TC Project LIT/9/006
NSNI/OSART/05/135
IAEA-TCR-03284
ORIGINAL: English

IAEA
Atoms for Peace: The First Half Century
1957–2007

REPORT OF THE OPERATIONAL SAFETY REVIEW TEAM OSART MISSION TO THE IGNALINA NUCLEAR POWER PLANT LITHUANIA

5 to 21 June 2006

DIVISION OF NUCLEAR INSTALLATION SAFETY

OPERATIONAL SAFETY REVIEW TEAM MISSION
conducted under IAEA Technical Co-operation Project LIT/9/006

DEPARTMENT OF TECHNICAL CO-OPERATION
Division for Europe

DEPARTMENT OF NUCLEAR SAFETY and SECURITY
Division of Nuclear Installation Safety

PREAMBLE

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

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

This Operational Safety Review Team mission was implemented under the Department of Technical Co-operation Assistance project LIT/9/006, Support for Nuclear Safety Review Missions.

FOREWORD
by the
Director General

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

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

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

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

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

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

CONTENT

INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the Government of Lithuania, an IAEA Operational Safety Review Team (OSART) of international experts visited Ignalina Nuclear Power Plant from 5 to 21 June 2006. The purpose of the mission was to review operating practices in the areas of management organization and administration; training and qualification; operations; maintenance; technical support; operating experience feedback; 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 Ignalina NPP OSART mission was the 135^{th} in the programme, which began in 1982. The team was composed of experts from Belgium; Czech Republic; Hungary; Russia; Slovakia; the Netherlands; The United Kingdom and Ukraine, together with the IAEA staff members and observers from Belgium, France, Ukraine and Russia. The collective nuclear power experience of the team was approximately 365 years.

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

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

MAIN CONCLUSIONS

The OSART team concluded that at Ignalina NPP the management and staff are really motivated to pursuit operation in a safe manner and transfer safe programmes, practices and behavior to the decommissioning phase.

The team identified a lot of commendable features in the organization, policies, programmes, procedures and application to the field.

As strengths the team identified:

- A management committed to promote safety culture approach (good sets of safety performance indicators, good training programme and series of meetings) who developed two systems to monitor and analyze commitment among the plant and contractor staff;
- A good effort to maintain house keeping and cleanliness in the major part of the plant was witnessed by the team;

- A notably good programme supported by several training sessions for maintenance contractors concerning maintenance planning and outage management is in place and consolidated.
- Good usage on safety areas of international aid, support and funds to improve the monitoring equipment, the general material condition and communication systems.

During the mission the team also focused on areas for improvement. During opened discussion between plant counterparts and experts frank exchanges took place. This teamwork conducted to identify recommendations and suggestions among which the most significant are as follow:

- Emergency response organization should develop pragmatic actions to enhance the efficiency of assembling points, the gathering, counting and protection of the workers, and improving drills and exercises;
- Fire response needs in the same manner clarification and training to be understood by all staff;
- Radiation protection monitoring, control, posting should be improved. Adherence to rules, coaching and information should be delivering to the staff and rules should be strictly reinforced and observed;
- Industrial safety should be treated as an area where continuous improvement is as paramount as continuous improvement in safe operation;
- Reporting from staff on deficiencies needs still to be re-enforced, awarded and promoted by more involved line management. Management expectations are set, however it should be re-enforced and acceptance of weak standards should be minimized.
- Existing self-assessment programme should take into account systematic approach to allow good usage of performance indicators as a leading tool for improvement;
- Finally, several observations conduct the team to encourage the plant to develop further the questioning attitude in areas such as: categorizing low level events and near misses, detecting weaknesses in the foreign material exclusion programme, supporting common owner attitude on systems, structures and components, improving modification process.

Ignalina management expressed a determination to address all areas identified for improvement and indicated its willingness to apply all necessary corrective actions. The plant management is eager to address in the safest manner all issues identified by the team and supported by the plant counterparts and accepted a follow-up visit in about eighteen months.

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

1.1 ORGANIZATION AND ADMINISTRATION

The company Ignalinos Atominė Elektrinė is a state owned enterprise of the Republic of Lithuania. The Ignalina Nuclear power plant (INPP) comprises two units.

The reactors are both RMBK 1500 MW channel type of Russian design. Unit 1 started operation in 1983 and was definitely shutdown at the end of 2004. Unit 2 started commercial operation in 1987 and will finally be shutdown at the end of 2009.

About 3300 employees work for the Ignalinos Atominė Elektrinė Company.

The 2004-version of the Safety Analysis Report for INPP, task 9 (INPP Safety Management), Chapter 2: "Organizational structure and management of the enterprise, management responsibilities, technical and engineering support", describes the applicable requirements and the organization.

Organizational charts are available for top-structure and all substructures of the organization. The organization has 7 layers of management, which is related to the large number of staff.

The organization is complex to manage because of the size and the multiple coordination lines: first the coordination lines between the maintenance directorate and the combined operations-maintenance departments and secondly the coordination lines with the shift-organisation.

The Safety and Quality Assurance Service Manager has an independent position and reports directly to the General Director.

Very detailed job descriptions have been developed and are in use to supplement the plant organizational charts. So called "distribution sheets" were developed to define the demarcation of responsibilities between departments.

Senior management meetings and departmental meetings are held on a periodical basis to monitor and discuss work-progress and quality of work. Several committees are in place which have periodical meetings to discuss, assess and advice the general director on safety matters.

The plant has external interfaces with the regulatory body, contractors, suppliers, the original designer, research institutes and international organisations.

The main regulatory functions for the plant are performed by the State Nuclear Power Safety Inspectorate (VATESI), the Ministry of Economy, the Radiation Protection Centre (Ministry of Health) and by the Ministry of Environment. There are 6 resident inspectors on the plant.

There is no evidence of backlogs in several departments. It can be concluded that the staffing and resources provided, are sufficient to accomplish the assigned safety tasks and responsibilities.

There is only a small turnover in the organization, 40 employees were recruited last year. The plant is reducing staff with approximately 200 employees per year.

The staffing policy however is also directed to retain a backup pool of experienced and knowledgeable staff. The strategy for staff reduction related to the closure of INPP2 is under development. Plant management is considering a reorganization after the closure of unit 2.

An individual performance appraisal system has not been developed and implemented in the plant. The team has made a suggestion to implement such a system.

The fitness for duty policy is established and well maintained. A number of shift personnel with important positions is frequently screened on alcohol and drugs. Contractors are screened if security personnel have doubts with respect to the fitness for duty. The plant is encouraged to consider expanding random screening to non-shift personnel.

Contractors qualified by the plant perform a number of activities. The plant requires the contractors to provide an information package (Quality Manual, list of qualifications of personnel, certificates etc.). This package is assessed by the plant. For new contractors audits are carried out and if the results meet the requirements these contractors are added to the list of qualified suppliers. For assignment of special projects the plant provides a special license to contractors if all requirements are fulfilled. On a periodical basis re-qualification of the contractor is carried out. Monitoring and evaluation of contractor performance is performed. It can be concluded that the qualification process for suppliers is in place.

The relationship between the plant and the regulator can be characterised as open and based on a mutual understanding and respect for each other's roles and responsibilities.

A daily report on the plant's safety status and potential events is sent to VATESI. The regulatory inspectors on site have access to computer-systems of the plant containing safety related information.

The threshold for reporting events is considered to be consistent with international practices.

Discussions between regulator and plant management are regularly held on plant operating issues and projects. There is no periodical scheduled meeting on top management level between the general director and the director of VATESI e.g. on policy issues, organisational matters, progress, problems, long-term projects etc. The team encourages the plant to consider arranging such meetings.

The operating organization's commitment to safety is declared in the plant safety policy which is also available on the website. Information on plant status and events is provided on the plant's web pages and this information is regularly updated.

Different committees (e.g. Safety Committee, Health and Safety Committee, ALARA Committee for outage-preparation/conduct) hold periodically meetings to discuss, assess and advice on safety matters. The committees and task forces have clearly defined charters and objectives. Agenda, minutes of meetings are prepared and actions are followed-up.

The Safety Committee is an advisory committee, which meets monthly. An external expert chairs the committee. Besides the internal members there are also 3 external members. This is estimated as good in order to have a more independent view.

No formal process for management of organizational changes is defined and implemented. Recently reorganization was prepared, related to the engineering department without prior analysis of potential adverse consequences to safety and multidisciplinary and independent review. Only a first draft version of a procedure is available. Therefore the team made a suggestion to develop requirements and implement a process for managing organizational changes.

1.2 MANAGEMENT ACTIVITIES

The management objectives are defined in the annual business plan. Departmental plans are defined on this basis.

The progress toward accomplishment of goals and objectives is reviewed on a detailed level in the separate departments.

Communication is very important, especially in such a complex and large organization.

A recent internal audit questioned the effectiveness of internal communication. However only instrumental corrective actions (improving intranet) were provided in the follow-up. The plant is encouraged to improve the communication by all available and applicable means.

Examples of managers reinforcing the safety policy to the staff were seen, however practices observed in the field showed that reinforcing management expectations on a number of areas could be improved.

Staff can report (safety) concerns to plant management. They can propose improvements in department-logbooks: mostly these proposals are procedural improvements. Staff can also report via so called 'yellow forms' which are led to the general director: mostly these forms are related to work conditions. However no evidence was obtained that these systems are used for reporting of low-level events and near misses. The team has issued a recommendation for this subject in the OE-section of this report.

The managers make field rounds to assess safety equipment status, to observe and discuss the conduct of work and to examine compliance with management expectations and objectives.

It can be concluded that all aspects of the plant programme for safe operation are covered by the 26 administrative procedures.

There is an adequate system in place for tracking corrective actions to their completion, however not all type of corrective actions are already fed into the system. Plant is encouraged to do so in order to have a complete overview.

Conventional codes, standards and industrial practices are used in the plant.

National requirements relating to the conditions of work in industrial establishments are defined in laws and support the safe operation of the power plant.

Industrial use, storage and transportation of hazardous materials are included in the environmental system of the plant, which is part of the power plant management system.

Monitoring and follow-up work-progress is performed in departments. However a condensed plant-overall picture for top-level management on progress of work, potential backlogs and some status-trends is not available. Examples of missing information are: completeness of training, indicators for status of industrial safety, follow-up of management field-inspections, number of overdue corrective actions, maintenance/surveillance backlogs, trends on audit and inspection findings etc. The plant is encouraged to develop more high-level management reporting in order to provide a better overall view on progress and performance to management.

The plant uses the WANO safety performance indicators and has defined in addition two plant-specific aggregated safety indicators. These indicators are quarterly reported to management and results are discussed in management meetings. Detailed performance indicators for both quality and progress of work, so called quality screens, are used in the Maintenance department.

The plant has also defined and applies a number of safety culture indicators. Besides safety culture assessments are carried out to monitor and improve safety culture in the plant. These activities are recognised by the team as good practices.

Engineering support has developed a good system for evaluation of reliability of safety related components: failure rates of safety components are analyzed and compared with acceptance criteria, practical corrective actions are defined and followed up.

The management has a clear understanding of the most important strengths and weaknesses of the plant's organisation. The managers and supervisors are held accountable for the achievement of assigned objectives.

Elements of the programme for Human Factors Management are in place but no systematic approach is implemented up to now. In the operating experience feedback section of this report, the team made a suggestion on this issue. The Health and Safety Surveillance department carries out investigations on working conditions such as lighting, noise, working hours, vibrations, etc. The management carries out assessments of subordinate activities, including off-hour plant tours. The working environment is generally suitable so that work can be carried out satisfactorily.

The Probabilistic Safety Analysis (PSA) was developed for level 1 and 2, for full power state. Shutdown states were not included. For initiating events, the external events were not included in the model. Swedish and Russian contractors supported the development of the PSA model. Nowadays the Lithuanian Energy Institute offers support on PSA-issues.

The PSA is mainly used for finding weaknesses in design modifications and for assessing the effects of potential improvements in design. PSA is applied for periodic safety reviews (SIP 1 -3 programmes).

1.3 MANAGEMENT OF SAFETY

The safety policy is disseminated in the plant by several means, e.g. oral communication, leaflets, brochures, intranet.

References to the safety standards are provided in the quality manual.

The technical director holds twice a week meetings with all managers. The general director has monthly (informative) meetings with all managers, in which safety matters are discussed.

A number of examples were seen that senior corporate managers reinforce their expectations to staff. Senior managers are knowledgeable and generally they have many years of nuclear experience.

Several useful posters and booklets to promote safety culture and "STARK" concept are displayed around the site to maintain focus on safety attitude;

A good system to spread internal and external information and training programme via intranet site and communication centers has been recently implemented;

Safety related activities are planned. Precautionary measures for routine jobs are included in work instructions. Risk assessment for special safety related jobs are not performed explicitly. The team encourages the plant to implement explicit risk assessment for such cases. Workers are allowed (by law) to refuse and stop unsafe work.

In order to apply conservative decision making, the plant is encouraged to formalize and implement the concept for operational decision making by an ad-hoc task force for upcoming safety related problems.

An adequate audit and review system is established to monitor and evaluate the safety performance. A number of peer reviews (ASSET, OSART, WANO, IPSART) have been conducted in the past, to provide an independent judgment on the effectiveness of the safety management system.

The managers contribute to the annual safety report and some of them are also involved in safety improvement programmes. These activities are examples of self-assessment and they show that elements of this programme exist, however no systematic approach for self-assessment is implemented. The team has made a suggestion to further develop and implement the concept of self-assessment in the plant.

Several mechanisms are in place to report deviations (FOBOS-, ARKI-system, logbooks, yellow forms, event reporting, etc). Root Cause Analysis is performed for the events reported. Event evaluation reports have to be completed one month after the event.

Corrective actions are reviewed to assess whether they have adequately addressed the issues identified in the audits and reviews.

The plant has several international contacts, e.g. visits, exchanges, projects, contractors, peer reviews etc. Experience is transferred within the operating organization by means of meetings, training, intranet etc.

The configuration management programme is established and implemented at the plant.

The programme controls plant modifications, including those of a temporary nature. The actual number of outstanding temporary modifications is small.

A system is established and implemented to ensure that changes to the plant are properly identified, screened, designed, evaluated and documented.

A programme for ageing management is in place. The physical degradation phenomena, including degradation caused by the various activities of operation, surveillance and maintenance, are analyzed.

Team conclusion related to safety culture features at Ignalina NPP:

During the OSART review the team has identified several features of the plant as being characteristic of its safety culture. These positive features are described below:

- The plant has developed and applies a safety performance indicator system and performs periodically a quantitative safety culture evaluation derived from staff opinion survey. The team has recognized this approach as a good practice.

- "Logbooks for personnel's proposals on improvements" are introduced at plant departments. The staff of the plant may advise their direct managers about safety issues. Everybody can make a suggestion to perform improvements in the area of documentation, equipment or personnel behavior.

- Good house keeping and cleanliness are maintained in many areas (pump house, most of the buildings etc.). Unfortunately this effort is not always consistent (e.g. fire water system and components).

- Management commitment to promote safety culture approach is obvious. They support the introduction of new concepts and ideas related to safety culture. It is good to see that management promote a focus on practical means to enhance safety culture.

- Plant maintenance contractors have several training sessions during a year concerning safety culture, maintenance planning and outage management. It is important because at many plants it is a challenge to achieve the same level of commitment to safety culture principles among contractors as compared to plant staff.

- Prior to assignment to a new job position each candidate has to attend a training lesson on safety culture principles. Well-prepared safety culture training manual is available for this purpose. The topics of this training include introduction to INSAG-4, plant safety policy, self-control "STARK" principles, plant safety indicators, INES scale, managerial and individual role in safety culture, blame free atmosphere etc. The plant has made significant improvement in introducing the blame free work culture, when errors are seen as an opportunity for improvement; the team therefore encourages the plant to continue this effort.

However several areas still could be improved:

- Emergency response organization needs to focus on pragmatic actions and needs to provide more training for all staff.

- The team evaluated the fire response procedure as complicated. Full-scale exercise (which has been never tested) could be planned to test the entire organization. The team noted that more fire drills and exercises could easily improve the situation.

- The large size of the plant site and large staff make not easy developing team work and ownership for systems and components. "It is not our equipment or problem", is the answer when staff are interested only in their department business. Paperwork sometimes seems more important than performance/good results. The team noted several examples of low level of questioning attitude:

    - Compliance oriented attitude: "we do what the law requires";
    - Complacency: "There has been no problem for 20 years with the current way";

- Some elements of personnel radiation monitoring and control system may become more significant when actual decommissioning works involving handling radioactive structures, equipments or parts will start. Efforts should be pursued to cope with good internationally accepted standards.

- The team is aware of the difficulty in maintaining motivation of staff created by decision about early shutdown of the plant. Uncertainty about the future of the plant leads to a situation when they are concerned about maintaining occupation for the future. Unnecessarily large and prolonged uncertainties about future responsibilities and even job security among key technical staff may result in loss of concentration on present job responsibilities or even to loss of qualified workforce.

1.4 QUALITY ASSURANCE PROGRAMME

Quality assurance is realized by the independent "safety and quality assurance" service by means of audits and inspections. The inspections and audits are done in compliance with the quality manual on the basis of an annual schedule. There are no long-term plans however the plant covered all areas. The areas are selected by a "graded approach": "Safety related processes" and processes with known problems are audited or inspected more frequently.

The "QA department" conducts internal and external audits under the supervision of certified lead auditors. Staff members who were trained to conduct audits assist the lead auditors. On average 12 internal audits are performed each year. Audits include the follow up of former audit actions, checks of compliance to rules and regulations and assessment of the quality of process activities. Audit reports contain observations (minor deviations) and "non conformities" (major deviation). External audits are conducted for certification of contractors. The plant mentioned difficulties to comply with this schedule.

The "Safety Surveillance section" conducts inspections, in order to report on compliance with regulations and regulatory requirements. Every year on average 20 inspections are performed.

Reports from audits and inspections are sent to managers in charge of implementing corrective actions. The audit reports are sent to safety committee on request only. The team encourages sending these audit reports systematically to the safety committee in order to get a broader management awareness and discussion on the audit results. Plant's regulator, VATESI, receives the internal audit reports after completion of the audit findings.

In the annual safety report, no specific conclusions are drawn nor are recommendations provided related to trends on findings of audits and inspections. The team encourages the plant to trend findings of audits and inspections and to evaluate these trends on potential safety improvements.

1.5 INDUSTRIAL SAFETY

The "Health and Safety department" in the technical directorate is responsible for industrial safety, radiation and environmental protection.

Plant's industrial safety policy is established according to the Lithuanian law.

Required procedures are well established defining organization, responsibilities and authorities for each staff member.

The industrial safety section of the Health and Safety department's main activities concern the conduct of industrial safety monitoring, measurement of risk factors and the participation in inspections of maintenance (systems, components, structures and working conditions).

Findings of the industrial safety inspections are recorded and reported to management for corrective actions. Industrial safety actions are discussed and followed up in the department meetings and in the industrial safety committee.

Management of all departments performs scheduled field inspections. The industrial safety section checks the completeness of the schedule and performs the follow up of the actions identified by the departments.

A few number of industrial safety related accidents is registered: 3 in 2004, 8 in 2005 and 2 in the first quarter of 2006. The difference between numbers of accidents in the last 2 years is attributed to changes of reporting criteria. New criteria include also accidents that happen on the way to and from the NPP.

The industrial safety performance indicator of the first quarter of 2006 does not meet the plant's performance objectives. However no evidence of a corrective action plan could be obtained.

Recording of near misses or minor events is not performed on plant level. This information to improve more proactively industrial safety is consequently not available.

Findings of inspections of the industrial safety section and the management inspections are not trended or further analyzed in order to determine root causes and identify overall improvement actions.

For special jobs precautionary measures with regard to industrial safety are defined. However these measures are defined without evidence of using the industrial safety risk inventory, formerly done for positions, jobs and workplaces.

No evidence of pre job briefings to emphasize industrial safety has been found expect in the maintenance departments.

During the mission several deviations were observed: instructions were not always fully comprehensive, hazards in the installations were not always recognized, employees do not always following applicable requirements, defects exist on signalization, training instructors did not always reinforce or correct industrial safety practices and inappropriate working practices. For this reason the team proposed a recommendation.

1.6 DOCUMENTS AND RECORDS MANAGEMENT

Documents are very important for the INPP organization: policies, organization and all related activities have been thoroughly documented and plant management is relying much on procedures and detailed documentation of activities.

The plant uses a document management system called “ARKI”. This system includes plant policies, guidelines, management procedures, work instructions and records (in total about 100.000 documents).

The ARKI system ensures unique document identification. The system allows for the management of the document life cycle: production, review, approval, distribution, temporary changes, periodical review, archiving and termination of documents.

Both hard copies and computer files of the documents are used in the organization.

The team observed as good performance, that in case of change of procedures and instructions, the employees are instructed.

The “Document Control department” of the Technical Directorate, is responsible for the documentation process and system. In all departments, dedicated employees are assigned for tasks related to documentation and they work in accordance with instructions from the Document Control department.

For temporary changes of documents a so-called “technical order” has to be processed, including endorsement and approved of all involved management.

Documents have a defined validity time and are to be reviewed within that period.

Request for prolongation of expired documents are dealt with by a so called “document committee”.

Documents are stored within the departments for one year, before being transferred to the central archive. Measures to prevent deterioration of documents and media are said to be in place. The archive is a new and up to date, equipped with all required facilities. It has been put recently in operation and in the future all documents actually stored locally will be included in the central archive.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.1. ORGANIZATION AND ADMINISTRATION

1.1(1) Issue: The process for individual performance appraisal is not well developed and implemented.

- At the beginning of the year no objectives on individual (safety) performance are agreed upon with the personnel. No criteria for (safety) behavior are set. This has for consequence that at the end of the year no evaluation could be performed on the basis of those objectives and criteria.
- No requirement and procedures for individual performance appraisal are available
- Plant staff is sometimes rewarded for good safety related performance based on an implicit evaluation only.

By not providing on a periodical basis management expectations and feedback on performance to all staff, the plant could miss the opportunities to improve staff performance.

Suggestion: Plant should consider developing and implementing a comprehensive process for individual performance appraisal.

Basis: IAEA Safety Standard NS-R-2:

2.8. The operating organization shall be staffed with competent managers and sufficient qualified personnel having a proper awareness of the technical and administrative requirements for safety and motivated to be safety conscious. Attitude towards safety shall be a criterion for the hiring or promoting of managers. Staff performance appraisals shall include a section on the attitude towards safety.

1.3. MANAGEMENT OF SAFETY

1.3(1) Issue: Elements of the self-assessment programme are available however no systematic approach is formalized and implemented.

- Only general requirements for self-assessment are defined.
- No procedures for self-assessment are available.
- In practice some elements of the programme exist (e.g. periodic safety reviews, annual safety report, reliability of safety related equipments) however in other areas self assessment is not performed (industrial safety, emergency planning and preparedness, operational experience feedback trending)
- No systematic approach is implemented.

Without established and implemented self-assessment programme, management will miss opportunities to learn from operational experience in order to improve safety performance.

Suggestion: Plant should consider formalizing and implementing a systematic approach for self-assessment in the organization.

Basis: IAEA Safety Series No. 50-C/SG-Q

401 Management Self Assessment:
Management at all levels shall regularly assess the processes for which it is responsible. Management shall determine its effectiveness in establishing, promoting and achieving nuclear safety objectives. Management process weaknesses and barriers that hinder the achievement of the nuclear safety objectives shall be identified and corrected.

Introduction - Basic Requirement 9 – Management Self Assessment – page 22
"The thrust of management self-assessment is to identify, correct and prevent management problems that hinder the achievement of the organization's objectives. This self-assessment methodology is in addition to the traditional audit/appraisal that determines the adequacy and extent of the QA programme development, documentation and implementation in accordance with specified requirements".

NS-G-2.4: 5.17
The safety performance of the operating organization should be routinely monitored in order to ensure that safety standards are maintained and improved

1.3(2) Issue: There is no formal process for formalizing and implementing safety related changes in the organization.

- No requirements and procedures for preparing and implementing safety related organizational changes are available.
- A reorganization of engineering support department has been prepared. Prior formal analysis and multidisciplinary and independent review was not done.

Without prior analysis and multidisciplinary review of impact on safety of the reorganization, the identification of potential adverse effect will be missed.

Suggestion: The plant should consider formalizing and implementing a process for managing safety related changes in the organization.

Basis: IAEA Safety Standard NS-G-2.3

5.3 Organizational changes should be carefully evaluated in order to avoid frequent modifications to the operational structure which may pose a threat to the stability of the organization.

5.4. An independent internal review to demonstrate that the provision for management of safety, including the provision for adequate control and supervision, will not be compromised should also be considered.

5.5 Special attention should be paid to the review and revision of plans for training personnel to ensure in advance that management and staff have a broad understanding the new tasks and functions that will follow the organizational changes.

NS-G-2.4

5.15. All the proposed plant modifications, including organizational changes, should be thoroughly planned. The operating organization should establish a procedure to ensure that the safety significance of any changes is assessed in advance, with the level of assessment based on the safety significance of the changes.

INSAG-18 Managing Change in the Nuclear Industry: The Effects on Safety.

Chapter 21: INSAG recommends that companies have a formal, systematic approach to review proposed changes, as they do for engineering changes.

1.3(a) Good practice: At INPP 2 systems for monitoring and analysis of safety culture have been developed and implemented.

Both systems are effective tools for management in monitoring safety performance and safety culture.

The first system concerns an assessment among staff, using a survey on safety culture that was developed with the aid of the aid of IAEA and experts from UK and Sweden. On average the survey is done every three years. The questionnaire consists of 33 questions. Answers are grouped towards 11 safety culture characteristics, i.e.:

- Leadership and commitment of top management to safety;
- Safety role of line management;
- Strategic business importance of safety;
- Supportive organizational culture;
- Involvement of employees in the process of safety enhancement;
- Study of operating experience;
- Measurement of safety performance;
- Mutual trust and responsibility of management and employees;
- Openness of communication;
- Absence of safety vs. production conflict;
- Demonstration of care for personnel by administration.

Safety culture monitoring consists of 5 stages:

- Detection of problem areas (causes of safety level degradation);
- Prioritization of each problem area;
- Analysis by determining relationships between the problem areas and the safety culture characteristics;
- Detection of low safety culture characteristics;

- Development and prioritization of corrective actions for safety culture development.

In this way trends on safety culture characteristics are available for management to make an assessment and define, if required, corrective actions.

This monitoring and analysis started in 1998 as a first trial among few numbers of staff (30 employees). In 2000 and 2004 the survey was done among 300 employees. The overall results were generally positive.

The second system comprises a set of 6 safety culture indicators. Some indicators are connected with follow-up of safety related corrective actions, others are characteristics to human performance.

The use of the indicators started in 2004. Information on changes of the safety culture indicators is regularly provided to the Director General; it is subject of discussion with the heads of the departments of the plant and a report is also forwarded to the regulatory body.

At the end of each year completed actions are analyzed and a progress report is made, which is also submitted to the regulatory authority. This information can be found on the intranet and is available to the staff.

This safety culture monitoring system allows top management and line managers to determine trends in nuclear safety performance and culture and corrective actions can be defined if needed.

1.5. INDUSTRIAL SAFETY PROGRAMME

1.5(1) Issue: Plant staff does not always respect rules and regulations on industrial safety.

The team has made the following observation:

- In room 130/2 axis 28, building maintenance shops, a protective chain was not fastened (exit from stairs to a free space of about 10 m above the floor)

- In the turbine hall, several industrial safety problems were observed: trip hazards and missing covers on electrical boxes,

- Pump house door entry unit 2, clearly states helmet and hearing protection to be worn. Although the guide was prepared to take the visiting team in without any of these personal protection items. In fact he did not have them himself. The guide got some protection items for the team but he had to go inside the building to get them.

- On leaving the pump house a staff member passed the team (all wearing safety helms) but she proceeded to her workplace not wearing her hearing protection or helmet.

- People walking through doors labelled with safety signs, without taking any notice.

- Trip hazard in MCR: behind the panels, there is a pathway with a 30-40 cm height without any barrier to prevent falling.

