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REPORT
of the

OPERATIONAL SAFETY REVIEW TEAM
(OSART)

MISSION
to

BORSSELE
Nuclear Power Plant

The Netherlands

21 November – 7 December, 2005

Operational Safety Review Mission
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PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) review of Borssele Nuclear Power Plant, The Netherlands. It includes recommendations for improvements affecting operational safety for consideration by the responsible Dutch 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 Dutch organizations is solely their responsibility.

FOREWORD
by the
Director General

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

An OSART mission, carried out only at the request of the relevant Member State, is directed towards a review of items essential to operational safety. The mission can be tailored to the particular needs of a plant. A full scope review would cover nine operational areas: management, organization and administration; training and qualification; operations; maintenance; technical support; radiation protection; chemistry; operating experience 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 judgements that were not intended would be a misinterpretation of this report.

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

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INTRODUCTION AND MAIN CONCLUSIONS

INTRODUCTION

At the request of the government of the The Netherlands, an IAEA Operational Safety Review Team (OSART) of international experts visited Borssele Nuclear Power Plant from 21 November to 07 December, 2005. The purpose of the mission was to review operating practices in the areas of Management Organization and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Radiation Protection; Chemistry; Operating Experience Feedback 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.

Borssele NPP is located on the estuary of the Schelde River in South of The Netherlands. It is owned and operated by N.V. Elektriciteits – Produktiemaatschappij Zuid – Nederland EPZ, which has received its NPP operating license, on the basis of the Nuclear Energy Law (KEW) from the Ministry of VROM and other Ministries in The Hague. The Borssele NPP is located near the village of Borsele in the Borsele municipality. Construction started in 1969, first production in 1973. The plant operates one two-loop PWR of KWU design with a gross capacity of 480 Megawatt, net capacity is 450 Megawatt. The EPZ organization counts 446 persons, but 121 of them are for operations of the 427 MWe capacity fossil fire plant on the adjacent site.

The Borssele OSART mission was the 134th in the programme, which began in 1982. The team was composed of experts from Belgium, France, Hungary, Japan, Romania, Russia, Slovakia, Slovenia, Sweden, the USA, together with the IAEA staff members and observers from Belgium, Lithuania, Republic of Korea and the IAEA. The collective nuclear power experience of the team was approximately 345 years.

Before visiting the plant, the team studied information provided by the IAEA and the Borssele 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 the managers of Borssele NPP are committed to improving the operational safety and reliability of their plant. The team found good areas of performance, including the following:

– The equipment in the plant is well maintained to preserve good material condition and generally in most of the locations visited by the team, the plant shows good housekeeping and cleanliness.

– The Probabilistic Safety Assessment (PSA) is used systematically to support operations and maintenance activities; and plant decision making.

– There is a good and open organizational culture including good communication between managers and workers.

– The plant is open to cooperation with international organizations and uses benchmarking to emulate good practices.

The team offered also a number of proposals for improvements in operational safety. The expression of these improvements is as follows:

– The management does not always succeed to clearly express and effectively communicate its expectations throughout the organization. Plant management is encouraged to write, to clarify, to explain, and to promote management expectations in all areas such as nuclear safety, industrial safety, or economy.

– The team found that the staff is not always rigorous in following the rules when performing their activities; sometimes rules are applied with accepted "flexibility". This might be attributed to a characteristic of the national Dutch culture; and it is compensated by several other positive arrangements such as toolbox meetings and the "issue of the month" initiative.

– In the team opinion, the attitude at the plant reflects some complacency with respect to some issues. Although the plant is aware of the problem of oil leaks around the main turbine, their actions have been focused on the long term solution to replace the relevant part of the oil system and also on fighting a potential fire. The team advised the plant to implement temporary compensatory actions to remediate the problem until the final solution is achieved.

The team also stressed other main strengths and weaknesses. The strengths are as follows:

– the use of computer applications such as the risk matrix, the Personal Data Assistance (PDA), and the provision of plant information during emergency planning and preparedness (EPP);

– the tools used for training such as crew evaluation on simulator and video training;

– the labelling of calibrated electrical instruments;

– the attention to ALARA principles that range from minimization of personnel dose rate to site radiation survey;

– the indication of safety awareness in several areas such as for maintenance staff checking in detail safety components; the organization of safe work around electrical cabinets; and for chemistry the signalization of boron measurement when out of function;

– the continuous improvement of the quality of work such as the assessment of cross comparison on test results for chemistry.

But the team also searches for weaknesses and they are addressed in the following way:

– the policy to control contractors and the surveillance of the contractors' practices by the plant management, regarding industrial safety;

– the necessary need to develop more computer applications to integrate all training and qualification information;

– the flexibility in reporting and in transcribing data on formal documents, in conducting pre- and post-job briefing, in adherence to RP requirements;

– the need for improvement of some programmes such as maintenance of pipe hangers; the trending of data from periodic tests; the analysis and trending of data for near misses; the enhancement of OE process; the labelling and shelf life for chemicals; and the development of unannounced exercises for EPP.

The overall impression of the team is that the plant has many attributes associated with strong safety culture. A stable work force with long experience in the plant has facilitated these developments.

And while a strong safety culture is evident in many ways, the concepts of safety culture need to be systematically re-enforced in the company as it faces changes and retirement of experienced employees.

The plant started a transition phase with a new organization and also with future challenges in terms of ageing, and increased economic pressures from a competitive market. The plant should continue to address these challenges.

Borssele NPP management expressed a determination to address the areas identified for improvement and is willing to accept a follow-up visit in about eighteen months.

1. MANAGEMENT, ORGANIZATON AND ADMINISTRATION

1.1. ORGANIZATION AND ADMINISTRATION

Borssele Nuclear Power Plant is a single reactor (two-loops PWR KWU Siemens design). With the coal fired power plant located beside, a gas turbine and five wind powered turbines, it is one of the production plants of the EPZ Company, owned by two Dutch utilities: Essent and DELTA.

Three hundred and twenty five employees work for the Nuclear Power Plant out of the 446 in EPZ.

Borssele Nuclear Power Plant started production in 1973, and is the only Nuclear Power Plant in the Netherlands since, following the Chernobyl accident, the Dutch nuclear scheme was stopped. The plant updated its safety design in 1997 and after a political decision to stop it in 2003, the company obtained on court the right to operate it furthermore. It has an operating license without expiry date. The Company is still in discussion with the authorities about the operation of the NPP beyond 2013; it intends to operate it until 2033.

As a consequence, the high level of safety performance and the benchmark with international standards is up most important for the plant.

Borssele Nuclear Power Plant's organization has been reviewed recently. The reorganization was meant to clarify the responsibilities; to shorten the management lines; to improve cross functional functions (particularly during outage); and anticipate and adjust the resources accordingly. The project started two years ago, and the reorganization is now completed. The Plant Manager has the overall responsibility on safety (Senior Nuclear Executive) since October 2005, and the next outage in 2006 will be the first one to be conducted under the new organization.

The Final Safety Analysis Report (FSAR) has lastly been updated in 2004 for the project to increase the fuel enrichment to 4,4% ^{235}U: the Technical Specifications have been updated in 2005 to accommodate the plant reorganization. These updates of the Technical Specifications were discussed and amended in the external nuclear safety committee and validated by the Safety Authorities.

Different committees are in place to make arrangements and find consensus before decisions at the appropriate level. The relatively small size of the plant helps cross functional functions to be fulfilled more easily.

The organization features an independent line to report to the Plant Manager and to the EPZ Director.

Although the resources managers (Human Resources and Finance) are headed by the EPZ Director, the Plant Manager has the formal authority to allocate resources for safety related activities.

The relationships with the regulatory body are clearly distributed: EPZ Director is responsible for licensing; Plant Manager for operations and organization concerns; QA manager and engineers for inspections and technical issues.

A three-year based business plan has been established for EPZ, which includes the goals and objectives at the Nuclear Power Plant as well as the resources allocated to reach them. This document is used to report and discuss with the company share holders.

The number of staff is now 325 people, distributed in four departments (production, maintenance, monitoring and control and technical support). Resources, finances and communications are attached to the corporate level.

Yearly objectives are discussed between EPZ Director and Plant Manager in bilateral or in the quarterly meetings with the managers. Safety goals and objectives, based on WANO indicators are regularly reviewed, and the main action plans are followed by the corporate level.

Because the Senior Nuclear Executive handover is very recent, all position are not settled yet, nevertheless Corporate Director and Plant Manager are giving clear evidence of this empowerment for the staff and the external bodies.

Functions and responsibilities are defined in the plant functions chart (EPZ organigram) and in the function description sheets (FTO). They are available for all job positions.

Resources and financial plans are discussed at a corporate level. Safety issues and programs to improve safety or enhance human performance are given the right priority.

In the new organization, in order to clarify the process towards contractors, the global responsibility has been handed over from Maintenance Department to Financial Department. In order to improve the supervision of the contractors, a special attention and strong connections have to be set up reinforce the links between the two departments involved in the policy toward contractors.

The plant has defined its staffing policy for the five coming years. A retirement scheme has been set up by the company to allow anticipated retirements. Recruitments have been made at the appropriate level to fulfil the missions and to anticipate the retirement of the managers or people holding key positions on the plant. In some departments, plans have been established to identify the potential loss of key competencies due to retirements or turnovers. This method could be extended and detailed in all departments to assess the global risk of loss of competencies in the coming years.

The plant has a system of annual performance appraisal which is based on performance objectives and behaviour criteria. The Human Resource department has issued a clear booklet to describe it. This process is participative and documented. However, it is not strongly coupled with skills and competencies. The plant does not require the managers to formally follow the skills of the subordinates and authorizations to do the work are based on the completion of the training programmes. The commitment of the managers to maintain and develop the skills could be reinforced and more documented, such as the example using the competencies matrix that has been developed in certain departments.

Since long time ago, a large range of operational activities as well as services have been performed by contractors. For minor contractors, the plant relies mainly on that experience to qualify them. Although the plant requirements are specified, they are seldom reviewed and formally audited. Evaluation of contractors is not formal, except for major contractors such as the nuclear fuel vendor; or when a problem is detected. The team suggests that the plant improves this process and reinforces its supervision of contractors.

The relation with the Regulatory Body is open and transparent. The contacts between the Regulatory Body and the plant management are frequent and address operations and management issues.

Regular meetings are held at different levels to review the safety performances of the plant and discuss safety concerns. As examples:

- In addition to the significant events reports, the plant communicates other minor events and the corrective actions decided by the plant. Those events and their classifications on the INES scale are sometimes discussed.

- A document has been issued by the plant to present the impact of the reorganization of the plant on safety.

The level of reported events is consistent with international standards.

Among the different committees of the plant, the Safety Committee is an advisory committee, chaired by the Plant Manager, to report and to discuss safety related issues. Deviations are discussed among managers and further analysis or actions are decided in this committee. This is an open and efficient committee that brings all managers together to discuss safety issues. Operational and technical issues are discussed in the Safety Committee. Twice a year, special Safety Committees address management of safety and safety culture issues.

An external Safety Committee is held three times a year. It is an advisory committee where significant events are presented and safety issues discussed as well as management and organization issues. This committee is composed of external experienced and knowledgeable senior members. It enables the plant to have an external cross view of its safety policy and to check that focus and priority are maintained on safety issues. As an example, this committee has given recommendations to the plant to manage the reorganization.

Plant operations safety committee (RBVC) and an external operations safety committee (ERBVC) roles are clearly defined, agendas are prepared and documented, performances and actions followed up.

The company also strives to have a clear and positive communication with the public. An internet site of the company provides different types of useful information about the plant policies, programmes, and performances, particularly regarding environment. Safety is given the overriding priority and the new safety objectives will be improved to support it, when the project safety performance indicators (SPI) is completed.

1.2. MANAGEMENT ACTIVITIES

Actions plans and performance indicators are defined and followed up in the departments and reported in the plant management meeting (MT-OPS) chaired by the Plant Manager.

However, the team recommends reviewing the performance indicators in order to link them to the main objectives and priorities, and to make a larger us of them towards the staff.

The downwards communication relies on the meetings at different levels of the organization, different committees and the company intranet system.

After decisions are made and actions decided, events and deviations analyzed, most of the corrective actions are put in the workflow (ISO) along with the work orders, in order to be tracked to their completion.

Human Performance is also addressed in the Event Reports. However, unlike most other plants, the company did not make usage of knowledgeable Human Performance (or human factor) adviser to analyse the work practices and give clues to managers and staff for the improvement of organization, process, skills or human performance in the field.

The probabilistic safety assessment (PSA) programme to improve risk informed decision making has been implemented long time ago in Borssele Nuclear Power Plant and is now used extensively at different levels for operations and outage. The team considers this as a good practice to be communicated to other Power Plants.

1.3. MANAGEMENT OF SAFETY

The safety policy of the plant is written and clearly expresses the commitment of the management to promote safety.

Programs have been implemented to improve the leadership of the managers and promote safety culture:

- In Operations Department, a human performance (HP programme is carried out and shift leader have been trained to reinforce human performance, team spirit and problem resolution.

- Based on WANO HP guidelines, it has been conducted in partnership with Essen Simulator Training Center (in Germany).

- Periodic tours in the field, intended to check the equipments, have been reviewed to focus on the work practices. Managers are now expected to be in the field with the technicians to improve the vertical communication, detect potential problems and check if the management expectations are well understood and met.

– A strong communication is also made to promote safe work practices with “the issue of the month” publicized in the company magazine, in the team meeting (“toolbox meeting”) and with posters around the plant.

This communication is efficient, but is often understood as limited to industrial safety issues.
As an example, the promotion of reports on minor industrial safety events could be encouraged in the area of Nuclear Safety and clear evidences of reward could be given to reinforce the detection of minor events, deviations, concerns or potential weaknesses in the area of Nuclear Safety.

The plant is encouraged to implement the new Safety Performance Indicators (SPI), to select among the SPI indicators stable ones for long term trend identification, and other temporary indicators linked to the top priorities of the plant for the considered period. The definition of its top priorities and the choice of the relevant temporary indicators could be reviewed periodically (yearly for example) and a large communication of these priorities could be made to use indicators as a management tool.

The Corporate and Plant management promotes international cooperation and the plant is well connected to the nuclear industry. WANO safety standards are used extensively.

In order to improve the safety performance of the plant, most managers share that priority has to be given to the promotion of safe work practices. Nevertheless, the safety indicators, and the targets defined in the yearly plans do not always enable the management to monitor the actions on the work practices and assess their evolution.

The plant promotes self-assessment and self-evaluation. Errors and deviations are analysed and the managers demonstrate non-blaming attitude.

The team has also noted the equipment ageing program implemented to analyse and understand the long term evolutions of equipment reliability.

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

– Probabilistic Safety Assessment (PSA) is used systematically to support operations and maintenance activities and plant decision making. This is a voluntary commitment of the plant to minimize risk inside the range of operating conditions allowed by the deterministic limitations. The results of this approach are evident in the decreasing trend of risk characteristics since the introduction of these risk applications.

– There is a good and open organizational culture: communication between managers and workers is visible. There are no big distances between hierarchical levels; this allows and encourages personnel to challenge each other on regular occasions.

– The plant is open to cooperation with international organizations and uses benchmarking to emulate good practices. This is exceptionally important for Borssele NPP, being the only nuclear plant of EPZ and in the Netherlands, in order to achieve its goal to be in the best quartile of nuclear plants worldwide. The team has identified it as a good practice.

– Overall plant personnel are very experienced, competent and skilled. Strong ownership of their areas of responsibility has been observed throughout the organization. The plant staffs are comprised of very motivated people - they want to do a good job, and they are proud of the good results achieved.

– General housekeeping and cleanliness in the plant is good in international comparison. This helps to maintain a strong focus on safe working conditions. Plant staff is encouraged to report dangerous situations via the intranet or printed forms available at various places in the plant.

– Optimization of man - machine interface in the main control room was performed with active participation of the control room personnel. This is a good example how the staff can contribute to the process of safety improvements in their own working environment.

– At the same time the team concluded that management does not always succeed to clearly express and effectively communicate its expectations throughout the organization. Plant management is encouraged to clarify management expectation that for EPZ safety has an overriding priority in comparison to all other factors including economics.

– The team found that the staff is not always very rigorous in following the rules when performing their activities; sometimes rules are applied with accepted "flexibility". This might be attributed to characteristics of national culture; and it appears to be compensated by several other positive arrangements in place, like toolbox meetings and the "issue of the month" initiative.

– In the team's opinion, the attitude at the plant reflects some complacency with respect to oil leak issues. Although the plant is aware of the problem of oil leaks around the main turbine, their actions have been focused on the long term solution to replace the relevant part of the oil system and also on fighting the worst case (i.e. the potential fire). The team advised the plant to implement temporary compensating actions to remediate the problem until the final solution is achieved. Countermeasures to limit the risk of fire due to the oil leak are not fully developed. This may be partly explained with the reliance on the upgrading of fire suppression systems to the best available technology, which has been implemented in the recent years. It is a concern that the operation of the low pressure fire water system is not under the supervision of the nuclear plant.

– The team encourages the plant to continue development of the Safety Culture programme, to use tangible indicators to focus the attention of the organization on this matter. The introduction of periodic assessment of Safety Culture planned by the plant starting in 2006 can be regarded as a future development in this direction.

1.4. QUALITY ASSURANCE PROGRAMME

The quality system of the plant is documented in the quality manual. The system is organized and comprehensive, apart for the contractor's area, which is only partially described.

In the organization, the QA Manager is under the EPZ director's authority. QA is well positioned in

the organization and can report to plant manager and EPZ director directly.
There are 15 main work processes described in the relevant procedures to cover the entire programme for safe operation but the contractor's policy, procedures, and audit programmes related to this field are not comprehensive.

The audit program is established on a four year base rolling programme so as to cover all fifteen processes and it is amended in the Safety Committee to adapt to the plant concerns. All audit reports are presented to the relevant committee and corrective actions are decided after the report has been discussed. QA audits programme and reviews are available on Intranet. The Safety Authority reviews the plant's QA system effectiveness.

1.5. INDUSTRIAL SAFETY PROGRAMME

There is a clear policy for industrial safety in the company which is easily accessable on the Intranet. Industrial safety requirements have been integrated in the plant work management procedures. Targets for industrial safety are defined on a yearly base.

There are clearly assigned responsibilities for the industrial safety supervision. The Plant Manager has the responsibility of industrial safety and he is advised by the industrial safety advisor. The industrial safety advisor, who is qualified by an external government body, gets from the Plant Manager the authority in the area of industrial safety. The industrial safety advisor is responsible for implementation of the new laws, regulations and industrial requirements in the plant procedures. The Maintenance Department is in charge of the surveillance programme for testing all industrial safety hardware in place.

Direct supervision of the industrial safety advisor by the plant manager and his integration in the Company, is now made possible. Responsibilities and the functional relationships are set according to the Dutch law.

The Industrial Safety Committee, chaired by the Plant Manager, takes decisions and reviews the industrial safety indicators and action plans. The Industrial Safety Committee is well organized, documented and the analysis of events with a root cause analysis method is efficient and provides useful information to its members. The programme and procedures are reviewed each year and modified when necessary. The requirements of initial training to all workers in the plant are defined.

After a comprehensive audit conducted in 2003 by a consultant specialized in the field, more than forty recommendations were issued. So far, five of them have been implemented at the plant and most of the others will be in the future. To reinforce communication to the workers, an "issue of the month " is chosen and communication is spread through the company magazine. Posters are displayed in the plant and the toolbox meeting held by every team. All staff (EPZ and contractors) is encouraged to report any event related to industrial safety through the Intranet. With this system, minor events are reported and their number is tracked as a performance indicator. The team encourages the plant to promote such reports with visible rewards to those who commit themselves in reporting minor events.

However, some practices and situations observed in the field do not meet the plant requirements. The team developed a recommendation for contractors' work practices and suggestions have been made to prevent unsafe situations.

1.6. DOCUMENT AND RECORDS MANAGEMENT

The organization of documents and records and the plant policy is written in the Quality Manual. A hierarchy of documents exists and standard formats and processes have been defined accordingly.

The system of production and archives is under control. The originals are kept; a digital copy and a digital back up are made. A strong fire prevention in the archive rooms and a physical separation of the digital back up minimize the risk of loss of documents.

The procedure of issue and change of documents is defined and controlled, especially for Operation documents. The production and control of documentation are standardized and enforced by administrative measures. The computer system and the company intranet are user friendly and make easy the access to the documents and information.

DETAILED MANAGEMENT, ORGANIZATION AND ADMINISTRATION FINDINGS

1.1. ORGANIZATION AND ADMINISTRATION

1.1(1) Issue: The programme for controlling contractors is not adequately defined. The process for qualifying and evaluating contractors is inconsistent.

For important contracts, the company frequently qualifies the contractor or hires a consultant to check the quality system of the contractor. However, for other contracts:

- The standards for contractors are not defined in the company QA programme.
- The plant does not always formally assess the qualification of the contractors and document it in a proper way.
- For many contracts, there is no formal evaluation of the contractors after they have finished the work.

Without a clear policy, and if no specific process is established to qualify and evaluate the contractors, the quality of the work may not meet the plant requirements, which could result in equipment deficiencies.

Suggestion: The plant should consider writing a programme and procedures to qualify and evaluate contractors.

Basis: NS-G-2.4 sec 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. Documented assurance should be obtained that contractor personnel have the required qualifications prior to independent involvement in these activities."

1.2. PLANT ORGANIZATION AND MANAGEMENT

1.2(a) Good Practice: The plant practices risk-informed decision making within the licensing conditions is implemented for many purposes. The plant makes efforts expanding this to all sensible applications for the full scope level 3 living PSA in line with the plant policy to optimise production in the environment where nuclear safety has the overriding priority.

Ever since the plant developed its first Probabilistic Safety Assessment (PSA) it has been used to support safety related decisions. The plant has over 20 years of experience with probabilistic evaluations of design improvements. In 1984 a PSA analysis was performed to evaluate different design options for secondary pressure relief. In 1987 a study was started to investigate the reliability of the electrical bus bars.

Since then the plant has added PSA insights as additional input in its safety related decisions more and more. Examples of applications are:

- Pilot studies have been performed to optimize the Technical Specifications.

- A pilot study on "Lower End States" has been performed. Useful lower end states have been defined, e.g. a Trip Monitor and a Critical Safety Functions Monitor.

- This year (2005) a pilot study has been undertaken to investigate the use of the PSA in precursor analyses, both as a selection tool and to provide additional insights in an event evaluation process.

- Borssele's PSA data have been used to support decision making with respect to source term forecast in (severe) accident situations. The programme (SPRINT) now shows the probabilities of the possible source terms.

The plant has experienced benefits both in safety increase and in cost reduction by using PSA and its applications in the decision making processes. Examples are:

- Reduction of workload in the refuelling outages while at the same time reducing the risk profile, both for the outage and for the complete fuel cycle.

- The PSA has been used in the design phase of the 1st Periodic Safety Review (PSR), where in several occasions the optimal design could only be selected by using PSA insights.

- The plant calculates the risk has actually occurred over the time by a living PSA tool, the "Risk Monitor". Due to the planned and unplanned unavailabilities the risk increases and its significance depends on the absolute risk increase and the time of the unavailability.

The plant has set yearly targets for risk increase due to planned and overall (planned and unplanned) unavailabilities. These risk increments are evaluated and analysed periodically (monthly and yearly) and corrective actions are initiated. The objective for planned unavailability has been set to 2 % of the Total Core Damage Frequency (TCDF). The target for the overall unavailability has been set to 5 % for 2000 with a decrease of 0,1 %/year to

2008. The yearly actual TCDF are 8,1%; 1,99%; 2,93%; 4,15% and 2,55% from 2000 to 2004 respectively.

The PSA and its applications support performance evaluation and identify possibilities for further developments. The results show that, while surveillance and planned maintenance has increased during power operation, the level of nuclear safety has improved over the years.

1.3. QUALITY ASSURANCE PROGRAMME

1.3(a) Good Practice: Despite its limited size, EPZ staff is participating in about 40 international working groups and commissions, e.g. in IAEA, WANO and VGB, NEA membership relations.

The EPZ managing director is Governor for the WANO Paris Centre. Additionally, an average of 5 persons of EPZ is yearly involved in WANO, OSART, AMAT and similar missions, resulting in over 90% EPZ management having international experience. The collective experience of the working groups and missions is used to improve the knowledge base, to strive to the international state of the art and to improve the plant and enhance safe work practices by comparison with the best industry practices and by emulating good performers. On the other hand Borssele experiences are shared with the international nuclear community.

There are many examples of major improvements in which EPZ was among the first ones in Europe and in many cases also has been an example for other European plants.

An important contribution was made by EPZ to the establishment of the IAEA guidelines for the equipment ageing management programme.

1.5. INDUSTRIAL SAFETY PROGRAMME

1.5(1) Issue: Contractors' industrial safety work practices observed in the field do not meet the requirements of the plant and supervision of contractors and tours by plant managers do not always allow these deviations to be corrected in a comprehensive and timely manner.

- A contractor worker was standing on the edge of the roof of the diesel engine building without a harness. The EPZ supervisor did not notice the hazard and only the manager asked him to walk away from the edge.

- A contractor worker working on the turbine hall anchoring bolts was working on a very noisy environment without ear protection.

- A contractor working in a confined space used acetone with neither personal protective equipment nor gloves. He did not have a work permit.

- On the concrete works on the reactor building, the scaffolding ended on each floor with wooden planks that were not secured and were too far from each other. The stairs to reach the upper floor were not secured.

