3 | 14 |
| 4 | 13 |
| 5 | 13 |
| 6 | 9 |
| 7 | 13 |
| 8 | 19 |
| 9 | 2 |
| **Σ** | **113** |

| | NPP | Number of good practices |
|---|---|---|
| 1 | Angra (1+2) | 15 |
| 2 | Nogent | 14 |
| 3 | Ling Ao | 12 |
| | Civaux | 12 |
| 4 | Dukovany | 11 |
| 5 | Temelin | 10 |
| | Krsko | 10 |
| | Santa Maria de Garona | 10 |
| 6 | Tricastin | 8 |
| 7 | Rovno | 6 |
| 8 | Paks | 5 |
| | Σ | 113 |

Average number of good practices: 10.27 per NPP

## OSART and Expert missions in 2001-2003

| MISSION_NO | MISS_TYPE | COUNTRY | PLANT | R_TYPE | R_SIZE | R_MODEL | PLANT_STAT | COMME_OPER | DATES | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|
| 110 | O | Czech Republic | Temelin 1/2 | WWER | 1000 | /320 | O | U1 10 June 2002 U2 18 April 2003 | 12 February–1 March | 2001 |
| 111 | P | China | Ling Ao | PWR | 1000 | Framat | C | | 6–23 August | 2001 |
| 112 | O | Hungary | Paks 1/4 | WWER | 440 | /213 | O | 01 Aug 1983 | 8–25 October | 2001 |
| 113 | O | Czech Republic | Dukovany 1/4 | WWER | 440 | /213 | O | 01 Nov 1985 | 5–22 November | 2001 |
| 114 | O | France | Tricastin | PWR | 915 | Framat | O | 01 Dec 1980 | 14–31 January | 2002 |
| 115 | O | Spain | Sta. M. de Garona | BWR-3 | 466 | GE | O | 01 May 1971 | 18 February–7 March | 2002 |
| 116 | O | Brazil | Angra 2 | PWR | 1229 | | O | 01 Nov 2000 | 12–31 October | 2002 |
| 117 | O | France | Nogent | PWR | 1360 | Framat | O | 01 Oct 1987 | 20 January–6 February | 2003 |
| 118 | O | France | Civaux | PWR | 1520 | Framat | O | 01 Dec 1997 | 12–28 May | 2003 |
| Not planned | E | Hungary | Paks | WWER | 440 | /213 | O | N/A | 16–25 June | 2003 |
| 119 | O | Brazil | Angra 1 | PWR | 657 | | O | 01 Apr 1982 | 30 June–17 July | 2003 |
| 120 | O | Ukraine | Rovno 1/2 | WWER | 440 | | O | 01 Dec 1980 | 19 Sept–9 Oct | 2003 |
| 121 | O | Slovenia | Krsko | PWR | 707 | Westin | O | 01 Oct 1981 | 20 October–6 November | 2003 |

All OSART and Pre-OSART missions were full scope missions

## Follow-up missions in 2001–2003

| MISSION_NO | MISS_TYPE | COUNTRY | PLANT | R_TYPE | R_SIZE | R_MODEL | PLANT_STAT | COMME_OPER | DATES | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|
| 55 | FU | Bulgaria | Kozloduy | WWER | 4x440 2x1000 | /230 | O | 1974–1982 | 15–19 January | 2001 |
| 56 | FU | Switzerland | Goesgen | PWR | 1000 | Siemens | O | Nov 1979 | 11–15 March | 2002 |
| 57 | FU | France | Belleville | PWR | 1300 | Framat | O | Oct.1987–July 1988 | 18 February–7 March | 2002 |
| 58 | FU | Switzerland | Muhleber g | BWR-4 | 355 | GE | O | 1973 | 9–14 June | 2002 |
| 59 | FU | USA | North Anna | PWR | 2x980 | Westing | O | 1978/1980 | 8–12 April | 2002 |
| 60 | FU | China | Ling Ao | PWR | 2x1000 | Framat | U1-O U2-C | U1 05/2002 U2 01/2003 | 18–22 November | 2002 |
| 61 | FU | Spain | Sta. M. de Garona | BWR-3 | 466 | GE | O | 01 May 1971 | 21–28 November | 2003 |
| 62 | FU | Czech Republic | Dukovany 1/4 | WWER | 440 | /213 | O | 1985–1987 | 6-10 October | 2003 |
| 63 | FU | France | Tricastin | PWR | 4x900 | Framat | O | 1980-1981 | 17–21 November | 2003 |
| 64 | FU | Czech Republic | Temelin 1/2 | WWER | 1000 | /320 | O | U1 10 June 2002 U2 18 April 2003 | 8–12 December | 2003 |

# APPENDIX I
# "OSMIR" OSART MISSION RESULTS DATABASE

## DESCRIPTION OF THE DATABASE

OSART mission results have been incorporated into a database known as **OSMIR**, an acronym for **OS**ART **Mi**ssion **R**esults. The database covers all missions since January 1991 up until the most recent mission whose official report has been published. The results of follow-up visits are also included.