- The escape stairs outside the turbine building at the end of unit 2, to be used in the event of fire, is closed and locked.

- In the reactor building, ALC tower: in electrical operations room 124/1, the telephone was not working.

- One step of the ladder to the platform of the tank with nitric acid is not fixed.

- Near the valve 2VF01 S01, a step of the ladder to go to the platform, is very damaged.

- 3 maintenance workers, unscrewed a part of fire protection piping in room 103D2 on 8/6, on a height of approximately 1 meter, without use of scaffolding, and without any barrier protecting worker from falling down.

- A protective screen is not foreseen at the pump in the sulphuric acid storage.

- In the room 109/166, a barrier is absent on the platform for servicing the tank LIH25BC11 – valves.

- No emergency lighting along the entry corridor in controlled area and in the TLD storage area.

- In diesel generator building, the lamps of the emergency lighting, marked with a red dot, were switched off with no possibility to be checked.

- In the remote control room, the emergency lamps are not marked as required by the plant standard, with a red dot.

- The instruction not to use the lift in the event of fire is on the inside of the lift.

- In room 117/2 room 301, 401: the room of the ECCS storage tank is under oxygen concentration surveillance because of presence of nitrogen 90 bars inside the tanks. An alarm is at the door outside the room. The oxygen meter is inside the room so it cannot be checked in the event of an alarm. There is no triangle danger sign to warn people for danger. This applies to all doors of these rooms.

- No site fire alarms are used

- A lot of examples of absence of industrial safety posters on working place in all maintenance departments.

- The loudspeaker between storage 7 and 8, is defect.

Not respecting rules and regulations regarding to industrial safety may lead to increase of personal injuries and industrial safety related accidents.

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

Basis: IAEA Safety Standard NS G 2-4 6.56

An industrial safety programme should be established and implemented to ensure that all risks to personal involved in plant activities, in particular those activities that are safety related, are kept ALARA.

2. TRAINING AND QUALIFICATIONS

2.1 TRAINING POLICY AND ORGANIZATION

The requirements of the Lithuanian nuclear regulatory authority (VATESI) specified in the document "General requirements on personnel management of the organizations operating nuclear facilities and their subcontractors") are well implemented in the Ignalina nuclear power plant (INPP) management level documents. Training policy is defined as a part of common Ignalina nuclear power plant policy. Due to the INPP policy the objective of training is to ensure that "all personnel acquire sufficient qualification to carry out their tasks in accordance with the objectives of the plant." Approach and requirements to the organization of personnel training, sharing of functions and responsibilities between the training center and line management are well determined in the documents of the 1st and 2nd level of the quality assurance for personnel management and training documents.

The INPP has established methods and training procedures basically complying with the systematic approach to training (SAT) requirements. This methods and procedures are implemented for initial training programmes and continuous training provided by the training center.

As a part of the Ignalina NPP preparation for decommissioning, the systematic analysis of decommissioning personnel training needs has been done, including feasibility study of planning, design and development of a decommissioning training center. The team has identified it as a good practice.

The team has found that nuclear safety and safety culture is well emphasized during initial training. Prior to assignment to a new job position each candidate attends short courses about safety culture principles (introduction to INSAG-4, plant safety policy, self-control (STARK) principles, plant safety indicators, INES scale, managerial and individual role in safety culture, non-blaming atmosphere etc.) and human factor in NPP operation (factors influencing human behavior, human error categories, barriers in defense-in-depth for human errors, plant events and statistics regarding human factor, ...). Plant psychologist was present at observed courses. Well-prepared safety culture training manual is available. The team identified it as a good performance.

In compliance with the plant training policy, the line managers are responsible for identification of training needs for their subordinated personnel and specific training programmes are prepared by the training department on written request of the line managers (e.g. training programme on use of a new tube cutting device prepared on written request of central maintenance department.).Process of reviewing the adequacy and effectiveness of the training with respect to the actual performance of employees in their jobs was found not effective enough in some areas of continuous training. Performance under industry standard and plant requirements was observed in some areas which should have been identified by the line managers in phase of training needs identification and consequently fixed by means of continuous training.

Staffing of the training department is about 50 people, including 18 full time instructors. The team found it to be sufficient to cover current INPP training needs including subcontractors.

Extent of control room continuous simulator and theoretical training (15 days a year) in the plant training center facility which is well equipped for theoretical and simulator training including relaxation and welfare services was identified by the team as a good performance.

There are differences between annual training plan based on requirements of department managers and real extent of conducted training based on availability of trainees and current needs. Better planning of training needs by the line managers will enable better preparation of training center capacities and increase quality of the training.

2.2 TRAINING FACILITIES, EQUIPMENT AND MATERIAL

Training center, located both in the industrial area of the INPP and in the off site location includes the full-scope simulator. There is sufficient number of classrooms for theoretical training in both locations. Practical training is performed on working places, at referring shops and/or laboratories.

The simulator used to support operation shift is of modern technology. The team was impressed with the equipment. Training is carried out once a year. The simulator exercises , are realistic and conducted in a reasonable time schedule. Simulator training is conducted close to a recreation area located some 10 km from the site. The staff could exercise during half day and maintain his health, close with his families during a three week period par a year.

Classroom and laboratories are well equipped with mockups and stands. Special purpose training stands are available in the maintenance shops.

The last version of operational documentation is available to the instructors in electronic form through the plant intranet. An effective system is established to distribute new revisions of operational documentation to classrooms.

The full-scope INPP simulator facility duplicate well the main control room of the INPP Unit 2 and the team found it to be the state-of-the art training tool for control room operational personnel.

The database of differences between the simulator and the reference unit control room is kept update and the control room crews are informed about them at the beginning of each simulator training course. However, potential impact of the differences on CR crew training is not systematically evaluated and the differences are not prioritized by their importance. The team has proposed a suggestion in this area.

After initial acceptance tests no regular annual simulator operability tests are performed to confirm overall simulator model completeness and integration. The team has developed a suggestion in this area.

Simulator instructor console provides standard functions for recording operator and system actions and behaviors (parameter curves, snapshots, operator actions record), however “Out of simulation limit” warning, identifying unrealistic evolution of some parameters was not included. The team has written a suggestion in this area.

In case of the reference unit design modification, evaluation of its impact on training simulator is well included in the plant design modification procedure.

2.3 QUALITY OF THE TRAINING PROGRAMMES

Training center has an accreditation (license) of Ministry of Education. In total 22 training programmes has been accredited and the trainees are getting a "state license". Inspections of the national accreditation authority is conducted approx. 1x3 years, the last one took place in 2006. The team identified the licensing of the INPP training center by the educational authority as a good practice, as it provides additional independent periodical evaluation of the training process quality.

For initial theoretical and practical training, stands, mockups, special training process diagrams are well prepared. Power point presentations including photos are effectively used by the training center instructors.

In the on site training center, some of process diagrams has been dated 2002, with mark "for training purposes only". It is implicitly understood as the responsibility of the instructor has to keep the training aids current with the actual status of the plant. However, this process is not explicitly formalized.

2.4 TRAINING PROGRAMMES FOR CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

Control room crew continuous training programmes (both theoretical and practical on simulator) well cover recent industry and plant specific operating experience. The training centre keeps current database of Ignalina NPP operational events as well as of the events in the nuclear industry. The events are analyzed from the point of view of potential INPP control room crew training needs. Well-prepared power point presentations on the subject are used within the control room crew annual continuous training programme. The team considers this as a good performance.

However no training needs analysis has been done so far for supplement training of the CR crews of the Unit 1 in long-term cold shut-down mode, focused on emergency scenarios specific for such plant status, (e.g. lost of natural circulation cooling).

Operational management regularly takes part in control room crew simulator emergency exercises, takes an active role in the CR crew evaluation and expresses management expectations on identified CR crew performance problems.

However, debriefing after simulator session is not structured to cover basis areas of control room crew performance (response to alarms, diagnosis, control board operation, use of procedures and technical specification, communication, command and control). As a result, deficiencies in use of procedure, verbal communication and shift supervisor/ deputy shift supervisor performance were not addressed in the observed debriefings.

Observed debriefing started by the simulator instructor and operational manager comments, in this way an opportunity was missed by the plant to evaluate turbine operator and reactor operator interpretation and understanding of the scenario transients and the control room crew self-assessment.

Detailed quantitative trainee performance evaluation is done by the simulator instructors for the CR crew initial simulator training, however such evaluation is not being done for continuous training.

At the end of each simulator training course, evaluation questionnaires are filled in by the trainees (control room crews) with set of graded answers on quality and content of the course and simulator instructor performance. However, the available data are not use as simulator training performance indicators. The plant is encouraged to use the data of existing simulator feedback questionnaires for establishing and trending simulator performance indicators.

The plant has not established systematic practical control room crew training on plant operation from remote shutdown panels. The team developed a recommendation and suggestion in this area.

2.5 TRAINING PROGRAMMES FOR FIELD OPERATORS

Set of standard training programmes is available for different job positions, based on the job duties and task analysis. The standard programme is individually modified taking into account trainee's actual qualification and experience. System of regular attestations for the job position (2 to 5 year cycle) is established. This is considered by the team as a good performance.

2.6 TRAINING PROGRAMMES FOR MAINTENANCE PERSONNEL

Training stands and mockups are used for practical training and examination of some categories of maintenance personnel. Priority of training mockup and stands procurement is given to tasks with difficult access and high dose rates. For specific new activities, special training programmes are developed on request of maintenance department management by the training center, which includes both theoretical and practical training (e.g. training programme on use of a new tube cutting device). Final evaluation after completing initial training for maintenance workers includes so called “evaluating work”, i.e. practical performance of a specific work with pre-defined performance criteria (e.g. a pump disassembling and assembling within a time limit). Such evaluating work are planned also for field operators and other categories of personnel. The team identified this as a good performance.

2.7 TRAINING PROGRAMMES FOR TECHNICAL PLANT SUPPORT PERSONNEL

Some performance under industry standard has been observed by the team which indicates weak feedback to continuous training. These weaknesses are reflected in chemistry, technical support and radiation protection areas. The plant is encouraged to introduce for the technical plant support personnel a practical evaluation after completion of initial training course developed currently for maintenance personnel (so called “evaluating work” with pre-defined performance criteria).

2.8 TRAINING PROGRAMMES FOR MANAGEMENT AND SUPERVISORY PERSONNEL

Training programmes for managers are focused on technical issues only. There are no regular training (initial, continuous) focused on managerial skills. (Coaching and mentoring, self-assessment techniques, root cause analysis, team training and communication, presentation skills). Insufficient coaching skills and training needs identification (by rounds and regular on-the-job observation of subordinates) were identified for some line managers. The team encourages the plant to introduce systematic training programmes on identified managerial skills deficiencies or on field observation.

Some times, occasional instructors (part time instructors or managers) were not providing sufficient instructional skills. The team encourages the plant to train plant experts involved as occasional instructors to improve their instructional skills to cope with the systematic approach to training (SAT) programme (NS-G-2.8).

TRAINING PROGRAMMES FOR TRAINING GROUP PERSONNEL

All training center full time instructors have "instructional skills" training including certificates from external training and educational institutions. As a basic qualification, pedagogical qualification, personal accreditation and work experience in a given training area are required for the training center full time instructors.

Simulator instructors' plant qualification is maintained current by annual 12 day internship at the operated unit control room and regular attestation (examination) using control room crew question database.

However, the plant has developed no "instructional skills" training programme for occasional (part-time) instructors and the team developed a suggestion in that area.

2.10 GENERAL EMPLOYEE TRAINING

All personnel working in the plant receive initial training on industrial safety, radiation protection, fire protection and emergency preparedness. For radiation protection and the works with increased risk of fire, specific computer-based training and examination tools have been developed by the plant training center. The plant personnel has to pass periodical attestation (in 2 to 5 year cycle, depending on the job category) comprising radiation protection, industrial safety and job specific areas. The departments have developed specific programmes of continuous training for their staff, however not all personnel is included in continuous training provided by the instructors of the training department. Low level of knowledge was identified by the team in some groups of the plant personnel regarding alerting and acting in case of fire or radiological emergency, which shows on deficiencies in continuous training on these subjects. These weaknesses are reflected in operation and emergency planning areas.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1. TRAINING POLICY AND ORGANIZATION

2.1(a) Good practice: As a part of the Ignalina NPP preparation for decommissioning, the systematic analysis of decommissioning personnel training needs has been done, including feasibility study of planning, design and development of a decommissioning training center.

The overall aim of the project was identification of training requirements to meet pre-decommissioning and decommissioning training needs in the short and medium term.

The project covered the following stages:

- Analysis of the Unit 1 expected decommissioning activities that require the training of the personnel. For each of identified field of activities the tasks were determined demanding the training of the personnel.
- Based on the tasks identified in the first stage, personnel training needs analysis was done as well as analysis of requirements for changing the existing training system with respect to the Ignalina NPP decommissioning. As a result, a training matrix was developed identifying number of people to be trained, number of trainers, the scope of training programmes and the projects for which they are to be trained.
- In the 3rd stage, needs of training center facilities, infrastructures, equipment and technical means including funding were analyzed.

International support and expertise was used in this project.

Such systematic approach to training for decommissioning phase of the plant life cycle done before real start of specific decommissioning activities can be considered as a good practice as it gives the plant an opportunity to prepare personnel with required qualification in proper timing and a cost-effective way.

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

2.2(1) Issue: The plant has not yet developed simulator configuration management procedure including periodical simulator operability tests. The plant has not implemented evaluation of differences between the simulator and the reference NPP unit.

- Procedure for regular simulator operability tests has not been developed to confirm overall simulator model completeness and integration,
- The database of differences between the simulator and the reference unit control room is kept update, however evaluation of a potential impact of the differences on CR crew training is not documented and the differences are not ranked by their importance.
- Simulator instructor console does not provide “out of simulation limits” warning on unrealistic evolution of pre-defined key parameters (e.g. simulated pressure exceeding pipe strength limit).

Without developing a test procedure to check the simulation performance, simulation limits, appropriateness and completeness of the simulator design data base, the simulator fidelity may be challenged.

Suggestion: The plant should consider developing a procedure of periodic simulator operability tests to verify simulator compliance with pre-defined performance and fidelity criteria.
The plant should consider the implementation of quantified evaluation of the differences between the simulator and the reference unit control room.

IAEA Basis: NS-G-2.8: 6.3: Training facilities and materials

"Representative simulator facilities should be used for training of control room operators and shift supervisors...

NS-G-2.8: 6.7 Training facilities and materials
"A procedure should be in place for the periodic review and timely modification and updating of training facilities..."

NS-G-2.8: 4.18 Training setting and methods

"Simulator sessions should be structured and planned...to avoid possible negative training due to the limits of simulation"

2.3. QUALITY OF THE TRAINING PROGRAMMES

2.3(a) Good practice: Training center has an accreditation (license) of the Ministry of Education. In total 22 training programmes has been accredited (trainees are getting a "state license"). Inspections of Ministry of Education are performed approx. once in 3 years, last in 2006.

Within the accreditation process following documents had to be submitted to the state accreditation authority (Territorial educational and consulting service) for reviewing:

- Specification of work training programmes (requiring the Lithuanian state license) to be provided by the training center (e.g. work with open fire, operators of steam and hot water pipe systems, operators of pressurized systems, crane operators, compressor operators, etc.)

- Specification of the classes for theoretical training including description of location and room area.

- Specification of training tools, training methodology documents and technical equipment for each type of training course.

- Training instructors qualification data (education, work experience, pedagogical experience, certificates available),

- Sanitary certificate (including inspection of work safety conditions)

The license for training center has been issued by the Ministry of Education based on recommendation of the accreditation authority.

The Ignalina NPP training center is periodically inspected by the state accreditation authority. In case of incompliance with the training center license conditions, the license can be taken back.

Licensing of the NPP training center by the educational authority can be considered as a good practice, as it provides additional independent periodical evaluation of the training process quality.

2.4. TRAINING PROGRAMMES FOR CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

2.4(1) Issue: The plant has not established systematic practical control room crew training on plant operation from remote shutdown panels.

In compliance with the plant operational procedure for remote shutdown panels, the control room crews perform standard plant shutdown and cool down from remote shutdown panels as minimum once a year. There are also regular annual emergency exercises on transferring operation from the main control room to remote shutdown panels. However, the team observed that:

- No standard training programme has been developed (including job-task analysis, training objectives, performance criteria, etc.) on the subject.
- Only a few out of seven shifts a year have real practical hands-on experience on performing annual manipulation on the real remote shutdown panels.
- No practical training on potential component or system failure transients when operating from remote shutdown panels is provided.

Without having a systematic training programme on control room crew refreshing practical training on remote shut down panels operation, the control room crew skills needed to cope with such design basis emergency event could not be ensured and periodically evaluated.

Recommendation: The plant should establish a systematic training programme on control room crew refreshing practical training on remote shut down panels operation.

Basis: IAEA NS-G-2.8, 4.19, Training setting and methods
"Training at a plant reference, full scope simulator facility should be provided for control room operators...Trainees should also be confronted with infrequent and abnormal situations which have a low probability of occurrence and therefore cannot be enacted in real plant practice..."

2.4(2) Issue: The plant has not yet fully implemented structured evaluation of control room operator continuous simulator training and has not yet established sets of simulator training performance indicators.

- Debriefings after simulator emergency exercise session are not structured to cover basic areas of control room crew performance (response to alarms, diagnosis, control board operation, use of procedures and/or technical specification, communication, command and control). As a result, deficiencies in use of procedure, verbal communication and shift supervisor/ deputy shift supervisor performance were not addressed in the observed debriefings.
- Debriefing starts by the simulator instructor comments. Opportunity is missed to evaluate the turbine operator and the reactor operator interpretation and understanding of the scenario transients and the CR crew self-assessment. This process could improve a bottom-up communication line.
- Detailed quantitative trainee performance evaluation is done by the simulator instructors for the control room crew initial simulator training, however such evaluation is not being done for continuous training.
- At the end of each simulator training course, evaluation questionnaires are filled in by the trainees (control room crews) with a set of graded answers on quality and content of the course and simulator instructor performance. However, the available data are not use as simulator training performance indicators.

Without having a systematic evaluation of CR crew continuous simulator training and trending of simulator performance indicators the plant could miss an opportunity for further improvements in the CR crew training programmes and CR crew performance.

Suggestion: The plant should consider systematical implementation of structured evaluation (critique) of continuous simulator training and simulator emergency exercises focused on management expectations in basic control room crew competences.

Basis: IAEA Safety Standard NS-G-2.8, 4.21, Training setting and methods

"All assessments of simulator training sessions should include an evaluation of the trainees, the feedback given and further measures considered as a result of evaluation."

3. OPERATIONS

3.1 ORGANIZATION AND FUNCTIONS

The operational structure is well defined and documented, roles and responsibilities are also clear and procedural evidence is available in abundance although a little complicated.

The organization of the shift staff is arranged in two sections, operational and administrative.

Management commitment to safety is not always clearly communicated on a regular basis; it tends to be more reactive than proactive. The team has made a recommendation in this area.

Departmental goals are set and printed out, then laminated for distribution to all the departmental heads, however these laminated goals were not on display but held in a folder and kept on a shelf or in a draw. The team did not get clear evidence that key performance indicators are used to indicate an improvement in performance and that management expectations have been understood by plant staff.

There are very many policies and procedures but unfortunately they are not all adhered to, for example the de-contamination process for leaving the controlled area and the fire procedures which will be discussed later in this document.

A dedicated day team for the operations department takes care of the shift team's welfare, so relieving them of any un-necessary administrative duties.

There is no individual self-assessment or behavioral safety observations carried out that can be used to improve management expectations on safety standards.

Unit 1 is shut down and in the process of being decommissioned; operating limits are clearly defined with regard to the unaffected reactor in event.

The interface and responsibly between other groups and departments is well documented and understood by departmental heads. This is reinforced during the daily morning meeting chaired by the Deputy Director General, which is conducted in a very professional manner in an open and honest environment, where the interface responsibilities are clearly defined and understood.

The shift supervisor has adequate support within the shift structure for normal operations.

The cooperation with maintenance organization is well established, especially during an outage.

The operations department and the maintenance department have daily morning meetings to discuss the release of plant for maintenance and the return to service after maintenance.

There is a check sheet in the main control room (MCR) which incorporates the reactor, auxiliary equipment and turbine current electrical status main parameter which is signed by all three operators and then counter signed by the deputy shift supervisor, although the parameter limits are not specified on this check sheet. Each operator also hand writes his log with more details entering operations with event times and plant state conditions.

During the observation of simulator training the team established, that the personnel very strictly followed the requirements to log entries. However during the field observations in the MCR it was noted that there were several deficiencies in log entries and documentation of different operational activities. On this issue the team has made a suggestion to improve log-keeping standards.

After an absence of more than six months staff goes through a re-qualifying process to ensure compliance and knowledge assessment.

Seven shifts are used in a five-shift rotation system, so there is always staff availability for the duty shift to cover the emergency scheme staffing levels, because of the seven-shift policy and the extra reserve positions on shift there is a very small amount of overtime required, consequently it does not become an issue.

There is in place drug and alcohol test procedure carried out every shift for operational staff prior to the start of the shift.

There is no formal management observations policy in place although good conduct can be rewarded in a few cases, although this is occasional and subjective.

There is also no personal appraisal system in place for personal development of individuals which could motivate staff to perform at a higher level.

The plant shift supervisor (PSS) does have a call up system if he needs expert help out of normal working hours, but there is no standby system in place to ensure that the expert is available if needed.

3.2 OPERATIONS FACILITIES AND OPERATOR AIDS

Operators have available to them the telephone and a radiophone plus the load speaker system, although the team did not hear the load speaker in use for the duration of the mission. Generally the telephones are used on site, there is an abundance of personnel on site, so at any one time contacting field operators is not a problem.

In the main control room, the numbers of annunciators on alarm position are generally kept to a minimum.

During the plant walk down tours the team observed several items of plant some of them safety related that did not have any labels attached. The team has made a recommendation in this area.

The team also noticed some operator aids containing useful information for operators unfortunately some of them were not authorized for use. The team developed a recommendation on that area.

The team noted that generally the lighting in the control rooms and the turbine hall was good. However, sometimes bulbs are out of service and the team encourages the site to address these inadequacies.

There is a full set of "Response to Alarm" manuals in the main control room, however the team did not observed that they are extensively used.

The shift personnel utilize a comprehensive process called TITAN, which is able to carrying out quick complicated calculations on systems status. The team recognized this as a good practice.

The site uses a computerized database system so called "FOBOS" which is able to record plant defects and routine work. This system is also able to produce reports on plant status. The team has recognized this as good performance.

Plant areas are very clean and house keeping is generally good. However, tripping hazards could be avoided in the many plant areas such as the Turbine Hall/Pump House by using simple demarcation of a walkway. (Painting a walkway on the floor)

The operation shift crews are supported by radiation protection and fire protection personnel and a number of qualified medical personnel on site, at all times.

3.3 OPERATING RULES AND PROCEDURES

Plant parameters are clearly indicated in the procedures, but they are not readily available to the operators in the form of a checklist for quick reference, although their training ensures that these parameters are known.

There is an abundance of procedures to ensure compliance but the structure of these procedures does appear to be a little complicated.

There is in place a procedure to address the situation when equipment or documentation is found to be outside of the operating limits and conditions (OLCs). This process is a log book kept in the MCR, actions emerging from log entries are then cleared by the relevant departments.

The computer data base programme ' FOBOS' is capable of tracking plant status, this system is used as a double check for plant log entries.

Operators do have the ability to print off operational procedures from the ARKI system as reference when carrying out operations out on the plant, but the team did not see a version control system to ensure that these print outs were the correct version.

The procedures are kept up to date, well structured and after any modification they are promptly updated and replaced. The qualities of procedures appeared to be good and are stored in a filing cabinet in the MCR.

There is a shift support department that regularly ensure that technical documentation are updated and are technically correct

All the emergency procedures are clearly written and available in the MCR filling cabinet, although the team would encourage the MCR to clearly demarcate those files used in an emergency from the normal running procedures i.e. change in colour and security of the file binding.

There is a very good Symptom Based Emergency Operating Procedure (SBEOP) flow chart readily available to the deputy plant shift supervisor (DPSS), these were developed following INPO experience, they positioned just behind the seat of the DPSS, these flow diagrams are clear, big and easy to follow they can be annotated on. The team recognized this as a good performance.

Additional support is given in the form of a Safety Parameter Display System (SPDS) which can display the state of plant to control critical safety functions. The team recognized this as a good practice.

The team observed during a simulator exercise that the MCR operator did not refer to the emergency procedures for 27 minutes; the team considered this practice to be an excessive amount of time to not refer to the procedures for compliance and would encourage the MCR staff to refer to the procedure much quicker for guidance in an event situation.

There is in place a temporary modifications system that is well communicated to operational staffing in a timely manner and confirmation of acceptance is gained by signature. The temporary modifications system is measured as part of the Operational Performance Indicators. However there is a system in place called Technical Orders which can temporarily change instructions or a set point but the same degree of diligence is not adhered to in this process as in the temporary modification process. The team has made a suggestion in this area to incorporate the Technical Orders into the Temporary Modification process.

3.4 CONDUCT OF OPERATIONS

Procedures are followed for normal operations, however self-verification in an event situation was not evident during the simulator exercise witnessed. There was some evidence improvement of communication ways although it was not consistent. The team encourages the operational staff during normal and emergency situations to re-enforce good communication policy and to introduce command and control techniques as used in other nuclear plants.

Shift turnover are carried out in a detailed and professional manner, good use of data logging historical information, a very definite announcement is made when the shift has been turned over to the next shift.

The team witnessed a pre-job briefs for diesel generator test runs and noted that not all the personnel involved in the test run were present at the pre-job brief, the team would encourage the operational staff to have full participation of all the personnel involved in the tests on safety related plant to ensure understanding of roles and responsibilities and actions in case of any deviation.

System ownership is not always employed; one system such as the fire fighting/protection system can be controlled by a number of different departments, i.e. electrical department look after emergency lighting, the Turbine department look after water tanks, the Mechanical department look after fire valves etc. but having said that the 08:00hrs morning meeting in the PSS's office establish a communication forum to ensure that all the relevant departmental understand roles and responsibilities for the smooth running of the plant.

During reactor load changes prior to testing the team witnessed a good approach to reactivity management programme with pre-job brief of significant individuals involved in the test and the presence of specialist engineers.

The team did not notice any issues linked to the control of keys. However the team observed that instructions are missing on how or were the keys could be obtained from, and some keys were not labeled. The team encourages the plant to improve the comprehensiveness of current system and implement a key log system where key move could be recorded.

The control room access is restricted to non-authorized personnel by the use of a card swipe system. The MCR supervisor do not fully control access to the control room; any person with the correct authorization could enter at any time. The team witnessed a number of occasions when a lot of people were present in the MCR, not including OSART team.

The plant has more than 800 surveillance tests, which are managed using the 'FOBOS' system. This system is used on a daily basis to identify plant configuration.

Generally the MCR is informed of plant changes in a timely manner although the team witnessed one event when a fire system plant change was not communicated to the MCR for 3.5 hours.

Scheduled operator walk downs are well prepared supported by a checklists. The field operator's team leader or a members of the operational management periodically escort a field operator during his rounds for coaching purposes and to clarify management expectations. The team encourages the plant to clearly write the process in place.

The team found many examples of good house keeping for instance some reactor corridors and unit 2 pump house. Unfortunately the team also found area's where housekeeping is below the expected standard on a nuclear power plant such as the fire water tank and associated fire pumps.

The team observed several tests where independent verification was proved by signature which is coherent with the QA procedure. However, the team found some records of a reactor start up (05/10/2005) which had missing signatures as verification hold points and missing time entry records.

The team observed the operators acceptance to defective plant and material condition is too high. During their plant walk down, the field operator did not recognized long-term degradation and deficiencies of certain components of the systems.

The first step of investigation after a scram or shut down is a full description of the event and reason for trip. Then a root cause analysis is conducted and corrective actions are identified. Information is tracked into a database called 'ASKIM', which traces the progress of the corrective actions to be taken before the start up phase.

The reactor start up procedures uses a step-by-step process and verification is recorded by signature.