- On the roof of the hydrazine station, a worker was working with a drill away from the scaffolding with no harness five meters above the floor. The work order was signed and the scaffolding was approved. The scaffolding was mobile on its wheels, and the iron fixing bars were lifted off the ground.

- Two contractors working with a vacuum cleaner on the frame of the building structure at the turbine level were standing on the edge of a hole (15m deep) without safety harness.

- Two contractors were seen using cutters not allowed on the plant.

Without strict attention to and adequate supervision of contractors' work practices and behaviour regarding industrial safety, there may be a risk of industrial safety events in the plant.

Recommendation: The plant should reinforce supervision of contractors in the area of industrial safety, developing the competencies and skills of EPZ supervisors to develop efficient supervision and evaluation of contractors.

Basis: NS-R-2- 2.10 'Contractors' staff shall be properly controlled and supervised by plant staff".

1.5(2) **Issue:** Some situations were found on the site that are not in line with good industrial safety practices.

- By design, some safety valve exhaust pipes are not directed outside the building. Due to spurious opening of the valve when technicians were working in the control cabinet near the control system of the safety valve, this safety valve opened. Access is not restricted. The risk assessment reviews have not identified this risk.

- In the turbine building, one escape route in case of emergency is blocked with a lorry carrying a spent fuel cask. An alternative escape route was not posted in case of emergency.

- Inside the building of the main cooling water pumps, not all the grates are attached to the structure.

- The chemical make up room (04 316) has no emergency shower but only an eye wash.

Unsafe situations could result in industrial safety events at the plant.

Suggestion: The plant should consider all opportunities to take additional actions to identify, analyse and correct unsafe situations.

Basis: NS-G 2.4 Chapter 6.56. "An industrial safety programme should …ensure that all risks to personnel… are kept as low as reasonably achievable."

2. TRAINING AND QUALIFICATIONS

2.1. TRAINING POLICY AND ORGANIZATION

Plant policy on personnel and its development is described in the document "Personnel and Training" (HP-N11). In the first section principles of training function are described, including statements on ensuring sufficient and qualified personnel for safe and reliable plant operation, responsibility of managers to ensure qualification requirements for each function, providing training and development to personnel according to the tasks they perform, assuring quality of initial and re-qualification training, assuring inclusion of operating experience, and compliance with regulatory requirements as appropriate.

The document also provides a list of respected regulatory acts and nuclear industry guidelines. Further, scope on personnel and training function is described, including references and corresponding implementation procedures that address development of job task descriptions, competence matrix development, preparation of individual training and development plans, preparation of the annual training schedule and the annual report.

The training department is positioned inside Human Resources department; its staff is composed of training manager, two full time instructors, clerk, and competency management system administrator. The training department overall performance is very high according to the scope and complexity of assigned responsibilities.

The training department is responsible for delivery of in-house developed training courses; for organizing training courses that are delivered by contractors; for maintaining competency management system and training records keeping. For conduct of the in-house developed training, subject matter experts (SMEs) are extensively used. Training responsibilities for conduct of practical (on-the-job) training are distributed among respective plant departments.

Training and personal development programmes are developed based on competency analysis and consequent training matrix for each job position. Nuclear safety, ALARA principles, industrial safety, operating experience (domestic and international) are included and re-enforced during general employee training, during conduct of initial training programmes and during refresher courses.

All training records produced within the plant training department; and certificates acquired by attending training at external organizations, are kept by the training department in paper form.

There are several computer-based applications used to register training activities. On the training record keeping system the team has developed a suggestion to integrate training record keeping system into centralized computerized information system.

Instructors are very knowledgeable and skilled for their job performance. The contracted staff for the conduct of simulator training is of appropriate size and comparable to general industry practice. External organizations are extensively used for delivering training. For specialized training on specific equipment vendor facilities are used. For safety related subjects, equipment vendors or recognized institutions in the nuclear field are used, for example Westinghouse, Framatome, WANO, NRG (Nuclear Research Group).

Evaluation of external courses is performed by the training manager. As an example, extensive evaluation of performance of NRG is assessed annually and results are evaluated during annual meeting. Records on such evaluations are available.

Documents from international organizations (IAEA, WANO, Verein für Grosskraftwerk Betreiber (VGB)) are screened for applicability for Borssele NPP, and applicable events are included in simulator training scenarios.

It has been noted that very good cooperation exists among training organization staff and plant departments or internal training groups. Examples exist where experienced plant personnel has moved to the training organization and back to other plant positions. In this regard, to further enhance the practice, the plant is encouraged to consider arrangement of medium term (one to two years) assignments as trainers for the candidates that are anticipated to fill in specific important plant position such as control room shift supervisor.

Attendance to the scheduled courses is good; omissions on participation are tracked and corrected if possible. For obligatory courses, remedial measures are implemented in a form of self-study (required reading of course material).

Plant management supports training functions by allocating sufficient resources and participation through specific phases of training cycle (definition of scope, approval, evaluations), including personal involvement in delivery of lectures. This practice, in addition to the subject content provides also for conveying over management expectations.

2.2. TRAINING FACILITIES, EQUIPMENT AND MATERIAL

Well-equipped classrooms are available at several locations including the training centre; fire brigade building; and electrical and instrumentation training facility. Classrooms are equipped with modern projection equipment that supports computer-based presentations.

Suitable room for self-study is provided at the training centre, equipped with computer terminals that are linked to the Plant Process Information System.

A replica full scope simulator, located at the training centre KSG&GfS near Essen in Germany, is used for training of Borssele plant personnel. Physical fidelity of simulator panels is maintained current with exception of some support functions. Example of this is communication equipment which is different than the one used at the plant control room. Having communication devices equivalent to the ones used in real control room would increase realism of training and respect for formal communicating practice.

Simulator configuration is handled efficiently; process is documented and followed in a computer database. Borssele NPP has overall control of simulator configuration and all changes are approved by the plant. KSG&GfS is responsible for simulator maintenance and implementation of agreed upgrades. This is performed consistently in relation to Borssele NPP requirements. Records are easily retrievable and kept in good order.

Discrepancies are appropriately documented, analyzed and processed for resolution. The software configuration change typically occurs once a year. During testing period, each discrepancy resolution is tested individually. Larger modifications are handled as separate projects.

Scenario exercise guides, used at KSG&GfS, are well prepared and with sufficient detail. Plant controlled documentation at simulator facility is updated regularly. Completeness of the documentation is verified by operations and training management during conduct of each pilot training course. The simulator is equipped with projection equipment and a computer with a link that enables access to the Borssele plant documentation database.

The electrical and instrumentation training facility includes fully equipped classroom and separate rooms for practical (on-the-job) training. A high number of comprehensive mock-ups is available and most of them were developed in-house. Many mock-ups have capability to introduce malfunctions and are excellent tool for training on troubleshooting techniques.

The mechanical maintenance training facility, intended for on-the-job training is located inside radiologically controlled area. The inventory of mock-ups to train the most critical work sequences, especially from the ALARA standpoint, includes a steam generator bottom section, special valve type (disassembly/reassembly), part of reactor vessel and adjacent wall to train on replacement of rupture plate special seals.

Training materials are generally well prepared, contain detailed information and are constructed in accordance with adult learning good practices. Reviewed examples of student materials were of a good quality, containing pictures, schematics, diagrams, etc., with important elements highlighted in colour. Students receive colour copies.

2.3. QUALITY OF THE TRAINING PROGRAMMES

Training programmes consist of initial training and periodic refresher training. Training programmes for plant personnel are developed consistent with a job analysis and competency matrix. Individual training plans are developed commensurate with qualification requirements for particular job function and related to department organizational structure. Training programmes are structured to cover required theoretical knowledge, practical training and on-the-job training. Training material for the basic course is under QA review scheme.

Periodic refresher training is provided to cover general items (like industrial safety, fire prevention), plant modifications and operating experience. Refresher training content is developed in cooperation with plant departments and approved by department managers. Target groups for attending the annual refresher course training on particular topics are identified commensurate to the job area responsibilities, as appropriate to support the competency profile. The attendance is tracked and records are kept.

Attention is paid to interdisciplinary training, especially in the maintenance field. The plant has developed a video presentation on maintenance work practices which is efficiently used in training, including simultaneous use of effective instructional techniques. The team has developed here a good practice.

2.4. TRAINING PROGRAMMES FOR CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

The initial training programme for control room operators and shift supervisors is well structured. The programme is prepared based on job analysis and competence matrix. First time acquisition of the license is monitored by the regulatory authority. This programme is divided into four modules. First module covers reactor theory and is conducted at outside organization. The second module covers plant systems and operation and is mainly conducted in a form of classroom lectures and self-study. Walk downs of plant systems are performed after delivering lectures on a particular system. The third module is performed on-the-job where trainees are assigned to work with the shift team, and the last module is conducted on the plant specific full scope simulator.

The annual retraining programme for operations control room personnel is developed corresponding to 5-year training plan. Learning objectives are developed based on competences and operational feedback. Additional topics are added based on operations management inputs and feedback from trainees. Operators attend two weeks of on-site training where one part is on plant modification (just before outage) and the second part is on applicable portions of the annual refresher course.

Two weeks of simulator training is conducted, one in each half of the year. The second course in the year each team is evaluated on the simulator. In addition to this, specific courses are organized, like Shift Team Work that took place during the mission.

Scenarios are prepared based on a 5-year cyclic plan. Borssele NPP operating experience information, obtained from the operating experience (OE) group, as well as reports on events or lessons learned from the industry, are appropriately analyzed by the training department and included in scenarios scheduled for implementation during the next year.

Scenario exercise guides are well prepared and contain appropriate learning objectives, instructions for trainers, and expected actions to be carried out by trainees. Before implementation, scenarios are tested by plant operations and training representatives during pilot simulator course.

For shift team evaluation the plant developed a method for continuous evaluation based on 20 elements that are documented in each scenario exercise guide; results are followed for recognition of weak areas in performance and used for future attention. On this item the team developed good practice.

2.5. TRAINING PROGRAMMES FOR FIELD OPERATORS

Field operator initial training is well developed and consistent with industry standards and practices. Initial training contains good balance between classroom theoretical training, supported by practical training at the plant, and on-the-job training at the plant. The classroom part lasts 9 weeks and covers basic theory, plant systems and operation. Plant walk downs are conducted to familiarize trainees with plant systems and layout of process areas.

For the conduct of on the job training each trainee is assigned to particular shift team, working together with experienced field operators. Trainees may transfer to another shift team in case of specific training opportunities arise. The trainee's progress is regularly evaluated and recorded by the trainee's mentor, the respective Shift Supervisor. After having sufficiently covered and mastered programme requirements trainee takes final exam carried out by the Operations Manager or his deputy and training department representative. Outstanding non-covered items, as allowed by the programme, are tracked and covered at the earliest opportunity as warranted by the plant operational status.

2.6. TRAINING PROGRAMMES FOR MAINTENANCE PERSONNEL

Training programmes for maintenance personnel are developed based on competency matrix that outlines training requirements.

The retraining programme puts emphasis on operating experience feedback and promotion of good practices in the areas of safety, ALARA principles, briefing practices, and peer-checking practice. Maintenance organization effectively uses short (~30 minutes) training sessions, so called "Toolboxmeetings", which are prepared in advance, and cover various topics and essential information. Conduct of these sessions is considered as good performance. These sessions are documented and records are kept in the training department.

Training for electrical and instrumentation personnel is usually divided into theoretical and practical part. Most of comprehensive mock-ups were developed in-house showing high dedication of its personnel and high orientation to safety. Well prepared lesson material is prepared for each mock-up. This area is recognized by the team as a high performing training environment.

Skilled workers are used intensively as trainers to carry out in-house training courses and especially on-the-job training. For acquiring special skills, workers often attend training at equipment vendor's training locations.

It has been noted that the plant experienced difficulties in obtaining requested training services at some external training providers either due to loss of particular capabilities at training providers or due to disappearance of particular training provider from the market. Related to such circumstances, in one instance the plant decided to acquire training mock-up for steam generator bottom part to internally assure required training.

Currently, there is no structured programme in place that would systematically deal with the reducing of industry support in providing high quality training to maintenance personnel. The team notes that not having available all necessary resources, in terms of knowledgeable and skilled workforce for performing highly demanding maintenance tasks, may have negative impact on quality of maintenance work on safety related and other critical components. The plant is encouraged to develop and implement a structured programme that would systematically address existing and potential loss of critical knowledge and skills of industry support. Supportive statements could be found in IAEA document NS-G-2-8, in paragraph 4.5. where it is mentioned that the training needs for duties important to safety are addressed; in paragraph 4.8. which states the requirements for ensuring all necessary resources and facilities for the implementation of training programmes; and in paragraph 4.11. where can be read that considerations should be given to enhancing training programmes for staff at ageing plants to compensate for losses due to retirements or other reasons.

2.7. TRAINING PROGRAMMES FOR TECHNICAL SUPPORT PERSONNEL

Personnel working in technical support, chemistry and radiation protection attend regular annual refresher training. Work specifics are covered on the job.

Training programme for fire protection first response team is comprehensive. First response team composed from shift personnel (nuclear & coal), security and volunteers receive initial training (3 weeks) and certification by authorized institution. Retraining programme consists of standard theoretical part, practical exercises and introduction of new equipment. Retraining is well organized and performed commensurate to the responsibilities and duty areas. A consequent number of training devices are available including imitation of human body, smoke generator, sound generator, etc. Conduct of fire protection team training is considered by the team as good performance.

Training on emergency preparedness is conducted regularly. Individuals fulfilling function of Site Emergency Director attend position specific training and once per year a simulator retraining course together with one shift team. Large scale emergency exercises are supported also by the full scope simulator. Nine simulator scenarios are prepared for this purpose.

2.8. TRAINING PROGRAMMES FOR MANAGEMENT AND SUPERVISORY PERSONNEL

Training for management and supervisory personnel is conducted and is aimed to gain and enhance supervisory skills, communication practices and managing people.

For this purpose, trainees may either attend courses that are organized at the plant or at specialized organizations. During past two years a number of courses were held, for example: WANO safety culture and human performance course (26 participants); leadership and communications course (14 participants); course on management responsibilities and opportunities (14 participants); employee assessment course (14 participants): course on public relations (4 participants); one MBA programme; training on coaching (1 participant).

Above figures shows positive orientation of the plant to provide its managers and supervisors with training in managerial knowledge and skills.

2.9. TRAINING PROGRAMMES FOR TRAINING GROUP

Instructors at the plant are typically recruited based on their technical knowledge and experience at previous work position. Such individuals would have also some experience as on-the-job trainers.

As initial training, instructors receive a course on didactics of one-week duration. During their work, experience exchange among instructors is encouraged by the training manager.
Training manager will always attend pilot course that individual instructor will deliver, developing useful feedbacks to instructor.

Instructor and other trainers (SMEs) are evaluated on their performance and coached on items that could be improved. In addition, yearly appraisal interview serves for verification of instructor competences.

Instructors are regularly assigned to perform operational duties at the plant like preparation of the outage or work position during the outage. Instructors refresh their knowledge on job details and further develop technical knowledge.

Simulator instructors are KSG&GfS employees. Required entry level educational background for simulator instructor is university engineer. Initial training programme for simulator instructors is extensive and lasts approximately 3 years. On-the-job training at Borssele NPP lasts as a minimum 26 weeks followed by a final evaluation.

Regular two week retraining on technical part is organized and consists of attendance to scheduled refresher course and attendance in main control room. Two weeks of retraining are provided for didactical and human performance related topics.

GfS instructors are evaluated on their performance once per year by department manager. Peer evaluation is also performed once per year. Borssele NPP operations and training management evaluates performance of instructors during conduct of pilot training courses as well as during shift team evaluation week.

Borssele NPP instructors and simulator instructors, observed during delivery of courses, demonstrated excellent technical knowledge on the subjects and matter of training as well as high proficiency in instructional skills.

2.10. GENERAL EMPLOYEE TRAINING

General employee training (GET) is conducted for new hired personnel and for contractor's personnel. New hired employees receive two days introduction course and two days with individual training programme. Contractors receive two day course.

Trainers that perform applicable portions of the programme are from radiation protection department, industrial safety officer, and training department.

DETAILED TRAINING AND QUALIFICATION FINDINGS

2.1. ORGANIZATION AND FUNCTIONS

2.1(1) Issue: The training record keeping system and administration of other T&Q related information are not integrated into centralized computerized information system and therefore not easily retrievable.

- Requirements on competences, qualifications, training matrix and individual training plans are consistently developed; however, corresponding information is not readily available to respective department managers.

- Competency management system is being managed inside training organization on local personal computers that does not provide the same level of data security as a central database that is managed according to required standards.

- For on-the-job training performed in chemistry department there are no records of trainees' performance for every specific internal course, except the final assessment of the training period and annually individual evaluation made by chemistry management.

There are several computer-based applications used by training department to register training activities. Additional applications are being used at particular training facilities at the plant. These applications are not linked and cross-functional information cannot be retrieved. The following are examples of applications:

- main application for record keeping is a stand-alone application called TOPPERS;

- training and qualification records for Emergency Preparedness Organization are kept in MS ACCESS database application;

- records on refresher courses are kept in MS EXCEL application;

- at electrical and I&C training facility a separate application exists for keeping records on training held at that particular location.

Without having consistent and comprehensive training and qualification record keeping system available that will assure controlled storage and suitable data retrieval capabilities essential information (on training; retraining; and on-the-job training) may not be timely and readily assured to line managers in order to deploy their staff effectively, ensuring that only suitably qualified and experienced staff are assigned to safety related tasks.

Suggestion: The plant should consider further development of its centralized computerized information system with integrating the training record keeping system and administration of other important training and qualification related information (on training; retraining; and on-the-job training).

Basis: NS-G-2-8, par 3.8, 4.44, 4.45, 4.46, 4.47, 4.48 and 5.2.

Par. 3.8. "Appropriate records of assessments against competence and qualification requirements should be established and maintained for each individual at the plant."

Par. 4.44 "Training documentation consists of records and reports … should be used to assist … monitoring the effectiveness …an annual follow-up by the management of personnel competence. … provide a historical record of the changes ….”

Par. 4.45. “The operating organization should maintain adequate records of the training … to enable line managers to deploy their staff effectively, ensuring that only suitably qualified and experienced staff are assigned to safety related tasks “

Par. 4.46. “Records of training programmes should be maintained to permit the review … and should be appropriately located, organized and indexed for ease of retrieval.”

Par. 4.47. “The administration, storage and safe keeping of records should follow the requirements of the plant’s quality assurance system, …”

Par. 4.48. “The training group should report periodically … Significant events or problems in training should be identified and reported ...”

Par. 5.2 “Training programmes … should include on the job training, … involves the use of training objectives, qualification guidelines and trainee assessment…”

2.3. CONTROL ROOM OPERATORS AND SHIFT SUPERVISORS

2.3(a) Good practice: The plant has developed and is effectively performing training for maintenance personnel on carrying out maintenance work, clearly identifying acceptable and unacceptable practices by using video presentation intermixed with instructor presentations, questioning sessions and group discussions.

Main objective of this training is setting the management expectations and standards, and getting agreement (consensus) on following the standards by maintenance personnel. The course is delivered by managers of maintenance department sections in cooperation with the manager of the radiation protection department.

The videos produced in support of this training cover work practice and work permit system, welding, working in confined space, working with tools in hot workshop, equipment qualification after repair. In all videos, examples of unacceptable performance are followed by examples of good performance. Video shots have been recorded in actual working conditions in the installation of the Borssele NPP. No professional actors have been used.

Video presentations are developed in close cooperation between training department and maintenance department. Storyboard for the video was developed inside training department, efficiently integrating human factor aspects, and good use of adult learning principles and modern instructional techniques. Video presentations by themselves are very well done and are good example of efficient training tools that can be developed in-house.

2.4. TRAINING PROGRAMMES

2.4(a) Good practice: The plant has developed an innovative method for continuous evaluation of trainee performance during initial and continuing simulator training, which is efficiently and consistently used.

This method has been developed based on management expectations, as outlined in the booklet "The guiding Markers for safe and reliable work in the control room". These expectations are further delineated into 20 performance indicators (evaluation criteria) describing expected behaviours (performances). Performance indicators are grouped as follows: communication, leadership, decision-making, team performance, individual performance, procedure knowledge and system knowledge.

The performance indicators are numbered and referred at appropriate points in the simulator exercise guide. During one-week course, approximately 1100 points are collected, representing good base for relevant statistical analysis.

The simulator trainer keeps track of accomplishment of each performance indicator, as it appears during conduct of the training scenario sequence. The shift team will get feedback based on these performance indicators after each exercise.

After all shifts have completed the weekly refresher simulator course, the simulator trainer enters all collected points into one common data table and produces a graph. This graph gives a good overview of the performance of all shifts. These results are used to determine training objectives for the next refresher courses.

All shift teams are assessed once a year by either operations manager, deputy operations manager or training manager. This assessment is based on the same performance indicators as described before. Management assessments results are compared to the results provided by the instructors. This comparison provides an indication of shift team performance as well as quality of assessments performed by simulator instructors.

To obtain ranking of each shift performance, additional evaluations are performed based on time spent to complete certain expected actions while performing specific emergency procedures. Four time-based indicators have been developed (Time spent in the E0 procedure (Reactor trip or Safety Injection) for every occasion; time the YZ (Safety injection) signal was by passed (reset); time needed to isolate ruptured steam generator; time needed to equalize pressure of the ruptured steam generator with primary pressure). These evaluations are summarized from all groups and provide indication of low performing shift if result fall below expected range which would then warrant remedial actions. These indicators are monitored the same way as abovementioned 20 performance indicators. This evaluation is scenario dependant and only specifically designed scenarios are appropriate for this kind of evaluation.

The following are valuable features of the above described method:

- provides effective support to collect good observable facts and their allocation to trainee respective shift function;
- is a tool that assures evaluating all crews the same way (consistency across operations);
- provides as established standard to identify areas to be improved;

- brings all evaluators at the same level;
- it is clear and concise;
- provides additional insights to particular evaluation criteria - for example, it will be evident if one operator would perform tasks of another;
- provides a good base for setting training goals for next simulator training course.

This is a transparent and effective method that is practical for evaluation of individual team performance as well as for effective analysis of overall performance and identification of weak points in overall operations control room personnel performance, supporting identification of items to be addressed in future training.

3. OPERATIONS

3.1. ORGANIZATION AND FUNCTIONS

The organization and administrative responsibilities of the Operations Department are clearly defined in procedures and key operations personnel are familiar with and understand these procedures.

The goals and objective of the operations organization have been established to support the EPZ Business Plan and Borssele Station Goals. These goals are communicated to the shift supervisors and section managers early in the year. These goals also become part of their personnel goals for the year.

By observation, it is noted that administrative tasks for the shift crew have been minimized. A favourable example is the use of personnel digital assistants (PDA), by the field operators, for recording their logs and transferring the data to a computer based trending program. Work management functions are performed by operations work management staff personnel so that these tasks do not burden the operators at the controls of the plant.

The overall management and feedback to the operations organization is effective. One example is the observation of the performance of the shift crews in the simulator by the Operations Manager and his deputy and the direct feedback they provide on the performance of the shift during the training evaluation.

Operations management clearly demonstrates their commitment to the safety culture by making safety the first and most important goal. This is reflected in all important documents from the EPZ Business Plan down through Borssele Station and department goals.

Borssele Nuclear Power Plant (NPP) has developed a "Living Probalistic Risk Assessment Model (PSA)" that covers both power operation and plant shutdown conditions. This tool helps to analyze the impact of planned and unplanned equipment unavailability on the total core damage frequency probability. This tool is used by the Work Management Organization to manage how work is scheduled during power operation as well as during maintenance shutdowns. The Framatome Group awarded EPZ an "Outage Innovations" prize in 2004 for this programme and it is considered as a strength.

The Operations organization has not developed an effective self-assessment programme to assist the organization in methodically identifying opportunities for improvement. They depend on the QA organization to provide assessment of their performance. The team encourages the plant to develop an effective department level self-assessment programme in line with international good practices.

The Borssele NPP is a single nuclear unit with only limited common services shared with a fossil plant on the same site. It is judged that activities or emergencies at the fossil unit will not affect the nuclear unit. The services shared are the 10 kV off-site power system and a firewater system. The interface responsibilities appear to be clearly defined and are understood by the Operations personnel and the other organizations.

The shift supervisors reported that they have the resources they need including on the back shifts. If they require more help, they call personnel in and if they have an emergency they use the beeper system to activate the Emergency Response Organization.

The team noted that operational issues are clearly documented and reported by the shift supervisor. The more significant issues are discussed at the 0830 plant coordination meeting. There is good coordination between the shift and the support groups. A noteworthy example was the isolation and clearance for the Technical Specification, Limiting Condition for Operation (LCO) controlled service water pump replacement. The equipment isolation was closely coordinated with the maintenance personnel who were standing by with the air impact tools to disassemble the pump. This coordination minimized the time the equipment was out of service.

Discussions with the shift supervisors and the Maintenance manager confirm that operations personnel understand the importance of maintenance activities.

Re-qualification training is scheduled and regularly conducted both on site and at the Essen simulator. Re-qualification training is built into the normal operator shift rotation. If a license holder is away from operating responsibilities for a period of time, the Operations manager and Training manager will develop a programme for regaining the required re-qualification training and on shift experience.

The Fitness For Duty (FFD) programme is based upon a pre-employment and annual physical exam. Additionally "for cause" checks may be conducted, if warranted. The team noted that the (FFD) programme does not have a "random test" component.