The information included in the OSMIR database is the same as the results contained in mission reports, except for minor editing such as replacing plant/utility specific terms and abbreviations with more universally understood terms.

To date the results of 56 OSART missions and 36 OSART follow-up visits have been incorporated covering the reviews carried out from 1991 to 2003. The information is filed according to:

Mission identification: Gives plant information e.g. name, country, reactor type and size, mission dates, type of mission, etc.

Mission results: Currently comprises 2337 recommendations, 1385 suggestions and 532 good practices, each of which is categorized by review area and topic together with a statement of the issue related to each recommendation and suggestion.

Follow-up visits: Results include information on the actions that have been taken by the NPPs in response to each recommendation and suggestion of the original mission, and IAEA team members' judgment on the effectiveness of remedial actions and progress made in implementing the improvements.

Results are defined in the OSART Guidelines, 1994 Edition, IAEA-TECDOC-744. Using this definition, the results are classified in OSMIR as:

| Search key | Result |
|---|---|
| R | Recommendations |
| S | Suggestions |
| G | Good Practices |

OSMIR is composed of several tables and contains all technical and administrative references described below:

| Technical | Administrative |
|---|---|
| Plant name | Mission No. |
| Reactor type and size | Country |
| Plant status | Mission dates |
| Mission type | Report status date |

One table in OSMIR contains all the OSART mission results in memo fields. Each recommendation and suggestion is logged in two member fields named *issue* and *result*. The issue explains what the problem is, while the result recommends or suggests a specific action to solve the problem. Consequently, to fully understand the concern, both *issue* and *results* should be retrieved together. In some instances *issues* are not provided.

Other table in OSMIR contains the OSART follow-up visit results. These results are logged in three memo fields, *Plant Response, IAEA Comment* and *Status of the Issue*. Not all OSART missions have follow-up visits.

Examples of searches that can be made in the database range from global searches, for example, all findings related to a review area, e.g. training and qualification, to specific searches, for example, looking for recommendations of generic significance for a given topic at WWER plants that have been assessed during a follow-up visit as having been satisfactorily responded to.

**Availability**
OSMIR has been offered to nuclear power plants, utilities, regulators, research institutes and organizations directly involved in the fuel cycle, as a source of information that can help them strengthen nuclear safety performance.

The OSMIR database has been set up using MS Access 2.0. Consequently, to readily operate this database the user should be familiar with Windows and Access. The tables however, can be exported to other databases in the market, such as: Paradox 3.X/4.X, FoxPro 2.0/2.5/2.6 and dBase III/IV. Copies of OSMIR are supplied on one CD-ROM.

To receive an OSMIR database, a request should be send to the address below:

Katsuhisa Sengoku
NSNI-OSS
IAEA, Wagrammer Strasse 5,
P.O. Box 100,
A-1400 Vienna, Austria
Fax: +43 1 2600 29937
E-mail: K.Sengoku@iaea.org

# THE KEY TOPICS OF THE OSMIR DATABASE

## 1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1. Corporate organization and management
2. Plant organization and management
3. Quality assurance programme
4. Regulatory and other statutory requirements
5. Industrial safety programme
6. Document and records management
7. Site access control (optional)

## 2. TRAINING AND QUALIFICATION

1. Organization and functions
2. Training facilities, equipment and material
3. Control room operators and shift supervisors
4. Field operators
5. Maintenance personnel
6. Technical support personnel
7. Radiation protection personnel
8. Chemistry personnel
9. Management personnel
10. General employee training

## 3. OPERATIONS

1. Organization and functions
2. Operations facilities and operator aids
3. Operating rules and procedures
4. Operating history
5. Conduct of operations
6. Work authorizations
7. Accident management
8. Fire protection programme

## 4. MAINTENANCE

1. Organization and functions
2. Maintenance facilities and equipment
3. Maintenance programs
4. Procedures, records and histories
5. Conduct and control of maintenance work
6. Material conditions
7. In-service inspections
8. Stores and warehouses
9. Outage management

**5. TECHNICAL SUPPORT**

1. Organization and functions
2. Surveillance programme
3. Operational experience feedback system
4. Plant modification system
5. Reactor engineering
6. Fuel handling
7. Safety related computer applications

**6. RADIATION PROTECTION**

1. Organization and functions
2. Radiation work control
3. Internal radiation exposure
4. Radiation protection instrumentation, equipment and facilities
5. Personnel dosimetry
6. Radioactive waste storage and discharge
7. Radiation protection support during emergencies

**7. CHEMISTRY**

1. Organization and functions
2. Chemistry control in plant systems
3. Chemical surveillance programme
4. Chemistry operational history
5. Laboratories, equipment and instruments
6. Quality control of operational chemical
7. Radiochemical measurements