Prior to reactor start up, the reason for the shut down has to be clearly defined; investigations carried out if necessary; safety related systems should be fully available, start up has to be authorized by the Director General; and by the regulating authority VATESI.

3.5. WORK AUTHORIZATIONS

A good computer data logging system is used to trace the different steps of the work process: from initialization of the work (either routine or emergent work) until de-isolation and return to service. The isolation system used is a tag-out system, which appears to be well supported by documentation and safety rules.

Work control and permit control present a number of verification hold points. All radiological aspects of the work control process are monitored by the Radiation Protection (RP) department and verification of the RP approval is captured by signature on the work permit.

Routine and none routine test procedures are independently verified by the specialist engineers or departments.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

The team noticed that fire response process and procedures are in place however they appear complicated to implement and understand. Plant staff and contractors interviewed did not have clear notion on what to do in the event of a fire. The team noticed that no full scale site fire drills have been completed and by consequence no lessons learnt were carried out. The team has made a recommendation in this area.

The fire protection system in place is adequate, however the general house keeping for the main firewater tank and the associated fire pumps need more attention.

Portable fire fighting equipment is adequately maintained on site although the team found a couple of locations were redundant fire extinguishers were missing.

Maintenance of fire barriers are adequate; bundles of more than 12 electrical cables are coated in a fire retardant coating; on one hand this is good however the coating makes it impossible to check for cable degradation and ageing. The team also found some inconsistency in emergency lighting: some are marked as emergency lighting and are on (in cable race) and some are off (e.g. on the reactor link corridor); all emergency lighting should be, by procedure, permanently on. The team encourages the site to address these non compliance with rules.

Different departments carry out surveillance and testing of fire fighting protection/detection systems. There is a central data base called 'FOBOS 'which shows the fire valve and equipment configuration, which is printed off by the fire brigade every day and placarded in the fire engine vehicles in the event of a fire.

The team witnessed a reactor operator smoking at the panel in the MCR. This is allowed under the site procedures. However the team judged that this is a demonstration of lack of ignition source control and an unnecessary increase in fire risk. The team encourages the plant to re-evaluate this policy.

When promoted, staff has to pass a technical examination relative to the new position.. In addition all staff has to pass an industrial safety and radiological safety examination prior to final authorization to perform task for the new position.

In complement to the internal fire organization, the site has a fully equipped fire brigade station situated just outside the site boundary, which is manned 24 hours a day by crew of 18 people per shift. The fire station and engines are well maintained.

The Civil Fire Fighting Brigade is less than seven minutes away, and its priority is directed to INPP

The team noted that the civil Fire Brigade do not have a access control procedure to record the time that a fire fighters puts on Breathing Apparatus (BA) and enter the fire zone, or records the ‘expected time out’ (a calculation of time, based on the amount of air that he had going into the fire zone). Apparently this is not a national regulatory requirement. The team encourages the fire brigade to develop a BA board to be used at the fire access control point. As example of improvement, the board could indicate at minimum the name of team member entering the fire zone, the bottle pressure at the time of entry, the expected time out, the description/purpose for entry, and the backup team members

3.7. MANAGEMENT OF ACCIDENT CONDITIONS

The conduct of operations procedures are of a great importance. Operational staff needs to be continuously trained to re-enforced staff knowledge to become second nature. Explanations are available in the procedures of Conduct of Operations but not widely practiced. The practice on the simulator is not practiced enough. The team encourages the site to develop command and control techniques to further controlling of event situations.

Emergency procedures require a large staff to be carried out. At INPP this is not a problem because the regulator imposes a 7 shift policy minimum.

DETAILED OPERATIONS FINDINGS

3.1. ORGANIZATIONS AND FUNCTIONS

3.1(1) Issue: Operations management expectations with regard to safety is neither systematically clearly communicated on a regular basis nor verified.

During the review the team noticed that management tend to be more reactive than proactive with regards to management expectations on good safety practice.

- Unauthorized operator aids are used at the plant
  - There were number of hand written signs (unauthorized) on equipment some of which was safety related.
  - In the MCR a PC is used for seismic monitoring, which has instructions for use attached to it. These instructions are not authorized.
- Field operators do not identify and report deficiencies after their walk downs
  - Valve hand wheels missing (2TU34S14, 2VG15S52)
  - Fixing bolts missing (2SS11D21)
- Management expectations on standards of operations
  - Operations Guide prepared to take a team into an area did not mention the required protective equipment although the requirements are clearly stated on the door.
  - Managers and staff do not follow the de-contamination process when leaving the controlled area.
  - Management accepts long existing defects.
  - TLD's are sometimes worn incorrectly in the controlled area but it is not corrected by members of management and/or heads of sections.

If low standards are accepted, it could lead to degradation of plant or personnel accidents.

Recommendation: Operations management should implement a clear communications policy with all staff on a regular basis with regard to safety expectations and understanding by personnel needs to be verified.

IAEA Basis: NS-G-2.4

3.16. This is part of manager's role in setting the standards and expectations for all staff in all aspects of safe management of a plant. In addition, managers themselves should visibly meet these standards and should help staff to understand why they are appropriate.

IAEA basis SG – Q1-2/ 352

Line management should periodically check that operator's aids conform to the approved configuration. Immediately action should be taken to remove those whose need has passed.

3.1(2) Issue: The operational logs and surveillance sheets do not always contain the necessary information or the information is not captured in the required format.

The team observed the following deficiencies:

- PSS logbook did not contain at 11:45 the safety test of 2RL02D31 performed at 10:10 on unit No2. The last information in the PSS logbook there was dated to 7:30. PSS said, that all he has entered important information into the logbook, but following the rules he should have entered information when he received (that means in real time).
- The team observed several log and check lists (PSS, DPSS), where the parameters are correctly recorded but no signature as verification, that is not in accordance with the required procedures.
- Fire valves 73,74 and 75 were not recorded as being shut in the MCR log for 3.5hours after they had been shut on 8/06/06
- In the refueling machine operator logs there was evidence that corrections had been made in the log with white liquid corrector, which is forbidden by rules.
- The DPSS failed to enter in his log the start time a routine start test of the Diesel Generator.

Not appropriately or timely logged and communicated to operational personnel the state of plant changes and entries, could lead to improper communication between operators and managers, and finally to incorrect action taken on safety related equipment.

Suggestion: The plant should consider controlling data and their format filled-in in proper performance logbook and surveillance sheets

IAEA Basis: SG-Q-13 /344.

344. The control room staff shall be informed of, and approve, work in the plant affecting the status of systems and components. Operators should be kept informed of the plant status by: ...Checklists; Logkeeping, Records of alarms; Reports of abnormal system conditions; Reports on defective equipment; etc.

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

3.2(1) Issue: The labeling practice is not systematically comprehensive and not periodically reviewed regarding the identification of all equipment.

Several type of equipment, a couple of which is safety related was found not to have identification labels attached.

The list of unmarked equipments is below:

- 2YD24S04 check valve,
- 2RD21S02 interim turbine extraction check valve in turbine hall 10m ,
- 2TH29S04 valve in A2 202/2 room,
- The de-aeration valve beside of 2SU16S107 valve on the tank 2SU16B05,

- The drain valve beside of 2SU16S12,
- Three valves on the pipeline Dy32 of system deactivation on the opposite site of room 113/18,
- 4 drain valves beside of 2SU16S101,102,103,104. On the same place the compressed air system valve was also not labeled,
- The root valve beside of 2SP11S12 valve,
- The valve beside of 2SS13S20 valve at the 2SH10D21 pump,
- 2 valves on the system of deactivation opposite to room 122/3,

Without the correct identification labelling of equipment could lead to incorrect operations or maintenance actions with the potential for negative influence on safety.

Recommendation: The plant should review the practice of permanent labeling for systematic implementation and permanent verification to ensure the correctness identification of all equipment.

Basis: 50-SG-Q13

342. Plant areas and installed items shall be uniquely and permanently labeled to provide plant personnel with sufficient information to positively identify them.

343. The identification should be consistent with the identification codes and terminology used in operation documents

3.2(a) **Good practice:** Connection of all new computerized systems for plant performance control to upgraded (TITAN) Information system through the local INPP network.

The original design to control and test the MCR performance defined that INPP plant would be controlled and monitored not from the MCR but from the local (field) control boards. In case of changeovers and tests, the MCR operators used to receive the data of plant status from the departmental shift staff through communications facilities. Moreover the shift staff used to have to do some calculations required for the job process in the manual way. The technical support staff did not have direct access to database of the TITAN computer information system.

At present the following INPP upgraded computerized systems designed to control plant performance have been connected to TITAN Computer System through the local computer network which includes about 1200 PCs:

- Diverse Shutdown System (DSS);
- Additional Emergency Protection on ORM and Coolant Flow in GDH Reduction (in Russian "ORM AZ and GDH AZ");
- Radiation Safety Monitoring System (in Russian "SAMRB");
- Special Water Purification Monitoring System (SWPS);
- Gas Equipment Monitoring System (GE);
- Fuel Claddings Integrity Monitoring System (FCIM);
- Additional Coolant Leak Monitoring System SOT Cable-Radar;
- Automatic Turbine Control System (ATCS);

- Automatic Rotor Monitoring System (ASKR);
- Additional MCP and Turbogenerators Vibrations Monitoring System (VIBRO);
- Refueling Machine (P3M).
- Now the INPP people enable to be additionally provided with the following:
  - All users are provided with data of INPP plant and system state in the common man-machine interface which has been developed for the upgraded TITAN IS;
  - The INPP departmental managers, operating and maintenance personnel, technical support personnel being at their working places are provided with current data of plant and system state which they need to control and review the plant performance conditions;
  - The MCR operators are provided with the data which they need to do the additional and independent control of plant state and changeovers which are controlled and monitored not from the Main Control Room;
  - INPP staff are provided with archive data delivered from the TITAN data base in case of potential deviations and events to review these event and deviation causes;
  - The INPP operating staff are provided with additional and processed information (namely, calculations aids like change parameter rate frequency, temperature parameters of heat exchange plant, integral parameters: water balance for a specified period of time, etc.) which the staff need to control and conduct the performance process in the proper way;
  - The staff understands and is aware of the operating process in a more extended way and ensures a better communication when they conduct common performance.

3.3. OPERATING RULES AND PROCEDURES

3.3(1) Issue: The procedure of temporary modifications is not applied to all temporary plant changes.

The technical orders applied by different operational department can by pass the system of temporary modification and it leads to a number of plant changes which in reality are temporary modifications without application of appropriate tags. It results in failure to provide the personnel with proper information about the changed technical status of equipment.

The following equipment was found without an attached tag with an explanation of the modification:

- A temporary change was found (technical order) which was declared to changing actuation set point of an interlock (2TF20L01). The tag about the performed change was not hanged. When the operator was asked about actual set point of interlock he told the old value.
- At the 2RP10, 20P05 measurement register the sensitivity was corrected on 3sec without any tags.
- At the reactor department there is new signal on 2HZ01Z21 panel for indication of leak HBK rooms (No: 0931-1983 technical order)

- At the reactor department there was modified the operation mode of 2TP00S07 (No: 0931-1959 technical order)
- At the electrical department a the protection KPY on 6 kV system was changed (No: 0931-583 technical order)
- At the electrical department was applied a microprocessor based device SIPROTEC on transformers 2BP14-17 (No: 0931-508 technical order)
- The position of driving arm on the system of emergency regulator and quick operation valves (turbine) was changed because of failure (No:0931-143)
- The set point of pressure decreasing of cooling water of heaters was modified to the value 0,4-0,6 bar (No:0931-129)
- The algorithm of pumps 1,2VK61,62D01 was modified (No:0931-1972)
- There was modified the flow measurement band of the steam generator feedwater system from 0.5t/h to 0.25. (No:0931-1969)
- There was increased the set point of protection system in the main unit computer. (No: 0931-1965)
- There was implemented a modification because of inoperability of feed water pumps recirculation valve failure -2RL03S71. (No: 0931-1951)
- There was implemented a temporary change on 2WZ56F21, 22 flow measures on 600-1000 m^3/h at the I&C department.

Without proper connection of temporary modifications introduced through technical orders to the process of handling of real temporary modification, the personnel would not have the opportunity to recognize existing modification which could lead to human failures during stressed situation.

Suggestion: The plant should consider applying the procedure for temporary modifications to all temporary plant changes including technical orders.

Basis: IAEA Safety Standard NS-G-2.3. 6.9.

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

3.3(a) Good practice: INPP Safety Parameter Display System (SPDS) with the additional functions for supporting MCR operators.

The SPDS objective is to display the processed and systemized data of state of plant and safety systems to control state of the critical safety functions (CSF) with regard to the previously selected parameters. The SPDS was designed by DSS, which designed and developed the upgrading of TITAN Information System and the Diverse Reactor Shutdown System (DRSS).

Additionally with reference to the implementation of the INPP Symptom-Based Emergency Operating Procedures (SBEOP) and outcomes obtained from validation of the SBEOP on the full scope simulator (FSS) the Technical Reference for developing SPDS included a number of additional and extended requirements to support the MCR operators.

Therefore in addition to the control of state of the critical safety functions and parameters of plant and systems, SPDS ensures that MCR operators can:

Control and check in the effective way the actuations of the safety systems with the SPDS algorithms which are specially developed for this System (with reference to both actual events caused the safety systems actuation and scheduled tests and checks of the specified systems):

- Control how accurately the reactor emergency protection, fast power reduction systems actuate;
- Control how accurately the emergency core cooling system (ECCS) actuates with regard to algorithms of ECCS-1, ECCS-2 (namely, with reference to splitting the Primary Circuit (PC) into two loops), ECCS -3, ECCS -4, ECCS -5;
- Control how accurately the accident localization system (ALS) actuates – with regard to the algorithms of ALS-1, ALS-2, ALS-3;
- Control how accurately the reliable power supply subsystem actuates – with reference to the algorithms of the Automatic Actuation of Standby Power Supply Protection (AASPSP).

In case of applying to SBEOP the SPDS calculation aids are used to ensure that actions of MCR operators are supported with reference to the specified SBEOP (totally there are 12 process tasks)

The installation of the SPDS with the extended functions enables plant staff to immediately respond to failures of elements of the safety systems after their actuation. It allows also to reducing the time required to do appropriate actions under SBEOP. This tool helps to lower the stress on the MCR operators during emergency situations. It could avoid human errors which might occur in case of manual calculations and data review and eventually to provide safe and reliable operations.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

3.6(1) Issue: The fire response procedures are too complicated and actions to follow are not well understood or communicated to all site staff including contractors.

There is no full-scale fire exercise or lessons learnt processor or procedure after a fire exercise to help staff understand, when staffs were intervened their knowledge of fire procedures was very weak.

- Reactor operator smoking at the control panels in MCR. Although this is permitted by plant procedure, the team felt this does not reflect a good conservative approach to reduce fire risk;
- After intense interrogation against plant staff there is still no clear guidance on what to do in a fire situation;
- Inconsistent understanding among staff, many interviewed;
- Fire Alarm test are not carried out;
- There is no separate and distinguished Fire alarm and Emergency alarm
- There does not appear to be a instruction card or booklet used for new employees during GET;

- A full-scale fire drill has never been carried out on site and there are no plans to do so;
- There is no General Employee Training (GET) programme to refresh staff in fire procedures only an initial training;
- "Actions in the event of a fire" posters are not posted around the site
- In the Administrative building corridor there are floor plans and routes to take which lead to the main foyer, but no signs in the foyer on what to do next.
- Contractor are not given the same degree of fire training as permanent staff and are not exercised
- There is no accounting for staff once buildings have been evacuated.

Absence of a simple and well-communicated action plan could result in staff confusion and misunderstanding of actions in the event of a real fire.

Recommendation: The plant should re-evaluate the fire response procedure and adopt a simplified actions that can be easily understood and communicate to all staff including contractors.

Basis: IAEA Safety Standard NS-G-2.1.

2.18. The emergency procedures should give clear instructions for operating personnel on immediate actions in the event of a fire alarm.

2.20. Regular fire exercises should be held to ensure that staff have a proper understanding of their responsibilities in the event of a fire. Records should be maintained of all exercises and of the lessons to be learned from them.

2.30. The operating organization shall make arrangements for ensuring fire safety on the basis of a fire safety analysis which shall be periodically updated. Such arrangements shall include: application of the principle of defense in depth; assessment of the impact of plant modifications on fire fighting; control of combustibles and ignition sources; inspection, maintenance and testing of fire protection measures; establishment of a manual fire fighting capability; and the training of plant personnel.

NS-G-2.1

6.9. Administrative procedures should be established and implemented to control potential ignition sources throughout the plant. The procedures should include controls to: restrict personnel smoking to designate safe areas and to prohibit personnel from smoking in all other areas;

4. MAINTENANCE

4.1. ORGANIZATION AND FUNCTIONS

Nuclear safety and maintenance policies are clearly stated in the organization and advertised to managers and all maintenance personnel. The goals and objectives are also well established in maintenance. Process for evaluating and revising plant maintenance policy and documents exists and is reviewed once per a year. Maintenance policies and programmes are well maintained and evaluated with industrial practices.

The organizational structure at Ignalina Nuclear Power Plant has been arranged in such way that the maintenance responsibilities are shared between the 'Centralized repair department' (CCR), 'Instrumentation and Control Department', 'Electrical Department', 'Chemical Department'. Deputy Technical Director on Maintenance manages the maintenance work, coordinates and controls activities of departments participating maintenance service. Three departments 'Maintenance Planning and Scheduling Department', 'Design Department', 'Decontamination Department' perform maintenance support functions. They are directly subordinate to the Deputy Technical Director on Maintenance.

There are operation-maintenance departments: Reactor Department, Turbine Department, Chemistry Department, Process Nitrogen and Boiler Department, Fire Protection and Communication Department. Each Department Manager is directly subordinate to the Technical Director. Their responsibilities are maintenance of structures, systems, components, rooms under supervision of the department and preparation of the systems and components for surveillance testing. Such maintenance personal are subordinate to the deputy manager on maintenance through senior foreman or group managers. Deputy Department Managers on maintenance are well coordinated and controlled by Deputy Technical Director on Maintenance. This organization is clearly described in the 'Guidance for maintenance management QA-2-010'.

Responsibilities and authorities of maintenance personnel are defined in plant administrative and QA documents: 'Organizational and responsibilities QA-1 PTOed-0108-9', 'Guidance for maintenance work planning and work implementation PTOed-1008-5B2' and personal Position Instructions. The maintenance management shows a strong commitment on safety culture. Nevertheless, maintenance personnel have very little advertising supports (concerning safety culture, levels and feed-back, industrial safety posters, no systematic reporting on backlogs, field inspection rounds, EPP exercises).

Staffing is sufficient for maintenance work during operation and outages. Each maintenance department activities is based on skills of their specialists. There is a strong organizational maintenance management system which is basically used since the start up of the plant and based on plant quality assurance documents such as 'Guidance for maintenance management QA-2-010' and plant procedures 'Guidance for maintenance work organization PTOed-1008-6', 'Maintenance activities organization and conducting work instruction PTOed-1012-32B5'. Maintenance configuration management is used at the plant. All separated maintenance staffs are united in one Plant Unit Staff under Deputy Technical Director on maintenance, who also is a Chief Plant Maintenance Manager (PTOed-1012-32B5).

Plant maintenance staff interface with other off-site support department and organizations is clearly defined in 'Organizational and responsibilities QA-1 PTOed-0108-9' and properly used during work implementation and work control.

Coordination among different maintenance groups and with operation and technical supporting groups is well established and activities of maintenance services are well coordinated by Deputy Technical Director on maintenance.

Interfaces with contractors support the effective use of contractor personnel. Contractors are accredited both by government of Lithuania (Ministry of Economy) and the plant in accordance with defined requirements. Most contractors are former plant departments staff. A comprehensive programme has been developed to assess the quality assurance organization of the contractors. Audits conducted in that area reflects the international practices. At the plant level, during performing maintenance activities the contractors follow the National requirements and the plant rules and procedures.

Maintenance specialists are adequately qualified based on national requirements and design documents. Most of specialists have a strong experience at the plant. Average age of maintenance staffs is 46. Proficiency was demonstrated during conduction work and observation by the team. Working knowledge of current maintenance procedures, practice and maintenance experience is basically evident.

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

Maintenance facilities provide sufficient workshops space with necessary equipment and accessories. There are new equipment facilities/tools/stands at the plant: machine-tools in most workshops; hydraulic/pneumatic facilities; welding automats; new plasma-cutting facilities; full scope-test stand of Main Circulation Pump and training mock-ups mock-up for main circuits 300 mm tubes welding; removable insulation mock-up; cutting/welding/reinstallation full scope mock-up of fuel reactor tube-channels. Maintenance facilities, mock-ups, warehouses and storage rooms are well arranged, equipped and housekept. Facilities are adequate for work and equipment is accessible for maintenance. Most of these maintenance facilities/mock-ups are used for maintenance training as well as for maintenance and maintenance tests allow to improving the quality of works, industrial safety, skills, ALARA programme, qualification of personal and interaction between managers and workers within maintenance staff. The team evaluates this as a good practice.

Equipment, mounted in workshops, as well as accessories including panels, mockups, checkout, testing and calibration equipment, are kept in good condition and installed according to their design layout. Tools and devices are stored in special boxes to minimize spread of contamination and to protect workers. Usage of supportive tools is carried out in accordance with plant procedures. However several deficiencies were found on the usage of rigging equipment at the plant. The team suggests improving rigging equipment control and testing programme to eliminate potential degradation of their condition and to ensure industrial safety during usage and storage.

Equipments under plant calibration programme are well protected and segregated. Measuring and test equipment are adequately calibrated and controlled according Lithuanian Metrology Law and Standardization Committee Rules to ensure accuracy and traceability. Log-books to register deviations found during calibrations activity of instrument are present at all departments in the plant. Nevertheless the team found few examples of unreadable/missed calibration labels, absence of calibration schedule in Chemistry Department and, several examples un-calibrated devices, which are used only as 'indicators'. The team encourages the plant to check all calibration needs, there is opportunity for improvement in that area.

To minimize radiation doses plant used decontamination facilities and remote controlled tools. Most maintenance procedures contain decontamination demands and illustrated schemes/pictures according ALARA plant programme. Maintenance personal use these facilities and tools for all maintenance activities in a controlled area. Maintenance personnel use chemicals in accordance with the detailed maintenance procedure. Flammable materials are stored properly. The chemical material is distributed by the workshop with a quantity sufficient for the work performed during a day/shift.

4.3. MAINTENANCE PROGRAMMES

Maintenance programme for plant equipments including maintenance cycle schemes are well established based on manufacture's and designer's documents. Maintenance programme is adequately developed on the basis of VD-E-01-98 "Basis Requirements for Nuclear Plants Maintenance", 'Maintenance. Management Procedure. PTOed-1008-6', 'Guidance for management and planning of maintenance work. PTO-1008-5B2' and other plant guidance's and procedures. Maintenance activities are completed addressing periodicity, in a timely manner. Effectiveness of the maintenance programme is periodically evaluated and upgraded based on plant and international experience. All maintenance history records are accurately saved in 'Passport of equipment' and kept up to date.

The plant applies wide predictive maintenance tools and devices like vibration monitoring for Main Circulation Pumps, auxiliary pumps, diesel generators, turbine generators, cooling pumps, safety valves. Vibration monitoring is comprehensive. Thermografical/optical diagnostics are well used to monitor and control condition of mechanical and electrical equipments. Plant radiation monitoring system is well implemented for potential leakages in contamination areas/rooms where maintenance staff is working on daily basis. LBB-acoustic techniques are properly used for detection places of leakage in contamination rooms of main circulation equipment without free personal access. However, acoustic and ultrasonic monitoring techniques are not used for detecting valves small leakages on auxiliary equipments. Eddy-current techniques are not used at the plant to control tubes/corps/headers of heat exchangers equipments and turbine condenser. Predictive techniques need further improvement to reflect current industry good practice. The team encourages the plant to use non intrusive techniques to detect some component degradations.

The in-service inspection (ISI) plan for RBMK-1500 is well established in accordance with the design requirements, VATESI rules, plant policy, ISI plant procedures and technical specifications. In service inspection is performed by 'Metal and Technical Inspection Department'. Appropriate ISI procedures and qualified equipment are being used. ISI inspectors of are qualified and certified by the Lithuanian ISI-Committee. Specific and modern ISI techniques are used for ISI inspections. Effective quality assurance system exists. At present plant is in the process to obtaining a National Accreditation, which will give a possibility to implement ISI control services for all Lithuanian non-nuclear industrial organization.

Hydraulic and Pneumatic tests are performed accordingly to 'PNAE G-7-008-89 Safety Rules of NPP equipment'. ISI inspectors are qualified in accordance with required procedures. ISI documentation is in a good condition. Generally documentation is retrievable, nevertheless the team found few examples where the operational ISI equipment instructions were missing at working places for ISI personal use. The team encourages the plant to remedie to this weakness. ISI results are reviewed and analyzed during each outage and timely corrective actions are taken. ISI results are stored in the 'M&TID' archive and are acceptable for involved personal.

All modifications to change frequency and/or extent of ISI inspections are approved by plant management (Technical Director or his Deputy) before informing the regulatory body (VATESI).

Corrective maintenance programme is well managed with daily/weekly/monthly plans and priorities are set in a proper manner. Plant use effectively intranet computer system 'FOBOS' to record defects of all components/equipments. Effectiveness of corrective maintenance programme is periodically reviewed when it is needed and fully reviewed once per year.

Plant life-time management and ageing programme were started since 1995 when first Safety Analyze Report was developed for Unit 1. After that in 1999 the first plant guidance for lifetime/ageing management was established. Today lifetime/ageing management is identified in several QA documents. There is a special VATESI approved list of all safety related components which are managed by lifetime and ageing plant programme. Special procedures are developed to manage components related to safety for life-time/age evaluation and management. Corrective actions programme is established in regard to all sort of degradation of equipment. Life-time/aging analyzes and risk calculations are periodically reviewed. Ageing history files are frequently used and stored. However, lifetime and age trend analyzes are not applied and the team encourages the plant to make further improvement in that specific area. Risk assessment and safety analyzes for lifetime and ageing management is well implemented at Vilnius Research Cybernetic and Computer System Institute (old plant contractor organization) under VATESI demands (VD-E-05-99) and based on plant data. Lifetime and ageing reports are sent every three months to VATESI authority for independent control and verification.

4.4. PROCEDURES, RECORDS AND HISTORIES

There is a detailed policy at the plant how to use the procedures in daily activities and this is well followed. The plant strictly follows the guidelines in the area of procedure use. The system of evaluation and revision of' procedures and work instructions is implemented through the Management Procedure QA-2-002, 'Documents and records control PTOed-0108-15, PTOed-0211-1'. Content of procedures is based on plant requirements. Acceptance criteria are identified.

All work procedures and instructions are periodically updated in all departments. To provide proper registration and access to documentation exists an electronic documentation storage and control computer system 'ARKI'. The system is protected against unauthorized modification and prevents registration of two or more documents under same number. Temporary changes in maintenance documentation are minimized in number, adequately controlled and promptly transformed to permanent changes.

The check-lists with hold points are included in either work orders or work instructions. Records are numbered and registered. Maintenance history is implemented in a 'equipment passport'. All records are properly secured. Condition of documentation/records storage is good. History is reviewed and analyzed.

Root cause analyses are developed to identify the source of the problem.

Safety performance trends are not always used for all plant maintenance activities. However the plant has a good examples of vibration laboratory test trends and this could be used by the plant apply this technique to other maintenance trends.

4.5. CONDUCT OF MAINTENANCE WORK

All maintenance works are properly authorized, controlled and documented. Maintenance activities are performed professionally and competently. Generally maintenance staffs are well trained and skilled.

Maintenance procedures are followed step by step with respect to inspection points and check-lists. ALARA principles are properly used when conducting maintenance activities.

The plant has developed a Foreign Material Exclusion Procedure (PTOed-1012-13B2) which determined the special requirements for metal parts/pieces, spare parts, plugs, instruments and tools, etc. Nevertheless no requirement is developed for plastic covers, plastic transparent/labels and color of this plastic, which are used in the fuel pool storage and in reactor/turbine building. The team recommends to improve the existing FME programme.