Controls to prevent excessive overtime work, a potential (FFD) concern, are controlled by government law which is much more limiting than the overtime limits that are considered good international practice.

A management observation programme has been created to provide a management presence in the field and to provide an opportunity for management coaching of workers to encourage the desired behaviours. A review of the results of this programme (Procedure PU-N01-03) shows that the operations management staff has made the scheduled tours and has documented the results. The material condition issues noted on the tours are reviewed at the Monday 0830 plant management meeting and the list of issues to be corrected given to the appropriate departments. If an issue is noted as uncorrected for more than two weeks, a work order (WO) is written to assure corrective actions. The team noted that some of the plant's administrative managers are not complying with the requirements of the tour schedule in the procedure. The team encourages the plant to review the procedural requirements to determine if it is the intent of Borssele senior management to have administrative managers performing management observation tours in the plant.

An effective programme of personnel performance reviews has been established per the established Human Resources programme. These incorporate both, station and personnel goals as well as human behaviours. The programme results in a face-to-face evaluation at the end of the period and a performance rating being assigned. Poor performers are provided additional coaching to improve their performance.

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

Operations personnel have adequate and reliable communications systems which include radios, a plant cell phone system, pagers, telephones and the plant paging system.

The main control room human factors design and man-machine interface are excellent. The team determined that a good practice exists in this area. The plant strives for a black board on control room annunciators and generally achieves that goal except for surveillances or maintenance in progress and the "fire water flow" annunciator (which indicates that fire water is being taken from the system). Control room lighting is excellent reflecting current lighting technology with parabolic light fixtures.

Some operator aids did not meet the guidance of Borssele station procedures which requires operator aids to be signed, dated and have a barcode and a controlled distribution red stamp. One example was at the remote shutdown panel. Additional examples of operator aids that did not meet the guidance of Borssele Station Procedures were found in the controlled area with drawings (the distribution stamp was not in red colour) and a single uncontrolled page of a procedure to control the primary plant demineralization (GK) panel was found in holder attached to panel. The team encourages the plant to further emphasize the quality of the implementation of the operator aids programme.

The process computer provides all of the required plant performance data. The team noted that the computer is not safety related and is not qualified to provide reliable information during adverse conditions that may be present during an accident. Accident qualified instrumentation is provided for the control room which is sufficient to support the management of the plant under these conditions. The qualified instruments are identified in the control room by a grey line around them.

The main control room is designed to meet all applicable habitability standards, toxic gas, flooding, etc.

The Remote Shutdown Panel is not designed for habitability under adverse conditions. It does have a controlled set of the applicable procedures, as well as a full set of the main control room emergency procedures for reference.

The team found that housekeeping was adequate but not as good as is expected by the best international standards. The "controlled area" housekeeping is much better than the non-nuclear portion of the plant and the pump houses. The plant is encouraged to improve housekeeping of the non-nuclear portion of the plant and pump houses to international standards.

Medical assistance to the plant is provided by a number of contract arrangements including a contract physician who is on site two days per week and a local physician who can be called to the plant as needed. A contract safety engineer, who is on site two days per week, provides industrial safety advice. Fire protection is provided, first by the plant fire brigade and then by the local Borssele village fire department, which can respond in less than 15 minutes.

The team observed that equipment isolations to support maintenance were clearly identified and appropriately performed including an independent verification by the maintenance technicians.

Special equipment to support normal and emergency plant activities is staged in the appropriate locations and is in good condition. This equipment includes dedicated fire hoses in a number of locations, an oil protection boom to protect the plant from oil spills in the bay, a special net for jelly fish intrusions and special equipment for operating motorized valves locally.

3.3. OPERATING RULES AND PROCEDURES

The Licensed Operators clearly understand the Technical Specifications and the associated limits are contained in the appropriate procedures. The team found there are adequate controls to ensure Technical Specification compliance.

Entries and exits of Limiting Conditions for Operation (LCO's) are formally documented in the control room in a special logbook (Deviations Handbook) on computer generated forms. A review of this log demonstrates that it is in compliance with plant procedures and international standards.

The surveillance programme is owned by the operations support organization that ensures the requirements of the Technical Specifications are met. The programme appears to meet international standards.

The normal operating procedures are written by the operators (system experts). The document control programme is excellent with controlled copies of procedures in the control room, and key work locations. They use a bar code system to track their procedures and the controlled copy is available electronically via the plant local area network computer system. A controlled copy can be printed out when needed and the computer can also be used to verify the version of the procedure being used is the current revision. The site administrative group is responsible for this process.

The plant process to report, document and correct procedure errors and problems is consistent with good industry practice. The team witnessed a procedure problem being handled correctly during simulator training. Recently, the expectation was provided that procedure issues should be captured under the malfunction reporting system for trending, but no data is yet available.

Safety related procedures are reviewed on a 2 year schedule and balance of plant procedures on a 3 year schedule. The Technical organization is responsible for the update of operating procedures to reflect plant modifications and no gaps were identified in that area.

Emergency procedures (controlled copies) are available in the control room, simulator control room and the remote shutdown panel and electronic copies are available via the plant local area network computer. The emergency procedures and Severe Accident Management Guidelines are symptom based and were written by the technical organization with the help of Westinghouse.

Alarm procedures exist, both in paper form and on the computer displays in front of the operator's desks. These displays appear to work very well for the operators as was demonstrated in both the simulator and the control room. The team noted that in at least one case there was an error in the location of the alarm as specified in the procedure which did not agree with the coordinates on the control panel. The team encourages the plant to review the remaining annunciator procedures to determine if there are additional errors and correct them.
The team noted some examples where operating information provided to the control room operators in procedures and on the control panels and process computer did not contain the same data to be used by the shifts in different operating modes. The team offers a suggestion to deal with this issue.

The procedure change programme is adequate. The shift personnel in the simulator as well as the control room demonstrated good knowledge of the process. An amendment to a procedure can be done at any time and has to be approved by the individual designated on the procedure. The procedure change process automatically informs the computer based document management system so that all procedure users may note that a procedure change exists.

The team did note however, that plant temporary procedures do not represent complete and proper guidance of sound operating information that can be easily used by the control room operators during specific operating conditions. The team offers a suggestion on this issue.

3.4. CONDUCT OF OPERATIONS

Shift turnover is carried out in a businesslike working environment under the general leadership of the shift supervisor. Nuclear operators and turbine operators of both shifts spend 20-30 minutes together in the control room discussing the current status of the reactor and turbine including relevant systems and equipment. Additionally, they review work requests to learn and understand the Work Orders for the upcoming activities and workout an appropriate work authorization approach. As soon as the shift turnover is finished, the shift briefing is conducted in a dedicated area of the control room with participation of the shift team. The purpose of the shift briefing is to plan and clarify the activities to be performed during shift. The team noted that the field operator responsible for the "controlled area" of the plant does not attend the shift briefing. The plant is encouraged to have him join the shift briefing, as a minimum, by speakerphone.

The team found that operators demonstrated attentiveness to their panels and there is clear guidance on procedure usage which is consistent with international practices.

However, the operators in the control room and simulator as well as the field operators did not routinely utilize "closed communications" in directing the operation of equipment, positioning valves or exchanging data. The plant is encouraged to strengthen their communications process to reduce the potential for communication errors.

The team also noted that pre-job and post-job briefs were not conducted for routine operational tests and surveillances and that the procedure requirement for pre-job and post-job briefs is weak compared to good international practices. A suggestion is offered to strengthen the plant requirements.

The nuclear and conventional operators have their own informal shift logs. The control room main log is maintained by the shift supervisor. The activities performed during the shift are to be reflected in a written form in the main shift log. There is a plant standard, PO-NO7-50, that describes the way of making records in the shift log. Numerous deficiencies were identified in the main operating log book and other formal documents related to operating activities. The team offers a suggestion to improve the quality of operating logs to meet international practices.

System and component changes are appropriately authorized either by the use of approved procedures or the approval of a senior licensed operator in the case of maintenance activities.

Work planning and preparation of the plant maintenance and test activities are performed in a timely manner by the operations support group. Effective use of E-Tags assures equipment safe isolation and provides control room, field operators and electricians with the visible evidence of the equipment condition via removable "tabs" of the form. Unfortunately these "tabs" are not taken back to the control room before starting the restoration procedure to assure that a system or a component is returned to an operational status.

The reactivity management programme is consistent with good international practices. The team was pleased to note, that the plant has incorporated Operating Experience from industry events into the reactivity management programme.

The key control system is consistent with accepted international practices. The keys needed by field operators are available to them and keys that need to be controlled are controlled.

The team determined that the plant's expectation is that control room access is limited to appropriate persons. While the control room is quiet and few additional personnel are present, the team did not note any attempt by operators to challenge personnel who were not part of the shift from entering the control room area. The "at the controls area" is not marked, so it is difficult for an observer to determine the boundary of the area requiring permission to enter. The boundary to the general control room area is at the work control counter of the control room work management area. Most personnel, who do not have reason to be in the control room, are stopped at this point since it takes a key card with control room access pass the counter. The team encourages the plant to mark (on the floor) a clearly define boundary to the "at the controls" area as is consistent with international good practices.

The surveillance test programme is well organized and properly executed. The results of surveillance programmes are reviewed and approved by the shift supervisor or his deputy as is the international practice.

The field operators conduct their rounds in a professional manner and are effective in verifying system and equipment status. They use personnel digital assistants (PDA's) to record rounds data, which is downloaded to a personnel computer for system trending and record retention.

The field operators are not as effective at verifying plant housekeeping and cleanliness. The team noted several examples where housekeeping was not up to good nuclear plant standards and the operators did not identify housekeeping issues. The plant is encouraged to re-enforce management expectations for field operators to identify or correct housekeeping deficiencies.
Field operators are expected to immediately correct industrial safety issues. If they need help, they will contact the appropriate department or the Shift supervisor for assistance.

The plant conducts independent verification of line-ups to safety systems when an entire system line-up is checked after a major outage. They do not perform an independent verification immediately after individual component maintenance or surveillance activities. The team surveillance test of the TE closed cooling water system where safety related (chain locked) valves were positioned and reposition using just a single operator performing the positioning with no independent verification. This does not meet international practices and a suggestion is offered in this area.

The plant has a foreign material exclusion (FME) programme that is judged to be adequate, although examples of some poor (FME) practices were observed in the area around the spent fuel pool where a spent fuel cask was being loaded.
The team found that event investigations following a reactor trip are consistent with international practices. If the cause of the trip is known, the restart check list is short. If the cause is not known, a more detailed investigation is required followed by a meeting of the Operational Decision Making

Committee which will make a recommendation to the Plant Manager. The results of this decision and the deliberations are reviewed by the Plant Nuclear Safety Committee.

3.5. WORK AUTHORIZATIONS

A Work Request (WR) follows any deficiency in the plant. Despite the fact that everybody in the Plant is encouraged to write a WR, operations personnel write most WR. The shift supervisor first screens a WR and then the operations support group prepares a Work Order (WO). WO in support of WR as well as for the scheduled maintenance and periodic test activities, are prepared in a timely manner and are included in the forthcoming week's work schedule. The PSA model report is prepared by an authorized engineer in support of the forthcoming outage and the work week schedule to assure plant nuclear safety and support Technical Specifications. The weekly PSA model report is considered obligatory. However, if the week work schedule PSA model is not done for a good reason, it does not stop the work activities for the specified week. There is also no requirement to perform the PSA evaluation in support of urgent work.

The operations support group performs, in a timely manner, work planning and preparation of plant maintenance and test activities. Work control is the responsibility of the shift personnel and is done via the Work Permit system. Radiation and hot work requires additional relevant work permits. Effective use of work orders, deviation forms and E-Tags assures appropriate control of the work, safe equipment isolation and provides control room, field operators and electricians with visible evidence of the equipment condition.

A comprehensive equipment re-qualification form is used before putting the equipment back into operation.

A pre-job brief discussing the details of the work is performed before the test or other activity is started. However, the shift supervisor and deputy shift supervisor do not always participate in the briefing to deliver their expectations to the team. No additional information (warnings, precautions, data from the previous similar activities, operation experience) other than technical aspects of the forthcoming work is provided.

The handling of temporary modifications is clearly described in the respective procedure. Any deviation from the normal status of an equipment or component is identified by filling a temporary modification (TMB) form. Shift personnel list all the existing modifications in the temporary modification book available in the control room. Colour-coded tags are used to differentiate the area of the modification: mechanical, electric and civil or leak so that the personnel can easily identify the nature of the defect or configuration change. During outage, the EPZ target is all the temporary modifications are to be completely and permanently solved; otherwise, if a temporary modification implementation is not definitively done, substantiation and justification have to be done by the technical support department. The temporary modification list is routinely monitored and assessed by plant management and discussed at the morning meetings. The shift personnel are informed about forthcoming modifications and receive some appropriate training as needed. During the review, the shift personnel demonstrated their full awareness of the modifications that are in place as all the changes are registered in the above-mentioned book and authorized by shift supervisor.

Field operators by filing leak forms, effectively monitor the modifications dedicated to leaks.

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

The plant has a diversity of the fire protection equipment including high and low pressure fire water systems, Innergen gas systems, portable carbon dioxide, dry-chemical, and foam extinguishers. The plant has been proactive in upgrading fire protection systems to the latest technologies and the team considers this a good practice.

High and low-pressure fire water systems provide water to provide fire protection. The low-pressure firewater building is located on the fossil-fuelled plant site and is attended by non-nuclear personnel. The team noted that the material condition, housekeeping, labelling, operating practices, surveillance and oversight of the low-pressure fire pump station do not meet nuclear power plant standards and the team recommends improvements in this area.

The plant uses an infrared light as a tool for the first-response the fire brigade. This thermal imager enables the fire fighters to locate victims quickly, even in areas with poor light, heavy smoke or in steam filled room. The camera is kept in the main control room area to be readily available.

The fire brigade of Borssele NPP has 3 manual gas detectors. With these detectors the firemen are provided with an extra safety tool. These detectors give the firemen information of the oxygen and carbon monoxide levels in combination with the level of explosion hazard in the areas where they have to perform surveys.

The fire protection equipment testing is performed by plant personnel as well as by contractors on a regular basis. There is a visible evidence of the tests performed on the fire extinguishers of all kinds in the form of yellow sticker with the red marks showing the dates of the last and forthcoming inspections. However, the plant does not follow the same approach in respect to fire hoses. Neither plant nor contractors maintain a register and keep relevant records regarding fire hose inspections or test results. There is no any indication on the fire hose of the test performed so that it is appears to be impossible to identify if the particular fire hose is fit for the purpose.

The deputy shift supervisors, on a 6-week schedule, perform a control of combustible material inspection, both in the controlled area and the rest of the plant. A checklist dedicated to the specified area of the plant is used to inspect the plant conditions regarding combustibles. The deputy shift supervisor makes records in the checklist describing the deficiencies. A list of minor deficiencies or Work Requests and subsequent Work Orders are compiled to take the combustible materials out of the production area.

While the plant performs inspections to minimize combustibles there is no formal “control of combustibles” programme to ensure the plant remains within its design basis fire loading. A suggestion is provided in this area.

The team noted that compensatory measures in place to deal with the fire safety risk to the main turbine from oil leaks were insufficient and provided a recommendation on this issue.

The organization, equipment and training of the fire fighting capacity of the plant has been based on a formal fire risk analysis, and is complementary to the system of preventive measures in accordance with the "defence in depth" principle. They described the residual risks resulting from fire in scenarios, and give the plant and the local government fire brigade information on adequate countermeasures for each of these scenarios. All realistic fire scenarios are described in a basic document which is incorporated in the emergency planning and preparedness programme (Alarmplan).

From the fire accident scenarios, requirements for the quantity of fire fighting equipment, training, have been derived. The plant has been able to optimize its fire fighting capacity and the scenario-based approach gives confidence in the adequacy of the capability to manage fire hazards.

The first response, plant fire brigade group, is a shift based team available 24 hours a day and consists of the deputy shift manager and two field operators from both the nuclear and fossil-fuelled plant sites and a security officer who is responsible for the fire vehicle acting as driver. Additionally, a team of volunteers (8-10 people) from the plant staff are available in case of a fire emergency within working hours (8.00-17.00) immediately and outside of working hours, within 40 minutes. The local government fire brigade works in close cooperation with the plant fire organization. The cooperation is based on the joint activities from a yearly scenario drill that takes place at the nuclear plant. During the drill, the local government fire brigade cooperates with the plant first response team and gets experience in fighting a fire in the nuclear plant and knowledge of different plant locations.

All members of the fire brigade organization of EPZ are trained in realistic heat circumstances. This training take places under supervision of an external training centre (in the Vlissingen Harbour) with the help of professional instructors. Shift operators are re-trained once (4 hours) every two years. Volunteer fire-fighters are being trained every year (8 hours).

3.7. MANAGEMENT OF ACCIDENT CONDITIONS

The responsibilities of the shift crew are clearly defined, assigned to the relevant shift positions and well understood by the control room personnel. The control room operators have specific criteria to identify the plant status as normal, deviation from normal operation or emergency.

The composition of the shift provides for comprehensive control of the installation under emergency conditions. Nuclear and conventional control room operators perform monitoring and control of the respective plant systems, supported by emergency procedures and plant process computer information and data.

According to an agreement with the plant designer, nuclear specialists can provide prompt and comprehensive support. The plant designer has up-to-date design documentation on the plant so that necessary analyses of the plant status can be performed and respective advice provided to the accident management team via telephone, E-mail or Fax.

The sampling laboratory and weather station are available to support the plant emergency team in generating a strategy to mitigate accident consequences. Several video cameras are installed in the compartments of the plant to monitor important equipment.

Communication methods between shift personnel and the emergency team are specified, clearly understood and exercised regularly during simulator scenarios.

The PSA model tool is available for the use by plant personnel. Dedicated personnel, for complex calculations, can use the full scope PSA model during emergency conditions and a simplified model is provided for plant personnel to perform prompt assessments of the plant safety status in different operating modes.

A comprehensive set of procedures covering abnormal and emergency conditions including “beyond design basis” are easily available for the control room operators. Everyone in the control room has access to the controlled copy of the Symptom Based Emergency Operating Procedures to be followed in case of reactor scram or safety injection. The shift supervisor manages the emergency until Site Emergency Director arrives and deputy shift supervisor acts independently to fill the responsibility for monitoring of the Critical Safety Functions. The deputy shift supervisor is provided with the safety panel that makes it possible to effectively monitor all the critical safety parameters of the installation. The operators can obtain the same information from the plant process computer to monitor safety parameters and equipment status. The plant process computer can only be used as an informal supportive tool as the system is not qualified for emergency conditions. The remote shutdown panel is also provided with the full set of emergency procedures and drawings; however, it is not designed to implement the full range of these emergency procedures (limited capabilities in monitoring and controlling of equipment). The remote shutdown panel is intended only for incidents initiated by external dangers.

Control room operators are accustomed to using both hard copy emergency procedures and plant process computer data. The team noted that the information dedicated to the CSF Status Trees in the control room and the one in the plant process computer are not identical. The differences were identified in the main control room. In the event the operating activities were to be performed from remote shutdown panel reserve control room, the operators would face the same issue.

Severe Accident Management Guidelines (SAMG) are used and controlled copies are available in both the main control room and remote shutdown panel. According to the specified rules, these procedures are to be entered in case the primary circuit temperature was higher than specified in the CSF Status Trees. The shift supervisor puts in force an Alarm Plan that describes the responsibilities of the emergency team. The plant maintains a roster, for the Site Emergency Director that contains information about the staffing of the emergency duty assignments for each week.

According to the stated requirements, control room personnel receive refresher training that includes a re-iteration of initial training in as far as it is not maintained through day to day operation. Simulator exercises cover infrequent normal operations and exercises including procedures for abnormal conditions, diagnostics and application of Emergency Operating Procedures and Critical Safety Function Restoration Procedures. Simulator training performance of each shift is formally observed by the Operations manager or his deputy during one of the annual training sessions.

DETAILED OPERATIONS FINDINGS

3.2. OPERATIONS FACILITIES AND OPERATOR AIDS

3.2(a) Good Practice: The plant has completely replaced the main control room by new design, in which control room personnel lead in the design process, and currently maintain their involvement for Man-Machine related modifications.

During the 1997 outage the old control room was completely removed and replaced by a new, ergonomic design. The general layout of the control room, the layout of the control and instrumentation panels and even type of instrumentation and buttons have been defined by operators, based on sound design and ergonomical principles. This has resulted in an extremely high degree of operator acceptance despite the completely different working environment. Simulator training shows that the layout improves operator actions, both in speed and in prevention of errors.

The complete removal of the control room was at that time unprecedented, as was the chosen process. The results, however, have fully justified that approach.

Ever since, a Man-Machine Interface group chaired by Operations initiates and guards modifications in the control room, local control panels and the Process Presentation System.

3.3. OPERATING RULES AND PROCEDURES

3.3(1) Issue: The operating information provided to the control room operators in the procedures on the Control Panels and Plant Process Computer does not always contain the same data to be used by shift in different operating modes.

During the review, the team observed the following deficiencies:

- Critical Safety Function (CSF) status tree “Subcriticality”: on the screen the instrumentation code is as follows: YX2X52/54, but in the hard copy and on the control room panel YX002X801, next status tree logic box: on the screen - YZ11U4U5, in the hard copy: YZ11, next status tree logic box: on the screen – YX1S01H62, YX1S02H62, but in the hard copy only text.

- CSF status tree “Core Cooling”: on the screen the instrumentation codes are as follows: YQ31T004...5, YQ32T001-6, YA1/2P64, but in the hard copy and on the control room the panel - Y2 001/002P64, YQ031T4/5, YQ032 1-3/6.

- CSF status tree “Containment”: the set point on the screen - < 30 mbar, but in the hard copy - <50 mbar. The mistake in the control room hard copy was identified some time ago and a subsequent “Deficiency Report” was produced, however the operations support group did not inform the shift personnel about incorrect data in the CFS status tree procedure.

In case the operating activities were to be performed from reserve control room (RCR) upon permission or order of the Site Emergency Director the operators would face the same issue.

Without having identical data provided by operating procedures, control panels and plant computer operator aids the operators might be confused while performing actions during some complex transients.

Suggestion: Consideration should be given at the plant to assure that the information provided to the operator via operating documentation, control panels and the Plant Process Computer contain the same valid data to be used in different operating modes by shift crew.

Basis: NS-G-2.4
6.76. Particular care should be taken in order that, although all versions of each document are appropriately filed and kept as a reference, only the correct, up to date versions are available to the site personnel for day to day activity.

3.3(2) Issue: The plant temporary procedures do not represent a complete and proper operator aid that provides sound operating information and can be easily used by control room operators during specific operating conditions.

During the review, the team noted that the plant had only 3 temporary procedures and observations are as follows:

- Temporary instruction 05/002 rev.1 of 01.11.2005 is not approved, contains a graph for the 32-d fuel cycle and supplemental document with explanations of the latter, and has no relevant reference to the affected master instruction: "Plant Start-up Procedure" and page numbering. The procedure was issued one and a half months later than expected after the outage had been finished. The plant produces the procedure regularly for the next fuel cycle.

- Temporary instruction 05/001 of 29.04.2005 contains a brief description of the problem and contains advice that is supported by a Design Department Report, has no relevant reference to the affected master instructions: CSF "Core Cooling"C1/2/3 procedures and page numbering.

- Temporary instruction 05/003 of 13.10.05 provides a description of a new strategy during starting up the TJ pump system, but is not referenced in the master checklist C-TJ-702 to be used during plant shutdown.

- The cover pages of the above temporary instructions do not specify the validity period.

Without following a strict and consistent approach in compiling the temporary procedures providing a set of consistent and sound operator actions, overall completeness and proper reference to the affected procedures the plant cannot assure the correct and appropriate operator actions.

Suggestion: Consideration should be given to reinforce and maintain a formal approach in compiling temporary procedures to provide the control room operators with the complete and proper instructions that can be easily used in specific operating conditions.

Basis: NS-R-2 para. 2.12.

2.12. When activities are proposed that are not included in the normal procedures special procedures shall be written in accordance with established administrative procedures. These special procedures shall include the contents and the operational details of the proposed activity. Such activities and special procedures shall be carefully reviewed for any safety implications. The approval of these special procedures shall follow the same process as that for the normal procedures of the plant.

50-SG-Q3 para. 320, 321

320. Under certain circumstances, a temporary document may be required to cover an activity for a limited period. This will be necessary when an immediate amendment to an existing document cannot be justified.

321. Temporary documents should be subject to the same controls as permanent documents. Temporary documents should have a defined period of validity. When this period expires the document should be withdrawn or integrated into an appropriate document or the temporary period of validity should be renewed.

50-SG-Q13 para. 324,325

324. Temporary procedures/instructions may be issued only when permanent procedures do not exist. The document control requirements for temporary procedures should be the same as the controls applied to permanent procedures. Acceptable occasions for temporary procedures are as follows:

– providing guidance in unusual situations not within the scope of the normal procedures;

– ensuring orderly and uniform operation for short periods when a system or a component is performing in a manner not covered by existing procedures or has been modified or extended in such a manner that portions of existing procedures do not apply.

325. Temporary procedures should designate the period of time during which they may be used. Their status should be periodically (typically at monthly intervals) reported to the plant management together with any numerical trends.

3.4. OPERATING HISTORY

3.4(1) Issue: Pre-job and post-job briefs for operational tests and surveillances are not required for routine surveillance or post maintenance tests.