**8. EMERGENCY PLANNING AND PREPAREDNESS**

1. Emergency organization and functions
2. Emergency plans
3. Emergency procedures
4. Emergency response facilities
5. Emergency equipment resources
6. Training, drills and exercises
7. Liaison with public and media

## 9. COMMISSIONING

1. Organization and management of commissioning
2. Commissioning programme
3. Training in commissioning
4. Preparation and approval of test procedures
5. Control of test and measuring equipment
6. Conduct of test and approval of test results
7. Maintenance during commissioning
8. Interface with operations
9. Interface with construction
10. Interface with engineering
11. Initial fuel loading
12. Plant handover
13. Work control and equipment isolation during commissioning
14. Control of temporary modifications

## APPENDIX II
## SHARING KNOWLEDGE ON EDUCATION AND TRAINING IN NUCLEAR SAFETY

Complementary to its training courses and workshops (about 80 every year), the Division of Nuclear Installation Safety (NSNI) is concentrating its efforts on assisting Member States to establish national sustainable education and training programmes that are in line with IAEA safety standards. The programme on education and training in nuclear safety includes the identification of Member States needs and the preparation and distribution of training material upon request.

**Framework**

The framework for the implementation of the education and training programme in nuclear safety is shown in Fig. 1. The axes of the figure show the main target groups on which training is to be focused (horizontal) and the level of detail to be pursued by the training (vertical).

The areas of specialized knowledge level are identified according to the structure of the IAEA Safety Standards to emphasize the fact that all the training provided by the IAEA is based on its own standards and recognized international practices.

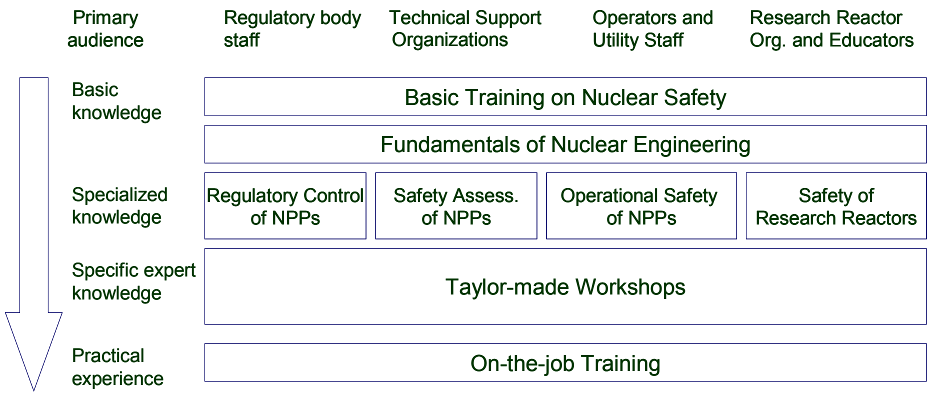


*FIG. 1. Framework for education and training.*

At the level of basic knowledge, training is intended to provide a broad overview of nuclear safety concepts and their application to nuclear power plants and research reactor design and operation. Its nature and scope are primarily oriented to junior professionals recently involved in nuclear safety related activities. It is also appropriate for some highly specialized professionals who lack a broader view of nuclear safety.

In order to fully appreciate and understand the basic training on nuclear safety it is necessary to have some academic education in fundamentals of nuclear engineering, including basic topics such as reactor physics, thermal hydraulics, instrumentation and control, materials, reactor technology, etc. This education is essential to those engaged in the nuclear safety field and is increasingly difficult to obtain due to the phasing out of nuclear engineering programmes in many universities worldwide. The material is presented through distance learning tools for self-study. Some packages are already available.

At the level of specialized knowledge, standard training courses are to be offered in all areas of competency. Target groups are technical staff of regulatory bodies, technical support organizations, nuclear power plant operators, research reactor operators and users, scientific personnel from research institutes, and educators. Standardized training packages were prepared for some of these areas.

At a more specific expert level, workshops are generally preferred as they provide more appropriate conditions for an effective exchange of information and experience among practitioners.

The framework for education and training is complemented by opportunities for practical on-the-job training awarded as Scientific Visits and Fellowships by the IAEA on a case-by-case basis.

**Training Materials**

Textbooks, lecturers' guidelines and computer based training tools are being prepared on topics relevant for the safety of nuclear installations. The material available to Member States is presented in tables 1 and 2 below. About 4000 CD's were distributed in 2003 and in the future most of the material will be available from the web site (http://www-ns.iaea.org/training/ni/search/taxonomysearch1.asp). Support on the use of the materials, as well as information on training methods, are being provided through training courses oriented to the trainers — so called 'train-the-trainers'.

**Textbooks**

A textbook of a specific course is a reference for all topics included in that course.

**Lecturers' Guidelines**

They consist on a set of documents that helps training centres organize a course on a specific topic and help the lecturers to prepare their presentations. The packages contain an organization manual, commented viewgraphs and relevant IAEA and INSAG publications.