Post maintenance testing is carried out, including tests after modification, and implemented according to plant maintenance and operational procedures. However the team found few examples where step-by-step procedures for post maintenance testing do not exist for all possible variants of tests. As an example, stroke times results before and after outage or corrective maintenance works are not verified for all safety valves/systems even when it is returned to operations. There is no special approval test-list which demand to control and measure stroke times for all safety valves/systems. It is exists only 4 operation procedures for 88 valves out of 1000 in Unit 2. The team encourages the plant to analyze this gab. Most of the maintenance results are recorded in log-books, check-lists and systematically updated. Procedures, records, check list and 'equipment passports' are in good condition.

4.6. MATERIAL CONDITIONS

Plant material condition procedures exist and are implemented for all maintenance activities. The plant has expended a large effort in the last several years in upgrading material conditions. However numerous examples of minor defects and deficiencies were found due to lack of maintenance, some of which apply to safety related systems. The team recommends the plant to further develop the programme and processes needed to ensure that maintenance works are always performed in good quality, in accordance plant procedures and design requirements.

Generally safety hazards are marked and additional protections are based on plant requirements. Walk downs is performed by the management, however the team found deficiencies which could be noticed and reported. An issue is developed in Operations area.

4.7. WORK CONTROL

Work control is implemented at all stages of maintenance service accordingly to established procedures. The foremen in Maintenance Departments review the results of these job clearances, analyze maintenance test results and determine if some follow up is required.. Daily and weekly meetings address work prioritization, work management and material and manpower requirements. This approach leads to good results and safe and effective completion of work.

The plant has implemented an on-line monitoring application for the management and work control of maintenance tasks in all areas (mechanic, I&C, electrical, welding, etc). Within the frame of this programme an intranet computer system was developed. The on-line system tracks all daily and weekly activities and monitors them in the aspect of maintenance management, planning and control.

Since 1997 plant has been introduced the information and intranet computer system 'FOBOS'. This system is used for controlling all work stages. The existence of comprehensive on-line monitoring system allows effective management and efficient control of maintenance activities of all the plant departments. This was considered by the team as a good practice.

4.8. SPARE PARTS AND MATERIALS

Procurement of spare parts and materials is defined by Lithuanian Procurement Law and corresponding plant procedures. There is a special Lithuanian Government Committee to control procurement process at INPP. Every three months, reports are sent to this authority for control and verification. Technical and quality assurance procurement plant policy is defined in plant procedures and consistent with plant design. Control of receipt of spare parts is well organized.

Plant spare parts storage and warehouses condition procedures exist, however numerous examples of deficiencies were found and some of them related to t5he storage of safety system equipment. The team suggests the plant to improve the spare parts and equipment warehouses programme.

After dismantling of INPP unit 3, many spare parts are stored in plant warehouses and could be used for other units need.

Generally preventive maintenance is performed on main spare parts. Temperature and humidity are measured and strictly regulated when appropriate. Minimum and maximum and reorder levels are defined regarding manufactures demands and plant procedures. Process for surplus, repair and return parts, for non-conforming and damaged spare parts is well organized and defined in plant procedure PTOed-2012-1B3.

Access of storage is well controlled by storage managers/workers as well as plant armed guard. QA audits and self-assessment are performed based on plant QA and procurement documents. All non conformances are reported in protocols and log-books. Corrective actions are conducted when needed.

4.9. OUTAGE MANAGEMENT

Before the outage all plant activities concerning nuclear safety are planned and approved by Nuclear Safety Department Manager according Plant procedures/requirements and established in "Technical Solutions', approved by Technical Director, but there is no special risk-assessment plant programme for evaluation and review core damage/nuclear safety influencing for all maintenance works at the plant.

The plant outage management is arranged in accordance with current procedures and on the basis of plant organizational structure. During the outage period, a manager for plant maintenance and managers of equipment maintenance and plant departments' activities are officially appointed.. Outage goals and objectives are defined in 'Guidance for maintenance work organization PTOed-1008-6'. Priorities are defined as follow: industrial and nuclear safety (including fulfillment of labor conditions requirements), maintain good level quality, good communications between different departments, planning and procedures for each activity.

Performance of outage tasks is ensured and monitored by maintenance managers departments and under-contract organizations. Such managers are then requested to produce daily/weekly reports submitted to the maintenance staff. These reports include statements of work status, reason for delays, etc. Based on such reports plant maintenance manager analyzes current status and specifies the activities for the following day. A daily morning meeting is held by Technical Director to combine and clarify all actions of operational and maintenance personnel. All activities are monitored in computer intranet system and accessible to all plant personnel.

Programmes related to ALARA are effectively implemented. The management discusses current personal doses and predictable ones, plant additional measures to decrease personnel exposure. Actual radiation exposure figures are presented to the maintenance staff in the form of schedules. Limit radiation exposure and individual dose rates is within 2-20 mSv/year range, and decreases from year to year. A general plan covers performance of the ALARA measures. The plant has good ALARA indicators for all maintenance staff, including contractors.

Acceptance of equipment after maintenance is based under results of acceptance tests and the results of 'controlled operation' (30 days after acceptance tests). Acceptance Committee defines quality rating for maintained equipment and quality of organization of maintenance activities in separate departments.

A report on comparison of goals set prior to outage and conclusion on the maintenance quality is prepared by maintenance managers in all departments. After each outage a final report is prepared with detected discrepancy, analysis of positive experience and corrective actions plan for effective follow-up.

A safety review is conducted to assess completeness of maintenance documents and final report before sending them to the VATESI (regulatory authorities).

Plant uses with effectiveness Primavera 5.0 computerized scheduling system integrated with the work control system and the plant computer intranet. The maintenance personnel is well trained in advance on outage activities according plant organization structure and procedures. During the outage adequate defense in depth is provided according plant procedures.

DETAILED MAINTENANCE FINDINGS

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

4.2(1) Issue: Rigging equipment control and testing are not always implemented in manner to ensure absence of degradation and to protect workers against injuries.

The team found several facts on rigging equipment usage at the plant which are lower than international good practice:

- plant do not use protocols or column/table in log-books where the visual number of damaged wires is fixed;
- the numerous results criteria's of rigging equipment visual tests are absent;
- There is no consistency in data collection form in rigging equipment log-books stored in different departments;
- there is no possibility or procedure to know if rigging equipment condition has changed during its operation and storage;
- loops of rigging equipment performed by manual tools could lead to weak quality and potential hazard;
- places for rigging storage are not properly marked;
- at this moment there is no qualified specialist at the plant to perform strength tests after rigging equipment manufacturing;
- no strong segregation between usable and damaged rigging equipment.

Without adequate rigging equipment control and testing at the plant, degradation could not be noticed and corrected and this could lead to decrease the industrial safety for personal.

Suggestion: Consideration should be given to improve in rigging equipment control and testing programme to eliminate potential degradation of their condition and to ensure industrial safety during usage and storage.

IAEA Basis: NS-G-2.6: 5.9 (g)

5.9 The content and format of a typical procedure should be in accordance with the provisions established for quality assurance. The content should therefore typically include the following:

g) Special tools and equipment: a listing of all special tools, rigging and equipment necessary to carry out the work'.

NS-G-2.6: 8.7 and (c)
Each of the workshops should be equipped with the following:

(c) Secure storage facilities for special tools and testing equipment needed for maintenance'

NS-G-2.6: 8.19
Plant management should provide suitable mobile lifting and transport facilities, with clear indications of their lifting capacity. In the selection and use of these facilities, due account should be taken of the possible radiological consequences of their failure.

Examples of precautions taken include regular examination and maintenance of lifting equipment, periodic testing, special inspections before major operations involving lifting and rigging, and cautionary notices limiting movements of loads over specified areas. All operations involving lifting and rigging should be performed by trained personnel.'

4.2(a) Good practice: The plant implemented a policy and wide programme to support usage of new equipment facilities/tools/stands and training mock-ups for mechanical maintenance. The main objectives are preparing and performing maintenance activities and implementing ALARA programme and practices.

There is a plant policy to enhance facilities/mock-ups for all mechanical maintenance workshops:

a) new equipment facilities/tools/stands:
  - machine-tools in most workshops;
  - hydraulic/pneumatic facilities;
  - welding automats;
  - new plasma-cutting facilities;
  - full scope-test stand of Main Circulation Pump;

b) training mock-ups:
  - mock-up for main circuits 300 mm tubes welding;
  - removable insulation mock-up;
  - cutting/welding/reinstallation full scope mock-up of fuel reactor tube-channels.

Size and arrangement of these maintenance facilities are appropriate for safe and efficient completion of work. Most of these maintenance facilities/mock-ups are used for maintenance training as well as for maintenance and maintenance tests to allow the improvement in the quality of works, industrial safety, skills, ALARA programme, qualification of personnel and interaction between managers and workers within maintenance staff.
In connection with the forthcoming plant decommissioning, the team evaluates this improvement as a good decision to enhance mechanical workshops and guaranty high-level safety requirements after Unit 2 shut down.

4.5. CONDUCT OF MAINTENANCE WORK

4.5(1) Issue: Programme and controls to exclude and eliminate foreign materials in the plant fuel pool storage, reactor and turbine buildings are not fully implemented.

The team found some examples of weak foreign materials exclusion practices:

Reactor building/Fuel pool storage:

- a piece of transparent plastic (10*20 cm) was noted on the water surface of pool room 157;

- use of clear plastic in reactor hall and spent fuel pool room;
- few loose parts was found close to the pool or on the top of covers of the pools (screw driver, metal pieces, rubber parts, cupper wires, etc).
- transparent plastic is used to protect a tool, to cover and protected electrical cabinets and to protect pipes for gas and water;

Turbine building:

- several opened pipes in the turbine floor (near solenoids of safety valves of the main steam valves of LP turbine);
- opened equipment such as servomotor for electrical driven valves (2RL02S47);
- open extremity of measurement equipment (level measurement of generator stator circuit tank #4);
- a lot of examples of caps missing on drainages or measuring line-tubes after root valves (the ends of these tubes are turned up and unplug).

Without a good control of foreign materials exclusion programme in the fuel pool rooms and in the reactor/turbine building potential risk exists to damage reactor fuel or safety related equipment.

Recommendation: The plant should strengthen its existing programme on foreign material exclusion to control and eliminate foreign materials in the fuel pool storage and reactor/turbine building.

Ref. NS-G-2.5: 5.19, 6.8: 'A policy for the exclusion of foreign materials should be adopted for all storage of irradiated fuel. Procedures should be in place to control the use of certain materials such as transparent sheets, which cannot be seen in water, and loose parts. Maintenance programmes should include procedures to prevent the introduction of foreign materials into the reactor'.

Note: The team agrees on the fact that clear plastic used to wrap the fresh fuel elements and keep it dry is close to design problem and could be acceptable if it is fully under control by plant staff.

4.6. MATERIAL CONDITION

4.6(1) Issue: The maintenance works are not always performed in accordance to the plant procedures and design requirements.

The team found several examples of inappropriate material condition:

Reactor building, (all level) and ALC tower:

- the covers on most electrical drives of valves VF61,62S02, VF62S03, TN32S02, TN34S02, VF62S02, VF61S04 are fixed by only 1 or 2 screws (there are 4 places to screw the covers) in the room 074;
- a valve VF61S81 have a broken wheel;
- oil level measurement do not have a marked signs about normal oil level in bearings of a core cooling pumps TH61D01 in the room 074;

- on a flange of safety valve (TH81S05) in the room 117/2 unit 2 some nuts and heads of screw-bolts are at different opposite sides others are at the same side;
- corrosion at many places on valves, pump vessels, supports, bolts and nuts in the room 074;
- Marks of former water leaks are present on a walls and ceiling in several rooms near RCCS pumps;
- The protection of top of electrical cabinets (behind MCR) against water leak in not made very professionally (near the main control room)
- I&C sensors transmitters are not fixed to the support plate by bolts. They are just pressed against the support plate (room 075/1);
- on a valve UK21S05 of fire water protection system many bolts on the flanges are missed, most of them are corroded;

D2 building:

- Marks of former water leak are visible on the ceiling at Control Devices Room behind MCR (320/D2); and protection of electrical cabinet against water projection is not done in a professional manner.

Turbine building:

- pressure transmitters on main and auxiliary feed water pumps 2RL02P01, P02,P04,P05; 2RL02P13,14,24,25,34,33,34; 2RL02F11,12,21,22,21,31,32; 2RL02F41, 43, 44, 51, 61, 63, 64, 65, 71, 2SU01P21B1, 2SU01P22B1 and 2SU01P23B1 are not mounted to support plate by bolts, although there are 4 holes on the support plate and 4 corresponding holes on the transmitter. It was explained that the expectation is that the transmitter is secured by pressing the support plate by the shrouded spindle against the transmitter. In this case the force is transferred to the impulse line. In case of 2RV21S03 there is even no contact between the transmitter and the support plate;
- signs of 'unfinished' maintenance work: missing bolts and nuts, nuts not tightened on covers of position indicator boxes, pipe flanges, idem for 2RA16S02;
- cover of the tank OTB11B02 is tightened by only 2 bolts;
- 2SF01S01 also fixed with 2 bolts and nuts, the other 4 nuts and bolts are missing. One bolt of 8 was not tightened on flange of inlet pipe to oil filter 2SF20N03;

Diesel generators:

- lots of oil drops on pipes in diesel #7 of unit 2;

Plant air compressor building:

- I&C sensors transmitters OUS41P25, OUS73F21 are not fixed to support plate by bolts and nuts (137/125); and no document such as 'technical solution' was presented to the team to approve the current practice..

Without good quality of maintenance work and good control the reliability of safety related equipment could be decreased.

Recommendation: The plant should ensure that maintenance works are always performed in good quality in accordance plant procedures and design requirements.

Basis: Ref. NS-R-2: 5.17: 'Responsibilities and lines of communication shall clearly be set out in writing for situations in which conditions of plant systems or equipment are not in accordance with operating procedures'.

Ref. INSAG-12; 3.3.9:116: 'Operating excellence: principle – maintaining excellent material condition and equipment performance.'

SS-50-C-SG-Q13; 359: 'Pertinent information from designers, manufactures and other operating organization should be used'.

4.7. WORK CONTROL

4.7(a) Good practice: The plant has implemented an on-line monitoring application for the management and work control of maintenance tasks in all areas (mechanic, I&C, electrical, welding, etc).

A deep detailed programme of continuous management and work control was developed at the plant. Within the frame of this programme an intranet computer system was developed. The on-line system tracks all daily and weekly activities and monitors them in the aspect of maintenance management, planning and control.

Such system allows management staff to perform an effective and efficient control of activities in the following maintenance directions:

- weekly and daily tasks;
- weekly reports on the results and performance indicators of the work fulfillment;
- minutes and protocols of all meetings, plans and schedules of maintenance and repair works;
- on-line monitoring of contractors' work arrangement;
- on-line monitoring of quality evaluation of activities of all maintenance departments including contractors;
- authorized access and review of plans and schedules of maintenance and repair works by means of 'PRIMAVERA 5.0' Programme.
- informing and announcements for the maintenance personnel;
- on-line control of works fulfillment stages by means of intranet computer programme 'FOBOS'.

The results of on-line monitoring are applied effectively for implementation of corrective actions. The maintenance personnel are well informed. The implementation of on-line monitoring programme allowed to reducing the number of log-books and other records, filled manually. The monitoring history is used in annual reports, what helps to improve feed-back. The on-line monitoring programme is actively applied in improvement of targets and performance indicators. The monitoring programme is reviewed periodically. The existence of comprehensive on-line monitoring system allows effectively manage and control the maintenance activities of all the plant departments and may be considered as good practice.

4.8. SPARE PARTS AND MATERIALS

4.8(1) Issue: Spare parts storage and warehouses conditions to protect equipment are not always implemented in manner to ensure perfect preservation of all safety and non safety spare parts/equipments stored at the plant.

The team found several examples of inadequate spare parts storage and warehouse condition at plant equipment depot:

- Not adequate space is available in suitable environmental conditions for all spare parts, which are stored in storage facilities. There are many examples where spare parts are stored out of warehouse under open sky.
- There is no segregation of safety and non-safety related spare parts. All types of spare parts are stored in one warehouse without clear separation.
- There is no formal physical barrier between reception area, storage area and area where spare parts are distributed for further plant activities.
- Many examples of water leaks on the floor or traces of leaks through the roof in several warehouses, where electrical spare parts of equipment are stored (495/3, 495/4, 568/1).
- In some areas, stainless steel tubes often are stored in direct contact with carbon steel on the same shelve (567/1).
- Electrical equipment/components surfaces are not protected from the ingress of foreign materials (dust, sheets of papers, empty cardboard boxes, former packing materials most of which are flammable) (495/3, 495/4, 568/1).
- Several examples of spare parts boxes are stored on metallic constructions of warehouse which are not designed for that purpose (495/3).
- There are several examples of non-protected open ends on pipes and tubes (567/1).

Inadequate storage of spare parts and equipment in well maintained warehouses of plant equipment depot could lead to degradation of equipment and/or the quality of safety and non safety spare parts/equipments.

Suggestion: Consideration should be given to improve spare parts storage and warehouses conditions to eliminate potential material degradation and guaranty high quality for safety and non safety spare parts/equipments stored at the plant equipment depot.

IAEA Basis: SS-50-C-SG-Q13; 417 Storage practices should ensure that: stainless steel components are protected from direct contact with other metals particularly carbon steel; machine surfaces are protected; equipment internals are protected form ingress of foreign materials; there is suitable segregation of safety related and non safety related components; parts/material/equipment protective caps reinstalled to seal items on which previous packaging or protective caps have deteriorated or been damaged or lost while in storage].

5. TECHNICAL SUPPORT

5.1 ORGANIZATION AND FUNCTIONS

The technical support function is assigned to several departments which report to the technical director. Routine function of technical support is assigned to each organization and each department and shop has engineer(s) in their organization, for example Electrical Department (ED). Other function is assigned to mainly Engineering Support Department (ESD) and Nuclear Safety Department (NSD). When problem, which needs technical support, arises, ESD or NSD is requested to solve it according to the subject.

Goals and tasks are established monthly and yearly by the department, for each group in the department. Its progress has to be reported and reviewed in the same manner by the Technical Director.
NSD discuss about Safety culture almost every day in daily meeting. Head of ESD had cascaded his commitment to safety to his staff. These managements understand the importance of the safety culture well.

Although the plant was designed and manufactured in former Soviet Union, interface with original design entities and research institutes continues based on contracts. Some engineers from these entities are working in the plant based on these contracts.

Overtime work is strictly controlled and rare. Good working conditions exist in this respect.

Plant specific Probabilistic Safety Analysis (PSA) model was developed and it is used sometimes to support the modification process. There are dedicated and knowledgeable PSA experts in the plant. PSA calculation activity is regulated by guideline with was approved by regulatory body. Results are reviewed by regulatory body and cross-checking is also conducted by the PSA calculation of Lithuanian Energy Institute. The plant also invited International Peer Review Service for Probabilistic Safety Assessment (IPERS) mission. The plant has adequate resources and active activities not only internally but also externally.

Job description is documented for each position. Qualification requirement is well determined for each position's job description. Training plan is developed concerning each individual background. Every three years each person's competence is reviewed. Final qualification is evaluated and delivered by a committee. There are three levels of committee to check competence according to the job. In some cases such as core calculation engineer, certificate from Russian Institute is required and it is under full control of the manager.

5.2 SURVEILLANCE PROGRAMME

Surveillance item, frequency and responsibility are documented in "Technical specifications on inspections and testing during operation", and the detail surveillance activity is documented in each equipment's 'instruction document' and referenced to the 'Technical specifications for operation'. Acceptance criteria and 'action to be taken when acceptance criteria cannot be met' are written in 'Technical specifications for operation', 'procedure to monitor parameters of passport' or each equipment's 'instruction' according to designer's or manufacture's requirement. Thus, surveillance programme is rather fragmented and not systematically determined and documented. Trend analysis of surveillance results is not required by the plant regulation and not conducted except for vibration monitoring. Procedures are prepared based on 'manual on preparation of working procedures'. This manual is not for the surveillance activity specifically but for the general work. All procedures are reviewed at least once per three years. All related departments have to approve the revisions. Responsibility for implementation and check was described in each step. However, the team found some weaknesses in this area and made a recommendation.

Qualification of personnel is conducted by each position not by each function. Theoretical and practical training are given depend on individual background. Before conducting surveillance testing the employee is required to have an on-the-job training for each surveillance testing. However, there is too little evidence of this on-the-job training. The team encouraged the plant to reconsider the necessary training document of on the job training on control of record.

Yearly schedule of surveillance test is developed at the beginning of the year by each department. During the review and approval process, other departments check to avoid conflicts, and just before testing, shift supervisor is responsible for avoiding the conflict. Yearly schedule is also submitted to VATESI. Safety and Quality Assurance Service department (SSQA) checks the previous day's surveillance results and reports it and coming schedule to VATESI daily. If the surveillance test results are not successful, SSQA has to analyze it. SSQA also conducts independent reviews for selected safety related activities and attend prescribed technical test, although these reviews are not comprehensive and systematic in respect of surveillance test. Resident inspectors also attends some surveillance testing. The scheduled surveillance testing is well controlled internally and externally.

The team observed some surveillance testing and also reviewed some surveillance test results. The team found some weaknesses in this area and made a suggestion.

Procedure is prepared for the special test, which has not been conducted before that time.

In addition to the normal surveillance activities, portable equipment designed to detect defects and failures on underground pipelines and in hard to reach areas is widely used. Such equipment includes but is not limited to: thermo-cameras, correctors, acoustic leak detectors, microphones, ultrasonic flow meters, and vibration diagnostics equipment. Application of this equipment enhances the quality of detection and allows identification of causes as well as conduct of the analyses required. The team considered this as a good performance.

The plant also introduced the 'leak detection system'. The team considered this as a good practice.

5.3 PLANT MODIFICATION SYSTEM

General modification implementation steps such as definition, objective, scope responsibility, process and records are well described in 'Plant modification management procedure'.
Modification categories are defined as same as safety class for safety equipment and system, and comprise of 4 categories.

Detailed activities are described in some of 'instructions'. Every staff can propose modification request using stipulated 'proposal form'. Proposal is initially reviewed in the requesting department and the responsible department. When they both agree on this proposal, the Technical Director reviews it. Even if it is not agreed this form is registered in plant document system. If the Technical Director agrees, a technical meeting on modification is held and the responsible department and relevant review department is assigned to prepare modification proposal or technical decision.

In INPP two types of modifications are developed: permanent and temporary modifications.

The permanent modification (5-10/year) are well prepared. They are initiated from different departments and then discussed at the Technical Committee (TC). If the TC agrees, the suggested permanent modification implementation process is started. This process involves all the relevant departments. For safety related equipment, modifications are analyzed and evaluated by a Safety and QA panel. Final verification on safety related equipment is authorized by VATESI (Licensing regulator).

The implementation of permanent modification (PM) is usually well documented in the form of technical orders. The content of technical orders will be finally described into the normal instruction within a approved time frame.

Modification proposal has to contain different items such as: objectives; references; modification way (more than 2 ways have to be proposed); technical requirements; functional requirements; category; influence on environment; radiation safety; impact on other systems; fire safety; impact on operations and maintenance; training resources; documentation; and schedule. For further details, a checklist is used to cover necessary items to be considered. Then, proposal is reviewed by relevant department. Responsibility of each department is clearly defined in the above-mentioned checklist.

Depending on the category of certain modifications (1, 2 or 3), ESS and NSD have to review it. After these reviews, each department's comments are discussed and final modification category and decision is made in the technical meeting. If category of the modification is 1, 2 or 3, this technical decision was further reviewed by SSQA, Safety Committee and VATESI. After these reviews, technical decision (technical report) is made.

In this plant modification programme, consideration of surveillance activities is not described but it is written in the document 'Instruction on technical task development'. All this process is controlled by one simple and clear form of 'Technical issue form'. Responsible department for modification and review were clearly defined in the 'technical issue'. Using this form it is easy to track and check the status of modification. The team identified this as a good performance.

The team reviewed procurement and modification test results for diverse shut down system, and some documents on computer application. The team found some weaknesses and made suggestion in this area.

Temporary modification process is also developed. The necessity of temporary modification has to be considered and if it is safety related system component. SSQA has to review independently. If necessary, the plant asks VATESI for authorization. Period of termination is determined not later than next outage and tag of modification indicates it. Process is controlled by simple sheet and all temporary modifications are listed and placed in the main control room.

Training requirement was included in the technical decision. Responsible department for modification is responsible for preparing the training materials. Influence to the simulator was also required to be evaluated if any change is necessary or not, according to modification procedure. Influence on the plant documents is also clearly required to be reviewed in the modification procedure. Configuration management is well considered.

5.4 REACTOR CORE MANAGEMENT (REACTOR ENGINEERING)

Nuclear physics laboratory (NPL) in nuclear safety department (NSD) is responsible for core management. The fuel laboratory is responsible for fuel integrity monitoring.

In the NPL, three groups are responsible for core monitoring, core parameter calculation and in-core/ex-core detector calibration respectively. It is clearly defined in the procedure 'description of the work in NSD'.

The core management programme is well established and includes core performance monitoring, fuel depletion calculations, reactivity calculations, neutronic calculations to ensure that core operation is within the operational limits.

Responsibilities of each personnel for different core management tasks are clearly defined in each job description. Training programme for each personnel is clearly identified and include on the job training. Qualification requirements for different core management tasks are clearly identified. Especially those who use the core calculation code has to obtain the certificate from Russian institute.

Operational limits for core parameters are clearly determined in 'passport'. Passport is developed based on 'technical conditions for the fuel' created by designer. Passport is also approved by VATESI.

Core monitoring is conducted based on 'procedure to monitor passport parameters' and 'procedure on control of operational limits and safety limits'. Current core condition such as burn-up of the fuel in the core is automatically calculated on-line system 'TITAN' and monitored by reactor operator. Although the burn-up of each fuel assembly is automatically monitored by TITAN system and STEPAN code, the procedure for burn-up check was not fully clear.

Refueling planning calculation is conducted two or three times per week, using 3D diffusion neutronic calculation code "STEPAN". Burn-up is transferred from the TITAN to STEPAN. According to this calculation, discharged fuel and load fresh fuel is identified. Important core parameter is calculated and checked by independent group at the time of each calculation and monthly. Core parameter check is conducted well.

In the 'procedure for reactor operation', the recommended power of channel for refueling is developed by NSD to comply with operational limits. According to this table reactor operator operates the reactor for refueling, if necessary.

After refueling, NSD checks correction factor of TITAN database, reactor parameter, discharged fuel in the spent fuel and N-16 in the refueled channel to assure that refueling had been conducted as planned. Core parameter and TITAN parameter are well monitored.

Before the outage, worth of fast acting control rods is measured and after shutdown sub-criticality is measured to confirm the core has necessary shut down margin in the cold state. During the shutdown state, neutron flux count rate is checked by reactor operators everyday and before performing safety related works. In case of fuel exchange in the core, sub-criticality is calculated and checked beforehand.

Before the restart, sub-criticality is also measured.

During the critical approach work, Deputy technical director or head of NSD manage the operation with the attendance of VATESI. Subcriticality is well monitored and measured during outage and before restart.

STEPAN code was maintained by the developer (Kurchatov Institute) based on contract. TITAN system is maintained by I&C department (ICS) , but NSD takes the responsibility for the core calculation part. Maintenance of these tools is well organized.

The plant has mainly two types of fuel integrity monitoring system and the fuel integrity is monitored continuously. Operation department is responsible for controlling this system and NSD carries out trend analysis to detect leak fuel. Furthermore, discharged fuel is checked during and after refueling. Also after shutdown, fuel integrity check is conducted.

Since 2003, fuel leak has increased. According to plant's investigation, reason is almost identified and the plant is trying to solve this problem. The team encourages the plant to continue this investigation and resolve it as soon as possible.

5.5 HANDLING OF FUEL AND CORE COMPONENTS

Fresh fuels are transported from manufacturer to the plant by train using dedicated container. At first, container is stored in the fresh fuel storage without opening the container.

In this storage, any combustible material was eliminated and fire extinguishers were prepared well. To detect flooding, water level sensors are installed and personal access is limited.