During the review:

- The team witnessed several different surveillances conducted by different shifts of plant operating personnel. It was noted that they do not conduct pre-job or post-job briefs for routine surveillance testing even when that testing is complex requiring the control of multiple systems by multiple personnel.

- The team noted that plant requirements (PO-N07-31) are weak, requiring pre-job and post-job briefs only when a test has been identified as having a high safety risk.

Without a strong requirement for pre-job briefs for routine but complex operations, including surveillances, the potential of operator error and undesirable or unsafe system operation exists. Without a strong requirement for post-job briefs the "learning safety culture" is not re-enforced.

Suggestion: Consideration should be given to performing pre-job and post-job briefs for all routine surveillances and post maintenance tests.

Basis: SGQ13 "Quality Assurance in Operations, Sec 305.
"Supervisors should…encourage good work…by promoting….proper use of pre-job briefs…"

"Supervisors should…encourage good work…by promoting….. proper use of post -job reporting and….post-job critiques."

3.4(2) Issue: The plant shifts personnel do not always strictly follow the plant standards in maintaining the main operating log book and other formal documents related to the operating activities.

During the review, the team observed the following:

- Numerous examples of deficiencies in entries in the main logbook: missing shift supervisor's signatures of both off-going and on-coming shifts, no signatures or relevant marks in the specified boxes at the top of the page dedicated to the status of safety systems, some corrections of the records with no signatures or explanations. Informal records of parameters in the private notebook made by field operator/electrician during emergency feed water pump test on 22.11.2005.

- Control room operators used "white out" to change two parameters of a test procedure form to correct the data with no signature or any explanation.

Without following a strict and consistent approach in operating records management, it may be difficult or even impossible to reconstruct the actual order and conditions of the shift operating actions or an event and specify the particular cause.

Suggestion: The plant should consider reinforcing the efforts to register and maintain the operational records in the operating documentation in a correct and consistent manner to assure the valid status and correctness of the records that are to be used for reference, analyses or investigation in a certain circumstances.

Basis: NS-R-2 Section 9 "The operating organization shall make arrangements for control of records and reports important to safety…. including plant operational data."

50-SG-Q13 302. Good practices in operation should be applied and include, for example:

- maintaining plant logs on the key operating and safety parameters and key event categories;

320. Shift changeover should address the following:

- Review of logs.

NS-G-2.4
6.32. Shift turnover should be carried out in a structured and professional manner. The effectiveness of shift turnover should be enhanced by a written account of the shift activities.

3.4(3) Issue: The programme for independent verification of system line-ups during operations is not sufficient in all cases.

During the review the team noted the following:

- Field operators, at the completion of surveillance testing activities, repositioned valves of safety related systems but no second independent verification was performed before considering the system "operable".

- The plant requirement for independent verification of safety related systems (PU-N07-02) is weak and requires only that the independent verifications be conducted within 1-2 days of the equipment line-up for systems with the highest safety significance and within a week for other required systems.

Without a requirement for prompt independent verification of system line-ups, the potential exists that a system could be in a configuration other than that required by the plant's design basis for a considerable period of time (days) and this could have a negative impact on the safe operation of these systems and their ability to function as designed to support plant operations and safe shutdown.

Suggestion: Consideration should be given by the plant, to strengthening the programme for timely independent verification of system line-ups during operation.

Basis: NS-G-2.6 5.9 "Return to service…. Checks necessary for returning the equipment to an operational condition after the person responsible has certified the task to be complete. Where appropriate, independent checking…should be specified…for example, confirmation of valve line-up."

3.6. FIRE PREVENTION AND PROTECTION PROGRAMME

3.6(a) Good Practice: The plant has upgraded the fire suppression systems to the latest technologies including an Innergen gas system for electrical areas and a water fog system for oil fire hazards.

The plant has replaced all automatic and manual Halon gas fire suppression systems with Innergen gas systems. This modification was made in anticipation of the prohibition of the use of Halon for environmental reasons. Innergen is a mixture of inert environmentally friendly gases, which reduce the oxygen in air to extinguish a fire.

The manual Halon extinguishers were exchanged for CO-2 extinguishers.

Additionally the turbine generator control oil, fire suppression system was upgraded to a water fog system which provides superior suppression of oil fires. It includes a sophisticated 2/3 bgic with multiple fire detector technologies. It has the ability to activate as often as needed to suppress the fire or any re-flash fire, and it is extremely effective minimizing the water used. Minimizing the water used, provides the environmental benefit of not requiring the disposal of large volumes of water, oil and fire debris, if the system were activated.

This good practice proactively implements technologies that are the best available and environmentally friendly.

3.6(1) Issue: The plant operating practice, surveillance and oversight regarding the low pressure fire safety pump system do not assure reliability and availability of the system at all times.

The plant has a variety of fire suppression systems including a high pressure water system which are well maintained. Nevertheless during the observation, the team noted:

- The material condition, housekeeping, cleanliness and labelling in the low pressure fire pump house do not fit the nuclear plant standard: debris, dust on the equipment, some labels on diesel driven pump are missing.
- The responsibility for operation, surveillance and maintaining the low-pressure fire pump station is diluted between nuclear and conventional bodies.
- No indication of the fire extinguishers location at the LP fire pump station.
- Unauthorised and unattended instruction dedicated to the diesel driven pump and an uncontrolled drawing of the system is located on the wall.
- The valve at the suction side of the fire fuel tank is not chained.
- There is no practice to control the quality of the fire diesel pump fuel.
- The “fire water” is taken frequently by conventional plant for the purposes other than fire reason. It causes routine operation of the fire protection pumps. The nuclear plant also takes some “fire water” from the low-pressure circuit upon particular need, such as floor cleaning. As a result, annunciator “Fire water flow” is continuously lighted or flashing at the NPP control room.
- No control of the fire water tank level exists at the nuclear power plant control room.
- The alarm “Fire water flow” is continuously lighted or flashing at the NPP control room.
- The firewater pumps test procedure PB-UJ-601 does not specify a period for the diesel driven fire pump being in test mode operation to check the diesel pump status and prove reliable operation.
- The diesel driven fire pump mode switch has only two positions: “manual” and “automatic”, has no locked cover in comparison with the “Jockey” fire pump and main electric driven fire pump and may be occasionally switched to the manual position that would make impossible automatic start-up.

Without proper housekeeping, surveillance and oversight of the low pressure fire water system pump house, the plant’s capability to fight fires may be challenged.

Recommendation: The plant should arrange for and maintain the respective level of operating practices, surveillance and oversight at the low pressure fire safety pump house to assure adequate standards and assure availability and long term reliability.

Basis: NS-G-2.1 Fire safety in the operation of nuclear power plants.

7.1. A comprehensive programme should be established and implemented to perform appropriate inspection, maintenance and testing of all fire protection measures (passive and active, including manual fire fighting equipment) specified as important to safety.

10.1. Fire protection features are not generally classified as safety and thus they may not be subject to the rigorous qualification requirements and the associated quality assurance programme applied to safety systems. However, fire has the potential to give rise to common cause failure and thus to pose a threat to safety, and therefore the installed active and passive fire protection measures should be considered safety related. An appropriate level of quality assurance should therefore be applied to fire protection features.

INSAG-15 3.5.

Nearly all events, ranging from industrial and radiological accidents, incidents and near misses to failures affecting nuclear safety, start with an unintentionally unsafe act or an unacceptable plant condition or process. These have often been latent and have gone undetected or been treated as ‘custom and practice’ and therefore been ignored. Then, in combination with another challenge to the system, a further more significant failure occurs. Minimizing existing latent shortcomings in working practices or plant conditions is therefore vital in avoiding more serious events.

3.6(2) Issue: Compensatory measures in place to deal with the fire safety risk to the main turbine due to the oil leaks and an inventory of accumulated oil are insufficient.

The plant has scheduled the replacement of the main turbine control oil system in the 2006 outage. However during the review the team noted the following:

- Numerous oil leaks from the control oil system of the turbine.
- Some of these leaks have existed for a long time (years).
- Leaking oil standing in the drain trays under the control oil system of the turbine.
- Leaking oil has soaked the floor under the control oil system.
- Leaking oil from valve SC0412001 was directed to a non fire proof plastic container.
- There were no special temporary instructions to deal with the additional fire loading due to the accumulation of oil from the control oil leaks.
- Leaking oil from a turbine bearing has accumulated in the "I" beam structure of the main condenser on the generator end.
- Leaking oil was seeping down electrical cables and was accumulating in a non-fire-rated plastic pan on top of an electrical junction box (SA00Z23).
- Leaking oil was standing in the drain trays under the hydraulic steam valves to the low pressure turbine. Valves SF13S011 & SF012S001.

Without additional plant corrective action, the oil leaks and the accumulation of oil create an unwarranted fire hazard that challenge the safety of the plant's turbine and associated equipment.

Recommendation: The plant should take additional compensatory measures to deal with the oil leaks and eliminate the inventory of accumulated oil, to reduce the fire safety risk around the main turbine.

Basis: NS-G-2.1: Section 2.13: "Effective procedures for …maintenance … should be …implemented throughout the lifetime of the plant with the object of ensuring the continued minimization of fire load…"

Section 6.7 "Administrative procedures should be….implemented to control …flammable liquids…"

Section 6.7(ii) "Approved containers … should be used whenever possible for …flammable liquids…"

Section 10.1. “Fire protection features are not generally classified as safety and thus they may not be subject to the rigorous qualification requirements and the associated quality assurance programme applied to safety systems. However, fire has the potential to give rise to common cause failure and thus to pose a threat to safety, and therefore the installed active and passive fire protection measures should be considered safety related. An appropriate level of quality assurance should therefore be applied to fire protection features.”

3.6(3) Issue: The plant does not have a formal programme to control combustibles to ensure that the safety related areas are continuously maintained within the plant's "design basis" fire loading.

While the team did not find performance deficiencies, there is no formal programme to ensure the transient fire loading of a safety related area does not exceed the fire loading "design basis" for that area. This fact was confirmed by discussions with Engineering, Maintenance and Operations personnel.

Without a "control of combustibles" programme to control the transient fire loading of safety related areas, there is no assurance that the plant remains within its "design basis" for fire hazards during activities that introduce combustible materials into the plant.

Suggestion: The plant should consider developing a "control of combustibles" programme to ensure that safety related areas of the plant are continuously maintained within their "design basis" fire loading.

Basis: NS-G-2.1: Section 6.6: "Administrative procedures should be established and implemented to provide effective control of temporary fire loads in areas important to safety during maintenance…. They should include a procedure for insuring work permits that require… a review to determine potential effects on fire safety …of potential temporary fire loads …and should specify any additional fire protection measures that are needed."

4. MAINTENANCE

4.1. ORGANIZATION AND FUNCTIONS

At Borssele NPP the maintenance organization is led by the maintenance manager and has 85 staff. The maintenance department was reorganized in June 2005 into three cross functional units plus one unit for civil works and building maintenance and one unit for workshop activities. Before the reorganization the department was organized in the traditional way by crafts. The maintenance department is responsible for all maintenance activities during operation and outage within the premises of Borssele NPP, and also for the cooling water intake and outlet as well as the main store facilities that are shared with the adjacent coal-fired power station. On the premises of the coal-fired power station there is also a fire fighting pumping station, which is operated and maintained by the coal fired power station and shared with Borssele NPP. The team noticed a few operational problems in that area which are covered in the Operational Section of this report.

The Maintenance Department is well organized and its personnel are well trained and experienced. When observing pump replacement in the cooling water intake and check before testing of emergency cooling pump TE001D001, the plant personnel demonstrated proficiency in maintenance works. Several senior members of the maintenance staff have been with Borssele NPP for a long period of time, and some also participated in the commissioning of the plant. The average age of maintenance staff is 50+, and a recruiting programme to compensate for retirement has been launched by the maintenance manager. The staffing goal is that the department should have about 80 staff by 2008.

For civil works, facilities maintenance, major modifications and outage works, the plant is very dependent on contractors. Many of the contractors are Original Equipment Manufacturers (OEMs) and/or have been with Borssele for a long time, and therefore have a good knowledge of the plant. However, bearing in mind the age of the Borssele NPP and the acquisitions and ongoing structural changes in the industry, the OSART team encourages the plant to strengthen and enhance their process for reviewing and assessing contractors up front and on the basis of works performed.

Performance indicators based on goals and objectives are established in the maintenance organization. Performance indicators are evaluated regularly in toolbox meetings and communicated throughout the organization.

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

The workshops are sufficiently equipped with tools and machine tools, and the equipment is well maintained. There are workshops outside the controlled area as well as workshops in the controlled area. On a case-to-case basis, temporary work places are established close to the equipment to be maintained, such as fuel transport cask handling in the pool floor area in the reactor building.

Continuous work is done all year long in the plant's containment building. In the summer of 2001 temperatures up to 29 ^{o}C was measured, which made the working conditions very demanding. The plant noted the problem and after installing extra cooling capacity of about 140kW, the temperature reduction on the 24m level was 2-3 ^{o}C and due to the improved cooling capacity, the humidity was reduced and the distance to the Wet Bulb Globe Temperature (WBGT) increased. The team consider the way the plant improved the working conditions in the reactor building as a good performance.

The plant has training facilities for As-Low-As-Reasonable-Achievable (ALARA) job training such as in-service-inspection (ISI) of steam generators and certain mechanical equipment. For complex components such as diesels and certain safety valves, the training is performed at the manufactures premises. For electrical maintenance, the plant has a well-equipped and organized in-house training facility.

Dedicated personnel do the tracking and inspections of lifting devices with a professional attitude to the importance of well maintained lifting equipment. The plant has a computerized system to track individual lifting tools and a random check on eyebolt UQ 560G647 showed that the system works. A random check showed that equipment with overdrawn next calibration date was available in the hot workshop [micrometer 2.01.0010-878]. The micrometer was then calibrated and found within tolerances. Calibration of mechanical measurement devises is done by using normal standards. However the calibration room is shared with maintenance of valves and is not temperature controlled. Furthermore there is no evidence that the plant has a calibration procedure to compensate for lack of temperature controlled calibration room. Though the OSART team has no evidence of component failure due to insufficient calibration, the team suggests introducing adequate calibration procedures and enhance environmental conditions in the calibration room in order to meet best international standard.

The calibration of electrical equipment is of a very high standard with good traceability and robust labelling of the instruments. The electrical calibration laboratory calibrates instruments used by electrical and I&C maintenance as well as operations. For easy identification of instruments used in electrical and I&C maintenance, the ID tag and calibration tag are placed on the protective cover of the instrument. In confined areas maintenance personnel sometimes take their instruments out of the protective cover. If the covers are then mixed, the ID of the instruments will be jeopardized. This is remedied by putting ID tags and calibration tags on both the protective cover and on the instrument itself. This is a very simple and effective solution to ensure traceability of instruments used for maintenance on safety systems and other vital components. The way the plant label electrical measurement equipment to ensure identification can be seen as a good performance.

4.3. MAINTENANCE PROGRAMMES

The maintenance programmes as described in AVS Opstelprocedure (PO-N12-77 v. 2.) are developed on the basis of national standard, the ASME Code IAEA standard, manufactures recommendations and the plants own experience. The programmes are maintained properly and analyzed and reviewed from time to time to assure that they are "fit for the purpose". The programmes are integrated in a common database with procedures giving the prerequisites for the different maintenance works. A review of temporary repair of worn pipe to de-aerator [BS30WRL00B001] in 2002 and following modification in 2004 shows that the programme in this area is efficient.

Thermographic monitoring is mainly used for electrical components. It is efficiently performed and recorded. Oil analysis is performed for components containing more than 50-60 litres of oil. The reason for this is to avoid unnecessary replacement of oil. Oil samples are taken every third month for vital components. A qualified external oil laboratory performs the analyses, and provides the plant with a detailed report of the oil's status.

The plant has state of the art programmes for vibration monitoring and analysis. For one of the vibration monitoring software programmes the plant has problem to maintain the data base because the manufacturer do not up date with the operating system. The plant therefore has a plan to replace the present system during 2005 to a Windows based system. The cost for the replacement will be shared by the adjacent coal-fired power station.

The ISI programmes are based on the regulatory requirements [the ASME code] and when necessary reinforced by complementary Preventive Maintenance (PM) programmes. However, for hangers and pipe supports, the OSART team has observed deficiencies on hangers and supports both inside and outside the controlled area. The OSART team suggests the plant should consider enhancing its PM programme to ensure timely inspections of hangers and pipe supports.

The maintenance department keeps records as hard copies and in databases, which are backed up regularly via the plant's intranet. Performance indicators and results from reviews of certain maintenance works are regularly discussed and communicated in toolbox meetings.

For valve condition monitoring on systems important to safety, the plant has developed a powerful process for condition monitoring of valves on systems important for safety. The way the process is used at the plant for trending and planning of maintenance can be seen as a good practice.

4.4. PROCEDURES, RECORDS AND HISTORIES

Policies and procedures are available, but are not always consistently followed. The "Werkmap" procedure is a powerful tool, but due to the recent reorganization, not yet fully implemented and understood in all maintenance areas. Further checks of Werkmap issued for mechanical and electrical maintenance jobs shows that the Werkmap is used differently in different disciplines and by different individuals in maintenance department. The team suggested the plant should consider unifying the use of the "Werkmap" job preparation procedure and communicating management's expectations.

4.5. CONDUCT OF MAINTENANCE WORK

Detected equipment abnormalities from surveillance, maintenance or incidents reports result in a work request (WA = werkaanmelding) in the EPZ work flow management system ISO. Work requests are issued and validated within each department that generates them, usually Operations. During the daily operations morning meeting (08:30 a.m.) the WA work requests are discussed and prioritised, then allocated by the shift supervisor to the representative of the maintenance department. When the request is accepted by the Maintenance Department it becomes a work order (WO), which will be included in the daily or weekly planning. High priority work starts immediately. Work orders are also directly generated by ISO (without WA) from the preventive maintenance programme (paragraph 6.6), which is managed by a module of the ISO software.

Corrective maintenance is the repair of equipment or components that have failed or the analysis of unexpected response of a system or component. In some cases corrective maintenance is a result of I&C or mechanical troubleshooting. Troubleshooting however will not always result in corrective maintenance and can also lead to improvements or corrections of test or surveillance procedures. The team encourages the plant to continue work in that area.

At Borssele NPP, mechanical maintenance personnel are trained in behaviour and observation techniques in electrical environments to make it possible for mechanical maintenance personnel to check electrical disconnections prior start of work. To train mechanical maintenance personnel to check electrical disconnections prior start of work enhances personal safety and can be seen as a good practice.

4.6. MATERIAL CONDITIONS

The systems and equipment observed during plant tours were generally in good condition. However in some areas, such as the floor in decontamination room and long free-hanging cables to actuators in the turbine building, the team encourages the plant to improve. Several oil leakages from the turbine have been observed by the team and a recommendation has been developed in the Operational Section.

4.7. WORK CONTROL

The work planning is done on a 1 to 5 week basis. In the weekly planning meeting all section managers attend and tasks, work load as well as potential on the job training are discussed and planned to optimize maintenance works.

The works is described in the Werkmap document package, which are the plants work authorization documents. The problem getting full acceptance of proper use of the Werkmap (see section 4.4) is well known by the maintenance management who has introduced video training for the maintenance staff on this subject. The team has observed a few sessions in video training, and found the video training tool very effective in training and briefing the maintenance staff in the Werkmap process and communicating management's expectations. The OSART team consider this as a good practice which has been developed in the Training and Qualification section.

4.8. SPARES PARTS AND MATERIALS

The warehouse is located on and shared with the adjacent coal fired plant. In the past it suffered from dust from the coal fired plant getting into the warehouse, but after installation of air locks and cleaning the warehouse, the environmental conditions are good. The warehouse is well equipped and fit for its purpose with separate areas for receiving and quality control of goods as well as separate and clearly marked areas for scraped items. However there are no separate areas designated for Borssele NPP, but the computerized inventory system prevents that non qualified parts are transferred between the plants.

The plant identify shelf life of components mainly in three different ways, which can cause confusion for the end user. Although the team found no evidence that components with expired shelf life have been installed at the plant, the team suggests the plant should consider unifying the process for identifying shelf life of components.

4.9. OUTAGE MANAGEMENT

Responsible for the outage coordination and master planning is the planning unit in the Operational Department. The outage planning is performed according to the procedure PU-N07-15, "Preparing, Planning, Performing and Evaluation of Refuelling and Maintenance Outages. All maintenance activities which are planned and prepared in the plants work flow management system (ISO), will be coordinated in the outage schedule. The coordination starts 24-12 month before the outage and the procedure PU-N07-15 gives detailed information of the whole process and ends with evaluation of the outage after the plant is in operation again.

To plan for systems out of service, the plant uses the processes Redundancy Matrix (N07-27-004) and a PSA based Safety Monitoring system. The actual planning for systems out of service is evaluated by a PSA assessment and if the result not is acceptable, the plan for systems out of service will be changed. The OSART team consider this as a good practice which has been developed in the

MOA section.

DETAILED MAINTENANCE FINDINGS

4.2. MAINTENANCE FACILITIES AND EQUIPMENT

4.2(1) Issue: The plant does not have clear instructions and a dedicated calibration laboratory with a temperature controlled and clean environment for calibration of mechanical measurement devices.

- Calibration of mechanical measurement devices is carried out in a room in the cold workshop which is also used for valve maintenance. For indicator clocks the calibration is performed on a stone table outside the calibration room.

- There is no evidence that the plant has a calibration procedure to compensate for calibration in a non-temperature controlled room.

- A random check also showed that micrometer 2.01.0010-878 had an expired calibration date and was available in the hot workshop.

Use of inadequate calibrated equipment in maintenance may lead to malfunction of safety equipment.

Suggestion: The plant should consider installing a temperature controlled and clean environment for calibration purposes and reviewing and up-dating instructions for calibration of mechanical equipment.

Basis: [Ref. SS-50-C-SG Q4, 314,315]
"Tools, gauges, instruments and other measuring and test equipment………
The selection, identification, use, calibration requirements……….."
Calibration of mechanical measure devises by the use of mechanical standards requires a well-controlled environment to achieve sufficient accuracy.

4.3. MAINTENANCE PROGRAMMES

4.3(1) Issue: The plant preventive maintenance programme does not fully cover timely inspections on hangers and pipe supports to ensure that piping systems are within the design basis.

Observations made in different safety and safety related areas of the plant shows that several hangers and supports were out of their designed settings.

- Pipe support TC10Z04 and adjacent valve are not properly configured. The sliding plate has slipped out of its foundation.
- Hanger adjacent to TS40Z0Z is missing.
- Hanger adjacent to TS40Z11 has a broken clamp.
- Difference in settings on hangers close to RP11B001.
- UF04S019 is not protected from falling off its support.
- System UF04 line above lifting beam G007 is supported in a cable tray.
- At pipe support for TF14202 and TF14201 in room 01.318, one anchor is bolt broken

Incorrect settings of hangers and pipe supports may lead to malfunction of systems and components.

Suggestion: The plant should consider enhancing its preventive maintenance programme to ensure timely inspections on hangers and pipe supports.

Basis: NS-G-2.6, 9.18
8.4 **"**Preventive maintenance should be of such a frequency… to ensure that the level of reliability and functionality of the plant's SSCs remain within in the design assumptions."

8.5 "The frequency with which SSCs not normally in use are maintained should be optimized to provide confidence that they will perform their functions satisfactorily."

9.18 "Other items that should be subject to surveillance are…….." structural supports (stack stay wires, pipe supports).

4.3(a) Good Practice: Valve condition monitoring on systems important to safety.

The plant has developed a powerful process for condition monitoring of valves on systems important for safety. Detailed drawings of these valves have been entered into a computerized drawing system. The drawings contain key dimensions of the valve components. When maintenance is performed on such a valve, up to 20 important dimensions are measured and compared to the values stored in the computer. The software checks as found and as-left values and highlights dimensions which are out of pre-determined acceptance criteria. The results are entered into the maintenance system to ensure that the valve is not returned to service before out of tolerance components have been replaced and all values are within specification.

The valves are categorized by complexity; importance for safety and importance for reliable production and those in higher categories have more dimensions recorded than those in lower categories.

The system has been used for maintenance of many valves since 1996 and the measured values have been used for trending and planning of maintenance.

4.4. PROCEDURES, RECORDS AND HISTORIES

4.4(1) Issue: The job preparation package ("Werkmap") is used inconsistently within the maintenance department and the expectations are not communicated sufficiently by management.

- Periodical inspection on Taprogge, UD011 N003/N004. Required risk analyses not filled in.

- Temperature measurements on diesel cylinders, EY035T005. All boxes not filled in with Y/N.

- Repair of concrete stands for UQ16D001. Work Breakdown Form (Stappenplan) KOC not properly filled in.

Inconsistent use of procedures can lead to safety problems and quality problems, and/or unavailability or unreliability of safety systems, equipment and components.

Suggestion: The plant should consider unifying the use of the "Werkmap" job preparation package and communicating management's expectations.

Basis: NS-G-2.6
5.14 "A comprehensive work planning and control system applying the defence in depth principle should be implemented………..so that work activities can be properly authorized, scheduled and carried out."

5.19 "The effectiveness of the work control process should be monitored by appropriate Indicators………"

4.5. CONDUCT OF MAINTENANCE WORK

4.5(a) Good Practice: Training of mechanical maintenance personnel to obtain authorization to perform safety checks in electrical cabinets to verify disconnection of components enhances personal safety.