**Training Process and Instructor Training**

Successful training depends on both the content of training materials and the quality of the training development, delivery, and assessment/evaluation system, including instructors. In addition to the training materials described above, the IAEA also has developed a comprehensive suite of documents related to the training process. The guidance and lessons learned in these documents are all based upon sharing of knowledge regarding the Systematic Approach to Training (SAT) that has been adopted by nuclear industry training organizations in many Member States. Provided below is a listing of these documents; all of which are available for downloading from the IAEA's website

**(http://www.iaea.org/Publications/index.html).**

Additionally, the IAEA's Technical Working Group on Training and Qualification of Nuclear Power Plant Personnel (TWG-T&Q) provides a continuing opportunity for sharing knowledge in the subject area. This TWG also advises the IAEA as to the most important needs regarding knowledge sharing in the industry. The TWG-T&Q encouraged the IAEA to develop a web-based mechanism for knowledge sharing regarding training and qualification of NPP personnel. The ENTRAC E-catalogue was recently initiated in response to this recommendation **(http://entrac.iaea.org).**

| Document No | Name of Document | Note |
|---|---|---|
| TRS-380 | Nuclear Power Plant Personnel Training and its Evaluation | |
| TECDOC-1392 | Development of Instructors for Nuclear Power Plant Personnel Training | |
| TECDOC-1411 | Use of Control Room Simulators for Training of Nuclear Power Plant Personnel | |
| TECDOC-1364 | Managing Human Resources in the Nuclear Power Industry | |
| TECDOC-1358 | Means of evaluation and improving the effectiveness of training of nuclear power plant personnel | |
| TECDOC-1254 | Training the staff of the regulatory body for nuclear facilities: a competency framework | |
| TECDOC-1232 | Assuring the Competence of NPP Contractor Personnel | |
| TECDOC-1204 | Systematic Approach to Human Performance Improvement: Training Solutions | |
| TECDOC-1170 | Analysis Phase of Systematic Approach to Training (SAT) for Nuclear Plant Personnel | |
| TECDOC-1057 | Experience in the Use of Systematic Approach to Training (SAT) for nuclear power plant personnel | |
| TECDOC-1024 | Selection, Competency Development and Assessment of Nuclear Power Managers | |

Information on the IAEA training programme and material may be addressed to:

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Information on the process of training using SAT may be addressed to:

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TABLE 1. STANDARD TRAINING MATERIAL

| **Title** | **Type** | **Level** * | **Media** |
|---|---|---|---|
| Basic Professional Training Course, Vol. 1, Vol. 2 and Workbook | Textbook | B | Textbook |
| Regulatory Control of NPPs | Textbook | S | Textbook |
| PSA Level 1 and Applications | Lect. Guidelines | E | CD, ANSN |
| Level 2 PSA | Lect. Guidelines | E | CD |
| Regulatory Aspects and Safety Documentation for Research Reactors | Lect. Guidelines | S | CD, ANSN |
| Research Reactor Ageing and Self-Assessment Methodology | Lect. Guidelines | E | CD, ANSN |
| Emergency Preparedness and Response for Research Reactors | Lect. Guidelines | E | CD, ANSN |
| Safety Assessment of NPPs to Assist Decision Making | Lect. Guidelines | S | CD |
| Management of Operational Safety of NPPs | Lect. Guidelines | E | CD, ANSN |