According to the schedule developed by NSD, fresh fuel container is transported to the reactor building. Container is opened and fuel is extracted from the container. At the same time, NSD and Reactor Department (RD) conduct visual inspection. In order to help to judge the surface scratch, reference acceptable scratch sample were prepared. After inspection, fresh fuel is hanged in the central hall until it is loaded into the refueling machine. All movements are planned and recorded by NSD and conducted by RD. Responsibility is well defined. However, the team found some weaknesses in this area and made a suggestion.

Refueling plan is prepared by NDS and approved by Technical Director. Clear line of order exists. RD conducts all transport operations according to specified procedures. During the on-power refueling, refueling operator has to confirm to the unit shift supervisor before spent fuel discharge and fresh fuel loading. During refueling activity, data such as opening load of seal were properly recorded. Clear communication existed especially during fuel movement in the core. (Every 1m movement) After refueling, unit shift supervisor comes to check the status of the central hall. Movement of fuel assembly is planned and recorded by NSD.

After leak fuel is identified, discharge of leaking fuel is determined according to I-131 level. And discharge of leak fuel is conducted on refueling process. Leak fuel is stored in the container with red rid in order to identify it. Leak fuel container was well identified.

Irradiated fuel is only stored in the designed storage places. Leak fuel is temporary stored near the core. It is also defined as storage area and fuel record of this storage is registered. The records of irradiated fuel are well maintained.

The plant has a foreign material exclusion programme (FME). However, there were several findings in the fuel handling area. (See Maintenance section in this report.)

5.6 COMPUTER BASED SYSTEMS IMPORTANT TO SAFETY

The I&C department (ICS) is responsible for establishing and maintaining whole computer application. Each department uses the computer system as common tool.

Computer based systems are classified using same definition of plant component defined by VATESI. The control of computer applications was conducted based on plant Quality Assurance procedure. Each department can request modifying and installing to the ICS according to procedure. ICS created a list of computer system components of safety relevant system and each component is clearly classified.

ICS staff is periodically trained. When computer system is modified, training for the user is provided by the coordination of training center or external contractor.

'Quality assurance programme, software management procedure' is established to manage the activity of the software. This document is applied at all departments as the management procedure of the software.

Documentation requirements are well established according to QA procedure.

Computer equipment maintenance is performed according to the 'regulation on the equipment and installations maintenance'. Procedure for recovery in case of failure or inoperability is established. Back up of the data are regularly created and safely kept. Spare parts are prepared and listed. According to the stock status, plant restocks the spare parts.

Only authorized person can access the system. It is achieved by physical separation, firewall and password access. Log of access to system is recorded.

Plant modification process about software/hardware is defined in the 'plant modification management procedure'. As it is described in detail in 5.3, modification process is well established. However, the team found a computer application, which was installed without following the plant modification process. The team made a suggestion in plant modification area.

DETAILED TECHNICAL SUPPORT FINDINGS

5.2. SURVEILLANCE PROGRAMME

5.2(1) Issue: Surveillance programme is not always developed and controlled in a systematic way.

Surveillance programme is fragmented into many documents. Further, the team found the following:

- Definition of frequency did not clearly determine the interval between two tests. Mentioning in such a way like 'once per month', the interval between two tests was scheduled more than one month.
- 'Action to be taken if surveillance frequency is not fulfilled' was not described in the 'schedule of inspection and testing (I&C Department)'.
- 'Action to be taken if surveillance frequency is not fulfilled' was not clearly and appropriately described in the 'schedule of inspection and testing (Reactor Department)'.
- Trend analysis of surveillance results were not required and conducted except for vibration monitoring.
- Evidence of 'on the job training' of each relevant surveillance activities before being qualified were not found.
- Yearly surveillance schedule (I&C) has been put into valid from 16-01-2006, but in this document some surveillance activities are scheduled before this date.
- 'Action to be taken if surveillance frequency is not fulfilled' was not written in technical specification.

The procedure for surveillance does not always assure that surveillance activity is done in a reliable way. For example:

General Statement

- Work step, criteria and remarks for this work step are described altogether in the same column of the test procedure.
- In the test procedure, check column whether each item satisfies the acceptance criteria was not found.
- In the test procedure, place to clearly check whether finally surveillance results met requirement was not found.
- In the procedure, remarks column for after test was not found.

Core parameter measurement (instability and void, power coefficient)

- For three tests, precondition of test were listed altogether without showing which precondition is needed for each test in N244-18-280.
- Format of the procedure is not consistent across different surveillance activities although they were conducted simultaneously.

ECCS pump function test

- In the procedure N170, there is no step to check the validity of measurement equipment to be used.
- The test procedure N170, MCR works and ECCS Pump room works altogether. It is impossible to conduct test by only using original procedure.
- In the test procedure N244-18-279, acceptance criteria for surveillance result were not described.
- In the test procedure N170, check column to confirm the status, which should be done before certain step does not exist. (Ex. Confirmation of valve opening from the ECCS room to MCR)
- 'Actions to be taken if acceptance criteria cannot be met' are specified in the procedures but early notification to the shift supervisor is not described, although it is described more general document in case of finding deficiency.

Without systematic and rigorous surveillance programme and proper surveillance testing procedures, the plant could fail to detect the unavailability of safety related systems timely.

Recommendation: Plant should develop its surveillance programme in a systematic way to guide organization and personnel in the entire process and to ensure that surveillance activity is done in a reliable way.

IAEA Basis: NS-G-2.6

5.3. Acceptance criteria and actions to be taken if acceptance criteria cannot be met should be clearly specified in the procedures.

5.8. The information contained in the procedure should be presented step by step in a logical order. All references and interfaces with other relevant procedures should be carefully reviewed and verified. The level of detail should be such that the individual carrying out the work can follow the procedure without further guidance or supervision.

5.9. The content and format of a typical procedure should be in accordance with the provisions established for quality assurance. The content should therefore typically include the following:

(d) Prerequisites: all special conditions for the plant or system, or the status of equipment necessary prior to the commencement of work covered by the procedure. Any necessary special training or mock-up practice should also be mentioned.

(c) Limiting conditions: any conditions, such as load reduction or the operation of standby equipment or safety systems, that results from carrying out the work and which limit the plant's operations. For example, when a system is undergoing repair, surveillance or testing, it should be considered unavailable for safety purposes unless it can be demonstrated to be able to perform its safety function to an acceptable degree.

(g) Special tools and equipment: a listing of all special tools, rigging and equipment necessary to carry out the work.

(i) Instruction text: a step by step listing of work details which identifies any changes in radiological or other conditions as work progresses. At selected steps, craft persons may be required to sign their names or their initials to indicate satisfactory completion of the preceding step or steps, either on the procedure or on an attached checklist.

9.1. A surveillance programme should be established by the operating organization to verify that provisions for safe operation that were made in the design and checked during construction and commissioning continue in effect during the operating lifetime of the plant and continue to supply data to be used for assessing the residual service life of SSCs. At the same time, the programme should verify that the safety margins are adequate and provide a high tolerance for anticipated operational occurrences, errors and malfunctions.

5.2(2) Issue: Management expectations and quality of controls are not always strict regarding surveillance activities.

General Statement:

- Only check list was carried to the test premises. (Not all parts of procedure)
- For the regular surveillance activities, pre-job briefing is not conducted to inform about hazards before the job.

Core parameter measurement (instability and void, power coefficient) observed by the expert:

- During the test procedure N244-18-277, the column on precondition was not signed and checked, although test had started already.
- In the test procedure N244-18-280, four struck out was found. Only two of them were signed and dated.
- In the test procedure N244-18-280, the pre-requested conditions such as number of unavailable pumps was changed by hand without any signature.
- In the test procedure N244-18-279, several signatures were apposed in the wrong column.
- In the test procedure N244-18-279, the note made by the operator was written outside of the procedure without name.
- In the test procedure N244-18-279, some columns (surname and step2) were not filled in.

ECCS pump function test:

- On the floor under the ECCS pump piping, oil leak from upper cable tray were existing. Although the operator had noticed it, plant conducted ECCS pump function test. Existence of the oil was not written in the working form.
- On the floor around ECCS pump, small nut was found. Test crews did not notice it, until it was pointed out by team.
- The team found that ECCS pump cable's water resistance tube were broken.

Without strict management expectations on the quality of the control and reporting of data, the plant could fail to detect the unavailability of safety related systems.

Suggestion: Management should consider enhancing expectations and quality of controls for surveillance activities so that they are implemented in a rigorous manner.

Basis: IAEA NS-G-2.6

5.2. The plant management should ensure that the procedures are correctly implemented and that special provisions are included where particular hazards are envisaged.

5.2(a) Good practice: Implementation of leak detection system

A unique for the RBMK reactor concept of leak detection system (before break) is being implemented at the plant. It allows lowering the sensitivity threshold significantly and as a result improving detection of coolant leaks on pipes and equipment located at the boundary of leak tight compartments. A system for monitoring of the pipelines in under reactor compartment and sections of steam pipelines has already been put into operation.

The test results of the installed systems confirmed that they ensure leak detection within one hour and inform about leak tightness failure at coolant pipelines and equipment by the rate of leak 10 times less than the critical one. This system also informs the location of the leak.

For the steam line leak detection, isolation humidity control according to the radar principle is applied. If there is ingress of moisture to the detector, its electrical resistance of fiber cable changes and can detect leak and identify the place. For another places like below reactor, humidity measuring and aerosol activity measuring is used. All these data are automatically analyzed and shown on the computer screen including main control room in a user- friendly manner.

5.3. PLANT MODIFICATION SYSTEM

5.3(1) Issue: Modification activity is not always conducted in a rigorous manner.

The team found the following:

- Core transient calculation code –PROGNOZ- were installed without following plant modification process, although relevant department conducted validation.
- In the design document TACpd-0911-71291,
    - It was not clear which measured data should be recorded. For example,
        - Measured data (I(%)) were not written from p78-81 etc.
        - Data were not written in P161 etc.
    - Signature and its date of responsible person were not written in p75, 77 etc.
    - Measured values were not written in p176.
    - Acceptance criteria were not written in P203.

- In the design document TACpd-1111-71719
    - Terminal numbers were corrected by pencil without signature in p19, 23 etc.
    - Inputted value was modified by pencil without plant person's signature in p114 etc., although contractors note and signature was found.
- Technical Director's final decision dates on modification were not written in the 'technical issue' of TACmod 1632-347, 1666-667,1666-828 and 1632-715.
- In the plant modification process, document department was defined to have a responsibility of reviewing technical specification. However it is drafted by another (responsible) department and discussed in the meeting.

Without strict control of modification activity, modification might not satisfy designed intention.

Suggestion: Plant should consider enhancing that modification activities are implemented in a more rigorous manner.

IAEA Basis: NS-G-2.3:
4.24. A structured change process under an effective system for configuration management should be in place to govern both hardware and software changes, including hardware upgrades and equivalent replacements, prior to the implementation of the change.
7.8. The ability to operate the modified plant safely should be verified through a testing programme which includes checks, measurements and evaluations prior to, during and on completion of the modification.

5.5. FUEL HANDLING

5.5(1) Issue: Fresh fuel storage and handling activities are not always implemented and controlled in a safe and rigorous manner.

- Two out of eight bolts which anchor the fresh fuel container during it was upright state were broken and not used.
- During the fresh fuel is lifting above 20m, persons were staying under it.
- There was no radiation monitoring, when fresh fuel container was opened at the plant,
- Bridges (crane) were parked over the fuel containers in both fresh fuel storage area and clean entrance area (room 174 A2).
- Although container was inspected visually on its damage, inspection on the acceleration or shock (comparing to design limits) during the transportation was not required.
- 'Radioactive II' and 'FISSILE' plates were not removed from fresh fuel container, although it was empty.
- There were no signs of restricting water in the clean entrance area (room 174 A2) .

- Many (more than 20) 'used seal' were found under the container in the fresh fuel storage.
- Some empty containers didn't have seals.
- Many water trace were found on the floor of fresh fuel storage .
- Small (unused) electrical box found on the corner of the fresh fuel storage.
- 'Actions to be taken if fuel drop happened' were specified in the procedures but early notification to the shift supervisor is not described, although it is described in more general document in case of emergency.

Without safe and rigorous implementation or control and handling of fresh fuel, inadvertent events or damage could appear.

Suggestion: Plant should consider enforcing that fresh fuel storage and handling activities are implemented and controlled in a safe and rigorous manner.

IAEA Basis: NS-G-2.5:

3.1. The ultimate safety objectives of a fresh fuel handling programme are to prevent inadvertent criticality and to prevent damage to the nuclear fuel when it is being transported, stored or manipulated.

3.3. Fuel handling procedures should, in particular, underline the need to minimize mechanical stresses, particularly lateral stresses, with emphasis on those cases where small stresses may be harmful to fuel assemblies. The magnitudes and directions of any forces applied to the fuel assemblies and of accelerations shall be maintained within design limits.

3.11. Heavy loads may endanger items important to safety if dropped and should not be moved above stored fuel (in racks, storage canisters or lifting devices). Exemptions should be justified.

3.24. A dry fresh fuel storage area should be clear of any equipment, valves or piping that undergo periodic surveillance by operating personnel.

6. OPERATING EXPERIENCE FEEDBACK

6.1 MANAGEMENT, ORGANIZATION AND FUNCTIONS OF THE OE PROGRAMME

The plant activities related to the Operating Experience Feedback (OEF) are based on in-house and industrial (external) events study with subsequent corrective actions development and implementation to avoid similar events to be happened at Ignalina NPP.

The plant management declares via high level administrative documents its adherence to follow safety culture principles including blame free policy and commitment to support OEF as an effective tool to enhance operational safety; however the statement related to the utilization of OE refers only to plant personnel and doesn't address contractors working on site. The statement does not also contain indication that low-level events and near misses are also the subject of the OEF programme. The team suggests the plant to enhance the Policy statements in this area.

The OEF programme is in place and comprises basic areas of OEF process including reporting, screening, analysis, corrective actions development and implementation and regular assessment of the whole OEF practices; however some activities such as low-level events and near misses handling, analysis, coding and trending of event are not covered in full scope.

A comprehensive set of procedures dedicated to the reportable events handling are developed, implemented and properly used by the plant personnel. Safety related events are to be reported according clearly stated criteria. Non-safety related deficiencies are classified as plant defects and treated via computerised "FOBOS" system. Those events that make no affect on operation and are considered as near misses usually are processed through the departmental "Logs of defects" and actually appeared to be out of OEF.

The OEF activities are widely spread throughout the plant and involve a lot of people from different departments. In order to provide the OEF routine management the plant has established an OEF group to coordinate the in-house and industrial OE data handling throughout the plant. In order to increase the effectiveness and adequacy the OEF system the management centre maintains contacts with different department and services via nominated OE coordinators who are treated the data received from OE screening engineer and participated in the event investigation team activities.

The coordinators are trained in the event analysis technique and periodically coached by experienced investigators while participating in the event analysis process. However no suitably qualified personnel are involved into activities related to human errors events investigation.

6.2. REPORTING OF OPERATING EXPERIENCE.

Following the Plant Encouragement Policy the personnel are committed to report events and usually to inform its direct supervisor.

A set of comprehensive procedures is developed, implemented and strictly used by personnel of different levels to handle the OE information. The reporting criteria are clearly specified and easily used by involved personnel while dealing with the event.

All events are reported via direct manager, reflected in the operating log and delivered to the attention of PSS.

Anyone among INPP employees has an opportunity to communicate to a head of a department and to the top management of the plant, including Director General, his proposals on the work enhancement and safety improvement. Analysis of employees' proposals on the work enhancements and safety improvements is useful tool for the safety management, since it allows finding more problems including potential ones, take preventive measures, involves a broad range of the staff into a discussion and safety problem resolution, and improves a competence of the staff. The team noted this approach as a good practice

6.3. SOURCES OF OPERATING EXPERIENCE

The plant maintains permanent contacts with major institutions to obtain industrial (external) operating experience and follows well-organised in-house practice. This comprises both events and good practices.

The plant responsible OEF engineer uses several external sources to obtain information related to events happened at different plants all over the world. This is primarily WANO MC Web site (on the daily basis), nuclear power plants with RBMK type of rectors and IAEA IRS system (upon receiving reports by mail). The in-house OE information is handled via the same OE engineer by involving a number of OE coordinators that are nominated at each department of the Technical directorate. An effective feedback form system is established to assure that the information is properly treated at the dedicated departments. The information cards with relevant feed back forms are under the control of plant computerised monitoring system "ASKIM".

Besides that centralised way of getting external operating experience the plant department heads or their deputies may obtain lessons (events and good practice) via contacts with particular supplier of equipment or services. As they maintain such contacts practically on the daily basis the data can be exchanged promptly and effectively.

The plant also uses the opportunity to obtain useful information and learn from a number of training courses, technical seminars, workshops and missions. The IAEA training courses, WANO technical support missions, technical exchange visits to other NPP are the examples of such diverse sources. During the mission the counterparts demonstrated some particular achievements that resulted from above mentioned activities.

6.4. SCREENING OF OPERATING EXPERIENCE INFORMATION

Screening of operating experience data is performed at different departments and services according to the nature of the event or a good practice. Industrial operating experience is screened and further processed on the daily basis by the responsible engineer of the plant operating experience group. Information cards with brief description of the event or good practice are compiled via the plant computerizes system and supported with the feedback forms that have to be answered by the addressee. The system traces the information card and feedback form and triggers signals if the deadline for response has been expired.

Regarding reportable events two level of screening is usually performed: initial by PSS while compiling a prompt event report and then by senior manager – Technical director or his deputy. This assures correctness of the events initial assessment, provides independence and eliminates subjectivity.

Department managers or other responsible and qualified representative have to perform screening of the low-level events and near misses in order to identify the importance of the event. In case of high importance of the event the same analysis is required as if it was an event with potential influence on safety. This approach makes additional barrier to prevent significant event and make it possible to learn from low-level events and near misses.

6.5. ANALYSIS

Based on the screening results the necessity of the analysis is identified by the senior management: Technical Director or Department Head of the plant. The relevant order is usually written in the PSS operating log with required details. The ASSET method is extensively used to investigate reportable events. All the operating experience coordinators have received the proper training regarding ASSET methodology application.

According to the plant procedures the full root cause analyses is required in case an event involved safety or safety related systems that is clearly defined by respective criteria to be checked by PSS. In other cases a simplified method of investigation is to be used unless the technical director or department head decided to perform the full scope investigation. Despite of the fact that method is rather new it is used widely. The practice of independent review is to be applied in the area of low-level events.

A team of nominated qualified investigators performs investigation. The team comprises respective managers and an expert from the event owner department. An independent investigator performs verification of the event analyses report in term of direct and root cause to assure the correctness of ASSET methodology application and reviews the corrective actions. This independent review is properly documented, distributed to the investigation team members and properly stored. The traceability of the corrective actions implementation is provided by the "ASKIM" plant computerised system that informs both the owner of corrective action and a person in charge of corrective action implementation control.

The plant does not use a properly educated human factors expert as a member of investigation team so that sometimes the quality of human error events analysis can be treated in an improper manner. The AMTO method that is described in a new plant procedure is considered as an additional tool to support ASSET methodology and contains a specific module that is to be used by an expert qualified in the area of human behaviour. The team suggests the plant to enhance its potential in this area.

6.6 CORRECTIVE ACTIONS

Corrective actions are the major output from the investigation process. The plant promotes the approach that corrective actions are referred to both the direct and root cause of an event to eliminate the consequences of accidents and causes of events and to prevent recurrence of similar events in future. As soon as the report is approved the corrective actions are included into the database and automatically delivered to the respective owner. The status of the corrective action is effectively monitored by the "ASKIM" plant computerized documentation system that allows revealing promptly the progress of implementation.

During the mission the plant demonstrated the positive rate of implemented corrective action in comparison with the planned ones. Steady decrease of the number of events for the recent three years and no recurrence of the similar events indicates that corrective actions that have been developed and implemented have been complete and effective.

The data on the planned and implemented corrective actions are analyzed by the plan operating experience group responsible engineer, represented in the relevant format and regularly delivered to the attention of the plant high-level management.

6.7. USE OF OPERATING EXPERIENCE

The operating experience data are used extensively in the process of control room and other plant personnel training at the training centre. The data, considered to be applicable to plant, are analyzed and incorporated into the training programmes of the relevant personnel. In maintenance service the information on the applicable in-house and external events is introduced to the foremen and workers to focus them on the important aspects: specifics, cautions of the forthcoming job.

However the plant practice does not foresee utilization of the relevant OE data before important plant operating activities via pre-job briefings. Despite of the fact that plant has treated a huge amount of valuable information regarding in house an external OE there are no managerial requirements to establish a practice of delivering the proper just in time data to the attention of the operating personnel involved into the activities important to safety. The screening of the OE related to the particular activity is not performed although both PSS and OE personnel have access to the plant event database as well as to computerized "FOBOS" system. The team suggests to enhance the plant practice related to use of in house and external operating experience.

6.8. DATABASE AND TRENDING

The plant maintains several effective databases to facilitate the operating experience information handling throughout departments and services. The reportable events database allows compiling the investigation report automatically as it contains the electronic templates compatible with the ASSET methodology content form. As soon as the first draft of the report is ready it can be easily retrieved from the system and reviewed by the members of investigation team. Necessary changes can be done to the report at this stage upon agreement of the investigation team members. Final version of the report receives the approved status and becomes accessible to everybody. The system makes no possibility to change the content of the report as soon as the leader of the investigation team approves it.

Low-level events are treated using a quite effective tool called "FOBOS" system that contains detailed information about several thousand defects beginning from very implementation of the software in the year 2001. At the power plant there is a computer "Database on unusual events" that includes all reports of the events (about 1000) reported to the plant and outside (to the regulatory body) for the entire period of its operation starting from 1983. The reports contain description of events and their consequences, direct and root causes, contributing factors and corrective measures.

The software allows retrieving events by many attributes (equipment, department, consequences, causes, etc.). This extends capabilities on improving staff training processes, preparations for the work execution, analysis of the events, which have already been occurred, and self-assessment.

The “FOBOS” computer application is also used to process plant defects that according to operating experience classification can be considered as low-level events. This system makes it possible to trace the defect status from the time it was identified to the final stage. However the plant operating experience practice does not foresee the coding of defects, its distribution to different causal factors and subsequent trending to identify the rate of repetitive events. The team suggests enhancing the plant practice in low-level events handling.

6.9. ASSESSMENT AND INDICATORS OF OPERATING EXPERIENCE

A systematic focused review of the operating experience programme is performed by plant OE responsible person. Monthly report on the events investigation is developed by independent plant engineer with the aim to assess the correctness of ASSES methodology application including decisions on direct and root causes as well as completeness and fulfilment of the corrective actions.

The OE monthly reports are usually delivered to the attention of the plant management and sent to the VATESI for the external independent assessment. This approach maintains a barrier against incorrect operating experience decision-making.

However no performance indicators directly related to the plant operating experience process are established, other that a monthly review (report) on reportable events and annual report on plant nuclear safety status with specific operating experience section that both cannot be considered as comprehensive self-assessment. The plant also has no opportunity to benchmark with other nuclear power plants and utilities with the aim of further improvements, as it has no data on the particular trends with regard to low-level event and near misses.

DETAILED OPERATING EXPERIENCE FINDINGS

6.1. MANAGEMENT OF OPERATING EXPERIENCE FEEDBACK

6.1(1) Issue: The plant policy and practice do not foresee participation of contractor's personnel in the operating experience feedback (OEF) system.

During the review, the team observed the following deficiencies:

- The plant OEF statement (2005.09.30 code PTOed – 0108-7B3) implies no participation of contractors in the OE process, but focuses only on plant personnel.
- The plant reporting procedure (2006.04.14 code PTOed – 0312-8B5) contains no indication of Contractors involvements into the events reporting process.
- The plant practice of having OE coordinator at the departments and shops does not foresee the same coordinator position at the Contractor organization.
- No formal way of interrelations is established and implemented to provide the Contractor with the opportunity of having the plant OE data and reporting low-level events and near misses.

Without having formally documented and established way of involving the contractor into the OEF process the plant looses the opportunity to share and obtain a large amount of valuable OE data to improve operational safety.

Suggestion: Consideration should be given to enhance the plant Operating Experience Feedback system by involving the contractors into utilization of the plant OE data.

IAEA Basis: NS-G-2.4
4.6 The operating organization should ensure that contractor and temporary personnel who perform activities on safety related structures, systems and components are qualified to perform their assigned tasks.

Note: TECDOC 1477: Low-level events and near misses.
Low-level events and near misses, which may reach several thousand per reactor operating year, need to be treated by the organizations as learning opportunities. A system for capturing these low-level events and near misses truly needs to be an organization-wide system in which all levels of the organization, including contractors, participate.

6.2. REPORTING OF OPERATING EXPERIENCE

6.2(a) Good practice: Anyone among INPP employees has an opportunity to communicate to a head of a department and to the top management of the plant, including Director General, his proposals on the work enhancement and safety improvement. This approach in fact provides the two level reporting systems to be used by the plant personnel. First is at the departmental level and the second, at the director general level in case of ineffective response.

That is provided by:

- Availability in each department a "Logbook of proposals on improvement", where employees describe the problems to be occurring and proposals on their resolution. The inserted proposals are considered by the leadership of a department, which makes a decision on implementation of a proposal.
- A formally accepted procedure of sending proposals to the Director General in a form of a special letter namely "A proposal on improvements", who then decide on implementation of a proposal. Director General considers all proposals, including anonymous ones.
- In all cases an employee, who has sent a proposal (except for anonymous one), is advised about a decision made by the management on implementation of a proposal or justified rejection.
- Number of the "Proposals on improvements" forwarded to the Director General is accounted in the existing system of the "Safety Culture" indicators.

Analysis of employees' proposals on the work enhancements and safety improvements is useful tool for the safety management, since it allows finding more problems including potential ones, take preventive measures, involves a broad range of the staff into a discussion and safety problem resolution, and improves a competence of the staff.

6.5. ANALYSIS

6.5(1) Issue: The plant event analysis practice related to the human performance deficiencies may not always assure the adequacy and correctness of identified causes as result of investigation process because the suitably qualified expert in human factor analysis is not involved.

During the review, the team observed the following deficiencies:

- The plant declared 13 human factor related events for the three recent years that aggregate 42 % of the total amount.
- The plant events investigation team comprises technical and OE personnel and involve no suitably qualified expert in the of human factor analysis.
- The newly implemented (2006.06.07) method of analyzing events related to human performance deficiencies anticipates the human factor specialist to take part in the event investigation by following the corresponding specific section of the document.

Without having properly educated human factors expert as a member of investigation team the analysis of human error events in respect of direct or root causes can be treated in an improper manner.

Suggestion: The plant should consider improving the adequacy and correctness of identifying causes and results of event investigation process by involving the suitably qualified specialists in the area of human factor into the investigation team.

IAEA Basis: NS-G-2.4
6.67 The responsibilities, qualification criteria and training requirements of personnel performing activities to review operating experience should be clearly defined. Personnel who conduct investigations of abnormal events should be provided with training in investigative root cause analysis techniques such as ... human factor analysis (including organizational factors)...

6.7. USE OF OPERATING EXPERIENCE

6.7(1) Issue: The plant practice does not always foresee utilization of the relevant OE data upon performing major plant operating activities important to safety via pre-job briefings.

During the review, the team observed the following deficiencies:

- In maintenance activities OE is used in pre-job briefing, however, this is not the practice in operations activities.
- Neither plant OEF personnel nor plant shift supervisor (PSS) perform screening of available OE data through the plant database to deliver it to the attention of operating personnel just before starting safety related operating activities.
- The "Operations Policy" (PTOed-0108-2B2) does specify the orientation on the use of best international practice (t.4) and operator experience (t.13) during operating activities, however the OE part does not envisaged in the working packages for the safety related operating tests or examinations and actually is not a subject of pre-job briefings.

Without having strong adherence to using the OE data during major safety related operating activities via pre-job briefing the valuable information dedicated to the particular actions may not be taken into account and in so doing may cause incorrect or inappropriate operator actions.