At Borssele NPP, mechanical maintenance personnel are trained in behaviour and observation techniques in electrical environments. The purpose of this is to authorize mechanical maintenance personnel to enter electrical compartments in order to check electrical disconnections prior to maintenance. The authorization is based on a training course in a toolbox meeting and personnel who have passed the training course will be authorized and listed.

4.8. SPARE PARTS AND MATERIALS

4.8(1) Issue: The shelf life of certain spare parts and consumables is inconsistently monitored within the maintenance department.

The plant has several parallel processes to identify the shelf life of components.

- Parts, which are used frequently in small quantities, are kept in stock at minimum quantities to ensure that they are renewed regularly.
- Parts with a life time of 10 to 20 years (O-rings, etc) are marked in the computer system and the warehouse manager receiving lists of items reaching or past end-of-life.
- Some parts have the expiration date written on their ID tag, which makes it possible for the warehouse personnel to check the date before release, and for field technicians to check before use.
- There is no evidence that periodic reviews are performed to verify that expired items have been removed from the warehouse.
- Synthetic oil SHC 626 is stored in the oil storage. Manufacture date is 1994-10-18 but no expire date is documented.

Inconsistent monitoring of shelf life for certain spare parts and consumables can lead to safety problems and quality problems, and/or unavailability or unreliability of safety systems, equipment and components.

Suggestion: The plant should consider unifying the process for identifying shelf life of components.

Basis: NS-G-2.6 8.23, 8.25, 8.33, 8.37
"—the shelf-life of the component.
Items that have a limited shelf-life should, if not used, be replaced at the appropriate time in order to ensure suitability……"

5. TECHNICAL SUPPORT

5.1. ORGANIZATION AND FUNCTIONS

The Technical Support (TS) activities are performed by different divisions. The Operations division coordinates surveillance and prequalification, performs plant performance (trend) analyses, evaluates and analyses temporary modifications one by one and their cumulative impact, supports modifications on the Human Machine Interface and balance of plant areas, operates Probabilistic Safety Assessment (PSA) applications such as Safety Monitor (planning function) and Risk Monitor (evaluation function), takes care of plant configuration control. These tasks are provided by the Deputy Shift Supervisors and senior engineers. The Maintenance division prepares and evaluates maintenance programmes and procedures, provides modification engineering, management and support, takes care of systems, structures and components (SSC) trend analysis. These tasks are performed by maintenance engineers and maintenance support engineers. The TS division provides engineering and support for modifications, takes care of aging management, defines in-service inspection (ISI) and quality control (QC) programs, prepares self-assessment against license condition in a 2-year period, maintains and evaluates the Safety Performance Indicator system (SPI), takes care of the classification of structures, systems and components (SSCs). TS also provides PSA and deterministic analyses; takes care of basic engineering and safety concepts; provides independent reviews for modifications, supports core design and fuel management; maintains the Technical Specifications, Emergency Operating Procedures (EOP) and Severe Accident Management Guidelines (SAMG); defines the bases of surveillance programme, controls the modification process providing support on engineering and design. A separate Project Department provides project management, support and evaluation, and takes care of project standards and procedures. The Monitoring division provides fuel management; takes care of core design and monitoring.

The plant organization described above was established on 1st of June, 2005 prior to the OSART mission; however the preparation and execution of this 2005 outage was done based on the previous competencies. Since the TS activities are shared among different divisions, adequate resources are provided for these tasks. The advantages of the distribution of the TS tasks are well reflected on the daily work; independent review is easier accommodated, efficient TS provided for routine tasks.

Domestic and foreign contractors provide sufficient support for TS activities. The main domestic contractors are the Nuclear Research and consultancy Group (NRG) and another engineering company the KEMA. The NRG provides studies and analyses, the KEMA is used for in service inspections (ISI) and quality control of the fuel manufacturing. The main foreign contractors are the Framatome ANP (FANP), the Belgatom, and both provide analyses and support to the plant staff, and the Scientech has developed the PSA applications and provides PSA updates for the plant.

The highest level of documentation dealing with goals and objectives is the Business Plan 2005-2007. The distribution of this document is restricted to the management team of the plant. The yearly plans of the divisions and departments are deduced from the Business Plan. The management expectations are communicated down to the lower levels of the organization.

The safety performance indicator (SPI) system development is in progress, it is foreseen to be implemented at the end of the first quarter of 2006. 62 specific indicators are ready, 27 need further development. The management has initially been trained on the SPI system.

The interfaces with other on-site and off-site groups are clearly defined and quality is an evaluation topic on the 2-years periodic self-assessment. The plant has a supplier evaluation system on the Procurement Department; the TS engineers are adequately involved into the evaluation process. Long-term relations are established with the partners of the TS area.

Some TS engineers are delegated during outages to provide technical support on the maintenance and operation areas such as support of planning by living PSA; independent review of surveillance; acting as a maintenance engineer. Obviously the yearly outage is a work peak and the overtime is satisfactorily controlled. The backlog in the TS area is not excessive and acceptable level of backlogs is on the low priority tasks.

The TS manager's responsibility for the training is clearly defined in his job description. The TS engineers have 2 weeks classroom and 2 weeks simulator training in Essen as initial training. 5 days per 2 years refreshment simulator training is also mandatory for the TS engineers.

The progress on TS activities is reported monthly, the progress on the tasks - defined in the 2 years self –assessment - are reported quarterly to the management meeting. The management team makes decisions or defines corrective actions if necessary. Daily contacts are organized between TS division staff and TS manager.

5.2. SURVEILLANCE PROGRAMME

The tasks and responsibilities related to surveillance are shared among different departments. The responsibilities and engagements are sufficiently defined in the corresponding procedures.

The plant has a well structured overall surveillance programme supported by appropriate computational applications (Integrated maintenance and surveillance database, component database (BRS), etc.). The programme is precisely cross-referenced to the relevant requirements such as domestic (NVR) and foreign (ASME, KTA, DSW, etc.) codes, OLCs and the internal requirements of the plant. All components, which are important or related to safety are involved, furthermore the scope of the programme is extended to those ones which are not safety classified but their surveillance is also reasonable. The scope of the programme is sufficiently maintained in case of plant modifications and experience feedback.

The Ageing Management (AM) has become a license condition for the plant following the last Periodic Safety Review (PSR). A dedicated team in the engineering department deals with AM and provides effective ageing experience feedback to the surveillance program. The AM is connected to the overall surveillance programme (PU-N12-19).

For the ageing experience feedback process the plant uses a comprehensive database. The database contains an inventory of internal and external ageing reports with their evaluations and resolutions. All reports from the ageing experience feedback system are in this database. The database is available to other departments (read only), which gives easy access to relevant data to maintenance engineers, operational experience feedback officers, and others. AM event reports, assessments are easy retrievable. The system of ageing experience feedback has caused smoother transfer of information and expertise between departments and between their programs. It stimulates a multidisciplinary approach. The system allows good traceability to work orders followed from ageing management actions. The system has proved a great help in improving existing programmes - by providing detailed and objective background information - and is continuing to do so. The database facilitates the preservation of ageing knowledge for future reference. The effort of the plant on the AM area is considered as a good performance by the team.

The plant has appropriate guideline (PO-N07-31) which describes the preparation and revision process of surveillance procedures. The surveillance working procedures have consistent format across different surveillance activities, however some inconsistencies in their content have been pointed out. The team has developed a suggestion in this area.

The scheduling of the surveillance programme is supported by computer applications. Based on the inputs of different periodic surveillance programmes, a yearly plan is made and fixed in the periodical work order system (ISO IV). The process of the short term planning is clearly defined in the corresponding procedure (PO-N12-50). As a result of weekly planning a controlled schedule is developed which is free from contradictions. Furthermore the introduction of the PSA based Safety Monitor into the weekly planning ensures, that all the scheduled activities will be carried out with the lowest possible risk increase. If the plant configuration deviates from what has been assumed during the planning phase, the re-evaluation of the risk is done by the control room staff using the Safety Monitor application prior to permitting the planned work order. The implementation of the Safety Monitor application has been considered as a good practice.

Clearly defined responsibilities are set in case of a failed surveillance test. The qualification is registered in the ISO IV system. A work request is launched for corrective actions if necessary. The reporting engagement is correctly defined in the corresponding procedure. It has been pointed out, that the trending and its evaluation are not consistent in the overall surveillance program. The team has developed a suggestion in this purpose.

Adequate assessment and fulfilment of predefined set of preliminary conditions ensure that special tests can only be approved if all information and possible consequences are taken into account. Clear special requirements are defined in the corresponding procedure (PO-N07-31) for the case if a special test should be performed. An assessment has to be made, if there is a potential risk in nuclear safety. The approval of the requested special test is given by the Safety Committee.

5.3. PLANT MODIFICATION SYSTEM

The process of the plant modification is clearly described in the corresponding (PU-N13-05) procedure. The method of prioritisation of the modifications is well described in the procedure (Z01-24-429). This method consistently assures that the safety important modifications have the overriding priority. According to the plant rules everyone can initiate a plant modification by launching a work request for it. Obviously, the work request has to be noted as a request for modification. All work requests are evaluated from the modification point of view even if they are not marked as modifications. This approach ensures that unintentional changes on the design are adequately eliminated. If a modification request is accepted, the responsible area is clearly defined for further management of the modification proposal.

The modifications are properly distinguished as minor or major. In both cases the Modification Committee and – if the modification is considered to be safety relevant or important - the Safety Committee provides appropriate control and prescribes improvement or corrective actions if necessary. The Safety Committee pays distinguished attention to the modifications; the Design and Licensing department provides appropriate review on the modification plans. By this approach the plant does not differentiate between the safety related and safety important modifications. All modifications which have significance to safety are managed as safety important.

If a conceptual design change takes place, appropriate specifications are given in the procedures PO-N13-72, PO-N13-78 and PO-N13-79 for mechanical, electrical and I&C and civil structures respectively. In case of "minor" modifications, the requirements of manufacturing, installation and testing are based on the requirements of the unmodified component.

The training organization is appropriately involved into the modification process. Adequate training on the modification is a prerequisite for the implementation. The handover of the modification to the "customer" can only be carried out after the final review and assessment of the complete documentation package – including results of the commissioning and prequalification tests - by the Design & Licensing department. By this final review and assessment an appropriate check is provided that the modification serves its original purpose without any additional negative effect on safety.

The control of the temporary modifications (TM) is similar to the permanent ones. The TM implementation process is well defined in the PO-N07-53 procedure. Special attention is paid to the Reactor Protection System based on the internal operational experience feedback. The TM periodic revision is properly provided. The actual amount of TMs (15 electrical and instrumentation and control, and 8 mechanical) is acceptable.

The revision of the modification documents is well organized, the independence of the reviewers are adequately ensured. Sufficient prescriptions are given to ensure that a modification can only be closed if all documentation designated in the documentation plan – which is part of the modification plan – is collected and provided to the plant archive.

5.4. REACTOR CORE MANAGEMENT (REACTOR ENGINEERING)

The fuel assemblies used by the plant are manufactured by the Framatome-ANP who is the only qualified fuel supplier of the plant. The core design is carried out by qualified contractors such as Framatome ANP and the NRG. The core management functions are clearly specified in the HP-N03 main process procedure. The role and responsibility of the contractors are sufficiently defined and differentiated from the plant's ones in the PU-N03-04 procedure. Clear job descriptions and qualification requirements are set to the personnel dealing with core management tasks. Sufficient, qualified personnel are assured on the Reactor Physics and Design & Licensing organisation to support the core management activities.

The core management procedures are clear and well understandable; and contain appropriate references to the design information. Detailed procedure (PU-N03-04) is prepared to assure subcriticality during reshuffling. The procedure N07-23-001 contains adequate guidance and prescriptions for the unit start up following refuelling and also provides sufficient verification of the core design. Proper instructions are given for unit start up following reactor trip in the N07-23-004 procedure.

The core monitoring activities are precisely defined in the N03-22 series procedures. The plant uses the "aeroball" software system for core monitoring; the software system is adequately maintained. All necessary values (power and flux density distribution, hot channel factor distribution, burn up (BU) distribution boron concentration in a function of BU, enthalpy rise distribution, DNBR) are sufficiently measured, calculated and compared to the core design calculations. The measurements are done twice a week by activation analyses, adequate independent review is provided for the preparatory of the system and for the results as well.

Based on the monitoring, the reactor engineering results are trended and analyzed and are monthly reported to the management. The results after the end of the cycle are assessed in the "Fuel cycle evaluation report", where the measurements and calculations of the cycle are thoroughly evaluated and compared.

The fuel integrity is sufficiently monitored by the Chemistry Department. All necessary data and trends are available for the reactor engineering to control fuel integrity question. Adequate limits and prescriptions are implemented into the operating procedures to assure fuel integrity. Failed fuel action plan is prepared and maintained by the reactor physics organization.

The operation history of the plant is not free from defected fuel. Following each event, a thorough evaluation and root cause investigation have been carried out. Based on the results a decision has been made for a design change of the fuel assemblies to implement a debris filter in the bottom nozzles of the assemblies. Since the 2004 outage, exclusively fuel with debris filters have been loaded.

5.5. HANDLING OF FUEL AND CORE COMPONENTS

Based on the experience gathered by the defected fuel event assessments, the plant pays distinguished attention to exclude foreign material intrusion. A specific procedure (WNW-OO-004) is addressed to this issue; the procedure defines clear requirements and provides adequate prescriptions to exclude foreign material getting into the systems. Also adequate prescriptions and limitations are set for craning heavy loads over the spent fuel storage pool. (See also the comments in "Operations" section of the report.).

The quality control of the fuel manufacturing is sufficiently provided by a contractor KEMA with an appropriate supervision of the plant personnel. All necessary inspections on the fuel assemblies and other core components are conducted at the manufacturer; consequently those components which do not meet the specifications will not be delivered to the plant. Following fuel delivery a thorough inspection is done under the supervision of a reactor engineer on the cask and on the fuel assemblies in order to be convinced, that the fuel has not been damaged as a result of transit. An adequately detailed procedure with checklist (N03-22-017) provides guidance for the inspection. The fresh fuel is loaded into the spent fuel pool, since there is no strategic reserve of fuel on site. Dry storage is not needed, and the storage installation was dismantled.

Well controlled radiation protection provisions are implemented during fuel handling. The number of employees in the containment are limited and continuous radiation protection supervision is assured.

Precise and accurate records are produced during fuel movement. Each handling step is registered on the handling plan; the load and movement of the refuelling machine are recorded on a register. The records contain all necessary data. All fuel movements are conducted by licensed personnel under the independent supervision of a reactor engineer. Online communication is established with the control room, assuring adequate operations personnel supervision.

An appropriate arrangement is provided in the spent fuel pool to handle leaking fuel. Special technology is available for the inspection and repair of leaking fuel assemblies.

The long term cycle planning is a responsibility of the reactor engineering. Precise criteria are set for the management of the spent fuel. The assemblies to be reprocessed are reported in an acceptance report, which is independently evaluated by the reprocessor (COGEMA). Leak tightness is assured for all fuel to be loaded in the core or to be loaded in spent fuel transport casks. Where appropriate, a sipping test is conducted to demonstrate leak tightness. Adequate storage environment is assured for irradiated fuel and core components in the spent fuel storage pool. The condition of the coolant is sufficiently controlled.

The handling history (movements in the spent fuel pool, core positions, orientation, etc.) of each fuel assembly and core component is registered in the "ALFA" software application. Appropriate guidelines are implemented for safeguards of nuclear fuel (PO-N03-51, N03-22-06÷09), all important data (irradiation history, masses, etc.) are recorded in the "BETA" special computer application.

5.6. COMPUTER BASED SYSTEMS IMPORTANT TO SAFETY

The maintenance division is responsible for the utilisation of the safety significant computer applications. The utilization programme is clearly defined in the HP-N13 procedure. The classification of the computer based system is well defined in the N13-51-001 procedure. An adequately maintained database (SKB) is established for software configuration control (PO-N13-21), appropriate backups and sufficient spare parts for the hardware are provided for the safety significant computer based systems. Detailed guidelines are prepared for emergency backup and correcting routines.

Modification of the safety significant applications is controlled via the standard modification rules of the plant (PU-N13-05), version control and rules of backup generation are given in the PU-N13-01. Effective experience feedback process is implemented for the users involving into the Human Machine Interface (HMI) group if necessary based on the N13-51-007 procedure.

5.2. SURVEILLANCE PROGRAMME

5.2(1) Issue: The plant has a guideline which describes the preparation and revision process of surveillance procedures; however the surveillance procedures are not consistent in their content.

- The required staffing as a prerequisite is given in the procedures, however the leader of the surveillance test is not designated (PB-TJ-204; PB-TJ-001).

- No specific chapter is dealing with potential hazards and countermeasures (PB-TJ-204; PB-TJ-001). This requirement is already given in the PO-N07-31 procedure. No specific chapter deals with the tasks that should be done if an unexpected plant/component response occurs during the execution of the surveillance test. It has to be noted that the appropriate behaviour for these cases is defined in the PU-N07-02 procedure in a general manner; however these expectations are not deduced and specified to the working procedural level.

- The PB-TJ-204 procedure doesn't contain any acceptance criteria.

- The acceptance criteria are given in the elaboration part of the procedure PB-YX-012-3 (Test of the neutron flux channel).

- The data collected by operational test procedure PB-TJ-001 do not differentiate between safety requirements and other data.

- There is quite a large amount of parameters to be checked and registered in the last pages of the periodic operational test procedures. Some of them are more important, since the judgement of the SSC availability has to be made based on them. Other parameters which do not make sense from the SSC availability point of view can also be checked (even registered), but their deviation is just an input for the maintenance.

Without clear prescriptions in the surveillance procedures the safety related information could be missed because of the lack of sufficient guidance.

Suggestion: Consideration should be given to perform a consistency review of the content of the surveillance procedures.

Basis: SS 50-C-SG-Q1 Annex V para (3): 'Responsibilities**.** Which persons are responsible for the particular activities defined in the document? Define the duties of the persons implementing the document. Identify the persons (by title) and their responsibilities and specify when a required action is needed.'

SS 50-C-SG-Q4 para 313.:
'The following information should be included in an inspection and testing plan:
..
The identification of who is to perform each inspection and test, and provision for recording that each has been performed satisfactorily;…"

SS 50-C-SG-Q1 Annex V para (7): ‘Precautions. What precautions are necessary to protect equipment, personnel and the public or to avoid an abnormal or emergency situation? Identify these 45 in the relevant steps of the procedure or instruction or highlight them in a separate section.’

NS-G-2.2 par 7.3: ‘The surveillance requirements should be specified in procedures with clear acceptance criteria so that there are no doubts concerning system operability or component operability. The relationship between these criteria and the limit or condition being confirmed should be available in written form.’

NS-G-2.6 par 5.3.: “Acceptance criteria and actions to be taken if acceptance criteria cannot be met should be clearly specified in the procedures.”

5.2(2) Issue: A comprehensive surveillance programme has been conducted by the plant, however trend analyses based on the results of the operational surveillance tests are not fully implemented.

- The evaluation of the results is usually limited to the qualification of the test (successful/failed).

- Adequate trend analysis is provided on the results of maintenance surveillance programmes:

  - Electrical: high voltage motors, batteries, reactor cooling pump motors, etc.;

  - I&C: reactor protection system equipments, I&C panels, etc.;

  - Civil structures: seawater depth trending, water intake building movement, etc.

- In case of the operational surveillance results the trending is not performed.

Without trend analyses of the results of the periodic operational tests, the potential risk exists that the deteriorative phenomena remain hidden and may not be noticed before exceeding the corresponding limits or the failure of SSCs .

Suggestion: The plant should consider extending the trend analyses to the results of the operational surveillance tests.

Basis: SS 50-C-Code para 334. : 'Surveillance tests during the operation stage are performed to:

…detect degradation;

…reveal unsatisfactory trends in the performance of individual components or component types on a long term basis.'

NS-G-2.6 para 6.10.: "Additionally, the results should be examined, where appropriate, for trends that may indicate the deterioration of equipment."

NS-G-2.6 para 9.46.: 'These documents should be used as a basis for reviews carried out:

- to demonstrate compliance with operational limits and conditions;

- to detect trends indicating deterioration of systems or components.'

5.2(a) Good Practice: The PSA based Safety Monitor has been introduced to allow Operations to calculate risk consequences of systems, structures and components (SSC) unavailability's and to take this into account.

The plant has built a Level 3 PSA for all plant states and for its spent fuel pool. This PSA is kept up to date with respect to the plant's configuration and operating procedures, operational experience on component data and event frequencies, and environmental developments. International developments are followed and incorporated when it is applicable.

As a result of using the Safety Monitor in the short term scheduling process, the plant - among many others - has achieved:

Reduction of workload in the refuelling outages while at the same time reducing the risk profile, both for the outage and for the complete fuel cycle.

Optimized surveillance intervals for Reactor Protection System (RPS) and Engineered Safety Features Actuation System (ESFAS), where a new surveillance strategy reduced the common cause failure probability. This has resulted improved safety level and lower cost.

Risk increase due to planned SSCs unavailabilities is evaluated in the planning phase and re-evaluated prior to execution of the work to ensure the lowest possible risk increase.

6. OPERATING EXPERIENCE

6.1. MANAGEMENT, ORGANIZATION AND FUNCTIONS OF THE OE PROGRAMME

The operating experience (OE) programme at EPZ is well established and OE is recognized as a means to prevent (recurring) events. It is also recognized as a source for learning and improving.

It is contained in the nuclear safety policy which includes also the blame free policy and the statement that all events and deviations are a source for learning. The relevant procedures also refer to the use of operating experience as a way to learn.

The OE process as described is in compliance with good international practice. Resources are allocated, tools and methods are defined and the plant has good contacts with external organizations. The performance is monitored by several committees.

The central organization to manage OE is the event analysis working group (SWG). They play a key role in all stages of the OE process from capturing, reporting analyzing to defining and following the implementation of corrective actions.

The SWG is part of operations assistance department and has a staff of 5 persons. In addition, there are contact persons, from every department, to coordinate analysis in their own department, to capture interesting events and to assist in defining and allocating the corrective actions.

Due to some recent changes in the organization, some of these people (5 on a part-time basis), who have an important role in the OE-process, still need to have adequate training e.g. on how to do root cause analysis. Furthermore, their role, duties and expectations must be well described and sufficient time must be allocated to fulfil their duties in the OE process. At the moment, this is not completely done. However, the persons charged with the OE process before the re-organization, are still performing their SWG task as an intermediate solution.

For the reporting of the low level and near miss events, the scope of an existing process for reporting of industrial safety problems and near misses, was extended to capture all near misses.

The expectation for everyone, to report on any deviation by means of this process is not yet communicated to all staff and procedures are not yet adapted.

Training of all personnel, according to their role and responsibility to report, analyze and take corrective actions has to be organized.

Also on the management of this system, some things have to be clarified about the role of the industrial safety department and the SWG.

Due to changes in the global plant organization, some other procedures (on near misses and follow-up of corrective actions) were found not to be in accordance with current practices. Once the working method is fixed, and everything is cleared out, the procedures have to be updated. For certain aspects, it was difficult to observe and comment on performance as the changes and enhancements were made recently. The team made a suggestion to complete the implementation of these changes in a timely manner.

All departments are involved in the reporting, analysis and implementation of the actions and lessons learned and the process is reviewed on a regular basis by the Reactor Safety Committee (RBVC) and the technical support group.

6.2. REPORTING OF OPERATING EXPERIENCE

For real, consequential events, more or less significant, or other important events, there exists a process that functions well and that is well known. Criteria for reporting these events are established in the procedure. These events are reported through the operations morning meeting and screened for analysis by SWG (they are called event reports).

Near miss events and potential problems, can be reported by anyone (by mail, intranet or paper form) to report any deviation or dangerous situation or industrial safety event. These reports are entered into a system that was initially developed to report only industrial safety problems. Recently it has also been used to capture other types of events or deviations: dangerous situations, environmental problems, radiation related problems, unwanted events.
This system has proved to be well known and used as there is no threshold for reporting – for the last 2 years (since 2004) 500 reports were entered into the system (about 1/3 during the outage). Through training sessions (for operations and other volunteer participants) and toolbox meetings (for maintenance staff) the new requirements are communicated.

However not all deviations seem to be reported as expected. During the mission, some near miss or low level events were observed that were not reported into the system. (Even if they were well known by several people). This could indicate that a real voluntary reporting of all low level and near miss events is not yet achieved or that the expectations are not clear to everyone. So there is a chance that interesting events are not reported and opportunities to improve are missed.

The team encourages the plant to have more clarification on the expectations and criteria in the procedure or to have a dedicated procedure for the low level and near miss reporting. Even if there is no threshold for reporting, establishing minimum reporting criteria and examples of what should be reported and include this in the training can help to solve this problem.

This is in line with the previous suggestion that there is a need for further implementation of recent changes.

Some departments keep separate logs of minor events happening in their area and do an internal follow up on the corrective actions and trends. They report if important deviations are observed.

Reporting to external organizations is in compliance with the requirements. Besides the reports required by Technical Specifications, the regulator also gets information about other events and can ask for a more comprehensive report is they feel necessary.

6.3. SOURCES OF OPERATING EXPERIENCE

Significant Events are analyzed, tracked and trended and coordinated by SWG. For low level/near miss events a similar, but lighter process, is in use since 2004. Other reports and indicators are analyzed by the reactor safety committee or the industrial safety committee to determine corrective actions.