* B…basic knowledge; S…specialized knowledge; E…specific expert knowledge

TABLE 2. COMPUTER BASED TRAINING TOOLS

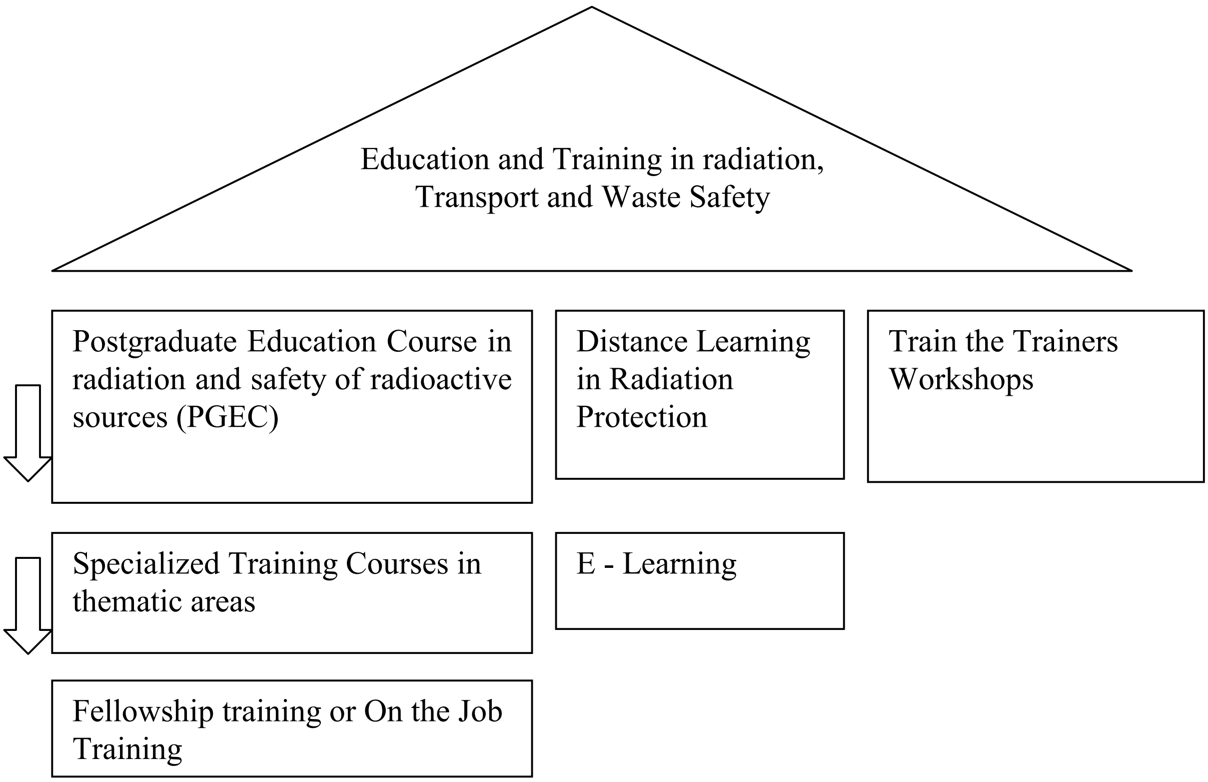
| Title | Type |
|---|---|
| *Fundamentals of Nuclear Engineering* | |
| Fundamentals of Thermal-hydraulics | Hypertext |
| Fundamentals of Reactor Physics | Hypertext |
| Basic Safety Concepts | Hypertext |
| Legal and Governmental Infrastructures for Nuclear Safety | Video |
| *Basic Nuclear Safety* | |
| Safety Related Characteristics of Reactors: Introduction | Multi-media |
| Safety Related Characteristics of Reactors: Radioactive Materials Inventory and Fission Product Decay Heat | Multi-media |
| Safety Related Characteristics of Reactors: Reactivity Control, Safety Systems, Passive Systems | Multi-media |
| IAEA Safety Fundamentals | Multi-media |
| Basic Principles for NPPs: INSAG-3, INSAG-12 | Multi-media |
| Defence-in-depth: INSAG-10 | Multi-media |
| Defence-in-depth — Implementation: The Spanish Experience | Multi-media |
| IAEA Design Safety Standards | Multi-media |
| IAEA Siting Standards | Multi-media |
| Siting Evaluation | Multi-media |
| Basic Concepts of Deterministic Safety Analysis | Multi-media |
| Deterministic Accident Analysis — Classification of Events | Multi-media |
| Design Basis Accident Analysis: Methods and Codes – RELAP 5 | Multi-media |
| Methods for Beyond Design Basis Accident Analysis – Part 1 | Multi-media |
| PSA Utilisation: Risk Management | Multi-media |
| PSA Utilisation: Design, Inspection, Regulatory Applications | Multi-media |
| Excellence on Operational Safety — The Vision | Multi-media |
| Challenging Operational Safety — Examples and Consequences | Multi-media |
| Assessing Operational Safety: Enhancement, Assessment, Effectiveness | Multi-media |
| Self-Assessing Operational Safety | Multi-media |
| Configuration Control | Multi-media |
| Maintenance & Surveillance Programs | Multi-media |
| IAEA Requirements for Safe Operation of NPPs | Multi-media |
| Operating Organization | Multi-media |
| Conduct of Operations | Multi-media |
| Enforcement of Standards in Daily Operations | Multi-media |
| Reducing Human Errors | Multi-media |
| Introduction to Safety Culture — Basic Concepts & Principles | Multi-media |
| Management of Safety & Safety Culture at NPPs | Multi-media |
| Structure and Development of Safety Culture | Multi-media |
| Safety Culture in an Operating Organization | Multi-media |
| *Specialized Knowledge* | |
| Regulatory Control of NPPs | Hypertext |
| The Safety Standards Programme Overview | Multi-media |
| Safety Requirements for Design of NPPs | Multi-media |
| Site Evaluation for Nuclear Installations, SR NS-R-3 | Multi-media |
| Safety Requirements for Site Evaluation of NPPs — Part 1 | Multi-media |
| Safety Requirements for Site Evaluation of NPPs — Part 2 | Multi-media |
| Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety Requirements | Multi-media |
| Requirements for Safe Operation of NPPs with Comparison to OSART Experience | Multi-media |
| Overview of Safety Guides for Operation of NPPs | Multi-media |
| Overview of Safety Guides for Design of NPPs | Multi-media |
| Overview of Safety Guides for Site Evaluation | Multi-media |
| Overview of Safety Guides for Legal and Governmental Infrastructure | Multi-media |
| Code of Conduct on the Safety of Research Reactors | Multi-media |
| Commissioning of NPPs | Multi-media |
| Evaluation of Seismic Hazards for NPPs | Multi-media |
| External Events Earthquakes in the Design of NPPs | Multi-media |
| Design of Fuel Handling and Storage Systems for NPPs | Multi-media |
| Seismic Design and Qualification for NPPs, SG NS-G-1.6 | Multi-media |