Suggestion: Consideration should be given to enhance the plant operating practice by utilization of the relevant OE data while performing major operating activities via pre-job briefings.

Basis: 50-C (Code on QA)
305. Supervisors should recognize and encourage good work practices by promoting the following:
— Proper use of pre-job briefings

6.8. DATABASE AND TRENDING OF OPERATING EXPERIENCE

6.8(1) Issue: The plant does not fully use the opportunity to learn from in house low-level events and near misses by using coding and trending methods to improve its safety.

During the review, the team observed the following deficiencies:

- Having several thousand events related to low-level events and near misses the plant has not established and introduced an appropriate coding system to distribute events according different causal factors.

- The plant does not perform low-level events and near misses trending related to different established causal factors to investigate the root causes of repetitive events.

Without introducing the system of coding and trending of low-level events and near misses the plant does not take additional opportunity to learn from in house operating experience to improve operational safety.

Suggestion: The plant should consider enhancing the operating experience feedback practice in respect of using coding and trending of low-level events and near misses to take the opportunity to learn from in house operating experience for the operational safety purposes.

IAEA Basis: NS-G-2.4:
6.66 Operating experience should be carefully examined by designated competent persons to detect any precursor signs of possible tendencies adverse to safety, so that corrective action can be taken before serious conditions arise. Trending should identify recurring similar events and continued problems based on the causes and initiators of previous events. Event trend reviews and conclusive interpretations should be provided periodically to the plant manager and to the management of the operating organization.

INSAG-15
3.4. A Reporting culture
Failures and 'near misses' are considered by organizations with good safety cultures as lessons, which can be used to avoid more serious events. There is thus a strong drive to ensure that all events which have the potential to be instructive are reported and investigated to discover the root causes, and that timely feedback is given on the findings and remedial actions, both to the work groups involved and to others in the organization or industry who might experience the same problem. This 'horizontal' communication is particularly important. Near misses are also very important because they usually present a greater variety and volume of information for learning.

7. RADIATION PROTECTION

7.1 ORGANIZATION AND FUNCTIONS

The Industrial Safety and Radiation Protection Department (ISRPD) integrates all kinds of "safety activities" e.g. industrial safety, radiation protection and environmental protection in one organization unit. This department is directly reports to the Technical director. ISRPD has a veto right on all radiation safety assessments, the Head of department supervises and signs all related documents.
The INPP follows the IAEA and ICRP recommendations. The basic legislative document regulating to radiation protection is the Lithuanian Hygiene Standard HN 87:2002 "Radiation Protection in Nuclear Facilities" issued by the Ministry of Health. Strategy of the Plant is declared in document "Policy of the IAES in Safety and QA area" QA-1-003 rev.3.

The second level documents regulating Radiation Protection (RP) and Environmental Protection are QA-2-005 rev.4 Radiation protection and QA-2-004 rev.3 Environmental Protection.

Responsibilities and authorities linked to particular working places are clearly defined in description of working duties. Responsibilities of radiation protection are incorporated in the description of working duties of all working places.

The ISRPD department comprises 138 persons, 85 of who represent RP operational and operational support staff. All staff has an appropriate level qualification and extensive experience. There are 50 specialists graduated from universities. Some members of RP staff are being re-qualified for new activities linked with final shutdown and decommissioning of the Ignalina NPP.

The ALARA principles and processes are well defined in series of the NPP documents. The plant has a set of indicators that shows individual and collective doses. These indicators are effectively used for evaluation of the RP processes and for benchmarking with other NPPs. Indicators are periodically reviewed at bi-weekly meetings with Technical Director.

Radiological events are reported to ISRPD department and to the Radiation Protection Center in Vilnius and VATESI. Events are investigated and evaluated according existing procedures.

RP department is involved in preparation of RP documentation /Instruction, Programme, Guidance/ regulating RP area. Overall resources dedicated to RP programme are adequate.

Basic entrance and refresher trainings in RP area are provided with period of 5 years. They consist of 30 hours training dedicated to workers and 60 hours to personnel responsible for RP. The RP personnel pass through the refreshing training at least twice a year.

Obligatory medical surveillance is performed before entrance to working process and periodically with a period of 1 year. There is no legislative requirement to provide medical test in case of exit from working process. The team encouraged to perform additional medical tests before use of respiratory devices.

Internal audits are performed once a year by Quality Assurance department and 4 times a year by the Radiation Protection Center of the Lithuanian Republic (RPC).

Doses are planned on the basis of normative calculated for specific types of work and technological equipments. Radiation doses are planned in advance for one-year period. The Plant accepted progressive approach to the individual groups doses planning. Instead of imposing general limit, selective assessment of radiation risk is used, planned annual individual doses for particular working groups differs from 2 mSv to 20 mSv.

Only qualified contractors having license issued by RPC are authorized to work at the plant in the controlled area. Before issuing license the contractor staff have to pass through RP training course. RP staff are responsible for supervision and preparation of training materials.

Robust package of well-prepared documents of different levels is available in electronic version from the NPP network (programme ARKI), printed version is distributed over working places. Documents are periodically reviewed and list of valid documents is annually approved by the General Director.

7.2 RADIATION WORK CONTROL

Radiation work permission (RPW) is closely linked with work permission (WP). Work is planned well in advance. Any activity that could results in a radiation exposure exceeding the personal control level for a day (0,2 mSv) is subject to approval using RWP.

Efficient pre-job briefing is provided to head of working group (WG). Head of WG bears the main responsibility for WG staff information. RWP contains all necessary information for workers protection. The briefing is provided before beginning of the work, workers obtain operative dosimeters and sign the RWP.

Radiation working permissions are issued only in printed form. There is still not available link between RWP issuing and FOBOS programme used for planning and execution of maintenance activities.

Radiation conditions in the radiation controlled area periodically surveyed. Records are logged and a computerized database is available for following the trends.

The surface contamination of workers before leaving the controlled area is checked and if the thresholds are exceeded, the events are reported, recorded and investigated. Monitors are available also at different places within controlled area (CA), but the team did not observe monitors installed next to toilets.

Entry points at the boundary of the CA have an adequate physical layout in order to ensure radiation protection requirements. All site and process premises of the plant are divided into controlled area and supervised area depending on the degree of radiation hazard. Entrances into controlled area are properly signed in the passage between the locker room and the changing area. Buildings and structures that are outside the controlled area as well as the territory of the INPP site belong to the supervised area.

The rooms of controlled area are clearly identified with signs "ZONING". The plant uses well-developed colour code philosophy to classify different areas within the controlled area. Green, yellow and red sign are used to represent dose rate, contamination or presence of aerosols. When necessary, combination of codes are used. The associated values for these areas also identify the control arrangements operated by the Plant, such as which areas must normally be kept locked.

There is a high number (16) of accesses to the controlled area. The physical layout of accesses was observed to be functional, but the capacity of measuring equipments situated in changing rooms at several places seems to be limiting factor during busy time. Decontamination department staff are available, should anyone need assistance.

Adequate numbers of manual and automatic personnel contamination monitors were observed. Prevailing part of manual and automatic personnel contamination monitors (except PPM-1 monitors) is older than 20 years and its physical lifetime has almost expired. It will be necessarily to focus considerable effort to replacement of RP equipment in a near future. The OSART team members have observed little RP equipment out of operation.

Storage of contaminated tools and equipments is adequate and effectively prevents spreading of contamination. Leaks in controlled area are kept under control, significant problems were not observed.

Internal contamination of each person entering controlled area is monitored annually. Additional monitoring is provided to people involved in higher radiation risk. Individual doses arising from internal contamination are kept very low, highest dose arising from internal contamination was estimated as 0.38 mSv in 2005.

Doses arising from external, internal exposures and operational monitoring are analyzed on daily basis, results are compared with planned values, corrective actions are taken immediately.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

ALARA principles have been applied and adapted at all process stages related to radiation exposure since 1997. Usage of new principles for managing, taking large-scale activities on equipment modernization, have allowed reducing collective dose of INPP and Contractors' staff from 18500 man mSv (1997) down to 2470 man mSv (2005). Collective dose during normal operation equals 12-20%, during maintenances – 80-88% of the annual collective dose.

High radiations doses are a limiting factor for execution of specific RBMK maintenance works. Thorough analyses and efficient application of ALARA have resulted in sets of "Projects of works performance". This complex programmes are well done and helps to execute very high dose (up to 150 mSv/h) and personal demanding tasks.

The INPP together with VNIPIET and NIKIET have developed non-reagent decontamination process of primary circuit. This methodology is based on the change of behavior of radiolysis products during cooling down. The team recognized this project as a good practice.

Individual monitoring of external exposure of personnel is performed with RADOS thermo-luminescent dosimeters (TLD) (legal dosimeter). Each worker entering the CA must wear the TLD dosimeter, where necessary neutron dosimeters are used. Members of fire brigade and safety guard must also wear TLD. Approximately 90% of operative personnel doses are monitored with electronic dosimeters RAD 51,52, 62, 80 during outage and approximately 60% during normal operation.

Once a month the TLDs is evaluated for a majority of the staff (except fire brigade and safety guard), remaining part of TLDs is evaluated in a 3 month period.

No extremity dosimeters are used. Exposure of extremities is eliminated by administrative regulation. Contact works on surfaces with dose rate >0,1mSv are not permitted. Evaluation of individual dose equivalents and effective doses is preformed by the NPP staff .

The individual exposure limits and control levels are set in accordance with IAEA BSS 115.

Automatic system of personnel monitoring processes data resulting from personnel monitoring. This programme effectively serves for personnel doses evaluation and dose planning. This programme also comprises of individual radiation doses history of all employees involved in radiation works at INPP.

Although INPP has well-established ALARA programme in several cases violation of dose rate limit valid for zone II and zone III were observed by the team members.

The team recommends that the INPP should improve postings, labeling, and special provisions in accordance with ALARA

Data resulting from RP activities are recorded in different forms electronic, printed and hand written. There is still not available centralized system of RP data recording and storage. A considerable improvement of RP records management is in progress. New information system for radiation safety monitoring “SAMRB” installed recently in the RP control room represents a high standard and provides a broad scale of possibilities for visualization, evaluation and analysis of radiological data. Record storage is managed in accordance with NPP regulations.

Individual monitoring of internal exposure of the staff is performed by gamma-spectrometry measurement system whole body counting (WBC) “ACCUSCAN”. Monitoring of internal exposure of the staff is conducted according to the “Monitoring Schedule on Provision of INPP Radiation Protection". No bioassay technique is available so far.

The programme provided by the research institute VNIIFTRI Moscow in the year 2004 and approved by Centre of Radiation Protection of Republic Lithuania calculates dose from internal contamination.

Average individual effective dose estimated for INPP staff in the year (2005) was as 0.41 mSv, maximal individual dose was estimated as 13.55 mSv. Doses from releases and discharges to the environment estimated for the critical group of population in 2005 were estimated as 2.09 μSv.

The team has observed signs of eating, smoking in controlled area, personnel was passing by contamination monitors without checking small personal items. Insufficient practices for excluding personal contamination may lead to increased individual effective doses and spreading of contamination. The team has made recommendation regarding observed situation. The INPP should improve practices for excluding and monitoring personal contamination.

7.4 RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

Due to specific features of the RBMK reactor control area (16 monitored exits) and a huge number of personnel (2800) entering control area every day, a specific arrangement of personal body contamination monitoring has been accepted. Personnel comes through portal monitors PPM (equipped with 4 scintillation detectors), exits from washrooms are monitored by WBM Rados 860 and PMW3 monitors. Effectiveness of personnel portal monitors was tested with use of gamma sources with different activities and it was proved that lower and upper parts of portal personal monitor (PPM) do not effectively monitor detection area. The team has made a recommendation this area.

Periodical calibration of the radiation monitoring instrumentation is conducted according to the State calibration techniques, methodical directives, and calibration methods with reference sources of ionizing radiation. No expired calibrations of RP equipment were observed.

Calibration of thermo-luminescent dosimetry system RADOS and gamma-spectrometry system WBC ACCUSCAN is conducted by Mendeleyev Center of Standardization, Metrology and Certification (Russia) once per year.

Sensitivity of TLD reader is determined every other day. Dosimeters are irradiated by source 90Sr – 90Y, nominal activity 37 MBq.

Adequate inventory of personnel protective clothing and respiratory devices is available. Detailed categorization of radiation work and instruction how to assign specific types of personnel protective devices has been developed and it is followed. Several types of approved respirators including full masks are available, but no periodic testing of respiratory protection devices are required and performed.

Protective Clothing (PC), boots and towels are washed in a special laundry unit. Capacity of unit is sufficient to annually wash approx 200 tons of PCs. Considerable improvement was noticed in PC surface contamination monitoring, a new automatic monitoring system is already installed and pre-operation tests are in progress, 3 new automatic washing machines have been added recently.

The plant has established a broad shielding programme, there are several types shielding that are available. The rules for labeling and posting are incorporated in RP procedures but the Team in several places observed deficiencies in its utilization.

Radioactive waste, contaminated materials, equipment and tools are temporarily stored at approved places. Appropriate decontamination facilities are using chemical, electrochemical methods and high-pressure water were observed in the reactor building and maintenance workshop.

7.5 RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

The plant currently has no repository capabilities for disposal of radioactive waste. Essentially the plant has been trying to manage its waste arising, processing and storage arrangements in facilities that are not designed for long term storage.

Radioactive waste management is regulated by the procedure “radioactive waste, housekeping”QA-2-013.

VATESI has issued new classification of radioactive waste VD-RA-01/2001 harmonized with international standards, nevertheless original classification into groups I, II, III based on dose rate measurements is still accepted. Clearance criteria and adequate measuring equipment are available and meets international standards.

Volume of radioactive waste production is planned in the framework INPP annual work schedule and it follows scope of planned maintenance activities. It is revised on monthly planning basis.

Production of radioactive waste has a decreasing trend during last decade but it is still high (approx. 500m3 of solid waste a year). There is potential for further improvement.

Considerable progress in waste processing technologies was observed. Free release facility, cementation unit and new interim storage have high a standard and play an important role in further improvement of radioactive waste management.

Solid waste is collected into plastic bags in the place of its origin and transported to the collection areas. Segregation of potentially clean waste in situ has still not been accepted. After dose rate checking the waste is kept in the safe metallic container.

The staff of Decontamination Shop operates storages of the solid radioactive waste and industrial waste storage site. Unloading of the solid radioactive waste from the containers into the cells of the storages is performed after measurement of its radionuclide composition by ISOCS equipment.

Radioactive waste of different activity groups, combustible, incombustible and compacted radioactive waste is stored in different cells of the storage. Storing of spent radioactive sources is done in a separate cell. Sources are stored in containers separately according to the types of radiation.

Liquid waste is evaporated and consequently processed by bituminization unit. Continuous record keeping of the volumes, mass, nuclide content and total activity of the solid radioactive waste is provided by the staff of Decontamination Shop.

Characterization and processing of radioactive waste accumulated during INPP operation period is a subject of ongoing international projects with the aim of retrieval and ultimate treatment in accordance with the international standard.

According to the normative documents of Lithuania, annual average exposure dose of critical group, resulting from normal operation of a nuclear power installation, shall not exceed 0,1 mSv/year due to gas-aerosol releases into atmosphere and 0,1 mSv/year owing to ingress of radionuclides into the heat sink.

Environment monitoring programme meets requirements of the Resolution LAND 42-2001 issued by the Lithuanian Ministry of Environment. It comprises automatic system of radiation monitoring stationary monitors ASRM, laboratory equipment for sampling, preparation and measurement of specific activity of samples and continuous monitoring of releases of radioactive substances into atmosphere through the ventilation stacks.

Monitoring of buildings 101/2 and 150 is performed by the radiometric installations RKS-07. All data arising from continuous monitoring systems are collected in the Radiation protection control room. This system represents high standard and provides a broad scope of possibilities for visualization, evaluation and analysis of radiological data. At actuation of a warning or emergency set point, an audible and light warning or emergency signals are activated in RMC (radiation monitoring centre). Automatic cutoff of a release into atmosphere at actuation of emergency alarm is not provided for. Data on volumetric activities of gas-aerosol releases are displayed in RMC.

Laboratory monitoring is based on data from stationary and portable sampling equipment as well as on stationary radiometric and spectrometric equipment. Considerable improvement in gaseous discharges monitoring was accepted on the basis of the EU experts recommendation. New tritium and 14C monitors are prepared for installation to ventilation stacks.

Annual collective doses to critical group of population arising from releases to the environment are estimated according to requirements of the Resolution LAND 42-2001. They are kept well under authorized limits and represents only fractions of authorized limits 0.1mSv, gaseous 1.09μSv, liquid 0.96 μSv. The team has observed considerable increase of I131 discharges since 2004 resulting from fuel leakages at Unit 2.

Dose rate resulting from gas-aerosol releases is monitored on INPP site and supervised area with the system of continuous gamma-monitoring of dose rate "SkyLink".

The plant submits monthly to the Ministry of Environment, VATESI, Ministry of Economy, Radiation Protection Center, etc. reports on releases and discharges of radioactive substances into environment. By the end of an accounting period is also submitted "Report on the results of radiation monitoring in the INPP region" to the supervisory bodies. In the event of a daily release exceeding 1% of the limit of annual release of radioactive substances into environment, INPP shall inform Ministry of Environment, explaining causes of releases increase and measures taken to reduce amount of releases into environment.

7.6. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

Emergency Preparedness Plan has been developed at INPP. In the Emergency Preparedness Plan the following classification of emergency situations is assumed: Announcement for preparedness, Local incident and Overall incident. Levels of emergency exposure of the staff and public are regulated by the Basic rules on radiation protection. HN 73:2001.

In the event of radiation accident, ERO, which involves RP staff as well, is established at INPP. As a chief of radiation and chemical protection service, head of RP Department is appointed.

Emergency centre is well equipped with ventilation systems, back up power supplies and communication means.

Adequate procedures, protective and monitoring equipments were found in place. Nevertheless expired protective mask filters were observed. Position of personnel contamination monitor does not prevent cross contamination.

System of RP staff mobilization during emergency is rather complicated. Clear rules concerning fitness to drive the car of mobile monitoring group are not defined.

Programme for evaluation and prediction of radiation situation Nostrodamus meets international standards. Meteorological information, on site and of site dosimetric information are available from Skylink teledosimetry system and from central radiation protection control room (SAMRB). Gamma spectrometric systems are available. NPP staff are periodically trained and passes trough EPP training once every 2 months.

DETAILED RADIATION PROTECTION FINDINGS

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

7.3(1) **Issue:** Barriers, postings and labeling for hot spots do not meet ALARA principles

- Though the NPP has well-established radiation monitoring programme number of hot spots without proper labeling and posting were observed by the OSART team members.
- There were recorded violations of dose rate limit valid for zone III (12 μGy/h) in room 143 - container 24 μGy/h, exit from maintenance workshop 45 μGy/h and for zone II (56 μGy/h) in room 217B/2 -hot spot 180 μGy/h, room 086/2 -hot spot 60μGy/h .
- Several technological equipments were observed labeled at reactor hall, radiation situation was not posted.
- Gas sampling stand at turbine hall with temporary shielding was labeled but no barrier installed. Hand written value of dose rate was not legible – when measured dose rate 150 μGy/h was found.

Lack of barriers, postings and labeling for hot spots in working area contributes to increased external exposures of the INPP staff.

Recommendation: The NPP should improve barriers, postings, labeling, and special provisions for hot spot in accordance with ALARA principles.

IAEA Basis: NS-G-2.7; 3.8, 3.43, 3.44

3.8. Warning symbols such as those recommended by the International Organization for Standardization (ISO) and appropriate information (such as radiation levels or contamination levels, the category of the zone, entry procedures or restrictions on access time, emergency procedures and contacts in an emergency) are required to be displayed at access points to controlled areas and specified zones and at other appropriate locations within the controlled area. Persons crossing a zone boundary should be made aware immediately that they have entered another zone in which dose rates or contamination levels, and thus the working conditions, are different.

3.43. Preparation of the work area may be necessary, for example by: cordoning it off and posting warning signs; laying down temporary coverings to retain contamination; and providing local changing areas for protective clothing, solid waste bins, additional radiation monitors, temporary radiation shielding or ventilation.

3.44. For tasks necessitating radiological precautions, a radiation work permit (RWP) should normally be prepared. Information and instructions that may be given in the RWP in addition to a description of the work would include for instance:

(a) details of average dose rates and possible areas of elevated activity in the working area on the basis of a survey made prior to the work or otherwise estimated;

7.3(2) **Issue:** In controlled area personnel do not strictly follow the established procedures and rules on excluding and monitoring personal contamination.

- Signs of eating (candy wrapping paper on piping, chewing gum wrapping in room 07 117/2), cigarette butts on floor were observed by OSART team at several places.
- Missing contamination monitor at Central Electric Control Room, not properly worn dosimeters, introduction of personal items to controlled area indicate that NPP personnel do not fully comply with basic RP regulations.
- The team has observed that personnel do not effectively use WBM Rados 860 and SZB-04 monitors for contamination check of small personal items, personnel passes through non monitored exits from zone II to III.
- SZB-04 monitors were found by the OSART team members out of operation in the area before changing room on 3-rd floor and at the exit from the spent fuel storage pools area.

Insufficient practices for excluding personal contamination may lead to increased individual effective doses and spreading of contamination.

Recommendation: The plant should reinforce, in controlled area, the personnel adherence to the established procedures and rules to improve practices for excluding and monitoring personal contamination.

IAEA Basis: RS-G-1-1: 2.36 & 2.38
2.36. Workers can by their own actions contribute to the protection and safety of themselves and others at work. The BSS (Ref. [2], para. I.10) specify that:
"Workers shall:
(a) follow any applicable rules and procedures for protection and safety specified by the employer, registrant or licensee;
(b) use properly the monitoring devices and the protective equipment and clothing provided;
(e) abstain from any willful action that could put themselves or others in situations that contravene the requirements of the Standards;

2.38. As it bears the prime responsibility for workers' protection, management "shall facilitate compliance by workers with the requirements of the Standards" (Ref. [2], para. I.9).

NS-G-2.7: 3.13:
3.13. Before items are removed from any contamination zone, and in any case before they are removed from controlled areas, they are required to be monitored as appropriate (Ref. [2], para. I.23) and suitable measures should be taken to avoid undue radiation hazards.

7.3(a) Good practice: Non-reagent decontamination of primary circuit

Reactor RBMK–1500 has a number of peculiarities:

- large number of channels
- branched pipeline network
- special thermal treatment of fuel channels from Zr-Nb alloy which provides certain limitation to the acid application for decontamination

- condensate-feed circuit operates in a neutral oxygen mode (200ppb O_2)

The INPP together with VNIPIET and NIKIET has developed non-reagent decontamination process of primary circuit. This methodology is based on the change of behaviour of radiolysis products (H_2 , H_2O_2 , O_2) during cooling down.

Process consists of the following stages:

1. Cooling down of primary circuit after shutdown till 180^{0}C with running MCP and by-pass purification system of primary circuit. Concentration of corrosion products in the water during this period is not very high.

2. Circulation cleaning of primary circuit in order to remove corrosion products which have appeared during cooling down. At this stage the iron corrosion products appear within the temperature range 150-110^{0}C

3. Boiling mode of primary circuit at the temperature 95-100^{0}C during 11 –1 6hours, Cooling Down Pumps are used and by-pass purification system of primary circuit is in operation. Concentration of corrosion products increases 2-4 ppm.

4. Main Circulation Pumps are switched on in order to remove corrosion products from the surface to water during this previous stage

5. Corrosion products are removed from stagnated zones by means of water speed acceleration

6. Flushing of equalizing pipelines between separator drums

7. Flushing of drain pipes from the main pipelines.

Gamma-sensor installed at the inlet pipe to the by-pass purification system of primary circuit provides monitoring of efficiency of different flushing stages. These sensor indications are displayed by the computer of local information system. On the basis of sensor readings the corrections of each stage are performed.

As a result of annual flushing the stable gamma level is maintained. During flushing the corrosion products in amount from 20 to 70 kg with activity from 70 to 200 TBq are removed.

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

7.4(1) Issue: Personnel contamination monitoring process with application of the personnel portal monitors (PPM-1) is not effective enough to fulfill requirements of the NPP monitoring programme.

- Due to the fact that 16 monitors are installed in the RBMK reactor radiation controlled area and due to the huge number of personnel (2800) entering radiation controlled area every day, a specific arrangement of personnel body contamination monitoring has been accepted. Personnel goes (but do not stop) through portal monitors PPM-1 equipped with 4 scintillation detectors, Only in the washrooms personnel could be monitored by WBM Rados 860 or PMW–3E.

- PPM-1 monitors are designed for detection of personnel surface contamination 0,4 Bq/cm^2 distributed over whole body. Their lower detection limit was estimated as approx. 3000 Bq. They are not able to detect localized contaminated areas (several 100 cm^2) with activity higher than 0, 4 Bq/cm^2.
- Several PPM-1 located in different areas were tested when passing through with gamma sources of total activity 4-7 kBq. It was proved that lower and upper part of PPM-1 (height of each approx. 10 cm) is not effectively monitored.

Low effectiveness personnel body monitoring performed by PPM-1 monitors represents potential hazard of external and internal exposures and spreading contamination from the radiation controlled area.

Recommendation: The plant should improve effectiveness of personnel body contamination monitoring performed by personnel portal monitors in accordance with the NPP monitoring programme.

IAEA Basis: RS-G-1-1; 5.23:
"Registrants and licensees shall:
(g) provide, as appropriate, at exits from controlled areas:
(i) equipment for monitoring for contamination of skin and clothing;
(ii) equipment for monitoring for contamination of any object or substance being removed from the area;

NS-G-2-7: 3.12
Equipment is required to be provided, as appropriate, for the monitoring of persons at exits from controlled areas in order to ensure that contamination levels on their clothing and body surfaces are below a specified level.

8. CHEMISTRY

8.1 ORGANIZATION AND FUNCTIONS

The document "Management of Chemistry" is developed at INPP. It describes the activity for safe support and operation reliability of main plant systems relating to the coolant chemistry control; exclusion of hazard materials; and responsibility of the Technical Director and Chiefs of plant's department.

The staff is well informed about the plant policy. The document "Objectives and tasks of Chemistry Department" is revised every year. This document describes the entire activity of the Chemistry Department related to operation, monitoring, maintenance and WANO performance indicator.

The Chemistry Department is responsible for chemical control of primary circuit, condensate polishing system, gas and oil, monitoring activities; radioactive waste management and operation activities for different systems such as:

- Make up water plant,
- Condensate polishing system
- Special low salted water chemical purification system,
- Radioactive waste treatment system,
- Storage of chemicals,
- Primary circuit bypass purification.

Radiation Protection and Industrial Safety Department is responsible for primary coolant and other media radioactivity control. Environmental laboratory is responsible for radiochemical control of environment. The Nuclear Safety Department is responsible for fuel leakages control. The Metal Control Division is responsible for corrosion-erosion control.

There are 234 employees working in chemistry department. The department is subdivided into the five main following divisions: -

- Make-up water plant,
- Radiochemical laboratory,
- Special water treatment group,
- Liquid waste treatment group
- Maintenance group.

The laboratories consist of two groups, water and gas & oil. The water group is responsible for control all plant water and chemical control of deposit. The gas & oil group is responsible for gas control of gas circuit, hydrogen control, turbine, transformers and diesel generators oil control.

The Chemistry Department is staffed with well-qualified personnel, capable of performing their roles and responsibilities in a safe manner.

The Chemistry Department interfaces well with a number of different departments including Regulations on Technical Directorate, Regulations on Chemical Department, Management of Chemistry and Job Descriptions. The responsibilities for the chemistry department staff are stated in their job descriptions.

The Chemistry Department is consulted on all matters related to chemical control, hazardous substances appliance, plant modifications and instructions on operation which could have consequence on chemistry. The chemistry department advice on the technical support related to chemistry.

Each day the head of the Chemistry Department and the deputy head take part in a number of different meetings to address any operational and maintenance chemistry topics. The meetings of the department management staff are held weekly, where equipment operation, chemical control results, documentation state and implementation of activities are discussed.

All chemistry personnel have to perform periodic walk-dawns in their designated work areas. A walkdown schedule is closely applied.