Corrective actions from all sources (event analysis reports, inspections, maintenance reports, other evaluation reports, committees) are registered in a central database for follow-up, as is described in a dedicated procedure. Most common sources of external experience are used and screened systematically: IRS, WANO, NRC, Owners Groups, Vendors and Manufacturers, Utilities and Industry event reports. Because of the plant design, special interest goes to VGB, GRS and Framatome (KWU). Good practices (internal or external) as source of OE are not mentioned in the procedure and rarely used.

6.4. SCREENING OF OPERATING EXPERIENCE INFORMATION

The screening of in-house events is done by the OE-working group (SWG) for the more important events that are reported by the daily morning meeting. The SWG is a multi-disciplinary group composed of experienced people with experience in all the different area's that manages the OE process on a daily basis. Criteria are specified in the procedure.

Also the external reports are screened by this group to decide on applicability for the plant. Depending on the source of external information and on criteria mentioned in the procedure, some external events are directly selected for further analysis, but in most cases they are sent to the concerned departments, so they can decide if some further analysis or actions are needed.

A list of all new events is prepared for discussion on the plant operations Safety Committee (RBVC). The screening of low-level events and near misses is done to categorize the area to which the report belongs, which department is involved to take action, to make risk estimation and to see if further analysis is necessary.

The risk assessment is done for areas of industrial safety, nuclear safety, environment, public acceptance and loss of profit by means of a clear and visual aid in the form of a coloured matrix.

This way, the low level and near-miss events that are reported can be ranked for further use.
The team considers this as a good practice Screening for reporting to the regulator is done in accordance with Technical Specifications and the same information is sent to VGB. To other organizations there is reporting according to the expectations.

6.5. ANALYSIS

The events reports and maintenance reports are analyzed using the human performance evaluation system (HPES) in 95 % of the cases. This is done by the members of the SWG that are working in the different departments, in collaboration with the people who were involved in the event or who have the right expertise. These SWG coordinators are trained to use the HPES-method on how to perform analysis (except for some who recently changed position).

Because of the permanent composition of SWG group, they can build up much expertise. As a result, the HPES method is applied rigorously and analysis are done in a very good way. In addition, because all analysis are handled by this group, there is a collective memory of past events, supported by the database, so that past internal and external events, are included in the new analysis.

Every 2 weeks there is an extra meeting where OE-coordinators and analysts from the different departments also participate to have an exchange on new event reports and where they comment on the analysis performed before approval: non-safety related event analysis are approved by SWG, safety related event analysis and corrective actions are always approved by the RBVC.

For near miss events, the departments concerned, are asked to define corrective measures and depending on the risk, a full analysis can be done. At the moment this is mainly managed by the Industrial safety department.

SWG can determine after screening or on request if a deeper analysis is needed. However there are no expectations for common cause analysis or analysis on root causes on groups of near misses. When trends are detected, these are reported to the department involved or to RBVC where actions are decided.

Some analysis takes more time to complete, especially after outages and when more departments are involved. But on average, the timeliness of the analysis is more or less as set in the objective (2 months).

6.6. CORRECTIVE ACTIONS

The corrective actions on the direct and root causes are defined by the analyst and confirmed by the responsible department. A target date is agreed in accordance with its priority. The maximum allowed delay to complete actions is 15 months (e.g. for outage related actions). This is done based on the judgment of the members of SWG and the department involved.

As mentioned in the procedure, attention is paid so that the actions are SMART (specific, measurable, achievable, realistic, within the agreed time).

Corrective actions from all sources (reports, inspections, event analysis, and committees**)** are registered in a central database for follow-up, as described in a dedicated procedure.

Apparently that procedure does not reflect completely the reality, as a recent change is not yet incorporated, and corrective actions from some sources (that are specified in that procedure) are not always entered into the database: e.g. RBVC actions.

The work order system is used to track the corrective actions, but as this system was developed a long time ago and is not really adapted to the needs for the follow up of corrective actions from event analysis, these actions are stored (or copied) in parallel into another database (excel-file) to manage and prioritize and are kept also in the event analysis database to have an overview on the complete status of the event.

Feedback to operating shift crews and staff of other involved departments is given by means of the “weekly operations programme”. This is a weekly list with interesting facts that is accessible on the intranet. The follow-up on events leading to important information for the operations shift crew is also done by means of the shift logbook.

All the time, after a report is made, during and after the analysis, until completion of the corrective actions, the report is available on intranet. Departments involved, also get a copy of the report to share with the staff involved.

Outstanding actions are discussed during periodical management meetings. However, it seems that in 50 % of the cases, the actions are not completed by the due date.

In the last annual report, the number of recurring events appeared to be ~25 %. After a closer look, the real number was more about 10 %; because actions are not always in line with the SMART principle. E.g. actions that are aimed to change culture or behaviour can take long time before they lead to the desired effect.

6.7. USE OF OPERATING EXPERIENCE

All information on event reports and analysis results and near miss reports is accessible for everyone through the intranet.

Lessons learned or corrective actions from OE can lead to corrections or enhancements of the work instructions or the lessons learned from individual events or trend analysis can lead to a toolbox meeting e.g. to raise the awareness about the human factor in events.

For operations personnel, the feedback on OE is part of the yearly refresher training which is also attended by other people and which is prepared by SWG.

Some statistical information derived from the annual report, lessons learned and important external events are on the agenda of that training.

Observations during pre-job briefings gave an indication that this practice is not well developed and thus an opportunity to communicate on important lessons and measures to prevent recurrence can be missed.

Following the re-organization the tasks done by senior technicians allow improvement in using OE in daily activities. The senior technicians, who do the preparation and the evaluation of the activities, are now also involved in the analysis of the events and participate to the SWG meetings. Therefore their adherence to the use of OE and of the lessons learned will be much stronger.

For all departments a reflection should be done on how to close the learning loop, not only for events and near misses that happened in their area, but also in other departments and external to the plant; pre-job briefings, toolbox trainings, refresher trainings are suited to do this.

A strong relation and use of OE information (internal and external) in the ageing management programme was observed.

The relation with the training centre and simulator instructors is good and the relevant information from OE is available to them. In annual meetings to discuss the program, OE is always looked at as in input.

6.8. DATABASE AND TRENDING OF OPERATING EXPERIENCE

Trending of reported and analyzed events is done for the events that are analyzed, according to the HPES categories and their relevance to nuclear safety. The results of this trend analysis are presented to the management in the OE annual report. There are also monthly and quarterly reports on the functioning of the departments where certain trends are mentioned.

Full coding (e.g. WANO coding system) on components, circuits, groups, activities, … involved, is not applied.

For the near misses the only coding that is done is on the nature of the near miss (8 categories) and the result of the risk estimation. There is some development to be done to enhance this as today, the database is not adapted to do this.

In the management meetings, corrective actions are defined to correct adverse trends or improve the performance. Periodical trending to detect adverse trends, weaknesses, common issues and causes, etc. can be improved. The team made a suggestion to improve trending of all events, more frequently, and to follow-up on the corrective actions in a clear and transparent way.

6.9. ASSESSMENT AND INDICATORS OF OPERATING EXPERIENCE

Quarterly reports and annual reports are made to give an overview of the performance of the OE process and organization and to draw attention if trends are detected or if the objectives are not met. There is also an annual, independent, evaluation of the quality of the (HPES) analysis and the reporting on OE by the SWG. This is done by the technical support department.

All these reports are part of the management review. They are distributed to the plant manager and department managers for evaluation and to take action if necessary.

From next year on, 15 indicators on the functioning of the OE process and about the number of certain categories of events will be included in the safety indicator. Some of these indicators are only updated in that system on a yearly basis, (e.g. number of events due to working practices). This can be too long to react on changes in the trend.

DETAILED OPERATION EXPERIENCE FINDINGS

6.1. MANAGEMENT OF OPERATING EXPERIENCE FEEDBACK

6.1(1) Issue: The implementation of recent changes in organization, roles and responsibilities of key personnel, and enhancements to the OE process is not complete.

- Some people with a new role in the OE process, after the re-organization, still need to be adequately trained (e.g. in analysis methods) to know what is expected and to perform their duty in the most effective way.

- The process, roles and responsibilities for the management of the near-miss reporting system need further clarification.

- Recent enhancements to the expectations and to the system for reporting all near miss events, which started in 2004 in the industrial safety area, are not (yet) communicated to everybody at Borssele NPP. Procedures are not updated (yet) to reflect these changes and the expectations.

- As a consequence, the number of events reported according to these new criteria is low.

- The procedure describing the follow-up of corrective actions does not always correspond to work practices: not all corrective actions from different sources or processes that are specified in the procedure are entered into the follow-up system (for some sources, only the most important ones, or conclusions, are entered as corrective actions).

- At the time of the OSART review, it is difficult to observe and comment on performance as the change has been to recently implemented.

Without timely and complete implementation of the changes there are risks of decreasing performance of the OE process with the possibility of occurrence or recurrence of undesirable events that could have been prevented.

Suggestion: The plant should consider implementing recent changes in the organization, roles and responsibilities of key personnel, and enhancements to the OE process.

This includes:

- Setting and communicating clear objectives and expectations for everyone, with regard to the reporting of all kinds of events and deviations, especially for low-level events and near-misses and using all relevant information in daily activities.

- Defining roles and responsibilities in the management of the OE-process, training staff in accordance with their duties and to allocating sufficient time to enable them to perform as expected.

- Adapting procedures to correspond to the changed situation and the enhanced process.

Basis: NS-R-2:
2.23. Operating experience shall be carefully examined by designated competent persons for any precursors of conditions adverse to safety, so that any necessary corrective action can be taken before serious conditions arise.

2.24. All plant personnel shall be required to report all events and shall be encouraged to report on any 'near misses' relevant to the safety of the plant.

34. A good nuclear safety culture has the following characteristics:
….Errors and near misses when committed are seen not only as a matter of concern but also as a source of experience from which benefit can be derived. Individuals are encouraged to identify, report and correct imperfections in their own work in order to help others as well as themselves to avert future problems.

6.4. ANALYSES AND TRENDING

6.4(a) Good Practice: A risk quantification matrix is used to perform risk evaluation and to rank the low level and near-miss events that are reported.

The use of a risk evaluation matrix permits the calculation of risk in respect of the potential consequences of a near miss event. The areas that are considered in this evaluation are: nuclear safety, industrial safety, public acceptance, environment and financial consequences. This is done using a clear and visual aid (coloured matrix).

The tool has proved to be useful to determine the degree of analysis that is required.
It can also be useful to find precursors and to measure the performance of near miss reporting: more events of a lower risk level indicates improvement.

Risk matrix

Potential consequences						Probability of incident with these consequences				
Category	**Nuclear safety**	**Health and safety**	**Environment**	**Public image**	**Financial consequences**	**A. Improbable** **10E-5/year**	**B. Rare** **10E-3/year**	**C.Infrequent** **10E-1/year**	**D. Regular** **1/year**	**E. frequent** **10/year**
0. Zero	Not relevant to nuclear safety INES Out of Scale	No consequences.	No effects	No consequences	No damage	0	0	0	0	0
1. Slight	Safety-related event without significant consequences INES 0	Accident requiring first aid. Illness.	Minor release or damage within site boundary.	No public unrest	< € 10,000	1	2	3	4	15
2. Limited	Significant safety-related event. No violation of Technical Specifications. INES 1	Slight injury. Temporary changes to work. Temporary irritations (not permanent).	Release slightly in excess of allowable limit. No permanent damage outside site boundary.	Local unrest	€ 10,000 - € 100,000	2	4	18	24	60
3. Serious	Significant safety-related event with violation of Technical Specifications. INES 1	Serious injury (permanent in some cases). Absence from work.	Release in excess of licensed limit. Impact outside site boundary. External complaints.	Regional unrest	€ 100,000 - € 500,000	9	18	27	72	90
4. Very serious	Significant failure in safety system and/or radioactive contamination within site boundary and/or radiation exposure of employee(s) above permitted limit. INES 2	Very serious, permanent injury. Disability Death.	Release seriously in excess of limit, with damage to environment. Corrective actions required outside site boundary.	National unrest	€ 0.5 million - € 10 million	12	24	72	96	120
5. Disastrous	Near accident with no safety barriers remaining and/or serious radioactive contamination within site boundary and/or radiation exposure of employee(s) with direct consequences for health and/or very minor release of radioactivity above the permitted limit. INES >=3	Several deaths.	Serious ecological effects. Extensive public concern and economic damage.	International unrest	> € 10 million	30	60	90	120	150

Low risk	Score 0 - 4; risk requires no follow-up action.	High risk	Score 30 - 72; unacceptable; in all cases, implement extra management measures or measures to restrict the consequences, in order to reduce the risk to a lower acceptable level.
Medium risk	Score 9 - 27; additional management measures required to further reduce the risk or limit consequences.	Extreme risk	Score 90 and higher; absolutely unacceptable. To be completely revised.

EPZ

6.8. DATABASE AND TRENDING OF OPERATING EXPERIENCE

6.8(1) Issue: Trending and common cause analysis of all reported events, including low level and near miss events is not fully implemented.

- At the moment of the OSART review, there is no real trending of near-miss events.

- The database for near misses is not adapted to include additional information that can be used for trending or to do searches on common causes.

- Until now there has only been one report (annual report 2004) where the reported near misses are grouped into 3 large root cause categories: behaviour, technical and organizational factors.

- The near-misses that require immediate action are sent to the departments involved, and actions are taken To address common causes and adverse trends identified in the yearly report, the report with the conclusions is sent to the appropriate committees. Determination of corrective actions and follow-up on the effectiveness is done in these committees.
  The next annual report will show if these have been effective.

Without good trending and common cause analysis of all reported events, including low level and near miss events, adverse trends and flaws in barriers in the organization, processes, procedures and human performance can remain undetected and preventive actions for improvement will not be defined in a timely manner, before they lead to real events with more serious consequences.

Suggestion: Consideration should be given to implementing a more comprehensive system for trending and common cause analysis of all reported events, including low level and near miss events.

Some elements for achieving this are:

- Development of criteria and categories for trending events, and the right tools (database) to enable trending and perform more advanced searches.

- Set expectations and indicators to measure performance and define the frequency for reporting on these as well as the trends and common causes that are observed Perform follow-up on effectiveness with special attention to common causes and trends related to human performance and behaviour.

Also trend reporting behaviour (no reports does not mean that nothing happened, it means that nothing is reported).

Basis: NS-G-2.4
6.64. … Low level events and near misses should be reported and reviewed thoroughly as potential precursors to degraded safety performance. …

6.66.….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.

75-INSAG-3 Rev. 1 – INSAG-12
112. … organizations have a programme of gathering information specific to their plants and using it to trend and improve the plant performance. The accumulated information is on reported plant events, errors, near misses, problems, observations, and even suggestions for improvement. The information is reviewed by representatives from different plant functions and it is assigned a safety significance level. ……

….. A process is established to track the various assessments and corresponding corrective actions and to determine unfavourable trends, which can be reversed….

Key Practical Issues in Strengthening Safety Culture INSAG-15

3.4. See entire paragraph on reporting culture

7. RADIATION PROTECTION

7.1. ORGANIZATION AND FUNCTIONS

The plant radiation protection policy is based on the radiation principles that are in compliance with the IAEA basic safety standard No 115. The plant goals are elaborated in the two years company plan. The monitoring department plan contains the adequate set of radiation performance indicators with values taking into account the operational experience. Performance indicators cover all anticipated parameters as indicators for individual and collective doses, “overexposures” higher than administrative limits, gaseous and liquid discharges, number of personnel contaminations or number of revealed surface contaminations. Actual status of the performance indicators is available for anyone in the intranet.

Responsibilities of the radiation protection (RP) department are clearly described and job descriptions are available. Optimization principles are well understood by the RP personnel. The RP department is independent from the production department and maintenance department and has adequate independence and authority.

The radiation protection staff is actively involved in elaboration and reviewing of plant documentation and in elaboration of operational procedures addressing radiological issues.

The management of Borssele Nuclear Power Plant (NPP) as well as the authorities are periodically informed about the radiation protection plant status. Reports are provided daily, weekly, monthly, quarterly and annually. The results can also be seen on the intranet. The radiation protection department has a good cooperation with the other plant departments.

The number of the RP employees is adequate to fulfil the requirements. Additional staff is hired for outages or to cover works, when additional human resources are needed. The plant is facing the problem of replacing the skilled personnel leaving for the retirement. The RP department is already preparing new persons to overtake RP responsibilities, duties and tasks.

A training programme for radiation protection workers exists at the NPP. The radiation protection staff acts as a lecturer in the training and operation experience feedback is thus ensured. Workers can get a special training on station’s mock-ups or in the training centre in Essen (Germany).

Health examinations of all radiation workers is required in one-year period. The Dutch law ensures that a doctor has the adequate radiation protection knowledge before being assigned as a NPP physician.

The qualified manager of nuclear safety and quality assurance conducts the monthly audits of the radiation protection department. A comprehensive quality assurance programme for radiation protection is available at the plant.

7.2. RADIATION WORK CONTROL

All planned works are sufficiently analysed in advance by the RP department. Radiological hazard activities are consulted in advance in order to find optimum radiation protection for workers. Hazardous works are trained in safe areas using mock-ups. Several mock-ups are available at the NPP.

The plant does not use the name “radiation work permit” but radiation conditions and requirements are described in the “work permit” that is a part of work package. The work permit contains all necessary information for worker protection. The pre-job briefing is provided mainly to the “leader” of the group and then the leader instructs the other members of the working group. Radiation protection technicians always supervise the work if it is combined with a higher radiation risk. The system works effectively.

However some workers did not follow the radiation protection requirements for working in contaminated areas and several persons were seen in the controlled area wearing items which are not allowed according to the site introduction film, such as watches, rings, necklaces, earrings; and radiation protection staff tolerates it.

NPP personnel working in radiation controlled area (RCA) get the periodical annual refresher RP training. But there is a possibility that persons can skip the required annual refresher training. The team suggests establishing a system to check that individuals meet all RP requirements, including the refresher training before issuing permission to enter the RCA.

There is the only one access point to the RCA and its layout and equipment installed is adequate. Personal contamination monitors situated at the exit from the RCA are appropriate to measure body and small items contamination in order to protect spread of contamination out of the RCA. All rooms in the RCA are colour labelled in order to inform persons about the radiation conditions in the room. Hot spots are appropriately posted to warn the workers against the higher radiation risk. Periodical radiation contamination and dose rate surveys in the RCA cover all accessible rooms with commensurate frequency. Records are also displayed on the plant intranet.

The exits of the RCA and their surroundings where the equipment is brought out of the RCA are subjected to quarterly monitoring for radioactive contamination. Since October 2000 the whole NPP site (including roofs) has been surveyed annually for radioactive contamination and dose rate. The results of the measurements are very well documented in user friendly and illustrative database. Based on the findings of 2000 and 2001, the working method and procedures with respect to monitoring of contamination of equipment and material leaving the controlled area were improved and extended. The team recognized this as a good practice.

7.3. CONTROL OF OCCUPATIONAL EXPOSURE

Optimization of the occupational exposure at the plant is implemented at all levels of the work. It starts from the planning stage, continues during the execution and finishes with the post analysis. The plant has set an administrative daily limit for each person entering the radiation controlled area and a performance indicator for individual annual dose is also established.

An ALARA procedure is developed and used in practice. The NPP procedure addressing dose optimisation contains only the criteria for the collective dose. The dose estimation form must be completed if the assessed collective dose is higher than 5 man.mSv. A written report for optimization is required when the estimated collective exposure is higher than 10 man.mSv. However the threshold for the individual exposure optimization is missing. Dose constraint represents a minimum level of individual protection that should be achieved in the process of optimization. The plant has recognised the deficiency during its last periodic safety review and suggested the actions to incorporate the dose constraint into the optimization process. The team encourages the plant to implement the dose constraint value into the optimization process in order to assure that the individuals receive an adequate level of protection.

Plant uses all available measures to reduce exposures. Strong attention is paid to protection of workers against the internal contamination. Respiratory equipment is provided to workers if air contamination is suspected. After completion each work permit submitted to optimisation is analysed and a report is written in order to save the feedback for future work.

Considerable work was done to reduce the personnel exposure. The levels of the dose rates on the primary circuit have dropped significantly since the beginning of operations due to actions and modifications taken, for example a dedicated effort to eliminate cobalt-containing reactor components and effective chemistry management of the primary coolant. The team recognized it as a good performance.

The plant uses a dose "lifetime graphs" and the plant makes effort to keep the individual maximum 5 year average dose lower than 3 mSv/year. This was identified as a good practice.

Internal contamination of each person is measured before the first entrance into the RCA, then when there is a suspicion for internal contamination, annually and after the finishing work at the plant. But a possibility exists that a person can skip the annual monitoring for internal contamination. The team made a suggestion under chapter 7.2.

Radioactivity of the air in ventilation systems is measured as well as mobile measurement equipment is available to warn workers against the possible internal contamination.

A sufficient number of TLD legal dosimeters for gamma, beta and neutrons and electronic personal dosimeters as operational dosimeters is available at the plant. Extremity dosimeters are also available. Each person working in the RCA is equipped with the appropriate dosimetry and every visitor is provided with an electronic personal dosimeter.

A set of administrative limits serves to inform radiation protection staff as well as the workers to maintain exposures within the limits. The records of personal exposure are stored in an electronic version and in a paper form. Procedures for unusual readings and for loss of dosimeters exist and regular comparison of the results of legal TLD dosimeters and operational dosimeters is performed. Discrepancies are analyzed and corrective actions are taken.

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

The power plant has a sufficient number of portable, mobile and stable radiation instrumentation. The calibration stand for radiation instrumentation has been modernized and ensures a high standard of the calibration. Skilled personnel provide the calibration services, approved calibration procedures are available and personnel follow them. The schedule for routine calibration is well established to ensure all instruments are required to be submitted to calibration on time.

Personal internal contamination is measured on the quick body monitor (QBM) and on the whole body counter. Well elaborated procedures for germanium whole body counter are available. Periodical checks are performed as expected.

Obsolete personal contamination monitors (PCM) at the RCA exit were replaced approximately five years ago. The new PCMs consist of beta sensitive probes as well as gamma plastic scintilators. Due to that fact, the monitors can also provide the indication of an internal contamination of personnel leaving the RCA. The gamma sensitivity of new PCM is comparable to the QBM sensitivity. However the quick body monitor is not periodically checked and the procedure for routine testing is not available. The team suggests the plant consider writing the routine programme and ensuring periodic tests of the quick body monitor.

The radioactive gas discharge sampling system had been rebuilt to meet the criteria of representativeness and isokinetic and the gaseous monitoring equipment is adequate. Liquid effluent monitors are in place. Gaseous and liquid monitors are properly calibrated and the samples taken for the analysis are submitted annually to governmental crosschecking. Reports are available at radiation protection department.

The NPP has an adequate and well-maintained inventory of protective clothing. Number and spectrum of respiratory equipment is enough and equipment is properly tested and maintained. Pictograms are available at all entrances to contaminated areas to notify personnel what is required at specific points. Laundry for washing of protective clothing exists at the plant. Showers are available at many places in the RCA.

A decontamination facility is available but the floor in the decontamination room does not fulfil the requirement to be easily decontaminated. The plant is aware of it and corrective actions are planned. The team encourages the plant to take corrective action in order to replace floor surface for an easily decontaminated one.

7.5. RADIOACTIVE WASTE MANAGEMENT AND DISCHARGES

Radioactive waste management programme is well implemented at the plant. Collection, treatment, volume minimization, packing, labelling and recording of waste is performed in a satisfactory manner. Plant goals are established in the annual company plan and performance indicators allow the management to follow the progress with waste generation. There is a positive trend to minimise generation of radioactive waste.

A good performance was recognised by the team in minimizing the generation of radioactive waste the used filters of breathing equipments are opened, charcoal absorber is measured and finally released from the RCA as non-radioactive waste. The rest covers of the filters are pressed to minimise their volume. The policy of packaging of radioactive waste is to minimise the exposure to the persons from the radioactive waste. Radioactive waste storage contains only limited number of containers due to their scheduled transport to the state depository.

Both gaseous and liquid releases are kept well below the authorised limits and the trend to minimise the released activity is visible. Performance indicators were set much lower than the limits and real values of releases are compared to them to provide early warning to the management if some deviation occurred. Results of releases are periodically submitted to the plant management and to the authorities.

The environmental monitoring programme is comprehensive enough to assess the influence of the NPP to its surroundings. The regulatory body approved the location of the sampling points, kind of samples, sampling frequency and kind of sample analyses. An external company provides the sampling and the analyses. Results are available every six months. The approved method of calculation of the doses to the members of critical group in the surrounding area is based on the data given in the plant safety review. RP department checks the results for trends and so far no trend has been observed.

7.6. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

Plant emergency documentation is well elaborated. Responsibilities are defined. Checklists for the different emergency response positions are available. The plant has a sufficient number of RP instrumentation, protective aids and well equipped emergency shelter.

Differences exist in plant procedure between the maximum doses in emergencies and in the radiation protection management of personnel undertaking intervention written in comparison to the IAEA requirements. The plant procedure is in compliance with the Dutch Law but it does not correspond to the IAEA standard. The team suggested the plant should consider revising the emergency procedure in order to incorporate IAEA requirements regarding maximum doses in emergencies and associated selection of volunteers and providing advance information to the personnel undertaking intervention in documented fashion.

Radiation protection personnel have emergency training once a year. Training is documented; analyzed and corrective actions are proposed and followed.