## APPENDIX III
## SHARING KNOWLEDGE ON EDUCATION AND TRAINING IN RADIATION PROTECTION, TRANSPORT AND WASTE SAFETY

In line with the General Conference resolutions and with the responsibility for the application of safety standards, NSRW has adopted different mechanisms for providing training in radiation, transport and waste safety.

**Framework:**

The training activities of the division are structured as below:




**PGEC** is a comprehensive training programme aimed at young professionals at graduate level and is conducted in five of the Agency's official languages. On completion of PGEC, for specialisation in a specific theme or practice, **specialized training courses** are provided, this is further complemented with **on the job tra**ining in the same theme. A Qualified Expert completes the three stages.

Complimentary to classroom based training is the **Distance Learning in Radiation Protection.** The scope of distance learning is further being widened by **E-learning.**

**Train the Trainers workshops** are aimed at self-sustainability of the Member Sates, by providing training in communication skill and use of standardised training packages to the potential lecturers.

**Training material**

Training materials are developed for the training courses offered. Presenter's material as Power Point presentations are developed for about 25 speacialised training courses and for most of the modules of PGEC as in Table 1.

Distance learning material is complete with students notes, supervisor's notes, workbook, self check questions, examination questions and Glossary.

Students' notes are developed for some of the specialised training courses and being developed for few more.

Interactive modules for E learning in radiation protection are under preparation.
More details and updated information on training activities can be had from
http://www-rasanet.iaea.org/training/training.htm.

Information on IAEA training programme in Radiation, Transport and Waste Safety and requests for training material can be addressed to:

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Fax-+ 43 1 26007
E mail: G.Sadagopan@iaea.org

TABLE 3. STANDARDIZED TRAINING MATERIALS DEVELOPED

**Specialized training courses**

| **Areas** | **Topics** |
|---|---|
| **Regulatory Infrastructure** | Training of regulators on Authorization and inspection of radiation sources in industrial radiography |
| | Training of regulators on Authorization and inspection of radiation sources in nuclear gauges and well logging |
| | Training of regulators on Authorization and inspection of radiation sources in research and industrial irradiators |
| | Training of regulators on Authorization and inspection of radiation sources in radiotherapy |
| | Training of regulators on Authorization and inspection of radiation sources in diagnostic radiology |
| | Training of regulators on Authorization and inspection of radiation sources in nuclear medicine |

| Areas | Topics |
|---|---|
| | |
| **Occupational Radiation Protection** | Occupational radiation protection |
| | |
| **Individual Monitoring** | Assessment of occupational exposure due to external sources of radiation<br><br>Assessment of occupational exposure due to Intakes of radio nuclides |
| | |
| **Transport Safety** | Safe transport of radioactive material (TCS 1) |
| | |
| **Waste Management** | Safety assessment of radioactive waste disposal facilities |
| | |
| **Patient Protection** | Radiation protection in diagnostic and interventional radiology<br><br>Radiation protection in nuclear medicine<br><br>Radiation protection in radiotherapy |
| | |
| **Emergency Response** | Train-the-trainers workshop on developing a national capability for response to radiation emergencies — 1 week<br><br>Train-the-trainers workshop on emergency planning and preparedness, accident assessment and response to reactor accidents – 1 week<br>Train-the-trainers workshop on monitoring during a nuclear or other radiological emergency — 1 week<br><br>Train-the-trainers workshop on practical response to a radiological emergency — 2 weeks<br><br>Train-the-trainers workshop on procedures for public information management in a nuclear or radiological emergency — 1 week<br><br>Train-the-trainers workshop on preparation, conduction and evaluation of the exercises<br><br>Train-the-trainers workshop on procedures for medical response during radiation emergency (practical) 1 week<br><br>Medical education for radiation emergencies preparedness (educational) — 1 week |
| | |

| Areas | Topics |
|---|---|
| SOURCE SAFETY | Radiation protection and safety in industrial radiography<br><br>Radiation protection and safety in industrial irradiators<br><br>Concepts of radiation protection and safety of sources |
| **Postgraduate** | **Educational Course (PGEC)**<br><br>Part I-Review of fundamentals<br><br>Part II — Quantities and measurements<br><br>Part III — Biological effects of ionizing radiation<br><br>Part IV — Principles of protection and the international framework<br><br>Part V — Regulatory Control<br>Part VI — Assessment of External and Internal Exposures<br><br>Part VIII — Medical exposures in diagnostic radiology, radiotherapy and nuclear medicine<br><br>Part IX — Exposure of the public due to practices (partial)<br><br>Part X — Intervention in situations of chronic and emergency exposure<br><br>Part XI — Training the trainers<br><br>Practical exercises for all parts<br><br>**Distance Learning in Radiation Protection**<br>4 modules — completed |