The results of the chemical control are submitted in a timely manner to the Plant Shift Supervisor. These results are presented in a hard copy and electronically forms. Almost all safety related data are available on the plant intranet. In case of deviations, the results are provided immediately to the relevant operating personnel and to the managers of chemistry, in order to decide and implement the corrective actions as soon as possible.

Engineers of the Chemistry Department have special chemistry education and sufficient initial training, skills and knowledge. The responsibility for the personnel training is defined clearly by the job description which is archived in the Training Center and in the chemistry Department.

Chemistry Department personnel have initial and continuous training and exercises. A systematic approach to training (SAT) is applied. However the OSART team considers the continuing training and the on-the-job practical laboratory skills as insufficient. The team has made a suggestion in this area.

8.2 CHEMISTRY CONTROL IN PLANT SYSTEMS

INPP is a one-circuit design plant with boiling reactor and neutral water chemistry. Chemistry control of primary, feed water, emergency reactor core cooling systems and gas control are performed accordingly to the technical specifications for safety operation of the Unit 2.

The amount and the periodicity of chemistry controls meet the requirements of the standards. The operational instructions ("Scope of chemical control at INPP") mentioned that chemistry indicators should be regularly monitored, sampling points should be maintain in safe order and chemistry staff has responsibility to respect all limit values of each chemistry performance indicator. The operational technical specifications and other operational documents set out the levels and control of chemistry parameters and pre-determined operational actions. The relationship between chemistry staff and operational staff is maintained at a good level.

In the last 5 years no deviations on chemical indicators on the safety related systems were observed:

- Electrical conductivity of primary circuit is at the level of 0.1 – 0.2 μSm/cm, which is within acceptable limit.
- Fe and Cu concentration in feed water is higher than normally observed in the international practice (4-7 ppb and 2 ppb), but it remains within the limits of the plant technical specification requirements.

Chemistry control is performed using automatic (on-line) and laboratory instrumentations. On-line instruments are used for water chemistry control to determine trends of chemistry performance. To enhance the reliability of the chemistry results, and improve the quality the control chemistry data of on-line devices are periodically compared to data obtained by manual analysis.

Sludge at the internal surfaces of the main equipment is sampled and analyzed in a special laboratory using atomic absorption detector analyst.

The periodicity of the chloride control in the primary circuit is not conforming to the requirements due to the fact that the automatic device is not electronically connected to the network data system. Shift supervisor or chemistry staff could not access to data by intranet. This value has to be sent from chemistry department to operations by oral system.

To ensure the control of organic carbon, special new equipment is under commissionning. Artesian water is used to produce demineralized water. Such artesian water contains almost no organic compounds.

Both instructions "Programme of corrosion-erosion monitoring of INPP equipment and pipelines metal" and "Instruction on INPP equipment condition from the chemistry point" were developed as follow-up activities after the previous OSART Mission recommendations. These instructions were issued to evaluate the chemistry regime influence to the erosion-corrosion process. The control of reference specimen, including the pre-stressed samples, did not reveal any noticeable deviations.

Corrosion product level in primary circuit is lower in INPP reactor compared to a similar type RBMK-1000 reactor. By consequence, the dose rate is less important at INPP compare to other VVER-1000 units. Corrosion damages due to chemistry regime are not detected.

Since 2003 it has been a remarkable increase in fuel leakage caused by fuel defect unique to Unit 2. Studies results have shown that when "erbium" fuel is used the reliability the fuel leakage decrease by a factor equal to 10. The analysis of water chemistry of primary circuit at Units 1-2 has not revealed any differences in chemistry regimes.

Between 2001 to 2005, 21 leak fuel assemblies (FA) were detected in Unit 1 and 71 leaky FAs in Unit 2. The cause was determined to be a deposit of zirconium oxide particles on the surface of fuel elements. The difference in the performance of fuel between the units is caused by the different factor such as treatments of the fuel channels. Nuclear Safety Department controls the quantity of deposits on the surfaces of the spent fuel assemblies (SFA) unloaded from the reactor. A programme on the reduction of the quantity of the leaking fuel assemblies in Unit 2 reactor was launched in 2004. It was developed on the basis of WANO recommendations. This programme includes the requirement to send 4 SFA (2 of leaking fuel elements) to the post reactor investigations; to perform SFA back-flushing in fuel channels during outages. This programme is not completely performed.

I-131 concentration limit in primary circuit is established when refueling defective assemblies. At the present time I-131 is 10 times higher than normal due to leaking FAs.

For the moment leaking FAs could not be stored in the fuel dry storage facility.

Desaerated start-ups has been performed at INPP since 1998. This process is described in details in the Procedure of Unit 2 start-up. on the objective is to minimize oxygen concentration in the primary circuit and it was considered by OSART team as a good practice.

The consumption of hazardous chemicals has been decreased many times since 1992 in the Chemical Department: Sulphuric acid by 2.5 times, NaOH by 3.5 times, HNO3 by– 4 times. This is mainly due to the modification of the design of the filter and application of new technologies in the primary and secondary circuits.

Powdex process on the cartridge filter primary coolant purification system is in place at INPP. Bypass cleaning by means of precoat filter allows to better purify the coolant from Zr and Nb isotopes by 100%, from iron by more than 99%. This was considered by the OSART team as good practice and detailed in the list of chemistry findings.

Condensate purification is efficient. Before startup, the programme of condensate and feedwater circuit cleaning is executed, which decreases in a very sensitive manner the concentration of iron in the primary circuit.

The low salted water purification process system was modified. This was considered by the OSART team as good practice and explained in this report.

Liquid radioactive waste generated as a result of operation is treated and then the solid residues are bitumized or solidified. This system was implemented in 2006.

Prior to maintenance the tubes of condensers are cleaned and dried. Part of condensers are covered with a special coating named plastocor.

8.3 CHEMICAL SURVEILLANCE PROGRAMME

The staff of the "express" laboratory of chemical department is subjected to have regular tests of knowledge for compliance with the qualification requirements. They should pass once per two years a knowledge test on the chemistry theory, once per quarter a test of skills on conducting check-samples analysis. However, the OSART team found that practice of analysis in chemistry, radiometric and environmental laboratory is not always in line with state-of-the-art of chemistry and radiometric analysis methods and quality assurance requirements. The team has made a recommendation in this area.

Safety-relevant chemistry parameters should be controlled by two methods. For instance, the concentration of chloride ions in the primary circuit is monitored on-line and compared periodically by using liquid Dionex 500 chromatograph. Such approach is applied to control also electric conductivity, oxygen, Fe, Cu.

Chemical and radiochemical measurement devices are checked by a metrological laboratory and have appropriate certificates.

Chemical and radiochemical devices are calibrated, however, in some cases the schedules of calibration are absent. The OSART team discovered that documentation and data, such a certificate or validity data are not always present or do not adequately support safe application of radioactive sources used for calibration of spectrometric devices. The team proposed a recommendation in this area.

The existing documentation on chemistry and radiochemistry describes the process of sampling, preparation of samples, and conduct of analyze however the OSART team found that not all aspects of these processes are covered by chemistry personnel. A recommendation was developed to address this deficiency.

ALARA principles are observed by the personnel of chemistry services. The dose rates of the personnel are controlled continuously. Surface contamination of sampling rooms and laboratories is insignificant, however staff of chemical divisions of different departments is not always informed about the results.

The OSART team noted some deviations from the standard practice in usage of individual protection means and control devices, which could be explained by the design particularities.

8.4 CHEMISTRY OPERATIONAL HISTORY

Results of analysis are systematically and daily evaluated. Reports are prepared on a monthly basis. The main indicators are trended, recorded, documented, archived and are easily retrievable. An electronic database containing chemical performance indicators has been developed and implemented. Trending of the main parameters was put in place in 1997. Annual reports are issued and make a part of the plant annual reports. They are submitted to VATESI. No reports on chemical performance limit violations were noticed

Results on recent developments and international and national recommendations have been considered by the plant. Based on the recommendations issued as a result of extra-budgetary activity, a programme was developed for the measurement of the Electrical Chemical Potential. The first results have been found to be positive, which was reflected in the report published by IAEA.

8.5 LABORATORIES, EQUIPMENT AND INSTRUMENTS

The laboratories of different departments are equipped with the required equipment for normal operation. Accuracy of measurements is provided. The before mentioned issues on calibration are reflected in paragraph 8.3.

All laboratories are equipped with ventilation system, but the control of these systems is not performed regularly. For instance, in environmental laboratory, this exhaust ventilation was found out of operation during the OSART visit.

The personnel always uses personnel protective means when they execute activities with hazardous chemicals. However, not all laboratories are completely equipped with protective means for eyes.

The OSART team underlines the good housekeeping in all storage premises of chemical department. For the most part, the chemicals are stored separately, labeled and have certificates. But sometimes violations of chemicals handling and storage requirements are observed for instance in the environmental laboratory. In order to improve the safety level, the team suggests the plant to keep handling of chemicals always in line with safety requirements of chemical, industrial and fire safety. A suggestion was developed in this area.

Post accident sampling system is not foreseen by the plant design that is why there are no procedures for obtaining, transporting and analyzing samples in post accident conditions

8.6 QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

INPP has developed and uses the instructions on incoming inspection of materials and chemicals. This document establishes the responsibilities and scope of control, applied to ion-exchange resins, oil products, additives, bitumen and other chemicals. In case of any discrepancies this given material is prohibited from further use at the plant. The results of analysis are transferred to the procurement department.

A schedule is established and followed to control oil, diesel fuel and additives.

DETAILED CHEMISTRY FINDINGS

8.1. ORGANIZATION AND FUNCTIONS

8.1(1) Issue: The continuing training and on the job training courses of chemistry and radiochemistry laboratory staff are not sufficiently developed.

- Continuous training of the radiometric control laboratory personnel is not performed actually. The last trained person was in 1998.
  - Refreshment training programme of Training Center does not include the position of laboratory assistant.
- Chemical department laboratory assistants training:
  - applications for refreshing trainings are not submitted to the Training Centre because this process is under responsibility of Chemical Department;
  - engineering personal of Chemical Department does not always register weak points of laboratory assistant's laboratory skills;
  - for laboratory assistant external the training time is not included in working hours;
  - insufficient attention is paid to laboratory practice, absence of laboratory practice training sessions in continuous refreshing training programme for the laboratory assistant.

Without proper continuing training programme the chemistry laboratory personnel could increase the risk to make errors and deliver weak information about plant status in the direction of operations personnel.

Suggestion: The plant should consider conducting continuing training and on-the-job training courses for chemistry and radiochemistry laboratory staff.

IAEA Basis: TECDOC-489.Safety aspects of water chemistry in LWR.
2.2 A programme for periodic (continuing) training of all personnel working in water chemistry control should be established.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

8.2(a) Good practice: Desaerated start-up of unit

Usually when choosing water chemistry method for specific reactor, special attention is paid to the normal operation parameters – basic operation mode. In such a case the facilities are designed for the achievement and the maintenance of the necessary parameters. The norms and means of achievement of the specific parameters are not always provided for transients due to their short duration. One of such parameters affecting the Inter Granular Stress Corrosion Cracking (IGSCC) is the oxygen concentration in the primary circuit water during hot hydraulic tests and during start-up phase after a continuous shutdown. After the welded joint defects of IGSCC type had been detected in the downcomers between separator drums and main circulation pump (MCP) the plant developed the programme of primary circuit water desaeration prior to start-up.

Desaeration procedure includes the following stages:

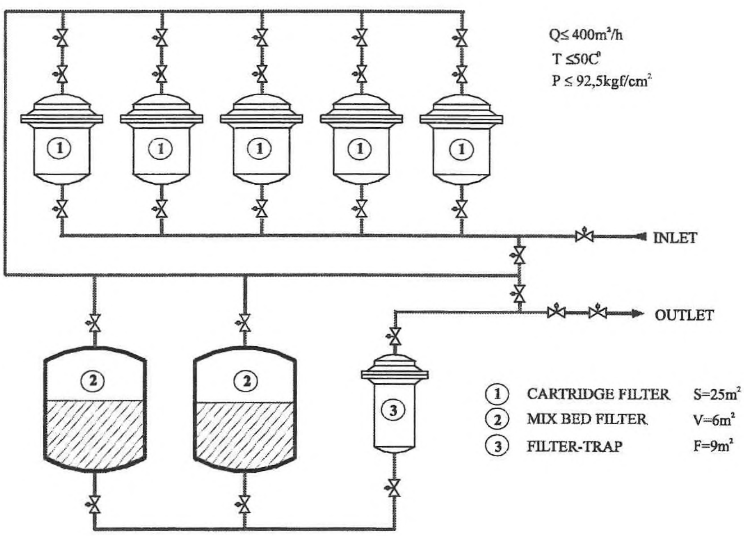
1. At temperature 70 ^{0}C the non-nuclear heating of the reactor coolant is started by running the main primary pumps. Initial contents of dissolved oxygen is around 6 ppm.
2. When temperature in the primary circuit reaches 100^{0}C the circulation is started in through the desaerator. The steam generated in the separator drums is convoyed together with the oxygen to the desaerator where the feed water for primary circuit is warmed up.
3. At temperature 110^{0}C the reactor heating is maintained till oxygen concentration decreases lower 200ppb.
4. Simultaneously with the removal of dissolved oxygen from the primary circuit water the feed water of the primary circuit is desaerated. Therefore the primary circuit make-up from the desaerators results only in minor increase of oxygen concentration in primary circuit water (which is less than 100 ppb)
5. During further heating till the nominal parameters the oxygen concentration decrease until 20-30ppb.

Actually no additional equipment is required for this procedure. Its performance causes extension of start-up activities by 5 to6 hours, however it ensures to avoid the cracking effect in sensitive zone.

8.2(b) Good practice: Powdex process on the cartridge filter for primary coolant purification system.

Primary Coolant Purification System (PCPS) is used for maintaining the water chemistry parameters. It operates under the same pressure as the reactor, however the temperature shall not exceed 50^{0}C. The system comprises 5 cartridge filters, 2 mix bed filters and a filter-trap.

CLEANING OF PRIMERY CIRCUIT WATER



In 10 years of operation the defects were identified on the valves caused by the abrasive qualities of the applied inorganic absorbent PERLITE. Only 20% of radioactivity of corrosion products were present in the primary circuit as particles with the size more than 45μm. Others radioactive pollutions were present in ion or colloid forms for which the efficiency of the cartridge filters with PERLITE was very low.

In 1993 of the usage of the powdered ion-resin was tested and held at PCPS. Since 1994 the ion exchange powdered resin has been in use at INPP. Taking into consideration the composition of impurities in the primary circuit water, as well as economical factor, the mixture of cationite and anionite of Microlite type was chosen with the ratio 2:1 and size of particles 20-80μm.

The following advantages were achieved using powdered resins:

- Powdered resins ensure an efficient purification not only for particulate impurities but also for the ion impurities and charged particles of minor size.
- Total exchange capacity of the powdered resins is used in a more complete way. The ion exchange kinetics has been improved which causes the increase of purification coefficient. As a result, after system installation the specific conductivity has decreased from 0.09 to 0.07 μSm/cm.
- In accordance with the practical experience during purification of water with specific activity. equal to 2.5E-5Ci/l performed in real conditions the cartridge filter with powdered resin makes the activity 5 times lower while the cartridge filter with PERLITE reduces it only for one third.
- It reduces the dose rate of the resin in the mix bed filters, decreases its destruction and the aforementioned resin can be used much longer (the life time of the resin in the mix bed filters is twice longer at about 2 years)
- When using the ion-exchange powder resin the lifetime extension of the cartridge filters with the powdered resin and reduction of pressure drops were identified.
- Due to the lifetime extension of the cartridge filter with the powdered resin and mix bed filter the capacity of the spent resin from the by-pass purification facility of the primary circuit has been decreased 2-3 times.
- Due to the exclusion of the abrasive absorbent PERLITE from the process the operation of equipment of the absorbent preparation unit and filter material retrieval has improved.

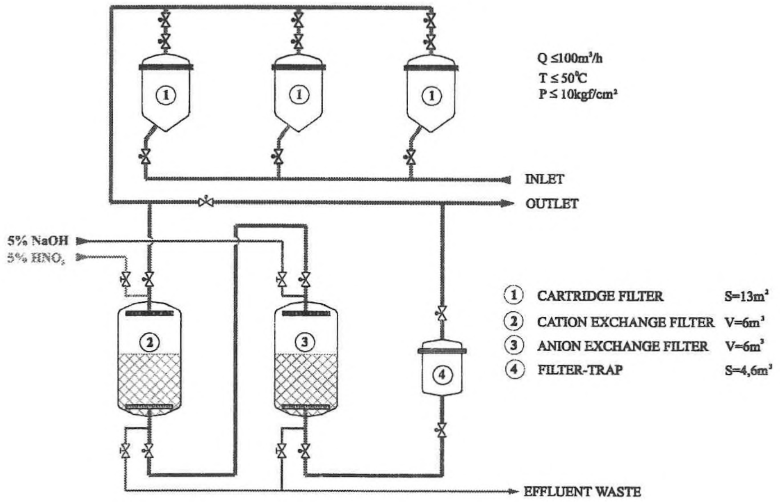
8.2(c) Good practice: Modification of purification facility of low salt water (LSW).
Special purification facility of low salt water was installed at INPP to purify water from impurities coming from the following equipment and systems:

- Blowdown of cooling circuit of control and protection system,
- Condensate with lubricant of turbine equipment,
- Spent fuel pool,

It consisted of three cartridge filters, H+filter(strong acid cation)and OH-filter(strong base anion).

PURIFICATION OF LOW SALT WATER

(CO-CURRENT REGENERATION)



The facility had a lot of operation deficiencies:

- Often cationite resin got oily due to the high concentration of oil (lubricant) in the water of turbine equipment
- Non-conformance between the exchange capacity of H+filter and OH-filter, which caused overrun of regeneration solutions
- Unsatisfactory quality of regeneration due to the tunnel effect.

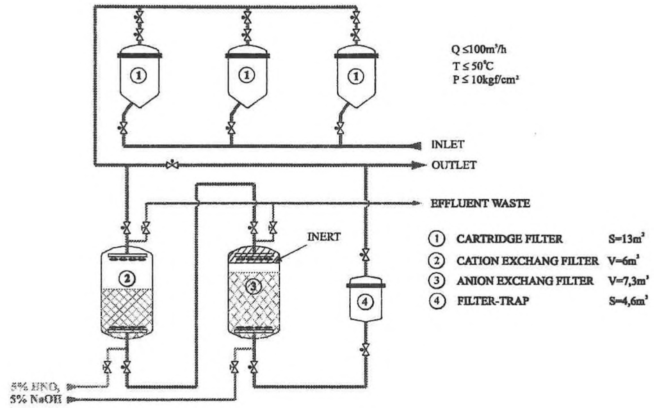
As a result the filter lifetime stopped at ~50 000m ^{3} and conductivity at the outlet was equal to 0.6-0.8μSm/cm.

After implementation of the Fast Acting Scram system where 24 channels were cooled in a film mode and the channel cavity was blown by the gaseous nitrogen the load to the LSW purification facility increased due to the necessity to retrieve nitric acid obtained as a result of irradiation. In order to improve the operation of facility and to prevent occurrence of tunnel effect, the plant developed the organisational and technical measures on reduction of oil capacity getting from the turbine equipment. The plant started modification of LSW purification facility for counter-current regeneration. As a result filter lifetime extended till ~ 80 000 - 100 000m ^{3} with conductivity at the outlet at about 0.3-0.5μSm/cm.

Although the significant improvement was evident the non-conformance between exchange capacity of H+filters and OH-filters still remained. In order to correct this last deficiency the plant decided to implement a modification on the OH-filter.

- Specialists performed calculation of the top and bottom distributor system. The special filter nozzles with the gap 0.25mm were installed on the bottom distributor system and with the gap 0.5mm – on the top distributor system.
- Protective device was developed and installed on the ventilated pipe.
- Floating inert material IN42 was loaded.
- Type of loaded anionite was changed.
- The capacity of loaded anionite was changed from 6 m ^{3} to 7.8 m ^{3}.

PURIFICATION OF LOW SALT WATER
(COUNTER-CURRENT)



Thus, the "compacted bed" concept was implemented on the OH- filter which resulted in the following changes:

- ➢ Filter lifetime extended till 160 000-220 000 m^3
- ➢ Water quality improved from 0.3-0.5μSm/cm to 0.12-0.18μSm/cm
- ➢ Capacity of drain water decreased of one third
- ➢ Regeneration time reduced for 30% and therefore specific amount of reagents for chemical regeneration and, respectively, the amount of radioactive wastes reduced
- ➢ Resin removal from the filter during backwashing was eliminated
- ➢ Stream is distributed along the filter cross-section in a more equal manner

All costs on this modification will be paid off within 1.5 –2 years.

In conclusions the modifications implemented at INPP are not expensive, however their performance resulted in great advantage as described in the following:

1. Improvement of coolant quality
2. Cost reduction for reagents and ion-exchange resin
3. Significant decrease of the amount of liquid radioactive wastes (more than twice)
4. Improvement of equipment reliability and reduction of water chemistry impact to the IGSCC in downcomers.

8.3. CHEMICAL SURVEILLANCE PROGRAMME

8.3(1) Issue: Practices of analysis in chemistry, radiometric and environmental laboratory are not always in line with the state-of–the art and not always in line with chemistry and radiometric analysis methods and quality assurance requirements.

- The laboratory assistant of chemistry department during performing pH measurement and Cl dosage:
  - performed only one measurement for each sample;
  - did not fix the preliminary results, nor final results;

- The laboratory assistant of chemistry department during performing oil analysis:
  - did not fix preliminary results, nor final results.
- When sampling, RP laboratory assistant did not check the flow rate of sample, which should be done accordingly to the sampling procedure.
- RP laboratory assistant had no skills on liquids measuring – The technician performed the leveling of the liquid in the glass holding the vessel not in her eyes level what resulted to the different amount of liquid in the vessels during sampling.
- The covering glass is not used in RP laboratory during evaporation of samples for radioactivity measurement.
- In the room 174/D-1 which is the RP laboratory the activity on measurement was performed when the door of the protective box was not completely closed, which should be done in order to provide the accuracy of measurement.
- From time to time the results of radiometric control in RP laboratory were reported with error 70 to 150 % (standard practice – not more than 30%) .
- At the Environmental laboratory the laboratory assistant has no skills in weighting, especially radioactive samples. Chemicals used have no expired date.
- In the Environmental laboratory at the end of the measurement not the entire amount of filtrated sample was transferred to the storage glass by the laboratory assistant, but the remaining sample was poured to waste.
- In Environmental laboratory logbooks, sometimes the results are registered with error of 60-90 %.

Without strictly applying up-to-date analytical methods and quality assurance measures the results of analysis might be incorrect and information on plant status given to operation could be wrong.

Recommendation: The plant should ensure that practices of analysis in chemical and radiometric laboratories are conform to the state-of –the art chemistry and in line with radiochemistry analysis methods and quality assurance requirement.

IAEA Basis: -TECDOC-489.Safety aspects of water chemistry in LWR.
2.5 Surveillance (2)" A Quality Assurance Control programme should be followed to assure that laboratory analyses are accurate and reproducible."

8.3(2) Issue: Certified and valid sources are not always used for calibration of spectrometric devices.
The team noted:
- Absence of procedures on registration and influence of the room background to the sensitivity of spectrometric analysis in the RP laboratory,
- Radioactive source Eu-152 No.130, which is used for radiometric calibration, has no certificate (RP laboratory).
- Radioactive source СГИ, used for calibration of gamma-spectrometric device are expired (certificates No.138/99/20457, 141/99/20460, 140/99/20459 expired 01/04/2002) (RP laboratory).
- Radiometric Laboratory (Nuclear Safety Dept.) – radioactive source for calibration ОСГИ No.35 has expired.

- Radiometric Laboratory (Nuclear Safety Dept.) – liquid source of Eu-152 (used for calibration) is stored in the glass and the top of the glass is covered by insulation tape. The glass is stored in safe without ventilation. The certificate for the source has expired.

Calibrations using uncertified or expired radioactive source could lead to incorrect results and information on plant status given to operation could be wrong.

Recommendation: The plant should use only certified and valid radioactive sources for calibration of radiochemistry devices.

IAEA Basis: TECDOC-489. Safety aspects of water chemistry in LWR.
2.2 Analytical instruments capable of achieving the necessary sensitivity with sufficient reliability for routine plant application are required for a successful plant chemistry programme.

8.3(3) Issue: The sampling and analyzing procedures are not consistent across the site.

While in general sampling and analyzing procedures are correct at the plant, the sampling procedures for diesel generator fluids and radiochemistry analysis describing the process of source preparation are not fully developed or absent. The following deficiencies have been found:

- Procedure for activated carbon preparation for gas activity control describes only partially the process of drying and could lead to incomplete removal of moister from the carbon (RP laboratory).
- During applying the radioactivity control procedure with usage of ion-exchange resins, the resins AB-17 and КУ 2-8 are stated (incorrectly), currently in practice other resins are used (RP laboratory).
- Radiometric Laboratory (Nuclear Safety Dept.) – there is no procedure to describe samples preparation.
- No procedure was found on liquid media samples preparation for gamma-spectrometric measurement. Same fact for the detection of necessary measurement amount and time for ensuring authenticity of the control (RP laboratory).
- In the Environmental laboratory filtrate drying process is not completely described in the procedure, details are missing for sampling preparation.
- In the Environmental laboratory the expert did not find of weighing accuracy registration procedure for sampling.
- In the Environmental laboratory 2 changes were incorporated in the sampling procedure by hand written.
- For the Diesel generator (DG): sampling from oil tanks and water tanks is performed from the lower part of level meter; and not from the tank itself. The backup oil tank is not controlled; sampling point is absent (DG).
- Only one valve is used in sampling devices for oil, water and diesel tanks sampling. Sampling point is not indicated on the scheme (DG);

- Sampling of procedure for oil (DG) exist but it is not known by field personnel who make the sample;
- People performing analyses does not have knowledge on the way the sampling is done (different person from different department)

Without proper execution of sampling information on plant chemistry status given to operations could be wrong.

Recommendation: The plant should ensure that the sampling and analyzing procedures are consistent across the site.

IAEA Basis: TECDOC-489. Safety aspects of water chemistry in LWR.
2.2 Analytical instruments capable of achieving the necessary sensitivity with sufficient reliability for routine plant application are required for a successful plant chemistry programme. Sampling techniques providing representative samples for analysis are required. It is recommended that utilities establish a manual of appropriate analytical methods and sampling systems for use by operator staff.

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

8.5(1) Issue: The handling of chemicals is not always fully in line with fire protection and industrial rules and safe practices.

- The levels of alarms in the sulphuric acid and NaOH tanks are absent.
- In the room 171/D-2, two (2) bags with oxalic acid are stored without stating the allowed quantity for storage and without taking measures on compliance with deleterious substance storage rules. One bag was under the table (RPD). The bags were not sealed to protect the chemical against humidity..
- In the room 171/D-2 tanks with nitric acid are stored together with hydrogen peroxide.
- Technological equipment in decontamination shop is not labeled with symbols for chemical hazard in spite of presence of HNO3and NaOH.
- Expired chemicals are stored together with non expired ones in same room. Ventilation does not operate. Flammable substances are stored here as well (Environmental laboratory).
- The storage room has no identifying signs. The existing storage is not suitable for aggressive liquids storage. Vessels with acids are stored in the storage room and no other information is written on the labels except the name of the acid (Environmental laboratory).
- The list of chemicals (including flammable substances) does not contain the information on their amount (Environmental laboratory).
- In the chemicals storage room (516/D0) some bottles with the expired chemicals for pH calibration are stored.
- In the Environmental laboratory, the laboratory assistant does not use protective glasses.

Flammable and hazardous chemical materials must be separated, marked, and controlled. The non-observance of standards of chemical handling can challenge fire safety and industrial safety.

Suggestion: The plant should consider ensuring that the chemicals handling is fully in line with fire protection and industrial rules and safe practices.

IAEA Basis: NS-R-2
2.30 The operation organization shall make arrangements for ensuring fire safety on the basis of a fire safety analysis which shall be periodically updated. Such arrangements shall include: application of the principle of defense in depth, assessment of impact of plant modifications of fire fighting; control of combustibles and ignition source; inspection, maintenance and testing of fire protection measures.