7.2. RADIATION WORK CONTROL

7.2(1) Issue: Persons may skip the annual refresher training or annual internal contamination measurement and some workers did not follow the radiation protection requirements for working in contaminated areas.

– NPP personnel working in the radiation controlled area (RCA) receive periodic annual refresher training in RP. However there is a possibility that persons can skip the required annual refresher training and still have access to the RCA. In 2004 two persons did not attend the annual refresher training.

– Internal contamination of workers is measured annually. However several persons were found last year without their internal contamination measurement and still have access to the RCA.

– Several workers were seen in contaminated areas without protective gloves.

– Initial training for incoming persons contains the information that wearing watches, rings, necklaces, and earrings is prohibited in the RCA. However, several persons were seen in the controlled area wearing such items and radiation protection staff tolerates it.

– Three pieces of used protective gloves were found thrown away on the floor in room 03.128 and several used protective aids (gloves etc) were found in storage racks in the corridor in front of rooms 03.323 – 03.326.

If a person does not have adequate knowledge he/she could increase risk due to radiation not only for himself/herself but also for other persons. Without a whole body count measurement, personal exposure due to internal contamination cannot be assessed. When workers do not use protective aids, they could become contaminated and spread contamination to potentially clean areas.

Suggestion: Consideration should be given to establishing a system to check that individuals meet all RP requirements, including the refresher training and periodic internal contamination measurement, before issuing permission to enter the RCA. The plant should consider reinforcing the requirements for workers to ensure that all RP rules are strictly followed.

Basis: RS-G-1.1, par. 5.100: "…Periodic retraining should be provided to ensure that workers have the most up to date knowledge relevant to their work … Training should be updated at regular intervals"

BSS115, par. I.10: "Workers shall follow any applicable rules, procedures, …use properly the protective equipment and clothing provided …"

7.2(a) Good Practice: NPP site radiation contamination survey.

Since October 2000 the whole NPP site (roofs including) has been surveyed annually for radioactive contamination and dose rate. Up to October 2000 this survey was performed at about 35 predetermined positions. The results of the measurements are very well documented in user friendly and illustrative database. Several hot spots with artificial activity and variation of natural background were found. Based on the findings of 2000 and 2001 the working method and procedures with respect to monitoring of contamination of equipment and material leaving the controlled area were improved and extended. In addition the exits and their surroundings, here the equipment is brought out of the RCA, are subjected to quarterly monitoring for radioactive contamination.

In 2005 no contamination from the NPP was found outside the RCA during the site contamination survey.

7.3. RADIATION DOSE CONTROL

7.3(a) Good Practice: Dose “lifetime graphs”; The plant strives to keep the individual maximum, 5 year average, dose lower than 3 mSv/year.

The RP department produces a dose “lifetime graph” every year in which a 5-year average line is inserted. In this way RP and workers have a simple overview of average dose for the last five years. These dose “lifetime graphs” support the plant policy to try and keep the individual maximum 5 year average dose lower than 3 mSv/year. The dose “lifetime graphs” are annually provided to the workers and if necessary, reviewed with the department managers. If during the year, a person is nearing 3 mSv, the department manager is consulted, in order to try to take measures to limit the dose in the rest of the year.

The individual dose was already a concern for the RP department and the NPP in the 80’s.

At that time the policy was to keep the individual dose for employees and regular contractors lower than an average of 10 mSv/year.

In the 80’s, a dose “lifetime graph” was made every year, to keep track of people with relatively high dose.

RP produces a dose “lifetime graph”, every year, in which a 5-year average line is inserted. In this way, RP and workers have a simple overview of the average dose for the last five years.

These dose “lifetime graphs” support the plant policy to try and keep the individual maximum 5 year average dose lower than 3 mSv/year.

A dose “lifetime graph”, with the 5-year average dose line, is produced every year.
The dose “lifetime graphs” are distributed to the nuclear workers.
The dose “lifetime graphs” are reviewed annually and whenever necessary with department managers.

If necessary, possible and desirable, measures are taken to lower the dose of an individual in the following year(s).

If, during the year, a person is nearing 3 mSv, the department manager is consulted in order to try to take measures to limit the dose in the rest of the year.

7.4. RADIATION PROTECTION INSTRUMENTATION, PROTECTIVE CLOTHING, AND FACILITIES

7.4(1) Issue: Quick body monitor (QBM) is not periodically tested and a procedure for routine testing is not available.

The quick body monitor at reception is used for measuring the internal contamination of new persons coming to work at the NPP, and all personnel working with ionizing radiation at the plant. An indication of the internal contamination of persons leaving the radiation controlled area (RCA) can be also obtained from personal contamination monitors that are installed at the exit from the RCA, as they are equipped with gamma probes whose sensitivity is comparable to the QBM.

- Last calibration of QBM was performed four years ago.
- Routine programme for the equipment testing has not been written.
- QBM is not periodically tested.

Without periodic testing, the monitor's parameters could change, and that could result in inaccurate measurement or monitor failure.

Suggestion: The plant should consider writing and implementing a procedure for periodic testing of the quick body monitor.

Basis: RS-G-1.1, par.5.46: "… The equipment should be calibrated to meet appropriate standards."

RS-G-1.2, par. 9.13: "… A system should be established … one such a system is a routine programme of equipment testing …"

7.6. RADIATION PROTECTION SUPPORT DURING EMERGENCIES

7.6(1) Issue: Differences exist in plant procedure between the maximum doses in emergencies and in the radiation protection management of personnel undertaking intervention in comparison to the IAEA requirements.

The values for dose limits (250 mSv – rescue of economically important goods and 750 mSv – life saving activities) applied for emergency purposes in the procedure N14-23-300 correspond to the values in Dutch Law. However they are not in compliance with those in BSS 115 (100 mSv and 500 mSv respectively).

IAEA BSS 115 states that workers undertaking the intervention when the dose may be above the maximum single year dose limit (50 mSv) should be volunteers. They must be clearly and comprehensive informed in advance about the risk. However the plant procedure written according to Dutch Law requires volunteers only above 100 mSv, 250 mSv or 750 mSv respectively. Information about the risk provided to the person undertaking intervention is not documented.

If a worker is allowed to receive a higher dose, his potential health consequence could be more severe. Without proper information about the health risk associated with the estimated exposure, a worker undertaking intervention would not be able to consider the risk to him.

Suggestion: The plant should consider to revising emergency procedure in order to incorporate IAEA requirements regarding maximum doses in emergencies and associated selection of volunteers and providing advance information to personnel undertaking intervention in a documented fashion.

Basis: BSS 115, par. V.27 – V.28: "When undertaking intervention under specified circumstances, all reasonable efforts shall be made to keep doses to workers below twice the maximum single year dose limit, except for life saving actions, in which every effort shall be made to keep doses below ten times the maximum single year dose limit in order to avoid deterministic effects on health. Workers who undertake actions in which the dose may exceed the maximum single year dose limit shall be volunteers and shall be clearly and comprehensively informed in advance of the associated health risk. In addition, workers undertaking actions in which their doses may approach or exceed ten times the maximum single year dose limit shall do so only when the benefits to others clearly outweigh their own risk."

8. CHEMISTRY

8.1. ORGANIZATION AND FUNCTIONS

The chemistry department personnel ensure chemistry control activities to maintain the integrity of systems and components through minimising the corrosion and erosion in primary and secondary systems, to limit build-up of deposits and environmental impact. All chemistry activities are the responsibility of the chemistry manager, who reports to the monitoring department manager and nuclear operations plant manager. The role of the chemistry department is well supported by the plant management, which is involved in analyses and approval of the department plans and projects.

Appropriate goals and objectives have been established for this organization and the functions are well organized and supported by informed and motivated personnel. Periodic reports ensure good information of performance and weaknesses. Routine tours of the plant performed by plant management also contribute to a realistic image of chemistry.

Job specifications of chemistry staff and contractors are well documented with responsibilities and expectations, and all personnel demonstrate good adherence to them. The chemistry staff and contractors ensure complete chemistry control of the plant in normal operation and outage. The on-call system is continuously used by the chemistry department to solve on-line instrumentation deficiencies in a timely manner and to perform emergency activities during nights and weekends.

Periodic assessment of chemistry activities based on the chemistry control programme results and personnel behaviour is properly carried out by the department manager. Internal and external audits properly complement the assessments and indicate good response to necessary corrective actions and good performance of chemistry activities. Long-term assessment results and modifications or actions planned for the chemistry department are included in two-year and ten-year reports for the plant, and used to report to the Netherlands Authorities. The two-year report, 2003-2004 and ten-year report, 1993-2002 indicate good adherence to the target indicators, minor deficiencies and correct improvement of plans for the chemistry area.

Strong relationships and effective benchmarking exists between Borssele chemistry department personnel and equivalent chemists from nuclear power plants in Germany, Finland, Switzerland and Spain. Useful information is also gathered by chemists by periodical participation at seminars organized by the associations of large power plant operators VGB and Advanced Nuclear Technology (ANT). The manufacturer Framatome also provides advice and periodical training through their experts in (radio) chemistry. The World Association of Nuclear Operators (WANO) contributes to personnel performance improvement by seminars and peer reviews.

The good interface between the operation and chemistry departments enables the plant to respond appropriately to systems parameters modifications. Efficient on-line monitoring of the most important chemistry parameters and alarms if parameter results are outside specification ranges ensures that a correct understanding of plant chemistry status is provided to the shift supervisor. Daily participation of the chemistry single point of contact (SPOC) in meetings ensures proper exchange of information and support requests with other plant departments. Correct and immediate actions (as per procedure PO-NO7-26) are taken in a timely manner in case of on-line monitoring trends and alarms and at the request of chemistry staff.

A planned job rotation of all personnel ensures good refreshment of activities routinely performed in laboratories and in the field. For work requiring special qualifications, two persons are established to ensure proper maintenance and calibration of the laboratories and field equipments. Good competencies of the chemical technical ensure proper support to sustaining and improving the chemistry control programme and to the activities of the other departments at the plant.

Training and qualification requests and responsibilities are clearly defined by chemistry management in individual development plans and job descriptions for all personnel (on fixed and non-fixed contracts). After completion of general employee training (supported by the training department), specialized chemistry training is performed effectively through on-the-job training. The trainees are properly trained and supervised by qualified staff, but their performance after on-the-job training is not properly recorded and effectively used for chemistry department training assessments. The team developed a suggestion for that issue in the training and qualification area.

The chemistry manager assesses training programme results and personnel skills through continuous observation and discussion. Successful on-the-job training is confirmed by the manager, who informs Human Resources and Training departments of the status of qualification. Refresher training for all staff is well performed annually by the training department. Training courses provided by the manufacturer also contribute to improving personnel knowledge in specific areas.

The tasks and responsibilities of contractors involved in chemistry control parameters, laboratory and on-line analyzers services are properly tracked and documented. The Quality Manual HP-NO4 establishes clearly directions for all activities specific for chemistry department. The logistic of all activities and support documentations are well described in procedure (PU-NO4-01). An effective personnel performance assessment, performed annually by the chemistry manager, contains not only conduct criteria, but also the contribution of each person to common goals and chemistry performance.

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

A good chemistry control programme is documented in internal procedures and has been established under the appropriate Dutch nuclear safety rules and guides, chemistry handbook, chemistry guidelines and the plant documents. The chemistry control programme for primary and secondary systems is based on two independent references for the chemistry operations manufacturer technical specifications: Framatome-ANP chemistry handbook and VGB Guideline. Both references were revised in 2005, and are properly reflected in procedure (NO4-22-001), who contains all the necessary data to ensure proper chemistry control for normal operation of the primary, secondary and auxiliary systems: expected values of (radio) chemistry parameters, warning and action limits and technical specifications. This procedure describes also the basis of establishing of limits. Good established monitoring parameters assess the corrosion process, corrosion product transport and radioactivity build-up. The sampling plan (systems parameters and sampling frequency) is completely documented in procedure (NO4-21-001).

Procedures (NO4-28-009 and NO4-28-003) contain detailed instructions for the staff to ensure chemistry control of primary and secondary systems and wet lay-up during plant outages. Every year, based on the outage characteristics, these procedures are revised and the staff is properly trained.

All chemistry activities are systematically performed with planned sampling and analysis scheduled under the supervision of the chemistry manager. The daily activities performed by the chemistry staff are correctly recorded in the laboratory's log, daily reports and in the routine schedules. Minor deviations from expected results are promptly re-analyzed and reported without time delay to ensure that the parameters are maintained within technical specifications.

All specific parameters for demineralised water used for make-up are routinely monitored and kept into specification limits. On-line analyzers of the water station properly monitor and support the control of demineralization processes.

All chemical parameters established by manufacturer for the primary system (pH, dissolved hydrogen and oxygen, anions and iron concentrations, etc.) are properly measured and maintained within technical specifications. A minor water leakage has been identified at one of the two steam generators, but has no significantly impact on controlled parameters, which are under proposed targets.

A good control of boron dilution is maintained and reported to the involved departments. An annunciation to the main control room in case of unavailability of boron on-line measurement equipment allows for alternative boron monitoring and timely corrective actions. No deviation has been recorded by the plant in the last years in on-line monitoring and the team developed a good practice for this.

The fuel integrity indicator is monitored daily and reported to the shift supervisor and chemistry manager for a quickly identification of fuel defects.

Chemistry control is adapted to the changes in plant material. In 1982 plant decided to replace stellite and as result the dose rate significantly decreased in primary system.

Borssele secondary side chemistry was improved by changing from phosphate treatment to High All-Volatile-Treatment after replacing of the Cu-Ni alloy condenser tubes with titanium. All secondary system parameters (pH, ammonia, hydrazine, dissolved oxygen, contaminants, etc.) are properly measured and controlled. The steam generator blow down water is continuously recuperated into the system after a proper purification through a mixed bed resin and magnetic filter.

Using operating experience, the plant adjusted the dosage of sodium hypochlorite in the cooling water system to improve the control of growth of mussels on the wall of the pipes. The chemistry department works with living mussels to detect their behaviours on sodium hypochlorite. The reduction of the sodium hypochlorite dosage in the system has led also to less release of this chemical to the environment.

Based on visual inspection and hide-out return, results from 2004, (with Framatome support for proper interpretation of analysis results), the plant decided to perform a chemical cleaning of the secondary side of the steam generators. Mechanical cleanings were unsuccessfully performed before 2000. An efficient chemical cleaning has been performed in Outage 2004 and removed more than 90% of hard deposited crud (totally 4400 kg) and reducing the risk of steam generator pipe leakage. The heat transfer of primary to secondary system was significantly improved after the chemical cleaning.

After analyses of an event from other similar plant, Borssele decided to improve the control of hydrogen to minimise the explosion risk during start-up. Supplementary monitoring of dissolved hydrogen in the primary system was documented as mandatory for start-ups.

The plant procedures and internal practices ensure proper segregation and minimisation of (rad) waste produced by chemistry activities in laboratories and in the field. The chemistry activities are performed as per ISO 14001 plant policies, with minimal environment pollution. All concentrated chemicals accidentally discharged from make-up tanks are properly collected in sumps and are not released before treatment. All chemical wastes from the plant are properly collected and segregated to be processed by qualified contractors.

8.3. CHEMICAL SURVEILLANCE PROGRAMME

The chemistry surveillance programme is based on the chemistry control programme. The performance indicators established to evaluate the results of chemistry control have good trends and total adherence to the targets**.** Both WANO indicators, fuel reliability and the chemistry indicator of the secondary side are below the proposed limit. Chemical parameter trends indicate a good prevention against heat transfer and corrosion problems through minimizing deposits in primary and secondary systems.

The analysis results and quality control measurements are properly recorded both on the paper and in an Excel electronic database. All records are reviewed daily, trended and signed by chemistry manager before being reported to the shift supervisor. A daily automatic backup of the database ensures good control of archived chemistry data. A database improvement project will be developed to automatically collect the quality assurance data from the laboratory equipment and also to include the radiation protection database.

The instrumentation in laboratories and field are well calibrated and properly maintained by qualified personnel (chemistry staff or contractors) or by contracted service engineers. The results of calibration and maintenance activities are properly recorded and archived in equipment handbooks and in an electronic database. Procedure (PU-NO4-02) clearly indicates all specific calibration activities required for (radio) chemistry analysis.

ALARA principles are properly implemented for the sampling, handling and storage the radioactive samples in the radiochemistry and emergency laboratories, and in the field.

The chemistry department and plant contractors participate, with good results, in two different inter-laboratory comparisons. The scope of the chemistry comparison is the control of system chemical components (boron, silica, ammonia, chloride, fluoride, sulphate, sodium, copper, and iron) and is performed twice per year. The last two inter-comparisons are acceptable for more than 96% of measurements. For the rejected results, (low-level of Na and Cl) analyse of the source of errors was performed, but the source was not identified. The scope of the (radio) chemistry comparison is the control liquid radioactive releases measurements and is performed once per year. All radiochemistry results made by the plant and their contractors are also in the acceptable range. A supplementary criteria evaluation of international comparison results on waste water measurements allows the plant to better assess the performance of the laboratory measurements and to improve the accuracy. The team identified this as a good practice.

8.4. CHEMISTRY OPERATIONAL HISTORY

The evaluation of the chemistry data is constantly done by the chemistry staff and manager and properly actions are implemented for chemistry control to minimize the analytical errors. All significantly abnormalities for control parameters or measurement instrumentations are properly identified by the chemistry manager, discussed with the shift supervisor and tracked in failure reports. The abnormal situation is analyzed and corrective actions are established for plant personnel to minimize the probability of repetition.

Procedure (NO4-28-001) contains a detailed check list for proper activities of the chemistry staff in case of secondary system water quality degradation and how to calculate the rate of leakage and the impact to boiler materials. Procedure NO4-28-004 contains logistic and other activities for chemistry staff to properly minimize the primary system water quality degradation and environment pollution.

Based on the document management system all chemistry staff participates in procedures reviews. All changes to procedures are properly analyzed, approved and communicated to the entire staff.

In February 2004 outage a hide-out return analyses was conducted with Framatome support and indicates a slightly acid characteristic for the steam generator crud. Next year, a new hide-out return will follow-up to monitor the effect of the chemical cleaning.

The 2004-outage report of the chemistry department indicates good management and results for all activities and monitoring performed (fuel sipping test, chemical cleaning, radionuclide and boron concentrations in primary system at different outage phases, etc.).

8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

The chemistry department measurements are properly shared in three different laboratories: non-radioactive (conventional) laboratory, radiochemistry laboratory, and the emergency laboratory. All three laboratories have appropriate space and necessary equipment to perform the chemistry and (radio) chemistry analysis. A good redundancy of measurement instrumentation, both on-line and from laboratories assures continuous monitoring and control of (radio) chemistry parameters.

Laboratory facilities ensure proper the environment and support of chemistry activities: ventilation, fume hoods, power supplies, purified water, lights, emergency shower, chemical storage cabinets, etc. The fume hoods are periodically checked and are provided with air flow measurement and have a visual alarm which signals improperly operation. Supplementary and continuous power supplies provided for the gamma spectrometer and liquid scintillation analyzer. Chemical storage cabinets are according with the Dutch rules. A plant project is in progress to install liquid nitrogen lines between the gamma spectrometers “Dewar’s” and the make-up tank. This change will minimize the risk to the staff from handling the “Dewar” liquid nitrogen on the stairs.

Internal procedures, which describe standards and reagents preparation, the instrument maintenance and calibration, sampling, corrective action, etc. are properly represented in all three laboratories and are followed by chemistry personnel. The results of these activities are good; nevertheless the chemistry laboratory quality control programme does not satisfactorily ensure that equipment calibration and verification are effective to maintain the accuracy of the analytical results. The team developed a suggestion to the plant for that issue.

Calibration and verification schedules properly include all laboratories and on-line equipment, and are performed only by qualified chemistry staff and qualified contractors. Results of calibration and daily verifications are recorded and communicated to the chemistry manager. All equipment is well maintained and has good performance (calibration and verification results, time of availability).

The chemicals used by chemistry staff in laboratories and in the plant are stored and labelled according with their hazard and environment requires; nevertheless a proper and documented quality control does not exist to ensure the adequacy of the labelling and shelf life for standards and reagents used by chemistry staff. For this issue the team developed a recommendation for the plant. Both conventional and radiochemistry laboratories are provided with chemical spill kits; nevertheless chemistry personnel are not trained in the use the laboratory spill kit.

Good housekeeping is maintained in all three laboratories and sampling areas. Proper radiation shields are installed to minimize the personnel dose from highly radioactive systems and samples, not only in normal operation, but also in case of a radiological emergency.

All chemistry personnel are periodically trained for properly sampling from the system, sample transportation and handling for analyzing preparation, and for measurements. Quarterly, the equipment operation, the facilities state and personnel skill are checked. The on-call chemistry staff ensures continuous availability of staff to perform (radio) chemistry analyzes in case of plant emergency.

8.6. QUALITY CONTROL OF OPERATIONAL CHEMICALS AND OTHER SUBSTANCES

A database for management of dangerous substances connected to the electronic ordering system ensures good control of ordering and use of chemicals in the plant, and does not allow ordering and use of non-authorized substances (toxic, inflammable, not approved for nuclear use, etc.).

The Borssele plant has developed an Intranet database for all dangerous substances used all personnel, called Gevaarlijke stoffen Informatie Systeem (GIS). The database is used by personnel as a user friendly tool to rapidly obtain the necessary data related to the substance (quantity stored in warehouse, storage place, technical characteristics, protective equipment, actions in case of emergency, etc.). A link from this database to the ordering electronic programme allows personnel to order the necessary chemicals, but a filter installed in the database does not allow access to order forbidden or restricted controlled substances without authorization. Only a few selected persons are authorized to order these substances. This makes the GIS a particularly effective tool to prevent uncontrolled ordering and use of toxic or hazardous substances such as organics, and chlorides and sulphates which could potentially damage safety-related equipment.

The team believes that this is a good performance to minimize the exposure of workers to toxic materials and to protect the plant materials.

The control of chemical concentrations and system contaminants is sustained properly by verifications of every lot of bulk chemicals, before it is used in the plant. The criteria of purity and limit values of impurities of all operating chemicals are clearly established.

Inspection field tours are done periodically by the chemistry staff and manager and cover all chemicals storage areas of the plant. The abnormalities observed and necessary corrective actions are documented and reported to the department manager.

DETAILED CHEMISTRY FINDINGS

8.2. CHEMISTRY CONTROL IN PLANT SYSTEMS

8.2(a) Good Practice: A proper annunciation to the main control room in case of unavailability of boron on-line measurement equipment allows for alternative boron monitoring and timely corrective actions.

The on-line boron analyzer has to measure, at every hour, the primary system boron concentration and to show automatically the results in the main control room for proper trending and control. Based on two internal experiences, when the analyzer was accidentally switched off and the technical specification was not met, the plant developed a control system of correctly actualization of measured data. This system gives an automatic alarm in the main control room in case a new boron concentration value is not registered in the main control room for 90 minutes. This prevents exceeding the required interval between boron measurements and permits timely use of an alternative method for boron measurement and for necessary corrective actions.

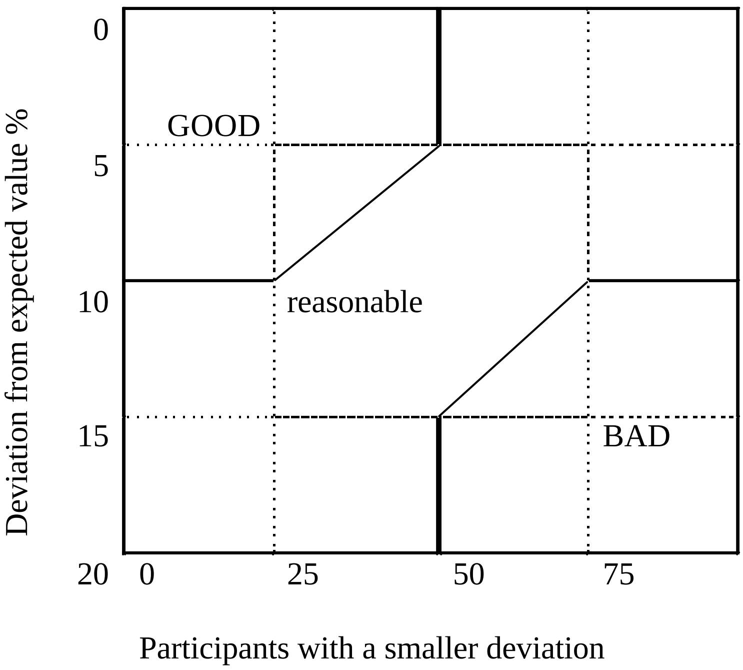
As results of this modification, no deviation was recorded by the plant in the last 10 years for on-line boron monitoring.

8.3. CHEMICAL SURVEILLANCE PROGRAMME

8.3(a) Good Practice: A supplementary criteria evaluation of international comparison results on waste water measurements allows the plant to better assess and improve the performance of laboratory measurements.

NPP Borssele participates yearly in international comparisons on radio waste water measurements with good results, but the plant was looking to improve the way to establish his performance and to compare with other laboratories, with higher performance. Not only the deviation from the real value is used, but a supplementary criterion is introduced: the number of participants with a smaller deviation. The result is good when the absolute value is less than 10% and also less than 50% of the participants with a smaller deviation. The results are not acceptable when deviation is more then 10% (respectively 15%) and the number of participants with a smaller deviation is more then 75% (respectively 50%). The criterion is combined in a matrix and is used as a stimulant for the plant to improve the results.