## APPENDIX IV
## SHARING KNOWLEDGE ON AGEING AND LONG TERM OPERATION

For more than ten years, the IAEA has developed its activity in the field of long-term operation of nuclear facilities, covering both physical and non-physical facets of aging phenomena. The IAEA has now reached a high professional level in this matter, recognized by the international community.

The Division of Nuclear Installation Safety (NSNI) is developing a Safety Knowledge-base on Ageing and Long Term Operation (SKALTO).

The goal of SKALTO is to identify and store relevant knowledge (or provide links to relevant knowledge sites) in order to facilitate its retrieval, updating, extension and dissemination to potential users and thus to promote more creative and effective activities related to long term operation. The key users include IAEA staffs and NPP operation, regulatory, technical support, design and supplier's organizations, and research institutes and universities.
NSNI also plans to establish safety knowledge base systems for other technical areas. SKALTO is a pilot model of these systems.

## Scope

SKALTO covers the following 4 areas related long term operation:

1. Ageing Management: Physical ageing of nuclear power plant systems, structures and components important to safety;
2. Periodic Safety Review;
3. Configuration Management;
4. Design Basis Data Management.

## Required functions and contents

To accomplish the above objective and goal, SKALTO provides the following functions:

1. To introduce relevant IAEA standards national regulations & international recommendations;
2. To present information sources for basic knowledge:
   - Common terminology, abbreviations;
   - Key documents, guidance;
   - Important R&D results;
   - Links to important web sites and database.
3. To preserve and present past IAEA services and national/ international activities;
4. To provide education & training materials;
5. To provide information of expert.

SKALTO consists of the index figure, the user's guide and actual materials. Figure 1 presents a top page of the index figure which shows the over-all structure of SKALTO and its main contents. Figure 2 shows relation between the index figure, the user's guide and actual materials. Users can easily access to materials from the index figure and the user's guide by clicking hyperlinks. The user's guide has the same structure with the index figure and also contains a brief explanation of each materials. Therefore the guide is not a users manual but a glimpse of SKALTO.