9. EMERGENCY PLANNING AND PREPAREDNESS

9.1. EMERGENCY PROGRAMME

The Atomic Energy Law defines the responsibilities in the field of accident prevention and management of accidents and their consequences. To cope with an accident at the Ignalina nuclear power plant (INPP), a specific national emergency response plan (NERP) has been issued and gives a description of the responsibilities & co-ordination actions between the concerned Ministries (Defence, Environment, Health, ...), other State Administration institutions (Civil Protection Department, Fire Rescue Department, ...), support bodies (VATESI, Radiation Protection Centre, ...) and counties and local authorities. It describes also the arrangements and implementation procedures with respect to the notification process and the protective measures for the population.

In the case of an emergency declared at the INPP and affecting more than one county, three management levels are activated:

- at the national level through mainly the Government Emergency Commission taking a leading role in the response actions and the Emergency Management Centre playing a role of general advisor to the Emergency Commission;

- at the county and municipal levels at which the organisation of the protection of the population and of the mitigation actions are managed directly or through the Emergency Management Centre. In particular, these authorities are responsible for the organisation of the evacuation.

VATESI is appointed as National Competent Authority under the Early Notification & Assistance conventions. Formal bilateral agreements exist with Latvia, Poland, Denmark, Norway. Unfortunately, such formal agreement does not exist with Belarus despite of presence of Belarusian territory in the 30 km emergency planning zone (EPZ). The team suggested the plant to support responsible authorities in establishing formal bilateral arrangements to ensure timely notification of Belarus in case of an emergency at the INPP.

The emergency response organisation (ERO) of INPP is developed and maintained by the Civil Defence & Emergency Protection staff (CD&EP) reporting directly to the INPP general manager. Two full-time members of the CD&EP are in charge of the ERO activities.

Among the INPP staff, about 500 persons are appointed, some with substitutes some without, to perform emergency tasks. The ERO-staff is not organized as an on-duty or on-call oriented system. Despite a large number of people belonging to the ERO-staff, the team founded some evidences of understaffed ERO-functions. The team got also no evidence of sufficient and adequate ERO-staff being mobilized in the case of an emergency. The team suggested optimizing the ERO staffing.

Agreements with the Visaginas hospital allowing to take care of about 20 irradiated and/or contaminated injured persons, with the local fire brigade and with a local transportation company confirmed the good relationships between the INPP and off-site organisations and support bodies.

9.2. RESPONSE FUNCTIONS

One of the first actions of the ERO-staff is to define an emergency classification in function of the situation. Three emergency classes are defined (alert, site emergency & general emergency) based on technical and radiological assessments and associated criteria. Upon the declaration of an emergency class, expected response actions such as taking of stable iodine, prepare for evacuation, initiate off-site monitoring teams, are listed in the ERO procedures/instructions. The team observed that the recommendation to take stable iodine is expected to be issued very quickly in the development of the emergency response, even before or without medical advise.

A Technical Support Centre Room supports the technical assessment and is composed of about 10 people (Operation manager supported by heads of subdivision sections (reactor, I&C, etc.)) giving a methodological support to Plant Shift Supervisor and recommendations to plant operation manager.

The radiological assessment is supported by a Radiation Safety Monitoring Room, staffed with a shift of 4 persons (supervisor, technician and two health physicists).

The emergency planning zones are clearly defined: a 3 km sanitary zone under the responsibility of the INPP and three zones under the responsibilities of the off-site authorities: 3-5 km as Precautionary Action Zone, 5-30 km as Urgent Protection action Zone (UPZ), 30-50 km as Longer term protective action zone (LPZ). The UPZ & LPZ are divided by sectors of 22.5 deg (16 sectors) and segments of distances (6 per sector). The UPZ and LPZ cover portions of territories from Belarus and Latvia.

In case of fire, the fire fighting is performed by an advanced post of fire brigade, located within the sanitary zone, having on-line connection with the plant fire alarms. The fire response is developed in the section 3.6 of the report.

In case of an emergency declared on-site, the INPP personnel is alerted by on-site sirens, on-site loudspeakers and on-site radio messages. This alert is followed by vocal instructions broadcasted via the radio and loudspeaker networks. The team experienced the monthly on-site sirens test. The team encourages the plant to add a post-announcement broadcasted on the on-site radios at the end of the test. The team observed that outside the site fence but within the 3 km sanitary zone, there are no dedicated means to provide an alert (no sirens or loudspeakers).

Adequate alerting arrangements (outdoor sirens) are installed to notify the population within the 3-30 km EPZ. Further instructions with respect to the actions to taken by the population are given by the radio and TV networks. The actuation of sirens could be performed by the Fire Rescue Department and the municipalities (Visaginas, Ignalina,...) in their own territory. The sirens of Visaginas can also, as a backup, being activated by the INPP plant shift supervisor, using a redundant activation line.

If the instruction is given to assemble people on-site, everybody has to reach his pre-designated assembly point, not necessary the nearest one. There are about 70 of such assembly points, not equipped with radiation protection means except stable iodine tablets. The assembly points are not identified and no indication route to these assembly points exists. The counting process is performed without any practical tool or equipment, even if the information from the access control system may be partly used. The team noted that the retrieval of any missing person (INPP staff but also contractors) is made without an endorsement by the ERO management response team.

If an evacuation of the site is decided, the INPP personnel is driven to Visaginas by bus requested under the agreement with the transportation company. The evacuation is performed without contamination check nor on-site nor off-site and without personal protection means for the drivers and the evacuees.

The team recommended improving the effectiveness of the assembling and accounting processes. The team recommended also to improve the effectiveness of the protection of the emergency workers and all the persons on the site in case of nuclear or radiological emergency.

9.3 EMERGENCY PLANS AND ORGANIZATION

The INPP ERO is based on the same structure of responsibilities as in routine operation of the plant. Each department or service is called to play also a role in the case of an emergency at the INPP. In that case, the heads of departments and services are appointed to lead the emergency response in the field of their responsibilities. Twelve key management ERO-functions (Operation, Maintenance, Radiation & Chemical protection, Medical group, Physical Security, Information group, …) are formed supporting the site emergency director.

The ERO-plan (about 900 pages) consisting of a general part with the general description of arrangements, training and equipment maintenance, … and an operational part giving the operational instructions, check-lists and if appropriated preformatted forms, for the different groups as well as specific instructions for specific hazards (chemical).

The team observed the weak integration of the ERO-plan with the fire response arrangements.

9.4. EMERGENCY PROCEDURES

Most of the procedures and instructions are incorporated in the ERO-plan. The plan and the associated procedures and instructions are to be reviewed or updated every 3 years.

The team observed that two different official logbooks (tracking of actions) are used by the key management ERO-functions, one for exercises and one to be used in a real emergency. There are no preformatted logbooks for the rest of the ERO-functions.

9.5. EMERGENCY RESPONSE FACILITIES

The main ERO-facility of the INPP is the Emergency Operation Centre (EOC) located in an underground shelter and consists of rooms dedicated for specific expert/service groups (ERO general management, public information, external communication/notification, radiation & analysis, maintenance/mitigation, physical protection, EOC logistic & medical support, external fire brigade command post) or to support or logistics equipments (HVAC, uninterruptible power system, storage of material and equipment, drinking water storage, air regeneration unit, rest room, sanitary, etc.). In full configuration, the EOC can accommodate between 30 and 60 ERO- management and support staff.

In general, the IT and telecommunication equipment of the EOC is found to be adequate. The team encourages the plant to reorganise the entrance of the EOC in order to perform a systematic radiation monitoring check and to avoid cross contamination.

The team encourages also the plant to complete the equipment of the EOC (e.g. back-up copies of specific software loaded on the computer, preformatted logbooks, food supply) and to reinforce the maintenance and verification procedures of the equipment as some evidences of drawbacks have been observed by the team.

Beside the EOC, the INPP disposes also of the Technical Support Centre Room and the Radiation Safety Monitoring Room (SAMRB).

The SAMRB staff can access through big user-friendly flat screens to a lot of information (more than 400 data or signals) concerning radiological situation inside the plant (in the systems, under RM-readings,...) and on- & off-site on line RM-monitoring (22 off-site gamma monitoring stations). The SAMRB disposes also of radiation monitoring equipment (direct RM-readers, sampling material and analysers,...) and personal protective means for daily and emergency purposes. The team identified the SAMRB equipment as a good performance.

The team visited the emergency response centre (ERC) of VATESI. The ERC is well designed and equipped. The ERC is staffed with about 12 persons and disposes of a direct connection to the INPP data information system with access to the actual process parameters and status. The ERC staff can also access to INPP documents (procedures, diagrams,...) using the ARKI electronic data management system.

9.6. EMERGENCY EQUIPMENT AND RESOURCES

For ERO-staff, protective means (gloves, respiratory protection equipment, stable iodine tablets, ...) are available at different locations (maintenance shops storages, EOC, ...).

For the non ERO-staff, stable iodine tablets are available.

The Radiation Protection Centre in Vilnius disposes of laboratories for alpha, beta and gamma measurements as well as mobile laboratory vehicles (spectrometry, air sampling, ...).

The local fire brigades dispose of appropriate protective equipment (dose meters, protective clothes, ...).

9.7. TRAINING, DRILLS AND EXERCISES

The team observed that the contractors must establish their own emergency instructions based on information and recommendations given by the plant, in order to be licensed by the INPP. As soon as the CD & EP have approved these instructions, the contractor's management becomes fully responsible for his staff in the case of a declared emergency at the INPP. The team encourages the plant to review this approach by imposing the same emergency instructions and arrangements to the contractors in order to avoid contradictory actions or deviations, as already observed by VATESI during their inspections.

For the ERO-staff, a three years-training programme is established as a guidance for establishing the yearly training programme for the different concerned ERO functions. Generally speaking, this top-down training approach (training given by managers to subordinates) represents 1 day training per 2 years for the key management ERO-functions and 1 day training per year for the rest of the ERO-staff. This yearly programme consists of lectures and possible functional training or practical sessions. It includes also a feedback of the previous full-scale exercise. The subjects and content of the lectures can be adapted on specific topics (like severe accident management guidelines (SAMG) for example). These training sessions are mainly classroom sessions except for the functional training, which could comprise some practical use of material or equipment.

Two main types of exercises are organized at the INPP.

Every 3 years, a full on-site exercise including all key functions, departments and sub-groups of the ERO-staff is organised. A limited participation of the non ERO-staff is also included in this exercise. The typical duration for this kind of exercise is 6 hours (during working hours). The participation of the off-site organizations and support bodies is however limited, except for VATESI and the media. A working group with representatives of different departments and services & CD & EP staff prepares the exercise scenario and sub-scenarios, including the expected response actions. During the exercise, a team of pre-designated controllers/evaluators is acting under the supervision of an exercise coordinator. The CD & EP staff and the exercise working group issue the exercise report based on evaluation of findings of the evaluators/controllers. It includes recommendations followed-up by the yearly action plan on EPP issued by the CD & EP staff.

Staff exercises for the key management functions is organized every 2 years with a typical duration of about 2 hours, normally during working time sometimes outside working time (last exercise organised outside working time dated of December 2000).
For these staff exercises, no off-site organization or support bodies participate.

The date of all full on-site scale and staff exercises is beforehand announced.

There are no unannounced drills, exercises, mobilization or ERO-availability tests, where as such unannounced drills or exercises are general practice at most plants.

The team observed a lack of systematic or organized verification of the regular participation of substitute(s) during exercises. Some positions have therefore never been tested by a substitute during an exercise.

The team recommended to improve the periodical drills and exercises programme including periodic, comprehensive and integrated on-site and off-site exercises.

9.8. QUALITY ASSURANCE

The ERO-plan, procedures and instructions are established under the general QA requirements.

The team appreciated the yearly issue by the CD & EP staff of an action plan on EPP (including training topics, exercise preparation actions,...) to be approved by the general director.

DETAILED EMERGENCY PLANNING AND PREPAREDNESS FINDINGS

9.1. EMERGENCY PROGRAMME

9.1(1) **Issue:** The staffing of the Emergency Response Organization (ERO) is not performed in an optimized manner.

- Despite a high number of appointed ERO staff (about 500) and some very well staffed groups (e.g. 2 shifts of 10 persons for the public information duties or shift of 4 persons for the radiation safety monitoring room), some ERO functions seem to be understaffed, like
  - On-site monitoring survey (1 manager & 2 monitoring members)
  - Radiological assessment group (1 manager and 2 assistants)
  - Civil defense and emergency response staff (2 persons)
- Only key management ERO-functions dispose of appointed substitutes. In some case, there is some overlap in this substitution (e.g. Technical Director and head of safety and QA service are the deputies of the General Manager)
- The actual ERO is not organized as an on-call system, even for the key ERO functions (e.g. EOC management & support functions)
- As no availability or unannounced mobilization test is performed to assess the real availability of the ERO-staff in different conditions (during working hours, during nights and WE, ...), there is no evidence that sufficient and adequate ERO-staff could be mobilized in the case of an emergency
- The plant does not have prescription or criteria to ensure that designated ERO-substitute should perform an exercise before to be appointed

Un-optimized emergency response organization staffing may lead to inadequate or delayed emergency response or to difficulties in the turnover process for long duration event.

Suggestion: Consideration should be taken by the plant to optimize the ERO staffing.

IAEA Basis: GS-R-2: 5.8, 5.9
Personnel shall be assigned to appropriate positions in all operating and response organizations in order to perform the functions necessary to meet the requirements [...]
Sufficient numbers of qualified personnel shall be available at all times in order that appropriate positions can be promptly staffed as necessary following the declaration and notification of a nuclear or radiological emergency

IAEA Basis: EPR-METHOD-2003
B2.3 (p92)
[...]Assign personnel to all the positions in the response organization needed to perform the functions [...] and ensure they can be staffed adequately [...]
B2.4 (p93)
[...] Identify personnel to take over key emergency management positions in situations where primary staff is unavailable. Provide for continuous 24-hour emergency operations [...]

9.1(2) **Issue:** A formal bilateral agreement with Belarus is absent. The Belorussian population within the radius of the 30 km zone could not be notified in a timely manner.

Due to the absence of bilateral agreement with Belarus, the notification of an emergency at the INPP could be delayed, impairing the safety of the population inside the 30 km zone situated in the Belarus territory.
International experience shows that solid, well-defined and agreed arrangements are needed for adequate assurance of timely notification.

- No official bilateral agreement with Belarus on notification & information exchange in the case of a nuclear or radiological emergency exists.
- Such bilateral agreements are concluded with Latvia, Poland, Denmark, Norway.

Absence of bilateral agreement with State within the defined emergency zones may delay the notification and impairing the safety of the concerned State's population.

Suggestion: Consideration should be taken by the plant to use its influence supporting competent authorities and bodies in order to establish as quick as possible formal bilateral arrangements with Belarus to ensure timely notification of responsible authorities and the population in the 30 km emergency planning zones within Belarus in the event of a nuclear emergency at the INPP.

Basis:

IAEA - Convention on Early Notification of a Nuclear Accident – Article 9
Bilateral and multilateral arrangements - In furtherance of their mutual interests, States Parties may consider, where deemed appropriate, the conclusion of bilateral or multilateral arrangements relating to the subject matter of this Convention.

IAEA GS-R-2: 4.15, 5.12,
In the event of a transnational emergency the notifying State shall promptly notify directly or through the IAEA those States that may be affected. Arrangements shall be made to ensure that all States within defined emergency zones are provided with appropriate information for developing their own preparedness to respond to an emergency and arrangements shall be made for appropriate trans-boundary co-ordination

IAEA NS-G-2.4: 6.58
The operating organization should establish the necessary organizational structure and should assign responsibilities for emergency preparedness and response. This includes arrangements for [...] (iv) timely notification and provision of information in the framework of the Convention on Early Notification of a Nuclear Accident

IAEA EPR-METHOD-2003
A4.5 (p61)
Other States within the emergency zones should establish bilateral or multilateral agreements that provide for rapid and direct notification by the facility.
B3.2 (p94)
This must include arrangements to receive prompt notifications of a site area or general emergency at any [...] category I or II facility located in another State that is

within the distances specified in Appendix 5 for the emergency zones and food restriction planning radius.

9.2. RESPONSE FUNCTIONS

9.2(1) Issue: The assembling and counting processes at the plant are not effective.

- The total number of assembly points is about 70 spread around the site boundaries, which is much more than the international practice
- The assembly points are not identified and no indication route to these assembly points exist
- Some assembly points were never tested during exercises
- There is no plant lay-out or map indicating the assembly points
- There is no general instruction booklet indicating type of signal(s), expected response actions and location of the assembly points
- The counting of the personnel is purely manual without any practical tool or equipment, even if the information from the access control system may be partly utilized
- Instruction is to reach the own predefined assembly point not the nearest one
- The retrieval of any missing person is under the direct responsibility of its direct line manager without an endorsement by the ERO management response team.
- The same process and responsibility delegation is applicable for the contractor staff: the INPP management does not endorse the responsibility to count and to retrieve a missing contractor's people, which is outside good international practice.

Ineffective assembling and counting of personnel in case of an emergency could lead to unnecessary personnel exposure and/or inadequate emergency response.

Recommendation: The plant should improve the effectiveness of the assembling and counting processes.

IAEA Basis: GS-R-2: 4.51
The operator of a facility [...] shall make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. This shall include arrangements: [...] for all persons on the site to take appropriate actions immediately upon notification of an emergency; to account for those on the site; to locate and recover those unaccounted for; [...]. The facility shall provide suitable assembly points for all persons on the site and "shall be provided with a sufficient number of safe escape routes, clearly and durably marked, with reliable emergency lighting, ventilation and other building services essential to the safe use of these routes...."

EPR-METHOD-2003: A4 (p63)
Provide instructions to those on site on their response in an emergency or have knowledgeable staff escort them. Post the instructions on the response expected to a warning signal, evacuation routes, and assembly areas.
Develop a procedure to monitor the dose in the on-site assembly areas or shelters and evacuate if necessary
A12.3 – 3.4 (p207)

[...] Describe the arrangements for protection of on-site personnel (see Element A4.6). Maps of the on-site area, showing assembly points, sheltered areas, and evacuation routes should be provided in an appendix.
A12.3 – Appendix 3 (p209)
Provide (or refer to publications providing) maps/diagrams of the on-site area or facility showing assembly points, sheltered areas, evacuation routes, monitoring/sampling locations, emergency facilities, and areas that are potentially hazardous under emergency conditions.
Table A14.II (p226)
Assembly point: Locations where non-essential personnel at the facility are assembled; accounted for and sheltered or evacuated [...] Areas [...] with sufficient room for on-site non essential (non-response) staff (including construction workers or other non permanent personnel). The location must be easily accessible, provide some protection from a release or exposure, and be continuously monitored.

9.2(2) **Issue:** The protection of the emergency workers and all the persons on the site in the event of a nuclear or radiological emergency is not fully effective.

- The assembly points are not equipped with personal protective measures, except a first aid kit and stable iodine tablets
- In the assembly points, there is no systematic provision of water, to be used to take the stable iodine tablets
- In the assembly points, there is no means to monitor the radiation exposure or contamination of the assembled persons
- No continuous monitoring of radiation levels in the EOC and in the TSC special room
- No contamination check of the assembled personnel
- No contamination check during the on-site evacuation process (nor on-site nor off-site)
- No personal protection means for the drivers of the evacuation buses
- In case of a site evacuation, the contractors have to provide their own transportation means
- Site evacuation could be, in case of lack of transportation means, made by escorting by walk to Visaginas (~8 to 10 km away from the plant)
- No direct reading dosimeter available for the medical staff
- No systematic contamination check at the entrance of the EOC (shelter) despite of the presence of a detection portal Potential of an uncontrolled spread of contamination in the EOC.
- The EOC radiation monitoring access portal is not situated properly with a possibility of cross contamination
- No presence of vinyl in the ambulances in order to avoid any risk of contamination spread (vinyl is available in the medical service premises)

Ineffective protection of emergency workers and all the persons on the site could lead to unnecessary personnel exposure and/or uncontrolled spread of contamination.

Recommendation: The plant should improve the effectiveness of the protection of the emergency workers and all the persons on the site in case of a nuclear or radiological emergency.

IAEA Basis: GS-R-2: 4.51
The operator of a facility [...] shall make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency.

GS-R-2: 4.50, 4.58, 4.62, 4.71, 4.91
Arrangements shall be made to protect emergency workers, in accordance with international standards.
Such assisting personnel as [...], medical personnel and drivers and crews of evacuation vehicles shall be designated as emergency workers.
[...] arrangements to assess continually and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance and international standards [...]
[...] This capability shall include arrangements for promptly conducting environmental monitoring and monitoring for contamination on people (e.g. evacuees) [...]
For the emergency zones, arrangements shall be made for monitoring the contamination levels of vehicles, personnel and goods moving into and out of contaminated areas in order to control the spread of contamination.

EPR-METHOD-2003
2.1.1. Goals of EPP (p5,6)
[...](7) to protect, to the extent practicable, the environment and property; [...] The seventh goal is addressed by limiting the spread of contamination [...]
4.1.2.(p36)
[...] On site there may be high dose rates, beta emitter contamination or other hazardous conditions in areas requiring action by the staff to mitigate the emergency. Therefore, people responding on site must be provided with appropriate protective equipment and training.
A4 (p63)
Develop a procedure to monitor the dose in the on-site assembly areas or shelters and evacuate if necessary [...]
Arrange to monitor and manage the contamination of evacuees from the site, estimate the dose [...] of those on site during the emergency
A6.7 (p69)
Arrange to provide protection for emergency workers [...] Include arrangements to continually assess and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance in compliance with international standards [...]
Table A14.II (p226, 227)
Assembly point: [...] The location must be easily accessible, provide some protection from a release or exposure, and be continuously monitored.
Emergency Operations Facility (EOF) [...] continuous monitoring of radiation levels; [...] sufficient protection to remain habitable (This should include provision to monitor and control radiological exposures and contamination, to control other hazards (e.g. heat, air quality) and to meet human needs (e.g. with food, water, and

sanitary and sleeping arrangement) if the facility may be isolated for an extended period during an emergency)
Operational Support Centre (OSC) [...] a location that will probably remain habitable under emergency conditions, continuous monitoring of radiation levels; ready access to equipment, instruments and protective clothing needed by response teams

B5.2 (p103)
[...] There should be provisions to continuously monitor radiological conditions and control of contamination within the facilities and for evacuation if warranted.

9.7. TRAINING, DRILLS AND EXERCISES

9.7(1) Issue: The periodical drills and exercises programme is not sufficient to assess the effectiveness of the emergency response capability. The programme does not include comprehensive and integrated on-site and off-site exercises allowing assessing the effectiveness of the coordinated response of all emergency response organizations.

- The plant does not have a systematic or organized process to check the regular participation of substitute(s) during exercises. Some positions have therefore never been tested by a substitute during an exercise.
- The turnover process of the ERO-functions was never tested during an exercise.
- The minimum exercise frequency is lower than 1 per year (minimum 1 per 2 years for the key management ERO-functions, 1 per 3 years for the full on-site scale exercise)
- During the 3 yearly full on-site scale exercise, the systematic active participation of off-site organization is limited to the regulatory body (VATESI) and the media
- No unannounced drills, exercises or mobilization tests are performed, where as it is a general practice at most NPPs.

Without sufficient periodical drills and exercise programme, the plant could not effectively assess the emergency response capability.

Recommendation: The plant should improve the periodical drills and exercises programme including periodic, comprehensive and integrated on-site and off-site exercises.

IAEA Basis: GS-R-2: 5.33, 5.34, 5.35
Exercise programmes shall be conducted to ensure that all specified functions required to be performed for emergency response and all organizational interfaces [...] are tested at suitable intervals. These programmes shall include the participation in some exercises of as many as possible of the organizations concerned.

The staff responsible for critical response functions [...] shall participate in a training exercise or drill at least once every year.
The officials off the site responsible for making decisions on protective actions for the population within the precautionary action zone and/or the urgent protective action planning zone [...] shall regularly participate in exercises.

NS-G-2.8: 4.34
The training for emergencies should include the periodic performance of emergency drills and exercises. [...] There should be full scale exercises involving external organizations such as the police, fire services, ambulance teams, rescue teams and other emergency services.

EPR-METHOD-2003 B6.3, B6.6 (p107)
Exercise scenarios, simulation, or play should be realistic. [...] Organizations that are not part of the response organization, but that could play an important role (e.g. the builder of the facility, the IAEA) should participate in exercises periodically.
The individuals [...] who would fill crucial leadership roles should participate in the training, drills or exercises. Substitutes who would not fill those positions during a real emergency should not be allowed.

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

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

Good Practice

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

- Novel;
- Has a proven benefit;
- Replicable (it can be used at other plants);
- Does not contradict an issue.

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

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

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

Safety Series No.110; The Safety of Nuclear Installations (Safety Fundamentals)

Safety Series No.115; International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources

Safety Series No.120; Radiation Protection and the Safety of Radiation Sources: (Safety Fundamentals)

NS-R-1; Safety of Nuclear Power Plants: Design Requirements

NS-R-2; Safety of Nuclear Power Plants: Operation (Safety Requirements)

NS-G-1.1; Software for Computer Based Systems Important to Safety in Nuclear Power Plants (Safety Guide)

NS-G-2.1; Fire Safety in the Operation of Nuclear Power Plans (Safety Guide)

NS-G-2.2; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (Safety Guide)

NS-G-2.3; Modifications to Nuclear Power Plants (Safety Guide)

NS-G-2.4; The Operating Organization for Nuclear Power Plants (Safety Guide)

NS-G-2.5; Core Management and Fuel Handling for Nuclear Power Plants (Safety Guide)

NS-G-2.6; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (Safety Guide)

NS-G-2.7; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (Safety Guide)

NS-G-2.8; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (Safety Guide)

NS-G-2.9; Commissioning for Nuclear Power Plants (Safety Guide)

NS-G-2-10; Periodic Safety Review of Nuclear Power Plants (Safety Guide)

50-C/SG-Q; Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations (Code and Safety Guides Q1-Q14)

RS-G-1.1; Occupational Radiation Protection (Safety Guide)

RS-G-1.2; Assessment of Occupational Exposure Due to Intakes of Radionuclides (Safety Guide)

RS-G-1.3; Assessment of Occupational Exposure Due to External Sources of Radiation (Safety Guide)

RS-G-1.4; Building Competence in Radiation Protection and the Safe Use of Radiation Sources (Safety Guide)

GS-R-2; Preparedness and Response for a Nuclear or Radiological Emergency (Safety Requirements)

INSAG, Safety Report Series

INSAG-4; Safety Culture

INSAG-10; Defense in Depth in Nuclear Safety

INSAG-12; Basic Safety Principles for Nuclear Power Plants, 75-INSAG-3 Rev.1

INSAG-13; Management of Operational Safety in Nuclear Power Plants

INSAG-14; Safe Management of the Operating Lifetimes of Nuclear Power Plants

INSAG-15; Key Practical Issues In Strengthening Safety Culture

INSAG-16; Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety

INSAG-17; Independence in Regulatory Decision Making

INSAG-18; Managing Change in the Nuclear Industry: The Effects on Safety

INSAG-19; Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life

Safety Report Series No.11; Developing Safety Culture in Nuclear Activities Practical Suggestions to Assist Progress

Safety Report Series No.21; Optimization of Radiation Protection in the Control of Occupational Exposure

TECDOCs and IAEA Services Series

TECDOC-489; Safety Aspects of Water Chemistry in Light Water Reactors

TECDOC-744; OSART Guidelines 1994 Edition

TECDOC-1329; Safety culture in nuclear installations - Guidance for use in the enhancement of safety culture

TECDOC-955; Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident

EPR-METHOD-2003; Method for developing arrangements for response to a nuclear or radiological emergency, (Updating IAEA-TECDOC-953)

EPR-ENATOM-2002; Emergency Notification and Assistance Technical Operations Manual\DPNSE223COMMUNOsart_TeamKatsuMaterials for OSART Prep.2004-07Publication\SafetyReport11.pdf

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