As the results of using of evaluation criteria, and the benchmarking with other inter-comparison participants, the sample preparations and the counting methods were improved and the number of deviations from the real value has decreased over time.



8.5. LABORATORIES, EQUIPMENT AND INSTRUMENTS

8.5(1) Issue: Properly documented quality control does not exist to ensure the adequacy of labelling and shelf life for standards and reagents used by chemistry staff.

- Five chemical standards expired in the cold chemistry laboratory are stored as good for use, and the working standards used to calibrate the equipment are prepared from expired standards (Cl, SO_4, F, Ca and Cu). There are new Cl, SO_4, F and Ca standards bottles in the laboratory, but no new Cu standard bottle.

- Two gas calibration standards used to calibrate equipment from the cold chemistry laboratory are expired. There is no label indicating that they are not to be used.

- Two expired gas calibration standards are stored in gas bottle storage area (room 26.105), near the gases for use; there is no indication to not be used.

- More than ten chemicals stored and used in chemical laboratories are expired, and the expiry date is prolonged by personnel (with permanent marker).

- All Dräger ampoules with reagents used to detect chemicals in air in case of a chemical emergency are expired. There are no other available ampoules to be used in case of emergency.

- There is no procedure or routine check of shelf life for standards and reagents used in the chemistry laboratories.

- Opened standards and reagents bottles have no indication on the opening date.

- Reagents with no expiry date allocated by the manufacturer are used indefinitely (no expiry date is allocated by the plant).

- Chemical waste (expired chemicals) stored in the chemical storage cabinet are not labelled as waste.

- A few chemicals stored in chemistry laboratories are not kept in the original container and do not have enough detailed labels (only the name of the substance, with permanent marker).

- One toxic chemical from the chemical cabinet in the cold chemistry laboratory is not identified as toxic, and is not stored in a toxic storage location.

- The reagent waste bottle from the Karl-Fisher coulometric titrator from the cold chemistry laboratory has no label.

- One substance stored in the chemicals cabinet of the hot chemistry laboratory has no identification label.

- In room 05 225, six glass bottles with chemical reagents used for on-line sodium analyzers are not labelled (no hazard, no name of reagents).

- In room 05 225, seven bottles with sodium calibration standard are not adequately labelled (labels do not indicate the standard name and expiry date).

– In room 05 225 two bottles with sodium standards have no labels.

– In room 05 225 is stored a sodium fluoride solution for sodium electrodes cleaning (poison); there is not a properly label.

– In room 05 225 are stored three bottles with expired and visible depreciated solutions.

Without a rigorous control of standards and reagents, the accuracy of analytical results and by consequence the chemistry of the plant could be affected.

Recommendation: A control process should be established and documented to ensure that proper labelling and shelf life control of standards and reagents is adequate.

Basis: 50-C/SG-Q13: Quality assurance for safety in nuclear power plants and other nuclear installations.

"403. Chemistry and radiochemistry work normally consist of:…controlling of laboratory conditions, practices, equipment and materials to ensure the accuracy of the analytical results/ ensuring the proper handling, storage, use and disposal of bulk chemicals, spent resins, laboratory chemicals, corrosive agents and cleaning agents."

8.5(2) Issue: The chemistry laboratory quality control programme does not ensure satisfactorily that equipments' calibration and verification are effective to maintain the accuracy of the analytical results.

- Quality check (QC) standards and calibration standards used for some of laboratories equipment are prepared from same primary standard source; not all internal procedures clearly indicated that the source used to prepare the QC standards should be different to the source used to prepare the calibration standard.

- On the hot laboratory pH-meter calibration pH 4, 7 and 10 are used; the electrode is rinse every time with demineralised water, but is not rinsed with the buffer before to introduce the electrode in bottle to avoid degradation of the pH buffers; same (the original) bottles are used every day for calibration.

- There is no available a list to easily identify and to maintain the necessary spare parts for the laboratories equipment (min/ max).

- The calibration curve for the Dionex ion chromatograph from hot laboratory uses only one standard, but the procedure NO4-26-068 specifies that the calibration curves should have 3 points and should not be forced through zero; there is no record into the equipment handbook to specify the reason of change from 3 points to 1 points calibration curve and to inform the personnel until the working procedure revision.

- A value for tritium background recorded for liquid scintillation analyzer from the hot laboratory exceeded the maximum acceptable limit; no records about the background analysis confirmation or for corrective actions exist in the equipment handbook.

- The conductivity-meter from room 05 225 used by chemistry staff for measurements in case of leak from sea water has the calibration data exceeded.

- The upper range of calibration curves for Aquamate ultraviolet/ visible spectrometer and Dionex ion chromatograph are not periodically checked (only the lower, normal used range is daily checked).

- The internal procedures for Aquamate ultraviolet/ visible spectrometer (NO4-27-048) and for N2H4, PO42-, NH4+ measurements (NO4-26-136, NO4-26-133, NO4-26-137) do not describe how to prepare the calibration standards and how to calibrate the equipment. The equipment handbook does not contain the calibration curves printing report (calibration curves are recorded in LIMS electronic database).

- Procedure NO4-26-133 for ammonia measuring specifies a wrong measuring range: 0.0÷15 mg/kg instead of 0.1÷15 mg/kg.

- Insufficient maintenance observed at the boron on-line analyzer Titro-analyzer Adi 2020 from primary side: 2 leakages of titration solution NaOH 0.5 N and one old leakage (B2O3 deposit) from the system water inlet; KCl crystal deposits inside of the pH electrodes; there is no routine for pH electrodes maintenance (except to fill the electrodes with KCl filling solution) (hot lab); there is no note in equipment handbook.

- Inappropriate practice on the preparation of one of three Cs-137 standards for NaI detector for monthly verification of total gamma counting (2 dilutions 10/ 1000 and

100/1000 instead of one 1/1000/ a mistake at calculation with one order); the internal procedures do not describe standards preparations (hot lab).

- Water leakage at one of two chlorine on-line meter (turbine building).

- Water leakage at one flow-meter from the sodium analyzer (room 05 226).

- The unused equipment and the spares parts of used equipments are stored together under the benches in cold and hot chemistry laboratories.

Without a rigorous control of equipments' calibration and verification, the accuracy of analytical results and by consequence the chemistry of the plant could be affected.

Suggestion: The plant should consider assessing and improving of the quality control programme applied in chemistry department to ensure the correct calibration and daily quality check of the chemistry equipment.

Basis: Quality assurance for safety in nuclear power plants and other nuclear installations.

"403. Chemistry and radiochemistry work normally consist of:…evaluating chemistry data to identify control problems and analytical errors, and to correct them/ controlling of laboratory conditions, practices, equipment and materials to ensure the accuracy of the analytical results…"

"408. Optimum inventory stock levels of spare parts should be maintained. Minimum/maximum quantities of spare parts should be established for prompt reordering when the minimum has been reached. These limits should be reviewed periodically…and adjusted on the basis of usage, maintenance experience, cost and lead time..."

9. EMERGENCY PLANNING AND PREPAREDNESS

9.1. EMERGENCY ORGANIZATION AND FUNCTIONS

After the Chernobyl accident in the year 1986, The Netherlands created a national system for nuclear emergency planning and preparedness contained in the "Nationaal Plan Kernongevallenbestrijding (National Plan for Nuclear Accident Control)" (NPK) in the year 1989. The relevant regulation has been incorporated into Kernenergiewet (KEW, Nuclear Energy Law) license in the year 1995. NPK divided nuclear objects into two types: so called A-objects and B-objects. All nuclear power plants are A-objects with the potential of national or even international radiological consequences. B-objects are small radioactive sources with potential to have only local radiological consequences.

The national emergency organization for nuclear accidents is called "Eenheid Planning en Advies nucleair" (EPAn, Nuclear Planning and Advice Unit). The minister of VROM (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Ministry for Public Housing, Planning and Environment) is responsible for the emergency planning and preparedness in the Netherlands. He is also responsible for the coordination of the national emergency response during a nuclear accident that involves the Netherlands. KFD (Kernfysische Dienst, Nuclear Physics Authority) is doing regulatory works within VROM, and will do connecting job between the plant and EPAn in case of emergency.

The highest level of the EPAn is formed by the Policy Team, called "Beleidsteam". The organizational level under the Policy Team is formed by specialists from three ministries, namely: the ministry of VROM (also the coordinator of the EPAn), the ministry of BZK(Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, Ministry for Home Affairs) and the ministry of VWS (Ministerie van Volksgezondheid, Welzijn en Sport, Ministry for Public Health and Sport). The Policy Team determines the policy and actions to protect public health, the environment and the national economy against the consequences of an actual nuclear accident.

The Policy Team is advised and supported by the so called "Front Office". The Front Office is responsible for the preparation of an integral advice to the Policy Team. This integral advice gives a prognosis of the emergency situation and achievable protective actions. The Front Office has a chairman who is in charge of the whole EPAn process. The Front Office is also responsible for the notification and information of the IAEA, the EU and neighbouring countries in case of a nuclear accident in the Netherlands.

On the next lower level of the EPAn organization are the three so called "Back Offices".
The Back Office "Radiological Information" (BORI) is responsible for the evaluation of the radioactive releases. It therefore gathers meteorological and radioactive release, contamination and sample information. The Back Office "Administrative and Operational Information" (BOBOI) is responsible for the administrative and operational processes, actually the chain of command within the governmental structure. The third Back Office is called "Public Health Information" (BOGI), responsible for public health.

Policy Team, the Front Office and the Back Offices all reside in the capital of the Netherlands, den Hague. The fourth level is formed by the Support Centers. These centers work in or close to the field; they gather information, take measurements and perform actions.

9.2. EMERGENCY PLANS

“Alarmplan” defines the emergency organization which is an integrated, separate organization that incorporates industrial and nuclear safety, first aid, fire fighting and site security functions.

The team was impressed by the fact that each sub-plan is based on a risk evaluation and on the possible scenarios for its particular area. Starting from the risk and possible scenario’s the plans give the methodology how the organization deals with the threads and how it mitigates their consequences. The sub-plans also describe the assets that are needed for this: organizational structure, personnel, written instructions and equipment. This new “Alarmplan” is evaluated by the team as a strength because it is clear, well structured and based on a traceable, defendable basis formed by the risk assessments.

The shift supervisor is, in case of an emergency, responsible for the emergency response until the emergency organization is operational. From that moment on the Site Emergency Director (SED) takes this responsibility over from the shift supervisor. The SED, as head of the emergency organization, is responsible for all decisions and actions taken by the emergency facilities.

Emergency Management Team consists of: the SED, the Manager Operations (MB), the Manager Radiation Protection (MSB) and the Manager Support Services (MOD). The SED can be advised by the Plant Security Manager (PSM) in case of a plant security issue. The liaison to the mayor of Borsele is an plant staff member who will be sent to the mayor to provide him with technical explanations on plant status and proposed actions.

“Rampbestrijdingsplan Kernenergiecentrale Borssele (Disaster Control Plan of Borssele Nuclear Power Plant)” is made by local governments as their own emergency plan. The plan gives a description of the protective action planning zones around the power plant. The local authorities are responsible for informing, warning and alarming the public; to decide on urgent protective actions in the first hour of an accident; to issue instructions to the public or to perform protective actions when there is a need to: shelter, iodine ingestion or evacuate the public; and measuring of radioactive contamination, decontamination of the public and rescue workers.

The mayor of Borsele will coordinate the local emergency response at mayor’ office in Heinkenszand. When the accident exceeds the border of the mayor’s jurisdiction the mayors of the adjacent districts will become involved. The mayor of Borsele will coordinate the team of mayors, police and fire men on the local level at RCC (Regional Coordination Center) in Middelburg. The local emergency team chaired by the mayor of Borssele gets its assignments on protective actions to be taken from the national authorities. The plant is only responsible to perform protective actions on its own site and to notify, to advice, to inform and to cooperate with the authorities.

The plant Emergency Management Team is expected to notify four emergency category, "Emergency Stand-by", "Plant Emergency", "On-Site Emergency" or "Off-site Emergency" and a description of the situation and an advice on actions, enabling authorities to decide on appropriate measures to protect public health, environmental and economic interests.

Protection zone of population is defined as follows (Guideline of Nuclear Accident Control, VROM, August 2004): Evacuation zone; 5 km; Iodine tablet ingestion zone: 10km; Sheltering zone: 20km.

9.3. EMERGENCY PROCEDURES

The plant emergency plan is called "Alarmplan". Like the emergency organization itself the underlying emergency plan is a combination of industrial and nuclear safety, fist aid, fire fighting and site security functions. Arbeidsomstandighedenbesluit (ARBO-besluit, Decision of Minister for Individual Safety) in year 1997 prescribes the rules for a regular industrial safety organization and the NPK defines the rules for an nuclear emergency organization. The plant emergency plan is divided into four sub-plans as follows: sub-plan Process events; sub-plan First aid (injury); sub-plan External threats; sub-plan Fire fighting.

The effectiveness of the "Alarmplan" of organization was demonstrated by prompt action of Shift supervisor, SED and staff to cope with an external event during the mission (intrusion attempted by some anti nuclear activists).

9.4. EMERGENCY RESPONSE FACILITIES

Major back fitting project of year 1997 included complete renewal of the control room, taking into account ergonomics and operational experience from the start of operation in year 1973. The position and layout of the panels and monitors in the new control room has been optimized to be able to keep a good overview during emergency situations. The control room personnel is protected against radioactive and chemo-toxic releases by an automatic ventilation system. Nevertheless, this control room is not protected against other severe external influences apart from air pollution.

The emergency control room, which will be used when the main control room cannot be used anymore for instance due to fire or severe external influences has newly been built in 1997. Its panels only hold the essential systems, monitors and controls to bring and keep the plant in a stable, safe situation. The reactor protection system and other bunkered systems guarantee a ten hours autonomous functioning of the most vital safety systems in case of severe external influences. This means that there is time for the on-duty shift to move to the emergency control room or to bring in a new shift.

"Alarmplan" organization will be situated in an emergency bunker Alarm Co-ordination Center (ACC). This bunker has several rooms for: the Site Emergency Director (SED), management operation organization room called MB, manager radiation protection room called MSB and the manager support services room called MOD. There are also other work locations that can be used by the "Alarmplan" staff during an accident situation, if these locations are safe to use. These work locations are for instance: the main control room, the emergency control room, the BOC-room (see following paragraph), the fire fighters garage, the cold laboratory, the site security building and the Technical Information Centre (TIC) room. The ACC has an air lock and a ventilation system that is able to sustain overpressure in the ACC. The air intake of this ventilation system contains active carbon filters. The ACC has its own emergency diesel generator.

The TIC is intended for use as an off-site coordination centre in case of site security problems. SED and his team can monitor plant parameters and site access routes from this location. TIC will only be used when the site and/or the ACC are not accessible. TIC has no special ventilation features.

The Operations Support Manager (BOC) and his team meet in the ACC at the formation of the alarm organization. From there they can be re-directed to their usual work location in office building to prepare a technical intervention in the plant.

The team was impressed by the provision of on-line plant or simulator process information to external parties. The plant can provide support teams from the plant vendor (Krisenstab, Framatome ANP at Erlangen) with on-line process information. On the same base, the VROM ministry Emergency Response Room has also a work station to view on-line process information from the plant's process computer. During emergency exercises, the same system can be connected to the plant's simulator in Essen (Germany). This way the simulator-controlled process data are being transmitted to the ACC, the Krisenstab and VROM, exactly the same way as the real process data would be transmitted in case of a real plant accident. This arrangement shows the effect of actions implemented by the operators in the plant or the simulator, under guidance of the Emergency Management Team.

9.5. EMERGENCY EQUIPMENT AND RESOURCES

The emergency operating procedures, Severe Accident Management Guidelines (SAMG) are in place in case that severe core damage cannot be prevented. These guidelines have been designed to use all technical options available to restore cooling to the nuclear fuel and to minimize the release of radioactivity. Many actions initiated from the SAMGs will be implemented by the Alarmplan organization rather than the control room staff.

Meteorological system to measure wind speed, wind direction, amount of precipitation, and inverse layer height is installed in the plant. This information is used by the MSB (Manager of Radiation Protection) to calculate the dispersion of radioactive releases. For these calculations a computer programme called WinREM is being used. This WinREM programme is easy to use for prediction of radioactivity diffusion and exposure estimate within 50 km of the plant. This information is required for advise to the authorities on the necessity for protective measures.

The ACC has a laboratory for analysis of gas- and water samples from the reactor and containment, when the normal laboratories are unavailable.

The emergency telephone system of the plant is redundant to the normal in-house network, and is connected to two redundant external telephone networks. The local and national authorities have also access to both external networks. These telephone connections are routinely tested.

However exercise practice doesn't not include unannounced page test and unannounced gathering test during off working hours, and emergency evacuation drill of site is being done without participation of near coal plant in the site. The team developed a suggestion to the plant for that issue.

9.6. TRAINING, DRILLS AND EXERCISES

Control room personnel is responsible to restore the installation after an incident to a stable safe condition under the supervision of Manager Operations of Emergency Management Team.

Application of the emergency procedures by the control room operators is the main tool to meet the operational challenges of an emergency situation. This allows the Alarmplan Emergency Management Team in the ACC to focus its attention on coordination of non process-related actions, such as communication with local and national authorities.

Training has gradually shifted from predominantly technical training, towards skills required for the organizational and communicative performance of the Emergency Management Team. This approach has started to contribute much during the emergency exercises which are held annually in cooperation with the local and national authorities.

The Result of National Nuclear Exercise on May 25, 2005 is as follows (System Evaluation of the National Nuclear Full Scale Exercise 2005, VROM & BZK, September 2005). Out of seventeen objectives, six were achieved by the players, eight were partially achieved and three were not achieved.

EPZ was only responsible for few of these objectives. General conclusion made by the external parties was that EPZ goals were evaluated as good in notification and information/advising the authorities.

During the 2005 May exercise, emergency relief team used a PDA (Personnel Digital Assistance) to receive the dose rate depending on evolution of the accident, adding to the realism of exercise. The team identified this as a good practice. The use of this PDA, the exercise could be done more realistic and effectively.

9.7. QUALITY PROGRAMME

The head of department named Operation Support group is responsible to implement and maintain Alarmplan documents are structured according to the plant’s QA-system and the structure of the alarm organization. He initiates the realization of all necessary documents. Preparedness of the separate groups within the emergency organization is delegated to the so called Group Managers. There is a Group Manager assigned to every individual group within the emergency organization. This manager is responsible that his group is well prepared for its particular tasks. This makes the group manager responsible for the selection, appointment and training of group members and also for the availability of tools and documents. Plant Operations Safety Committee (RBVC) reviews the annual evaluation report.

9.4. EMERGENCY RESPONSE FACILITIES

9.4(1) Issue: Communication methods and tools to transfer information about on- and off-site situation between centres are not sufficiently developed in emergency installation:

- Although the plant has already redundant telephone lines, communication between emergency centres relies mainly on telephone and fax equipment, except on line process communication. Use of more modern technology such as a telephone conference or video conference or information sharing on Web will be better for smooth communication.

- Intense contact of technical advising centre (Krisenstab, Erlangen in Germany) from Alarm Coordination Center (ACC) could be strengthened by improvement of information exchange method.

- As for smooth information exchange among responsible organizations, use of advanced information technology is limited to radiation protection area, Calamiteiten Web (CalWeb). It is operated by BORI (Back Office Radiological Information) of RIVM (Royal Institute for Public Health and Environment). To achieve a more efficient information exchange, the area of information exchange could be expanded to include not only radiation measurement results and process data but also general matters such as the evolution of the incident, decision making result of organization.

- The EPZ liaison officer delegated to the mayor of Borsele in case of emergency situation did not have a mobile communication device or means to obtain latest information. This person couldn't be contacted without any device.

Without more proper communication capability, response to emergency situation could be difficult to cope with.

Suggestion: The plant should consider developing additional modern communication methods and tools to enhance the quality of transfer of information about development of situation related to on- and off-site useful in case of emergency situation between emergency centres.

Basis: Safety Standards Series No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency, Logistical Support and Facilities 5.25. "Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation shall be provided for performing the functions. These support items shall be located or provided in a manner that allows their effective use under postulated emergency conditions."

9.6. EMERGENCY EQUIPMENT AND RESOURCES

9.6(1) Issue: Exercise practice at the Borssele plant are not sufficiently developed.

- The plant does not practice unannounced pager tests, and present tests are done periodically to check only the function of the pager.

- Unannounced gathering test for emergency staff during off working hours is not done by the plant.

- Participation of the coal plant staff is not included in evacuation drills of the nuclear power plant.

Without extensive practice exercises, the response ability, in case of emergency, could not be strengthened.

Suggestion: Consideration should be given to enhancing practice exercises for emergency preparedness.

Basis: Safety Standards Series No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency, Training, Drills and Exercise 5.36. "The performance of exercises at facilities in threat category shall be evaluated against established response objectives that demonstrate that identification, notification, activation and other initial response actions can be performed in time to achieve the practical goals of emergency response."

9.6(a) Good practice: Use of a contamination and dose rate simulation device during exercise will help participates of drill.

For realistic contamination and dose rate data input during drills, the use of a PDA (Personal Digital Assistance, portable data system with GPS localization) has proven to be particularly useful. The release of radioactivity in a simulated accident is calculated with a release model and fed into the PDA memory.

During the 2005 May exercise the emergency relief team use the PDA to "measure (hypothetical data)" the dose rate in the field depending on the evolution of the accident.

This adds to realism of their surveillance and communications exercise.

DEFINITIONS

DEFINITIONS – OSART MISSION

Recommendation

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

Suggestion

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

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

Good practice

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

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

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

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

LIST OF IAEA REFERENCES (BASIS)

Safety Standards

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; Defence in Depth in Nuclear Safety

INSAG-12; Basic Safety Principles for Nuclear Power Plants, 75-INSAG-3 Rev.1

INSAG-13; Management of Operational Safety in Nuclear Power Plants

INSAG-14; Safe Management of the Operating Lifetimes of Nuclear Power Plants

INSAG-15; Key Practical Issues In Strengthening Safety Culture

INSAG-16; Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety

INSAG-17; Independence in Regulatory Decision Making

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

INSAG-19; Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life

Safety Report Series No.11; Developing Safety Culture in Nuclear Activities Practical Suggestions to Assist Progress

Safety Report Series No.21; Optimization of Radiation Protection in the Control of Occupational Exposure

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

ACKNOWLEDGEMENT

The Government of The Netherlands, and the staff of Borssele Nuclear Power Plant provided valuable support to the OSART mission to Borssele NPP. Throughout the whole OSART mission, the team members felt welcome and enjoyed excellent cooperation and fruitful discussions with Borssele Nuclear Power Plant managers and staff, and other local and national authorities. Information was provided openly and in the spirit of seeking improvements in operational safety. There was a rich exchange of knowledge and experience which contributed significantly to the success of the mission. It also established many personal contacts that will not end with the completion of the mission and submission of this report. The efforts of the plant counterparts, liaison officers, interpreters and the secretaries were outstanding. This was of significant support to the OSART team in order to complete its mission in a fruitful manner.

The IAEA, the Division of Nuclear Installation Safety and its Operational Safety Section wish to thank all those involved for the excellent working conditions during the Borssele Nuclear Power Plant review.

TEAM COMPOSITION OSART MISSION

DUBOIS, Dominique – IAEA
Division of Nuclear Installation Safety
Years of Nuclear Experience: 27
TEAM LEADER

VAMOS, Gabor – IAEA
Division of Nuclear Installation Safety
Years of Nuclear Experience: 31
DEPUTY TEAM LEADER

BROUZENG, Nicolas – France
Dampiere Nuclear Power Plant
Years of Nuclear Experience: 16
MANAGEMENT ORGANIZATION AND ADMINISTRATION

PRIBOZIC, Franc - Slovenia
Krsko Nuclear Power Plant
Years of Nuclear Experience: 23
TRAINING AND QUALIFICATION

ROMBERG, Wayne – United States of America
Oyster Creek Nuclear Generation Station
Years of Nuclear Experience: 37
OPERATIONS I

MARTYNENKO, Yury – Russia
Russia Research Institute
Years of Nuclear Experience: 20
OPERATIONS II

SJOQVIST, Nils-Goran – Sweden
Oskarshamm Nuclear Power Plant
Years of Nuclear Experience: 33
MAINTENANCE

PEKÁRIK, Géza – Hungary
Paks Nuclear Power Plant Ltd
Years of Nuclear Experience: 18
TECHNICAL SUPPORT

DEBROUWERE, Christiaan – Belgium
Doel Nuclear Power Plant
Years of Nuclear Experience: 17
OPERATING EXPERIENCE FEEDBACK

DOBIS, Lubomir – Slovakia
Atomove Elektarne Bohunice
Years of Nuclear Experience: 26
RADIATION PROTECTION

ANGHEL, Cecilia – Romania
Cernavoda Nuclear Power Plant
Years of Nuclear Experience: 10
CHEMISTRY

TAKAHSHI, Keizo – Japan
Japan Atomic Energy Agency
Years of Nuclear Experience: 33
EMERGENCY PLANNING AND PREPAREDNESS

PARK, Woong – Republic of Korea
Yonggwang Nuclear Power Site
Years of Nuclear Experience: 21
OBSERVER

LESIN, Sergej – Lithuania
Ignalina Nuclear Power Plant
Years of Nuclear Experience: 17
OBSERVER

KOOP, Jennifer – IAEA
Division of Nuclear Installation Safety
Years of Nuclear Experience: 1
OBSERVER