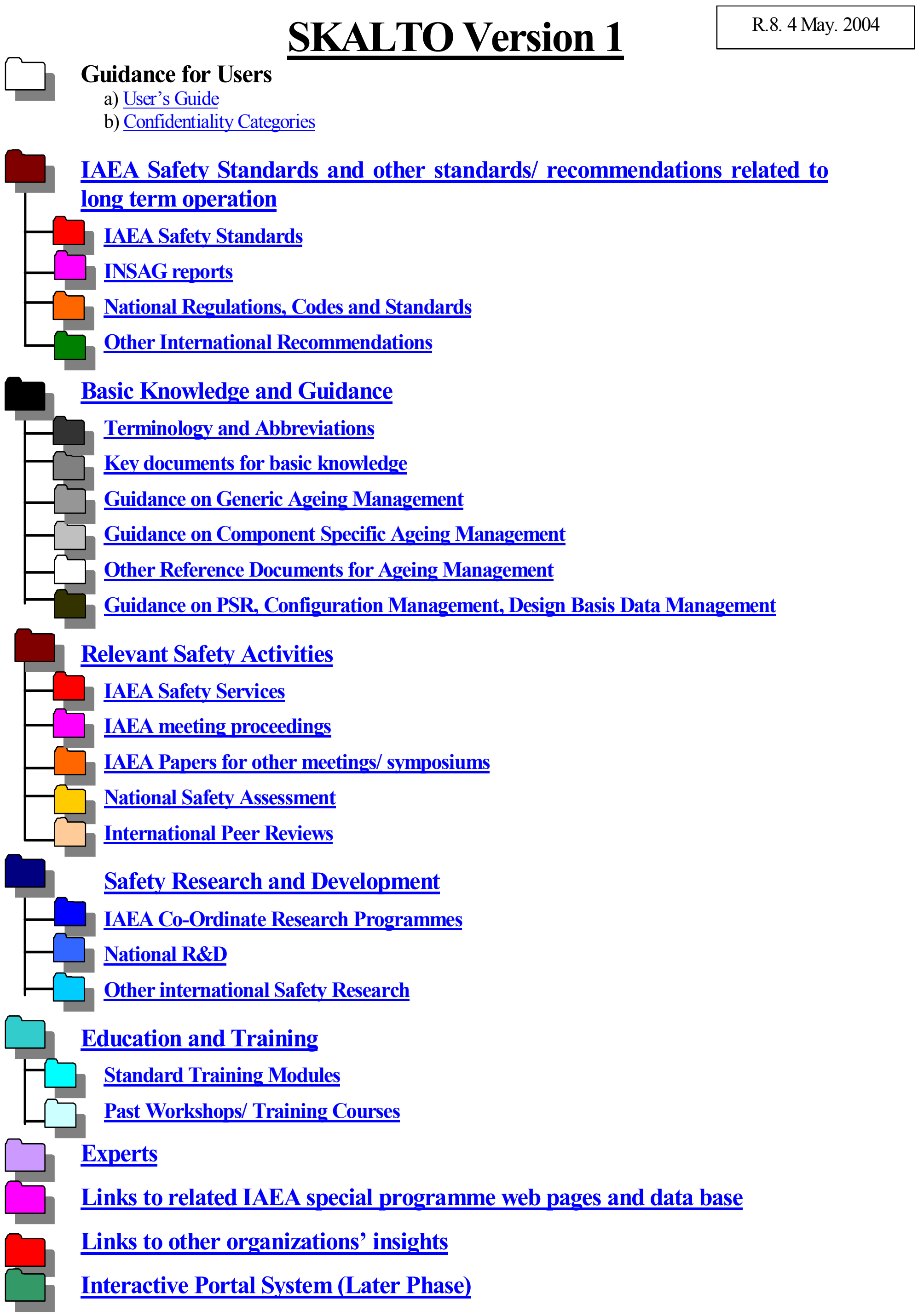


*FIG. 2. Overall structure for SKALTO.*

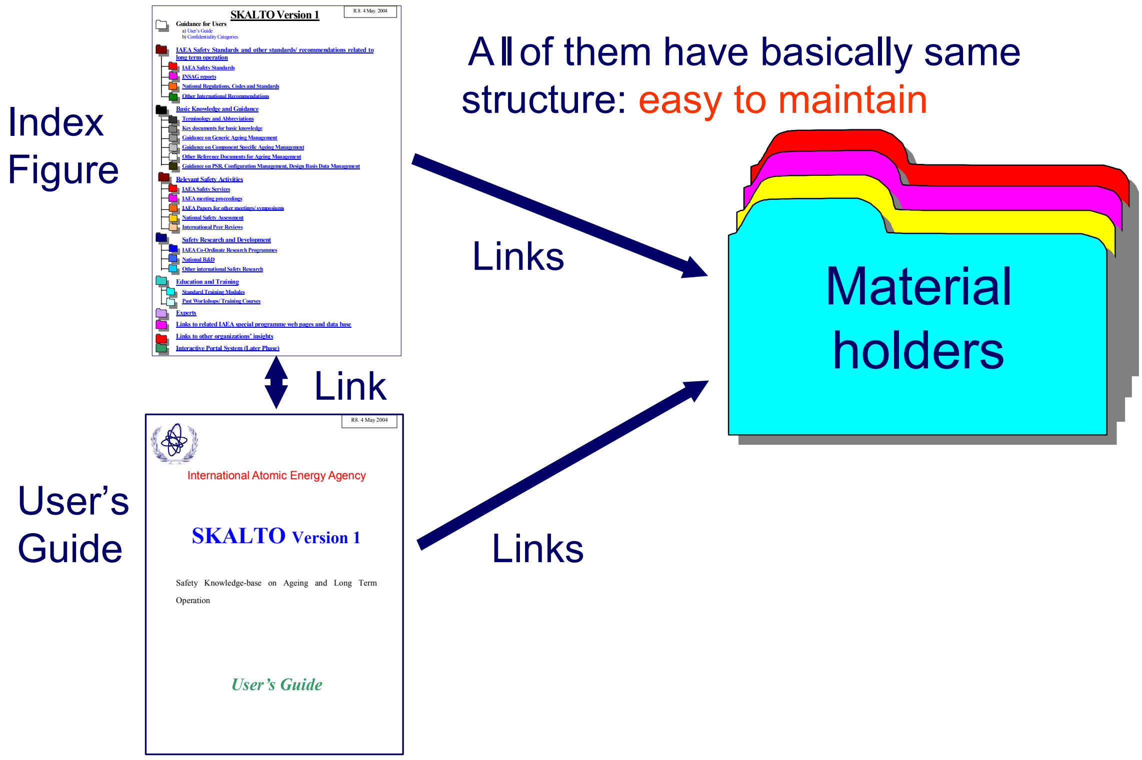


*FIG. 3. Relation between the index figure, the user's guide and actual materials.*

## Current status and future plan

A prototype SKALTO is currently carried on IAEA intranet and thus limited for the Agency's internal use. However the reduced scope SKALTO which includes published documents is being carried on the IAEA web page on the extra budgetary programme "SALTO (Safety Aspects of Long Term Operation of Water Moderated Reactors": [http://www-ns.iaea.org/projects/salto/default.htm.](http://www-ns.iaea.org/projects/salto/default.htm)

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